DISCUSSION PAPER

April 2015 ■ RFF DP 15-15

A Primer on Comprehensive Policy Options for States to Comply with the Clean Power Plan

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RESOURCES FOR THE FUTURE

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Abstract

The US Environmental Protection Agency (EPA) has proposed regulations to reduce emissions of carbon dioxide (CO_2)from existing fossil electricity generators in its proposed Clean Power Plan rule under section 111(d) of the Clean Air Act. The proposal is based on the best system of emissions reductions (BSER) and calls for states to develop plans to achieve reductions that are demonstrated to be equivalent to those attained by the application of BSER to each state. Policy options from which states may choose are not restricted; the BSER and state plans are distinct from one another. This primer describes the different types of incentive-based comprehensive policies that states could adopt and how policy design features can address particular objectives including overall cost-effectiveness, distributional consequences for electricity consumers and producers, administrative costs, and emissions of other pollutants. We also elucidate some trade-offs that state policymakers will face as they develop their plans for Clean Power Plan compliance.

Key Words: tradable performance standard, climate policy, clean energy standard, cap and trade, allowance allocation

JEL Classification Numbers: Q42, Q48, Q54, Q58

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1. Introduction

The policy debate over how to limit emissions of greenhouse gases in the United States has produced many proposals in the last several years. Enthusiasm for a comprehensive federal cap-and-trade policy culminated in the Waxman-Markey legislation that passed the House of Representatives in 2009 but failed to be taken up by the Senate. In the absence of federal climate policy legislation, President Obama endorsed a sector-based approach and indicated the intention to pursue incremental policies instead of comprehensive legislation (Lehman and Marshall 2010). In the meantime, after a 2007 Supreme Court decision and a 2009 Endangerment Finding affirming that the US Environmental Protection Agency (EPA) is authorized and required to regulate greenhouse gases, EPA began to move forward (EPA 2009). In 2011, EPA finalized new greenhouse gas standards for light-duty vehicles to address emissions from mobile sources and the requirement to consider CO_2 emissions in state permitting decisions for new point sources.[1] On September 20, 2013, the agency issued proposed new source performance standards for CO_2 emissions from newly constructed power plants under section 111(b) of the Clean Air Act.

Now EPA is focused on regulating CO_2 emissions from existing power plants, which were responsible for 38 percent of US greenhouse gas emissions in 2012 and a slightly higher share of total CO_2 emissions. On June 2, 2014, EPA announced the Clean Power Plan (CPP), its proposal for regulating emissions of CO_2 from existing power plants under section 111(d) of the Clean Air Act (EPA 2014a). One of the important features of section 111(d) is the role for states to develop implementation plans that are subject to EPA approval. The proposed CPP grants

* Karen Palmer is a senior fellow and research director and Anthony Paul is a center fellow, both at Resources for the Future. The authors wish to thank Hang Yin for research assistance. The authors acknowledge support from the Alliance for Sustainable Energy, LLC, the manager and operator of the National Renewable Energy Laboratory, the US Department of Energy, and RFF's Center for Energy and Climate Economics.

[1] In the summer of 2014, the US Supreme Court ruled in UARG v. EPA that states could not require a stationary source to obtain a prevention of significant deterioration air permit under Title V solely on the basis of its greenhouse gas emissions, but it can require sources that need permits on the basis of emissions of other pollutants to comply with Best Available Control Technology (BACT) requirements for greenhouse gases.

considerable flexibility to states in exactly how compliance is achieved, requiring only that state plans demonstrate that they can achieve emissions rate (or emissions) reductions equivalent to those required by EPA. EPA indicates that it will provide opportunities for states to coordinate with one another on developing multistate compliance plans (EPA 2014a, 34833). Given the many potential regulatory pathways open to states and the limited experience at most state air offices with regulating emissions of CO_2, the flexibility afforded to states under the EPA proposal presents both an opportunity and a challenge.

This document is a primer for state regulators and others on comprehensive policy instruments that states can choose among in developing plans to comply with the proposed CPP. The authority to determine if a state plan is sufficient for compliance rests solely with EPA; this document is not intended to substitute for or predict the outcome of an EPA review. It is intended to provide insights into the policy options available to states and their specific design features. We evaluate these options against a set of four criteria and illuminate trade-offs between different approaches: (1) cost-effectiveness, (2) distributional consequences, (3) administrative burden, and (4) other environmental outcomes.

In summary, we find the following:

- The Clean Power Plan embodies a federal-state partnership under which EPA sets goals and states make policies to meet them. The flexibility inherent in this partnership sets the stage for states to mitigate emissions through cost-effective policies that can be tailored to meet the needs of individual states.
- The form of the goals and the form of the policies included in a state's plan are separate, although if the goal and policy take different forms, that increases administrative complexity. Rate goals offer flexibility to adjust for changes in the amount of covered generation, mass goals offer environmental integrity.
- The economic efficiency and distributional consequences (for consumers and producers) of the different comprehensive policy options are greatly affected by how the value of emissions allowances (the rights to emit CO_2) is allocated and by the scope of technologies covered by the policy.
- From a national perspective, the most economically efficient comprehensive policy is one that imposes an explicit price on CO_2 emissions, does not incorporate a production incentive to either electricity generation or consumption, and makes productive use of allowance value. Mass-based options with particular

forms of allowance allocation (described later) are the most economically efficient.

- The appeal of using electricity production incentives to reduce the electricity price impacts of the Clean Power Plan and encourage economic activity may be attractive to states despite the elevated total compliance costs that come with production incentives. Production incentives can be targeted under a mass-based policy to address and reduce potential leakage of emissions and economic activity.
- Mass-based policies offer the advantage of administrative simplicity, although this can be compromised by other design decisions.

In the remainder of this document, we first provide some background on the proposed rule, including a discussion of policy flexibility afforded to states, the opportunities for multistate coordination, and the regulatory timeline going forward. Then we discuss the form of the goals that states may adopt, either rate- or mass-based, and are subsequently obligated to meet. Next, we describe several different incentive-based comprehensive policy approaches that are available to the states, important features that affect their performance, and differences and similarities across them. Each of these policies can achieve compliance with the proposed rule on its own, without other supplementary policies. We then evaluate the different policies against the four criteria identified above. Finally, we conclude.

2. Background on the Proposed Clean Power Plan

The CPP is one of two proposed regulations to address emissions of CO_2 from electricity generators under section 111 of the Clean Air Act. The first proposed regulation is the New Source Performance Standard for CO_2 emissions from new or modified generating units, which was proposed on September 20, 2013. The second is the proposed CPP, which would regulate CO_2 emissions from existing electricity generators, defined as all generators that commenced construction on or before January 8, 2014 (EPA 2014d, 1430).

The proposed CPP consists of three steps. In the first step EPA establishes emissions rate goals for existing generators that vary by state based on the application of the best system of emissions reduction (BSER), which EPA defines using four building blocks.[2] States may or may not convert these rate goals to mass-based goals. The second step involves the states developing plans to meet the goals and approval or rejection of the state plans by EPA. The third step is monitoring of state performance relative to the plans. EPA maintains an important distinction between the first two steps, and a state need not use any of the BSER building blocks in its plan for achieving emissions reductions. States merely need to demonstrate that their plans are expected to achieve the goals and ultimately, in step three, to demonstrate that they meet the goals.

The schedule for the required EPA and state actions is as follows. EPA has committed to announcing a final rule by the summer of 2015, at which time it will also announce a proposed federal implementation plan that would apply to states that do not propose a plan or fail to receive EPA approval for a proposed plan.[3] States will have another year after that to submit their plans and are allowed to request a one-year extension, into the summer of 2017. If states choose to coordinate with other states and submit multistate plans, they can request an additional year extension into the summer of 2018. Once EPA receives a plan it must publish a final decision on that plan within 12 months. EPA requests comment on two options for the timing of compliance, but only the first option is addressed here. Interim goals are to apply for a compliance period that starts at the beginning of 2020 and extends through 2029, followed by final goals for 2030. The interim goals must be met on average over the 2020 to 2029 period, not necessarily in each year.[4] The final goal must be met on a three-year average basis beginning in

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[2] Building block 1 is heat rate improvements at coal units, building block 2 is dispatch substitution of existing natural gas combined cycle generators for coal boilers, building block 3 is increasing generation from non-emitting sources, and building block 4 is energy efficiency. Consistent with the composition of the building blocks, the resulting state emission rate goals include not only generation from exisitng emitting sources in the calculation but also generation from non-hydro renewable generators, at risk and new nuclear generators and energy savings from energy efficiency programs. This formulation means that if a state adopts a rate-based goal then verified energy savings from energy efficiency policies would be eligible to help achieve emissions rate compliance by adding energy savings to the denominator of a state's achieved emissions rate calculation that would be compared to its goal.

[3] The schedule initially published by EPA indicated that a final rule would be issued in June 2015, but the deadline has been extended to midsummer as the agency considers the millions of comments received on the proposed rule. EPA has conducted an extensive public outreach process both prior to and since publication of the proposed rule. This effort is expected to continue throughout the process of developing and approving state plans. Indeed, EPA requires the states to certify that they have conducted public processes in the development of their plans.

[4] EPA will monitor performance relative to a state's plan throughout the decade.

2030 if no subsequent rule is published to cover the period after 2030. EPA proposes that the final goals should persist in perpetuity if no new rule emerges (EPA 2014a, 34839).

The proposed rule encourages flexibility by suggesting many potential mechanisms that states could use for compliance and indicating a willingness to consider any proposal, not just those that are employed in the BSER. We characterize the policy options available to the states as fitting into two categories: comprehensive policies and portfolio approaches. Comprehensive policies are those that can bring states into compliance using a single instrument and are the focus of this document. A regulatory portfolio approach consists of a suite of individual measures targeting specific technologies or outcomes that together can bring a state into compliance.[5] Elements of a portfolio could be implemented in conjunction with a comprehensive policy to achieve particular policy outcomes that would not be met by the comprehensive policy alone.

States are allowed to work together to come up with multistate compliance plans; they need not be contiguous states. Multistate plans could be particularly appropriate for neighboring states in the power sector because wholesale electricity markets often span state borders and thus joining in a common plan can help to deal with leakage issues and interstate considerations for renewables and energy efficiency under a rate-based policy. On the other hand, gains from trade may be more the result of differences in abatement opportunities and those may be greater from teaming up with states that are not near neighbors. EPA has expressed willingness to allow states or groups of states to use existing programs, such as the Regional Greenhouse Gas Initiative (RGGI) CO_2 cap-and-trade program in the Northeast or the AB32 cap-and-trade program in California, as compliance mechanisms (EPA 2014a, 34838). To do this, states need to demonstrate that the existing programs will yield emissions rate (or emissions) reductions that are equivalent to those required under the proposed rule. States are invited to submit their plans, which would be akin to state implementation plans that states submit to EPA to demonstrate how they plan to comply with the National Ambient Air Quality Standards. Any state that chooses not to submit a plan or that submits a plan that is not approved by EPA will be subject to a federal plan.

[5] Linn and Richardson (2013) review the economics and risks of several of the potential policies that might be comprise a portfolio approach including technology mandates (for clean generaiton and efficiency), subsidies for clean technologies and subsidies for new investment.

3. State Goals: Rate- or Mass-Based

A state plan may either retain the rate-based goal published by EPA or convert it to a mass-based goal, essentially setting a limit on tons of CO_2 emissions. EPA released a Technical Support Document (TSD) that provides some examples of how states could make the conversion (EPA 2014e).[6] State plans must contain a policy or set of policies that will induce compliance with the goal no matter whether the goal is rate- or mass-based, and the form of the policy need not correspond to that of the goal (EPA 2014b, footnote 2). Any of the four combinations of a rate- or mass-based goal and a rate- or mass-based policy can be adopted by states, although the relative simplicity of administering policies that are harmonized with the form of the goal may be attractive to states.

Each form of the goal has advantages and disadvantages. A rate-based goal allows for flexibility in that emissions can automatically adjust to unanticipated changes in the amount of covered generation due to factors such as weather trends or unexpected changes in population or economic growth. This flexibility would reduce the cost of reaching the goal in the case of faster-than-expected growth, and enhance environmental benefits in the case of slower-than-expected growth. A mass-based goal provides environmental certainty and would lead to outcomes opposite those of rate goals: greater environmental benefits under fast growth and reduced cost in the case of slow growth. The main issue a state must consider when choosing between a rate- and a mass-based goal is the uncertainty about how the power sector will evolve between now and 2030. Another issue is that a mass-based goal offers relative simplicity in demonstrating compliance with an implementation plan.

One might expect that a rate-based goal would be paired with a rate-based policy, and similarly for mass-based goals and policies. However, goal and policy are distinct, and such pairing need not be the case. For example, one can conceive of a mass-based policy being employed by a state that opts to keep an emissions rate goal, particularly if the state has an existing mass-based policy. This could appeal to states because of the flexibility inherent in a rate goal and the administrative simplicity inherent in a mass policy. To implement such a combination, a state plan would presumably use modeling to show that the rate outcomes built into a mass-based policy are expected to meet the goals published by EPA. The motivation for combining a mass-based goal with a rate-based policy is not as clear.

[6] EPA suggests in the TSD that the approaches to rate to mass coversion offered in the TSD are not necessarily the only approaches that EPA will approve.

4. Description of Comprehensive Policies

A comprehensive policy can address all sources of emissions and provide stringency sufficient for any level of emissions or emissions rate reduction without any other policy in place. In this section, we focus on three policy instruments that place an implicit or explicit price on CO_2 emissions: mass-based policy, rate-based policy (which we also refer to as tradable performance standards), and clean energy standards.

At a high level, the advantages of flexible comprehensive policies are twofold: cost-effectiveness and administrative simplicity. The cost-effectiveness advantages of comprehensive incentive-based policies have been well documented in the environmental economics literature for decades (Baumol and Oates 1988). These policies work by creating goals and incentives for emissions reductions or, in some cases, clean technology adoption, but leave it to the market to find the least-cost way to get to the desired environmental outcome. These comprehensive policies are also robust to unexpected changes in market conditions or technology costs because they do not pick a particular technology for reducing emissions, the cost-effectiveness of which might change with changes in fuel prices and technological development. Administrative simplicity springs from the comprehensive nature of the policies; one policy alone is sufficient. Other administrative advantages relate to demonstrating compliance with the environmental regulation and enabling cooperation among groups of states.

Flexibility is particularly important in the case of CO_2 emissions mitigation for at least two reasons. First, the costs of the amount of reductions in CO_2 emissions that will ultimately be required to address global warming are substantial, and flexible incentive-based approaches provide a way to keep those costs as low as possible. Second, the conventional pollution control technology options for reducing CO_2 emissions on a source by source basis are limited relative to the suite of system-wide abatement opportunities, so a more flexible approach is sensible.

In the following subsections we describe the three forms of incentive-based comprehensive policies. Each of these comprehensive policies imposes a cost and, in some cases, an electricity production incentive on different types of generators or consumers based on emissions, production, or consumption. These cost and incentive components play a prominent role in our evaluation of the policies, which is presented in the subsequent section.

4.1. Mass-Based Policies

Mass-based policy for emissions abatement from the power sector is becoming an increasingly important policy instrument for environmental regulators around the world.[7] The SO_2 emissions trading program that took effect in 1995 in the United States under Title IV of the Clean Air Act is the seminal mass-based policy. It exceeded expectations in terms of cost-effectiveness, and since then several other regulatory programs have followed suit. NO_x emissions in the eastern United States are covered by two separate mass-based policies under the Clean Air Interstate Rule (CAIR), one annual and one covering just the summer months. The Cross State Air Pollution Rule proposed by EPA, which contains mass-based policies for NO_x and SO_2 emissions, may ultimately replace CAIR. CO_2 emissions are covered by mass-based policies in the Northeast (RGGI), California (AB32), and the European Union (EU ETS). South Korea's CO_2 emissions trading system came into being on January 1, 2015 (Kim 2015). China has recently announced plans for a national carbon market (Chen and Reklev 2014) and regional experiments are under way there (Munnings et al. 2014).

The basic mechanics of a mass-based trading policy are simple. A regulator chooses an emissions budget (cap) denominated in tons of CO_2, which is why we refer to this policy mechanism as mass-based. The budget can change over time and typically is structured to decline over time, creating increasing emissions reductions. At regular intervals, the government distributes, either through an auction or through direct allocation, a quantity of emissions allowances (rights to emit) that typically, over the course of a year, equals the annual emissions budget chosen by the regulator, although other compliance time periods could apply. Each allowance corresponds to one ton of CO_2 emissions, and any covered generator that emits CO_2 must acquire an allowance for each ton of emissions and surrender to the government sufficient allowances to cover all of its emissions at the end of the compliance period. The allowances are fully tradable throughout the compliance period, and in many cases policymakers allow entities not covered by the policy to trade allowances. Generators with emissions greater than the number of allowances initially purchased at auction (or received via direct allocation) may acquire more allowances from others who have them in excess. Assuming that the regulator has chosen an emissions budget that is below the level of emissions that would occur in the absence of any program, the allowances will be scarce and acquire a positive price as they are purchased

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[7] Mass-based policies are sometimes referred to as cap-and- trade policies.

at auction or traded. A tighter budget will lead to higher allowance prices (carbon price) and therefore more emissions reductions than a looser budget.

Mass-based trading policies can have several features that affect the costs of reaching any particular level of emissions (or emissions rate) as well as the incidence (or who bears the costs) of the policy. These include the method for allocating allowances, the scope of the policy, and features that affect compliance flexibility. Each of these is discussed in turn in the following subsections.

A mass-based policy could directly impose an emissions fee instead of imposing an emissions budget and allowing a market to reveal a price.[8] The fee would be denominated in $/ton (i.e., cost per unit mass of emissions), and thus we characterize this type of policy as mass-based. If EPA were to allow this, a price (as opposed to quantity) approach in a state plan for CPP compliance would require modeling to determine the appropriate fee that would lead to an expected quantity of emissions or emissions rate reductions and ultimately compliance with the CPP goals. The fee would need to be revisited over time to ensure that the goals in the state plans are being met. The revenues raised by a price approach could be used by states in the same ways as allowance revenues generated under a mass-based trading policy, a topic discussed in the next subsection.

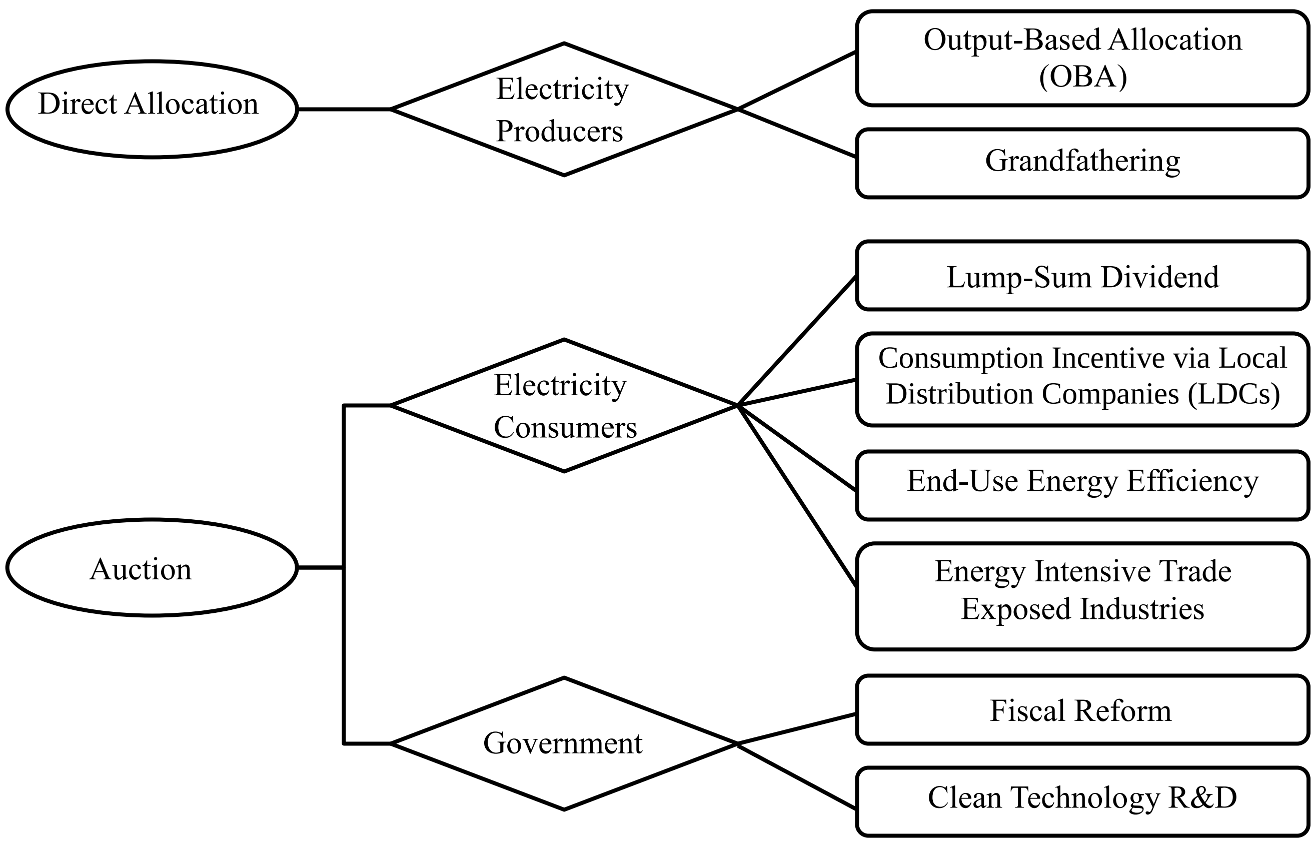
4.1.1. Allowance Allocation

One aspect of designing a mass-based policy is determining how to allocate the value of emissions allowances. If some of the allowances are sold in an auction, as is done in RGGI, California's AB32 program, and the EU Emissions Trading System, then the revenues raised by the allowance auction must be allocated by the regulator, and there are many possible approaches. Without an auction, allowances may be allocated directly to generators, as is done under Title IV for SO_2 emissions and CAIR for NO_x emissions. Several of the options for allowance allocation that are popular for distributional or political reasons affect economic incentives within the power sector, with implications for cost-effectiveness and incidence of the policy. This makes the allocation of allowance value an important consideration.

[8] Wara et al. (2014) discuss how EPA might adjust its proposed rule, primarily by adjusting the definition of an emissions rate standard, to make it more general in order to clarify that the policy accommodates state excise taxes on carbon emissions as a state compliance mechanism.

Broadly speaking, allowance value can be allocated to three constituencies: electricity producers, electricity consumers, and government. Within each group, there are multiple approaches that can be taken. Figure 1 illustrates the various allocation options, which are discussed in more detail below. Allocation to producers is labeled “Direct Allocation” because producers are the point of compliance under mass-based policies, and those who need allowances receive them under direct allocation. For allocation to the other two constituencies, generators who need allowances for compliance can purchase them at an auction, and the revenues from that auction can be allocated to consumers or by the government to other purposes. Any of the eight approaches may be implemented in any combination; for example, 50 percent of allowance value could fund energy efficiency programs, with 40 percent sent to producers via an output-based allocation, and 10 percent used to protect energy-intensive trade-exposed industries.

Figure 1. Options for Allowance Value Allocation under Mass-Based Policy



Electricity Producers

Allowance value can be distributed to electricity producers either by an output-based allocation (OBA) or by grandfathering. In either case, generators receive allowances for free, rendering an allowance auction unnecessary. OBA awards eligible generators emissions allowances for each MWh of generation based on the ratio of the total emissions budget to total generation by eligible generators, so it changes over time based on actual production and creates an incentive to produce. The set of eligible generators can include all generators or a subset; that is, the policymaker must identify which generators will be allowance value recipients. As discussed in section 5, the scope of the policy can have important implications for how OBA is manifest in power markets (Burtraw et al. 2005).

Under a grandfathering system, the allocation is set for all time when the policy is designed, typically based on a generator's share of production in a recent historic year.[9] Because the allocation is fixed for all time, producers have no incentive to alter production to earn allowances; they are simply received as a fixed quantity of allowances that is independent of current generation. Generators that participate in competitive electricity markets will bid to supply power at a price that reflects the opportunity cost of using allowances—the fact that once they have been used to cover emissions from electricity generation, they are not available to sell at their market price—even though they are received for free.[10]

Electricity Consumers

The simplest way to allocate allowance value to consumers is through a lump-sum dividend. Lump-sum means that consumers receive checks in the mail at regular intervals for a portion of the total allowance value, separate from electricity bills. This is akin to the system by which Alaska allocates oil revenue to its citizens through the Alaska Permanent Fund; that is, the payment that each citizen receives is not contingent on his or her oil consumption. Because allowances are auctioned, generators in both regulated and competitive states will incorporate the costs of purchased allowances into electricity prices. The virtue of this allocation approach is that consumers will respond to the cost of emissions and, collectively, get back the payments through the lump sum dividends that cover the emissions cost.

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[9] This is the approach that was used to allocate the majority of the emissions allowances created under the Title IV SO_2 allowance trading program run by EPA.

[10] In competitive electricity markets, such as those run by independent system operators in many regions of the country, generators will offer to sell power to the market at a price that covers their variable cost of generation. If generators must use a valuable emissions allowance to produce a MWh of electricity (an allowance that could be sold if not used), then the generator will offer to sell that MWh at a price that fully compensates it for the cost of the allowance that is used in production, even if that allowance was obtained for free.

Another way to allocate allowances to electricity consumers is to give the allowance revenue to local distribution companies (LDCs) with the stipulation that they rebate that value to consumers through a credit on their electricity bills, either based on volume of sales or just as a single line-item credit (this approach is labeled "Consumption Incentive via LDCs" in Figure 1).[11] How consumers react to such a credit depends on how they respond to changes in energy costs. A perfectly optimizing consumer would consider whether the rebate is based on kWh sales or is simply a fixed credit that is independent of consumption. However, few electricity consumers dissect their electricity bills closely enough to understand whether a credit is based on consumption or not, and therefore changes in the average electricity bill may be more of a determining factor of impacts on consumer demand (Ito 2014) than whether the rebate is consumption based. In general, if the allocation lowers bills, it will increase consumption and thereby raise the costs of compliance with the emissions reduction goal. Instead of a broad-based rebate, allowance revenue could be targeted to alleviate price increases for particular classes of consumers, such as low-income households, for whom energy costs constitute a more substantial share of total income.

Allowance value could be allocated to consumers by providing funding for programs that promote end-use energy efficiency. The majority of the RGGI program allowance value is used this way. One justification for this approach is to keep electricity demand and allowance costs low and thereby to limit demand for power imports and emissions leakage to other states. The extent to which spending allowance revenue dollars on energy efficiency achieves these goals depends on how effective the programs are in reducing electricity consumption, and at what cost. Given the extent of uncertainty associated with savings estimates from current methods of evaluation and the variety of approaches used, priority should be given to improved measurement and verification.

Energy-intensive trade-exposed (EITE) industries are also candidates for allowance value allocation. Industries with particularly electricity-intensive production processes, such as aluminum, may be disadvantaged in international and broader national markets if electricity prices rise as a result of a state's plan to comply with the CPP. Fischer and Fox (2007, 2010) show that allocating allowance value to EITE industries, particularly in the form of an incentive

[11] In California, most of the allowance value is allowed to accumulate and is returned every six months as a line item on the customer's bill. This system is intended to convey to customers that their rebates are divorced from their level of consumption.

for onshore production, can ameliorate the negative international competition implications of an emissions reduction policy and associated concerns about emissions. The argument applies also to in-state and out-of-state production. It is likely that a small fraction of total allowance value would be sufficient to achieve the goal of mitigating competitiveness impacts on EITE firms.

Government

Instead of allocating allowance revenue within the power sector, it could be used for other purposes by state governments. Two such options are fiscal reform and funding for clean technology research and development (R&D). In either case, incentives in the power sector are likely not affected by the allowance allocation, at least in the short run, resulting in emissions cost pass-through to consumers via retail prices.

4.1.2. Scope

Scope refers to the set of generators covered by a state policy. It has size, technology, and vintage dimensions. There are two incentive considerations related to scope: whether emissions from a source are covered by an emissions budget or rate target, and whether a source is eligible for an allocation of allowances under OBA. We refer to these two aspects of scope as coverage scope and eligibility scope. Scope can also have a geographic dimension characterizing a state's choice of whether to pursue multistate cooperation.

With respect to size, small generators are often excluded from mass-based regulatory programs, and the proposed CPP is no exception. Title IV and other EPA cap-and-trade regulations for NO_x and SO_2, as well as the RGGI program for CO_2, exclude generators that are smaller than 25 MW in capacity. The calculation of goals in the proposed CPP rule excludes small sources, but the exclusion is not specified in capacity terms. It is defined instead by four related factors, including a minimum generation level that effectively excludes units under 25 MW in size.[12]

Technology and vintage aspects of both emissions coverage and eligibility to earn allowances are central to the performance of a mass-based policy. Five types of generators characterize the fleet sufficiently for considering scope: (1) existing nonemitting (renewables, hydro, and nuclear), (2) existing fossil-fired boilers and simple cycle combustion turbines, (3) existing natural gas combined cycle (NGCC), (4) new NGCC, and (5) new nonemitting. Three of these types could be excluded from the scope of a mass-based policy. New NGCC may be excluded both from emissions coverage and from eligibility for an allowance allocation. Existing nonemitting and existing fossil-fired boilers and turbines may be considered for exclusion from eligibility for an allowance allocation under an output-based approach.

The scope of the CPP proposal suggests that emissions from both existing NGCC and other existing fossil-fired plants would be covered by a mass-based policy. In its proposal, EPA asked for comments on whether states should include emissions from new NGCC plants in their compliance plans. New NGCC plants are subject to strict emissions rate limits proposed under section 111(b) of the Clean Air Act (EPA 2014a, 34852). It is also conceivable that new NGCC units could be incorporated for emissions coverage but not given an allowance allocation under OBA. This could happen if a state decided to dedicate its allowance value exclusively to the promotion of renewables and energy efficiency, for example.

In general, with OBA, the choice of which generators are eligible to earn allowances can be entirely separate from whose emissions are covered. For example, nonemitting generators face no restrictions under a mass-based policy, and they may or may not be eligible to earn allowances, depending on what a state decides. Also, even though emissions from existing coal

[12] An affected EGU is defined as "any boiler, integrated gasification combined cycle (IGCC), or combustion turbine (in either simple cycle or combined cycle configuration) that (1) is capable of combusting at least 250 million Btu per hour; (2) combusts fossil fuel for more than 10 percent of its total annual heat input (stationary combustion turbines have an additional criteria that they combust over 90 percent natural gas); (3) sells the greater of 219,000 MWh per year and one-third of its potential electrical output to a utility distribution system; and (4) was not in operation or under construction as of January 8, 2014." Note that 219,000 MWh is the amount of generation from a 25 MW plant operating at full capacity for 8,760 hours, which is the total number of hours in a typical year. The rule says further, "The minimum fossil fuel consumption condition applies over any consecutive three-year period (or as long as the unit has been in operation, if less). The minimum electricity sales condition applies on an annual basis for boilers and IGCC facilities and over rolling three-year periods for combustion turbines (or as long as the unit has been in operation, if less)" (EPA 2014a, 34854).

units are necessarily covered by a mass-based policy, these generators need not be eligible to earn allowances under OBA.

While responsibility for developing compliance plans rests with each state, EPA also proposed that states may come up with multistate compliance plans, and it provides additional time for such plans to be developed and negotiated among partnering states. If states cooperate to craft multistate plans or other forms of cooperation, then research and experience suggest that there will be gains from trade that can be shared among all who cooperate. This sharing can be accomplished to bring gains for all cooperating parties through decisions about allowance allocation or perhaps through the use of trading ratios (i.e., where some fraction or multiple of emissions allowances from another jurisdiction is required to cover one ton of local emissions), although when trading ratios are used, the amount of total emissions across the cooperating states cannot be predicted, which is similar to rate-based policies (Burtraw et al. 2013).

4.1.3. Compliance Flexibility

A mass-based policy can include additional features that offer flexibility. Banking or borrowing of allowances or both create flexibility by removing the requirement that the emissions budget be achieved in every year. Instead, allowances issued in the current year could be saved for use in a future compliance period (banking), or allowances with a future vintage could be purchased from and submitted to the government early, to cover emissions in a year before that for which they were intended by the regulator (borrowing). An allowance debt is then repaid by acquiring more allowances in the future vintage than necessary to cover actual emissions in that year.[13] Banking and borrowing reduce the impact of yearly volatility in markets such as those for fuel that affect the power sector, while holding cumulative emissions constant. This in turn reduces cumulative costs. One risk with borrowing is that a borrower might go bankrupt without ever paying back the allowance debt. To avoid this risk, mass-based trading proposals often have not allowed long-term borrowing. Other cost containment measures, such as price ceilings and offsets associated with emissions reductions outside the regulated sector, would erode the emissions abatement from covered sources and therefore may be inappropriate for states to include in compliance plans for the CPP as currently proposed.

[13] Another way to implement allowance debt repayment is for the regulator not to publish the allowances that are borrowed from a future year. The borrower would then owe a payment to the regulator equal to the quantity of allowances borrowed times the allowance price in that year.

Flexibility comes also from implementing relatively longer compliance periods, even without banking or borrowing.[14] For example, instead of requiring an alignment of emissions and allowances every year, EPA proposes that it could be done on a decadal basis from 2020 to 2029 and on a three-year basis thereafter. By proposing a 10-year compliance period and offering a conversion of rate goals to mass goals, EPA indicates that mass-based policies that allow banking or borrowing or both within that initial time window or that are implemented with compliance periods that are longer than one year are acceptable.

4.2. Rate-Based Tradable Performance Standard (TPS)

A flexible rate-based system, which we will refer to as a tradable performance standard (TPS), sets an emissions rate standard that the regulated sector must meet on average.[15] It obligates generators that emit at a rate above the standard to buy tradable allowances from those who make power at an emissions rate below the standard, where these allowances are equal to the difference between actual emissions rate and the standard times the amount of electricity produced. Those generators that are cleaner than the standard are awarded allowances based on how far below the standard they are and how much they produce. For example if the standard is set at 1,000 pounds per MWh, a generator operating at 990 pounds per MWh would receive 10 allowances for every MWh produced. Generators that emit at rates above the standard are charged based on how far above they are and how much electricity they produce. Issues of compliance flexibility and scope apply to TPS policy design as they do to a mass-based policy. Banking, borrowing, price ceilings, and the other flexibility features mentioned for mass policies are also applicable to a TPS. Options for scope, both in terms of coverage of emissions and eligibility to earn allowances, under TPS are not addressed further here, as they are the same as those under a mass-based policy with OBA with two important caveats. First, the two types of coverage are synonymous under TPS: generators whose emissions are covered are all eligible to earn allowances. Second, excluding existing coal boilers from emissions coverage and allowance allocation is not efficacious under TPS.

[14] This is actually just a different way of framing banking and borrowing that can achieve identical outcomes. The frequency of allowance distributions need not correspond to the length of the compliance period.

[15] In contrast, an inflexible rate-based standard must be met by each source. This is the form of the standard for new sources proposed under section 111(b).

If states choose to join together under a TPS, all of the cooperating states could adopt a uniform emissions rate goal, or there could be geographic differentiation whereby states would retain their own emissions rate goals (and thus their own allocation of emissions allowances) but allow interstate trading of allowances.[16] When each state retains its own emission rate goal, each state would credit the covered generators at a rate equal to the goal, but states or utilities within the state would be allowed to trade allowances with entities in other states that are part of the larger trading region. This approach to implementing a multistate policy would avoid the need to develop a common rate goal and the associated interstate transfers of initial emissions allowance value, while still harvesting gains from trade. If the cost-effectiveness benefits of state cooperation lead to reduced electricity prices and greater consumption, then emissions could rise as a result of cooperation. Emissions might also rise even if demand does not change, if generation gravitates to the states within the trading region that have the higher emissions rate goal.

4.3. Clean Energy Standard

A clean energy standard (CES) is another form of comprehensive carbon emissions abatement policy. A CES is a portfolio standard, like a renewable portfolio standard (RPS), that stipulates a minimum percentage of power demand must be met by qualified clean energy technologies. A CES creates tradable clean energy credits denominated in MWh and awards them to a broader array of low carbon-intensity generation technologies than are qualified under an RPS and accordingly sets a higher requirement for the minimum percentage of demand that must be supplied by clean generation. Local distribution companies are obligated to hold a minimum percentage of credits based on sales. They buy the credits from the generators that earn them based on production.

The core difference between a CES and an RPS is the treatment of nuclear, natural gas, and coal or gas with CCS. An RPS treats all these zero- and low-carbon generation technologies the same way as traditional coal-fired boilers: it gives them no credit. A CES can give equal credit to nuclear generation and renewable generation, and credit each MWh of generation by natural gas at a lower rate. The crediting rates for clean generating sources can be set in different ways. Technology-based crediting would provide a credit based on technology type, typically giving nonemitting generators a full credit per MWh, gas combined cycle units a half credit, coal

[16] An alternative to subcategorization is a trading ratios approach (Michel and Nielsen 2014).

generators with CCS 90 percent of a credit, and natural gas generators with CCS 95 percent of a credit. These crediting rates are roughly concordant with the relative carbon intensities of the different generation technologies compared with that of a coal boiler without CCS.

An alternative approach is to set crediting rates based on emissions intensity and, in particular, on the relationship between a technology's emissions rate and a reference emissions rate, typically slightly lower than the emissions rate of the cleanest coal-fired boiler, although any rate could be used. The Clean Energy Standard Act of 2012 (S 2146) proposed by Senator Bingaman (D-NM) is an example of an intensity-based CES that employs a reference crediting rate that excludes coal-fired generators without CCS from receiving credit.[17] A well-designed CES will share most of the properties of a TPS or mass-based policy that uses an output-based approach to allocating allowances.[18] The main difference is that a CES goal is expressed as a percentage of electricity consumption (MWh), instead of in emissions or emissions rate terms, and the credits are denominated in MWhs.

5. Policy Evaluation

The comprehensive policies described in the previous section are evaluated in this section on the grounds of cost-effectiveness, distributional considerations (particularly for producers versus consumers), administrative cost, and other environmental outcomes. Most of this evaluation focuses on the policies and allocation methods that have direct and measurable effects within the power sector: mass-based policy with output based allocation (OBA) to electricity producers or allocation to local distribution companies (LDCs), a tradable performance standard (TPS), and a clean energy standard (CES). These are compared with a mass-based policy that auctions allowances and returns revenues to consumers by a lump-sum dividend because that approach encourages the full range of emissions reduction actions. In section 4, we describe other allocation approaches for mass-based policies that receive less attention here: funding for end-use energy efficiency or clean technology research and development, support for energy-intensive trade-exposed industries, and fiscal reform. The effects of these methods of allowance

[17] Note that the Clean Energy Standard Act of 2012 also had some features, such as the small utility exemption and the existing hydro exclusion, that raised its cost, offsetting some of the efficiency enhancements from an intensity-based design (Paul et al. 2013a).

[18] One distinction is that the point of compliance under a TPS or cap-and-trade program is generators. Under CES, the point of compliance is local distribution companies.

allocation are more difficult to evaluate because they depend on a number of factors that extend beyond the power sector or are hard to project, such as the efficacy of energy efficiency spending and the extent to which markets underinvest in research and development.

5.1. Cost-Effectiveness

The relative cost-effectiveness of the three types of comprehensive policies stems from the incentives that each creates for electricity consumers and producers to take actions to reduce CO_2 emissions. These emissions reductions can come from (1) making investments to improve the efficiency of and reduce emissions at existing coal plants, (2) switching from higher to lower emissions-intensive generators within a particular fuel type (e.g., gas or coal), (3) switching fuels from coal to natural gas, (4) substituting nonemitting sources such as nuclear and renewables for emitting sources, and (5) consumers reducing overall electricity use through conservation or end-use efficiency measures.[19] Economically efficient policies provide incentives to undertake each of these actions until the marginal cost of the last ton of emissions reductions resulting from each action is equal across all actions. Policies that fail to encourage any subset of these actions will fall short on cost-effectiveness grounds.

The overall incentives associated with a particular policy come from the combination of fees (the cost of emissions allowances or clean energy credits) and production incentives (allowances allocated under an output-based approach or TPS, or clean energy credit revenues). How these features compare across policies reveals implications for cost-effectiveness of the different policies. The fee and production incentive components of a select set of comprehensive policies, defined by different combinations of instrument, scope, and allocation approach, are illustrated in Table 1. Each component in the table is expressed in $/MWh terms, and the notation is defined at the bottom of the table. The table also includes five columns, one for each of the five emissions reducing actions identified above, that map each action to the policies that provide an incentive for that action. The policies are ordered from those which encourage a subset of actions to those that encourage all possible actions. In general, policies tend to be more cost-effective if they encourage a broader range of the various actions for reducing emissions.

[19] These five ways of reducing emissions cover all of the focused policy options that a state might pursue to reduce emissions in lieu of a comprehensive approach such as biomass co-firing or natural gas co-firing at existing coal facilities (subsumed in item 1) or improvements in the efficiency of the transmission and distribution grid, which are captured in item 5. For more information about a list of over 25 options that have been identified as ways to reduce electricity sector CO_2 emissions see NACAA (forthcoming).

Only one of the policy options, mass-based with an auction and revenues to the government found in row 6 of Table 1, encourages all five actions to reduce emissions in both competitive and regulated electricity markets. When a mass-based policy covers all generators, the allowance cost associated with all CO_2 emissions encourages each of the actions that involve shifting to lower or nonemitting fuels to produce electricity. Because this policy has no production incentive, retail electricity prices reflect the cost of the allowances required to produce a unit of electricity and provide an efficient incentive to conserve electricity. When electricity prices are set by cost-of-service regulation, producers are allowed to pass on to consumers only costs that are actually realized; this situation characterizes auctioned allowances but not those that are grandfathered (Burtraw et al. 2001). When allowance costs are passed to consumers, demand reductions can be a major contributor of low-cost emissions reductions (Paul et al. 2014). On the other hand, a production incentive tends to encourage electricity generation and consumption, and therefore it mutes incentives for conservation and investment in energy efficiency and diminishes the cost-effectiveness of the policy.[20] At the same time, such production incentives reduce the impact of the policy on electricity prices, which may help achieve other important political objectives. Whether the political benefits outweigh the economic efficiency costs will likely vary across states and across policy options.

[20] One way to restore the incentive to conserve electricity under a TPS or cap-and-trade policy with OBA is to credit electricity savings from energy efficiency programs as proposed in the CPP.

Table 1. Fees, Production Incentives and Relevant Emissions Reducing Options for Selected Comprehensive Policies

			Relevant Options for Reducing Emissions				
Policy	Fee ($/MWh)	Production Incentive ($/MWh)	Reduce coal emissions through onsite upgrades	Re-dispatch within fuel generator types	Coal to gas re-dispatch	Greater use of nonemitting generators	Energy conservation & efficiency
1.Technology-based CES	$P_{CES} * T_{CES}$	$P_{CES} * CR_i$			x	x	
2. Intensity-based CES	$P_{CES} * T_{CES}$	$P_{CES} * CR_i$	[#]	x	x	x	
3a. TPS – all generators	$P_{CO2} * ER_i$	$P_{CO2} * ER_{All}$	x	x	x	x	
3b. Mass-based – OBA to all generators	$P_{CO2} * ER_i$	$P_{CO2} * ER_{All}$	x	x	x	x	
4. Mass-based – LDCs	$P_{CO2} * ER_i$	$P_{CO2} * ER_{LDC}$	x	x	x	x	
5. Mass-based –grandfathering	$P_{CO2} * ER_i$	0	x	x	x	x	x[+]
6. Mass-based – auction	$P_{CO2} * ER_i$	0	x	x	x	x	x

Notes:

[#] Only if the emissions intensity target for receiving CES credits exceeds the emissions rate for some coal boilers.

[+] The price effect – and therefore the incentive for energy efficiency or conservation - of grandfathering will be important under competitive pricing of electricity but not under cost-of-service regulation.

Variable Name	Definition
P_{CES}	clean energy credit price under CES ($/MWh)
P_{CO2}	price of emitting a ton of CO_2 under TPS or mass-based policies ($/ton)
T_{CES}	target for the clean share of retail sales under CES (%)
CR_i	crediting rate for generator or technology class *i* under CES (credits/MWh)
ER_i	emissions rate of generator *i* (tons/MWh)
ER_{All}	average emissions rate of local generation (tons/MWh), equivalent to target under TPS
ER_{LDC}	local emissions divided by local generation plus net imported power (tons/MWh)

Both mass-based policies with allowance allocation to producers (OBA) or consumers (LDC) and rate-based policies include either a production or consumption incentive and thus fail to encourage emissions reduction through lower electricity demand. The size of the economic efficiency loss associated with the incentive depends on its scope and the form of electricity market regulation. In general, more targeted production incentives result in smaller electricity price increases and work against encouraging conservation. For example, narrowing the scope of an OBA to exclude existing clean generators increases the production incentive received by the remaining fleet identically for all generators.[21] This larger incentive value lowers marginal generation costs. In cost-of-service states, total costs across all generators are unaffected by the narrowing of policy scope, so electricity prices and consumption are unaffected.[22] In competitive regions, the effect on marginal costs is directly relevant for electricity prices. Since existing clean generation is almost never on the margin, marginal costs fall as other generators receive a higher production incentive. The reduction in electricity prices that follows drives increased demand, higher compliance costs, and thus lower cost-effectiveness.

The incentives created under a TPS are identical to those under a mass-based policy with OBA of the same scope and thus both policies are grouped together in rows 3a and 3b of Table 1. The similarity is that generators are charged based on their emissions rate and credited at a uniform rate for each unit of production. A difference, aside from relative incentives, is that under a mass-based policy, the number of allowances is fixed at the level of the budget, but under TPS the allowed emissions vary with the level of covered generation and potentially with efficiency savings.

The extent to which each of the policies encourages emissions reductions from changes in how electricity is produced (the first four options identified in Table 1) depends on the extent of differentiation in the net fee (fee minus production incentive) across emitting generators. In general, more differentiation in the net fee leads to stronger incentives to pursue the full range of emissions reduction activities. For example, under a CES, the incentive payment for generation varies among generator types, depending on technology type (for technology-based CES) or unit-level emissions intensity (for intensity-based CES). The production incentive is paid only to

[21] Similar logic applies to the narrowing of the scope of a TPS from all generators to a smaller subset of eligible generators, including fossil only, as shown in Burtraw et al. (2014).

[22] The reduction in marginal costs could lead to increase in profitable power exports, which would reduce electricity prices.

the subset of generators that qualify either because of technology type or because their emissions rate is below the reference level. For both types of CES policies, the fee component is uniform for all generators (both emitting and nonemitting), as is the price of the clean credits that electricity retailers must hold for each MWh sold. The result of the differentiation in the net fee across generators is fuel switching from coal to natural gas and increased generation from renewables and incremental nuclear. The intensity-based CES further differentiates the net fee across NGCC generators to encourage substitution from higher- to lower-emitting units. Typically, a CES does not differentiate among coal boilers (unless one is retrofitted with CCS) and thus provides no incentive to invest in heat rate improvements at coal plants. However, heat rate improvements are encouraged by both TPS and mass-based policies where the fee is differentiated across all generators based on emissions rates.[23]

One important aspect of the CPP that will affect incentives to switch from coal to gas or to increase use of more efficient NGCC generators is the decision, currently left to the states in EPA’s proposal, about whether to include new NGCC generators in the state plan for CPP compliance. The implications of this decision for incentives and investment outcomes will depend on whether a state adopts a rate- or mass-based policy. Under a mass-based policy that does not employ OBA, including new NGCC units under the mass-based budget will discourage generation from these units relative to a mass-based policy that covers only existing fossil generators. A mass-based policy with OBA that includes new NGCC or a TPS that includes new NGCC units would encourage investment in these generators in states with an emissions rate goal that is above the emissions rate of new NGCCs; investment would be discouraged in states with goals below the new NGCC emissions rate.

Another important aspect of state-level climate policy under the CPP that could have implications for cost-effectiveness is the possibility that different states within the same region may pursue different policies for compliance, and thus the policy choice of a neighboring state may affect the outcome from a state’s own policy. For example, if a state adopts a mass-based policy and its neighbor adopts a TPS, investors might prefer to locate new generation capacity in the state with the TPS because of the ability to earn credits there (and the absence of a firm limit

[23] In principle, it would be possible to set the reference emissions rate at a high enough level to create incentives for making investments to improve performance of existing coal plants, but in practice, subsidizing coal without CCS under a policy that is labeled a clean energy standard is unlikely, although in Pennsylvania, the alternative energy portfolio standard includes waste coal as a technology that is eligible to earn credits.

on emissions).[24] The result would be leakage of generation, emissions, and economic activity from the mass-based state into the TPS state and an overall increase in total emissions. One potential consequence is that states, seeking to protect their generation industry, might behave strategically and tend to adopt rate-based policies instead of more efficient mass-based approaches (Bushnell et al. 2014). One potential remedy for dealing with this type of leakage is to use targeted OBA of allowances under a mass-based policy to encourage more generation from new NGCC or renewable generators within the state. This approach can maintain the administrative advantages of a mass-based approach but limits (potentially eliminates or reverses) incentives for leakage of generation and emissions to neighboring states (Burtraw et al. 2015). The negative cost-effectiveness implications, relative to an allocation approach that does not subsidize generation, have been mentioned already.

When allowances are auctioned and revenues are used by the government for fiscal reform or to fund research, there may be important consequences for cost-effectiveness that extend beyond the electricity sector. Research related to allowance allocation generated under a federal mass-based trading policy has found that offsetting preexisting distortionary taxes, such as taxes on labor or capital income, can generate greater social welfare than a lump-sum dividend approach (Bovenberg and Goulder 2002; Carbone et al. 2013, 2014). Such fiscal reform could involve reduced income taxes or capital gains taxes or reduction of budget deficits (and thus future distortionary taxes). There is no literature on the social welfare consequences of allocating allowance value for fiscal reform at the state level, where government revenue typically comes from a different mix of taxes that varies a great deal across states.

The last approach to allowance allocation is funding for R&D of clean energy technologies. Economists have argued that because it is difficult for private parties to appropriate the value of their innovations, the market economy does not invest enough in R&D, and this argument applies to innovations related to clean ways to produce and more efficient ways to use energy. Incentives to innovate will be positively affected by introducing a CO_2 budget but may not be sufficient to motivate research into the development of major new technological solutions for energy. Using a portion of allowance value to fund R&D could help overcome these barriers and potentially put the sector in a better place to meet future climate objectives.

[24] Sufficient transmission capability between the states would be a necessity.

5.2. Distributional Considerations

Allowance auction revenue allocation provides an important avenue for mitigating adverse impacts on consumers that is separate from prices. If allowance value is returned to consumers as a lump-sum dividend, they will be compensated on average for the allowance cost contribution to the higher electricity rates while still paying much of the higher resource costs of electricity supply. Some of the revenue from auctions can also be used to target low-income households or EITE commercial and industrial customers who may be particularly adversely impacted by the policy (Blonz et al. 2012; Fischer and Fox 2007, 2010). If auction revenue is distributed to local distribution companies on the basis of sales, this will lower electricity prices relative to an auction but generally will not leave consumers as a group as well off as they would be if they received allowance value as lump-sum dividends.

Direct allocation to producers (output-based allocation or grandfathering) changes the equation for consumers. In competitive states, grandfathering allowances to producers results in increases in electricity prices that are similar to the increases under an auction and in windfall profits to producers at the expense of consumers who have no claim on allowance value. Windfall profits can also accrue to generators under other policies that do not provide a production incentive for electricity. In cost-of-service regulated states, allocation by grandfathering will mute the electricity price impacts that occur under an auction with some benefit to consumers, but generally prices are not reduced sufficiently to offset the loss of the allowance revenue dividend that consumers could have received from lump-sum allocations.

Policies with production incentive features that mute electricity price impacts have effects for producers and consumers that depend partly on the scope of the policy or allowance allocation. In general, consumers fare better under a narrowly focused TPS or OBA policy that targets a subset of generators or sales than under broader-based TPS or OBA policies because the targeted policies can result in lower electricity prices (Burtraw et al. 2014; Burtraw et al. 2015). So a policy that returns allowances to local distribution companies based on all electricity sales may not be as advantageous to consumers as one that targets a subset of producers. Similarly, the price impact of a CES policy will be partially mitigated by eliminating or limiting the ability of existing clean generators to earn credits under the policy (Paul et al. 2013b; Mignone et al. 2012). Narrowing the scope of a CES in this way will benefit electricity consumers at the expense of existing clean generators.

The consequences of the policies for electricity producers also depend on electricity market regulation and will vary by technology type. In cost-of-service regulated states, generators do not earn excess returns beyond the rate of return on capital allowed under the regulation. As a result, all the policies have essentially no effect on producers in cost-of-service states other than the potential boost to investment in new generators that could increase the size of the rate base on which regulated firms are allowed to earn a fair rate of return.

5.3. Administrative Cost

Administrative burden of EPA's CPP proposal is a concern for states, particularly for those states with limited resources for regulatory implementation or enforcement. In general, administrative costs of regulation are lower for simpler regulatory approaches. A mass-based policy, except for one with OBA, solely involves distribution of allowances, monitoring of emissions from affected sources, and collection of allowances to cover emissions. Given that most affected generators are already required to have continuous emissions monitors installed and to report those emissions to EPA, monitoring emissions is not an incremental cost. As a result, mass-based policies can be the most straightforward to administer.

Administrative cost is greater for a TPS (or mass-based policy with OBA) because both emissions and various components of the denominator or basis of the emissions rate must be tracked. While generation is metered, energy savings from energy efficiency programs are not, and assessing them would be a burden depending on what the standards are for measurement and verification and what current practices a state has in place. Administrative cost will be higher if the state goal and policy are of different forms (mass versus rate) than if they take the same form because of the work associated with reconciling the two.

Coordinating with other states is another way to lower administrative burden within a particular state. While at the front end the negotiation of a coordinated program will be costly, the savings over the decade of the first compliance period of having an integrated approach could be substantial. If the states agree to a mass-based approach, then a single trading system could substitute for multiple state trading systems.

5.4. Other Environmental Outcomes

While the focus of the proposed CPP rule is on carbon emissions, the policy could also have important effects on emissions of SO_2 and other criteria and toxic air pollutants from the electricity sector. SO_2 emissions are an important contributor to acid rain, but even more important (from an environmental benefits perspective), they have been shown to contribute to concentrations of fine particulates that are associated with premature mortality. Since the passage of the 1990 Clean Air Act amendments, emissions of SO_2 from electricity generators have been regulated by a cap-and-trade program established under Title IV of the act. For much of the eastern half of the country, the Title IV caps were further tightened by the Clean Air Interstate Rule (CAIR) and the subsequent Cross State Air Pollution Rule (CSAPR), although both rules have been the subject of ongoing legal battles.

Typically, under a cap-and-trade form of regulation, the emissions budget is not only a cap but also a floor on emissions, since reductions in one location tend to be offset by increases in other locations, or perhaps at other points in time if the program allows for banking or borrowing of emissions reductions. However, the promulgation of the Mercury and Air Toxics Standards (MATS) by EPA in 2011 imposed emissions standards for mercury and other toxic pollutants, or associated gases, that are expected to have the effect of reducing SO_2 emissions below the Title IV caps and the subsequent CAIR and CSAPR caps. This means that further reductions in SO_2 resulting from further reductions in coal-fired generation brought about by CPP compliance will not be offset by increases in SO_2 emissions in other places or times because the SO_2 budget is no longer the binding regulation, having been replaced by the MATS rule.[25] As a result, plans to comply with the CPP will have local air quality benefits in addition to climate change benefits, and these will vary depending on policy design and by state. Nationwide, the benefits could be as large as, or even larger than, CO_2-related benefits.[26]

In general, potential SO_2-related benefits will be bigger in states that have existing coal-fired generation and for policies that rely more on fuel switching from coal to gas and other generation sources than on electricity price increases to reduce emissions. Fuel switching and thus declines in SO_2 emissions will be more prevalent when allowance prices are higher and electricity price effects are muted, as would be the case under a more focused TPS policy (Burtraw et al. 2014). Electricity sector simulation modeling can provide insights about the likely magnitude or range of these impacts within any particular state.

6. Conclusion

EPA plans to regulate emissions of CO_2 from existing power plants under its proposed Clean Power Plan rule issued under section 111(d) of the Clean Air Act. The proposed rule

[25] In this context, the word "binding" refers to the fact that aggregate emissions of SO_2 are expected to fall well below the limits in current regulations focused on SO_2 emissions specifically.

[26] For more information about the potential local air quality benefits of regulation under 111(d), see Burtraw et al. (2014), Thompson et al. (2014), and Driscoll et al. (2015).

defines the best system of emissions reductions (BSER) that quantify emissions rate reductions achievable by particular actions, and then applies the BSER to each state to find an associated CO_2 emissions rate goal for each state. Under the proposal, each state is required to develop a plan to achieve emissions rates equivalent to those prescribed by the application of BSER to the particular state, but they need not use the approaches underlying the BSER. In fact, states are free to choose any regulatory approach that they can demonstrate to EPA will achieve the goals.

States are allowed to convert their emissions rate goals into mass-based goals. The decisions about the form of the goals and the form of the policies included in a state's plan are completely separate; in particular, having a rate-based goal does not mean that a state has to employ a rate-based policy, particularly if there is an existing mass-based program in place. Rate-based goals provide flexibility in the face of uncertain economic conditions relative to mass-based goals but may erode (or enhance) the environmental outcomes. A mass-based goal provides environmental certainty but could prove to cost more (or less) to attain.

Given the large amount of flexibility afforded to states in developing their plans for compliance, states may want to consider several different options for achieving the required reductions. The options include both comprehensive policies, which can achieve the goals by themselves, and a portfolio approach built of other policies designed to promote specific policy objectives. The economic efficiency and distributional consequences (for consumers and producers) of the different comprehensive policy options are greatly affected by how allowance value is allocated and by the scope of the policy.

From a national perspective, the most economically efficient comprehensive policy is one that imposes an explicit price on CO_2 emissions, does not incorporate an incentive for either electricity generation or consumption, and makes productive use of allowance revenue. These policies can influence all relevant choices within the sector about the fuels and technologies used to produce electricity and lead to an amount of electricity consumption that is consistent with achieving the policy goal at lowest cost, given its sector-specific focus.[27] Economics research suggests that using the revenue from such a policy to offset distortionary taxes on capital and labor may be the most economically efficient policy, and the opportunities for such efficiency-

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[27] When a carbon pricing policy excludes other sources of emissions, such as natural gas and oil use outside the electricity sector, it creates an incentive to move away from electricity to other fuels, which could create some emissions leakage to other sectors. Leakage is also a concern when different states use different types of policy instruments.

enhancing tax reforms have been extensively studied in the federal context, but less so at the state level. The government may also choose to use allowance revenue to pay for research and development related to clean energy technologies on both the demand and supply sides or to refund the value to consumers in a way that is divorced from energy consumption choices and from their electricity bills.

Policies that create a production incentive for electricity (rate-based tradable performance standards, mass-based policy with allowance allocation to consumers through electricity bills or OBA to generators, and clean energy standards) are less cost-effective than a mass-based policy with no production incentive because they reduce electricity prices, which elevates consumption and compliance costs. The political appeal of lower electricity prices may be attractive to states despite the elevated total compliance costs that these policies lead to. A targeted mass-based policy with OBA could be used to attract investment in new generators and limit emissions leakage and leakage of economic activity.

The final formulation of a rule to mitigate CO_2 emissions from existing power generators remains to be seen. EPA is scheduled to publish a final rule in the summer of 2015. One important aspect of the policy that is likely to remain in the final rule is the federal-state partnership under which EPA sets goals and states make policies to meet them. The flexibility inherent in this partnership sets the stage for states to mitigate emissions by cost-effective policies that can be tailored to meet the needs of individual states.

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