CO_2 Allowance Allocation Options

Considerations for State Policymakers when Developing Mass-Based Compliance Strategies Under the Clean Power Plan

PREPARED FOR

NRDC

NATURAL RESOURCES DEFENSE COUNCIL

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NOVEMBER 2016

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This report was prepared for the Natural Resources Defense Council. All results and any errors are the responsibility of the authors and do not represent the opinion of The Brattle Group or its clients.

We acknowledge the valuable contributions and peer review of Metin Celebi, Marc Chupka, and Frank Graves of The Brattle Group for peer review.

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Executive Summary

In August of 2015, the U.S. Environmental Protection Agency (EPA) finalized the first nationwide CO_2 regulation for existing electric generating units (EGUs). Accordingly to EPA, these power plants produce 30% of the nation's total greenhouse gas (GHG) emissions, making electricity the largest source of GHG emissions in the U.S. economy.[1] The Clean Power Plan (CPP) aims to reduce CO_2 emissions from the electricity sector to 32% below 2005 levels by 2030, according to EPA estimates. States have substantial flexibility in how to design state implementation plans (SIPs) for CPP compliance. Recently, the U.S. Supreme Court granted a stay that temporarily suspends implementation of the CPP while the D.C. Circuit Court of Appeals reviews legal challenges.[2] Some states are proceeding with CPP compliance planning or stakeholder engagement processes despite the stay, while others have suspended their efforts to develop SIPs.[3] The Clean Power Plan serves as the primary example in this paper even though the concepts discussed also apply to other mass-based carbon reduction approaches that states choose to implement.

One option for reducing carbon emissions from the power sector is to set a mass-based standard that imposes a cap on total CO_2 emissions from all covered EGUs in the state. The state issues a total quantity of CO_2 allowances at or below the emissions cap, with each allowance representing the permit to produce one ton of CO_2 emissions. As part of the implementation plans, state regulators need to determine how emissions allowances are initially distributed, whether by free allocation to individual entities or by centralized auction to compliance entities. After the initial distribution, entities holding allowances can freely trade them with each other. Each covered generating plant is responsible for demonstrating compliance to the EPA by surrendering one allowance for each ton of CO_2 emitted. This system is similar to the existing SO_2, NO_X, and CO_2 markets that are currently operating in the U.S. and internationally.

One of the most challenging and contentious issues for states pursuing mass-based compliance plans will be the initial distribution of CO_2 allowances, given the large economic value at stake. According to the EPA's projections, the nationwide economic value of these allowances could be approximately $30 billion per year by 2030 if all states adopted mass-based compliance plans.[4]

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1 See EPA (2016).

2 See Stohr and Dlouhy (2016).

3 See E&E Publishing (2016).

4 This number is based on an EPA estimate of CO_2 allowance prices, other simulation analyses have estimated lower prices (for example due to lower gas price assumptions or updated production tax credit assumptions) or higher prices (for example if assuming higher technology costs or gas prices). The EPA estimate is $28 billion per year, based on its mass-based Regulatory Impact Analysis simulations that assumed every state would implement a mass-based approach but would not engage in cross-state trading of allowances. The number represents 1.67 billion tons of CO_2 allowances in

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Given the substantial economic value at stake, the initial allowance distribution will have large financial consequences for any eligible generation owners, businesses, or electricity users. Even freely-distributed allowances have monetary value equal to the revealed prices in the bilateral or secondary exchange markets. Any entity holding allowances can earn proceeds from their sale, or avoid the purchase costs of allowances that would otherwise be needed for compliance. Direct allowance allocations can also introduce economic incentives that affect operating and investment decisions and consequently may affect environmental outcomes.

This report is commissioned by the Natural Resource Defense Council (NRDC), a not-for-profit environmental organization. The NRDC has asked us to describe the economic and policy implications of different allowance allocation approaches, particularly in terms of the impacts on customer bills. We therefore discuss customer bills as a key metric throughout this paper, but also attempt to discuss a range of other potential policy objectives that are likely to be considered.

To systematically evaluate options for the direct allocation or auction of allowances, we suggest that states follow a structured process, such as the one illustrated in Figure 1. As a first step, we suggest that states establish clear overarching policy objectives that when taken together will define the "best interests" of the state. For most states, we assume that these objectives will include meeting the CO_2 emissions requirements while keeping electricity bills and electric system costs as low as possible.[5] Some states may also specify a number of other objectives and considerations, such as retention and creation of jobs, financial implications for generation owners, technology development goals, and localized environmental impacts.

When designing an implementation plan including the initial allowance distribution, we suggest that policymakers evaluate design decisions *first* focusing on the best interests of the state overall, and *then later* considering the implications of individual constituents within the state. By deferring any examination of wealth transfers among interested parties to a later stage, policymakers will be able to focus on achieving the best outcome for the entire state as defined

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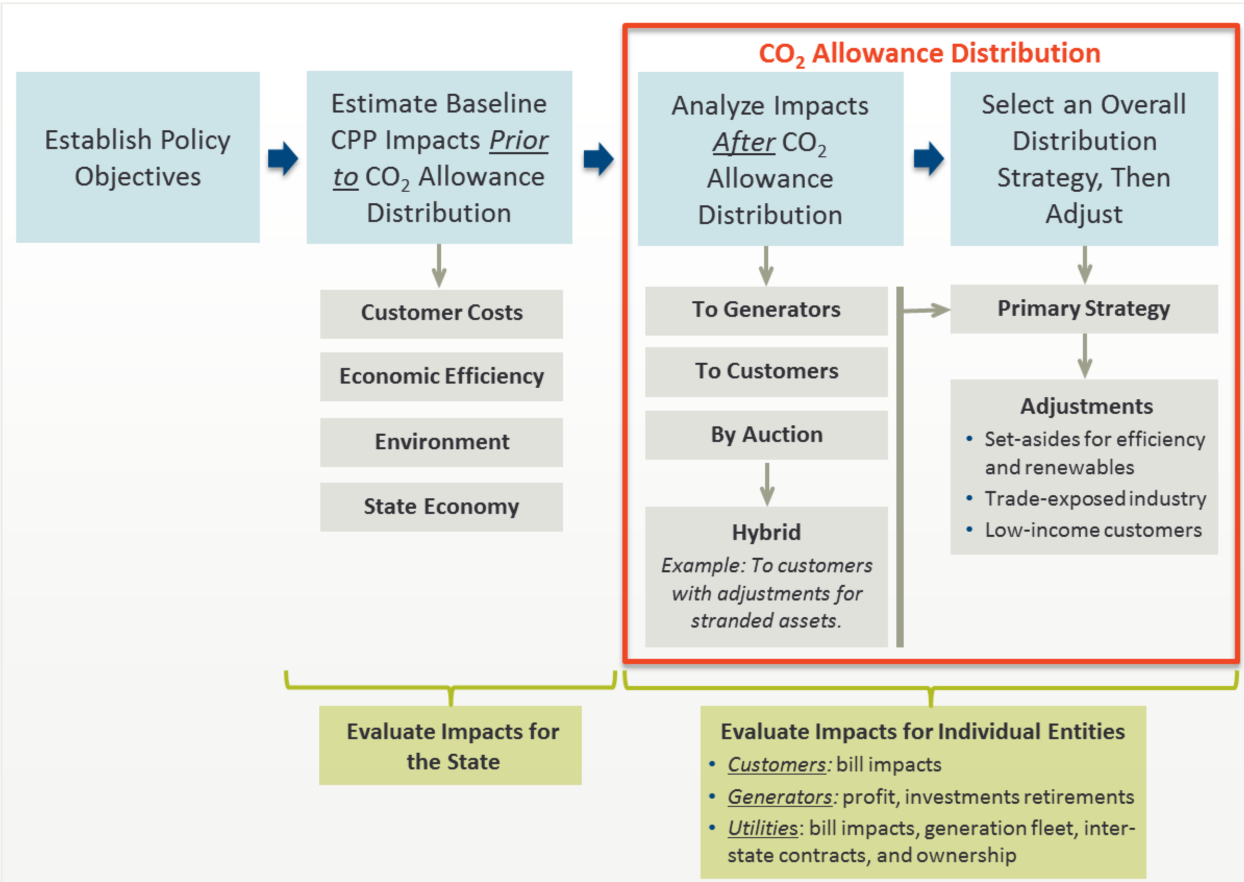
2030 with different CO_2 prices across states, and an escalation from 2011$ to 2030$ at a 2% inflation rate. The EPA-simulated weighted average CO_2 price is $17/ton in 2030$. See EPA (2016).

5 The definition of "electric system costs" may vary depending on the state, but as a default we assume it is defined analogous to the "adjusted production cost" metric often used in electricity sector benefit-cost studies as: (a) in-state production plus investment costs, plus (b) net costs (or revenues) from importing (or exporting) capacity, energy, and CO_2 allowances. This adjusted production cost metric measures the net compliance costs (or net revenues) to the state, regardless of whether those costs or benefits accrue to customers or generators. Other states will also include the societal cost of CO_2 emissions or other adjustments to reflect a more comprehensive societal cost metric. For example, see SPP (2013), Section 7.5.1.

by policy objectives.[6] This approach makes it less likely that a state would craft a suboptimal policy based on the concerns of a small number of vocal constituencies with concentrated interests. One advantage of a mass-based plan is that it creates a late-stage opportunity to use CO_2 allowance allocations to address the concerns of any parties that are adversely affected by the plan.

Figure 1
Structured Process for Selecting CO_2 Allowance Distribution Approach Under a Mass-Based Plan



The baseline economic implications of the CPP depend on wholesale and retail power price impacts before CO_2 allowance distributions. These impacts will be a fundamental consideration for all states' implementation plans. Generally, wholesale power prices will increase by approximately the same amount regardless of how allowances are initially distributed, whether

6 In other words, we suggest that policymakers should attempt to pursue a Pareto optimal policy that will maximize the net benefits to the state, where the net benefits are defined in terms of state policy objectives. This approach will defer any examination of wealth transfers among individual customer or generator interests for as long as possible. More than in other policy contexts, the distribution of allowances creates a later-stage opportunity to design a policy that compensates the adversely affected parties whose individual interests are not aligned with the best interests of the state.

they are allocated for free or auctioned to the highest bidder.[7] This is because generators would incur increased operating costs and, therefore, increase their offer prices for selling power by the cost of using CO_2 allowances. This is true *even if the generators were originally awarded the CO_2 allowances for free.* Regardless of whether an allowance was purchased or freely allocated, a generator will use that allowance for compliance only if it can earn a greater profit by selling power than by selling the allowance at the going market price. The opportunity cost of using an allowance will increase the market price for electricity not only in organized wholesale markets, but also in new bilateral contracts in traditionally regulated regions. Energy procured via existing bilateral contracts may be hedged against such price increases for a time, but new bilateral arrangements will reflect these price increases once existing contracts have expired.

Wholesale power price increases will translate to increases in customer bills in the baseline analysis before considering any offsetting measures.[8] This is most obvious in retail choice states where customers are more directly exposed to wholesale power prices. For generators, the impacts of higher power prices are mixed. Low-emitting generators will become more profitable as they earn higher wholesale energy revenues under the CPP; high-emitting generators' financial performance will degrade. Impacts on vertically integrated utilities and their customers will depend on each utility's position as a net buyer or seller of power, its proportion of high-emitting generation, and its contractual relationships with other generators and customers, some of which extend across state boundaries.

Once the baseline impacts of CPP on each affected party are understood, CO_2 allowance distribution options can be analyzed as adjustments that will award the value of those allowances toward a particular sector or in support of policy programs. The primary options for distributing emissions allowances are: (1) free allocation to generators, (2) free allocation to customers, and (3) centralized auctions selling CO_2 allowances to the highest bidder. Each of these options has a number of variations, and they can be combined into a hybrid approach that reflects a state's specific circumstances. If the state opts to cap emissions from new gas-fired combined-cycle (CC) plants in addition to existing generators under the new source complement as proposed by the EPA, the CPP gives state regulators complete authority to distribute allowances however

7 Wholesale power prices will increase regardless of the allowance allocation approach chosen. However, the exact amount of the price increases may differ because some types of allocation approaches could create incentives that can change energy offer prices, economic dispatch, retirement, investment, and energy efficiency decisions, and may consequently change wholesale power prices. The output-based allocation approach in the EPA's proposed plan would introduce some such incentives. However, if the allowance distribution approach is designed to avoid all such incentives then power prices would increase by exactly the same amount in a totally efficient marketplace regardless of how allowances are distributed.

8 Offsetting measures can include using CO_2 allowance auction revenues or direct allocations to distribution utilities to either directly offset customer bills or reduce customer bills through investments in energy efficiency.

they choose from among these options. However, if the state does not cover new CCs, it may face some restrictions on how to distribute the allowances.[9]

How allowance distribution translates to customer bill impacts will vary depending on the state's regulatory structure. In states with retail competition, the value of the allowances can be returned to customers by either allocating the allowances to the regulated electric distribution companies or auctioning off the allowances. In either case, the proceeds from auctioning or bilaterally selling the allowances could be allocated to bill rebates, energy efficiency, or programs that benefit customers. In contrast, if allowances are allocated to generators in retail restructured states, then the value of those allowances would flow to the private investors that own generating plants and so would not offer any means of offsetting customer bills.

"In states with retail competition, the value of the allowances can be returned to customers by either allocating the allowances to the regulated electric distribution companies or auctioning off the allowances…. In contrast, if allowances are allocated to generators in retail restructured states, then the value of those allowances would flow to the private investors that own generating plants"

In states with vertically integrated utilities, customer bill impacts can vary by utility. Regardless of how the allowances are initially distributed, the state regulator could require the utility to either surrender allowances for CPP compliance or sell them in a way that would minimize the cost of service, and provide transparent accounting of how allowances were used to benefit customers. Each utility's net allowance position and therefore net bill impacts will depend on its resource portfolio and the allocation method. For instance, a utility with a primarily fossil-based generation fleet may prefer distributing allowances only to covered generators. However, a utility that relies more heavily on renewable resources may prefer a customer-based approach or one that allocates to all covered and non-covered generation including renewables. In another example, a utility that relies on contracts with independent power producers (IPPs) or is otherwise dependent on power purchases may prefer customer-based allocations. Utilities engaging in the cross-border contracting and ownership of generation will depend on allowance allocations in each state and the ability to transfer allowances across state borders.[10] If the state wishes to ensure that all allowance value

9 The EPA has noted that not covering new gas CCs under a mass-based plan could induce over-generation and over-investment of new CCs such that the required CO_2 emissions reductions from existing EGUs are achieved partly by shifting emissions to new units that are not covered. States must either cover new gas CCs or else propose some other mechanism for mitigating CO_2 leakage to new CCs. The mass-based compliance approach under the proposed federal implementation plan does not cover emissions from new gas CCs, but uses an allowance allocation approach to attempt to partially offset the leakage incentive. It does so by allocating some allowances on an updating output basis to existing CCs that have a high capacity factor and some to new renewable generation. Two recent studies concluded that the EPA's CO_2 allocations mechanism would not be effective in preventing leakage to new gas CCs. See Burtraw, *et al.* (2016) and M.J. Bradley & Associates (2016).

10 Cross-border generation ownership and contracting can introduce the risk that some utilities and their customers would be awarded few or no allowances. In the extreme example, assume the utility owns

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will flow to in-state customers, then it should distribute the allowances or auction revenues to in-state customers. Under generation-based allocations, the value of some allowances would flow to IPPs and out-of-state customers.

After analyzing the potential impacts associated with the three general approaches on the most affected constituencies, the state can select one that is best aligned with its policy objectives. A state may alternatively want to use a hybrid strategy that combines elements from these approaches. For example, one hybrid approach would be to use customer-based allocations but make adjustments for stranded asset costs if one utility's customers are most adversely affected by coal plant retirements. As another example, a state could award customer-based allocations to public power entities, and award allowance auction revenues to other customers.

> ***"The dollar value of incentives from free CO_2 allowance allocations should be evaluated just like other customer-funded programs, given that the alternative is to allocate the allowance value back to customers."***

We recommend that state policymakers carefully consider the intended or unintended economic incentives that may be introduced when crafting the allowance allocations approach. The dollar value of incentives from free CO_2 allowance allocations should be evaluated just like other customer-funded programs, given that the alternative is to allocate the allowance value back to customers. As an example of an intentional incentive, allocation awards might be used to create incentives for energy efficiency or renewables investments. As an example of unintended incentives, free allowance allocations can induce unintended behaviors and economic inefficiencies. To avoid adverse outcomes, we recommend that states examine the following potential impacts when deciding on the initial distribution of allowances:

- **Generation-Based Approaches.** If allowance allocations are updated based on future operations or online status, the approach may create incentives for the generators to deviate from the traditional cost-minimizing operation that includes the cost of emissions. The incentives and potential inefficiencies that we recommend carefully examining include:
  - *Operations and Dispatch*. Allocating allowances based on updating future (as opposed to pre-CPP historical) generation output or CO_2 emissions would introduce incentives to produce more power from power plants that are qualified to earn free allowances. For example, allowance distributions that are based on prior period's operation would create incentives for qualified generators to bid lower than their true operating costs (with the cost of the emissions incorporated). They would then uneconomically increase production in order to increase their free allowances in the subsequent

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coal generation in State A which is used to serve customers in State B. State A may allocate CO_2 allowances to in-state customers to avoid having the value of those allowances flow to out-of-state interests. If State B takes the alternative approach of allocating allowances to generators, then the utility will be left with no allowance allocations in either state.

period. Such adverse incentives and resulting behaviors could result in higher electric system costs to achieve the same level of covered CO_2 reductions.[11]

- *Retirement Decisions.* If fossil plants are allocated free allowances that would be forfeited by plant retirement, this would create incentives to prolong the operating life of high-emitting resources that otherwise would retire and cost-effectively reduce emissions. Further, until a state has clearly communicated that generators will not be awarded any allocations or that allocations will not depend on retirement status, their owners will have an incentive to postpone retirement dates at least until uncertainties around allowance allocations are resolved.[12]
- *New Investment Decisions.* Allocating free allowances only to certain types of new generators would create additional incentives to invest in those types of plants rather than others. Thus, using allowance allocations to create investment incentives should be evaluated just as if the regulator were using customers' money to pay for those generation investments.

- **Customer-Based Approaches**. Customer-based allocations can introduce economic incentives based on how the allowance value is awarded to customers. Policymakers will therefore want to ensure that the retail rate structure and program funding reflects the overarching policy objectives, for example:
  - *Incentives for Energy Efficiency and Distributed Generation*. Prior to allowance distributions, any increases in customer bills will increase customers' desire to pursue greater energy efficiency and distributed generation. A volumetric-based refund of allowance value would offset these incentives. Thus, to avoid weakening the incentives for conservation, state regulators can decide to refund the allowance value to customers through energy efficiency programs or through rebate approaches not directly linked to customer use, such as lump sum reimbursements. For example, the Regional Greenhouse Gas Initiative (RGGI) states return CO_2 allowance value to customers primarily by using investments in energy efficiency to reduce retail bills.[13] Analysis Group recently found, in its evaluation of the economic benefits of the RGGI program, that investments in energy efficiency programs were the most beneficial

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[11] This is true except in cases where the output-based allowances are acting to correct an externality or some other sort of market failure. Even if these types of allocations increase electric system costs, policymakers may still pursue output-based allocations for other policy reasons.

[12] For example, allowance allocations to generators could be established as a pre-determined schedule that depends on plant age but does not depend on retirement or online status. In that case, the retirement decision will not be influenced by allocations.

[13] The RGGI states use proceeds from allowance auctions to make these investments, but a state that uses direct allocations to the distribution companies serving customers could use a similar approach by requiring the utilities to sell some allowances and use the revenues to fund energy efficiency programs. See Regional Greenhouse Gas Initiative (2015a).

approach of those studied for supporting the economic objectives of the participating states.[14]

– *Trade-Exposed Industries*. Prior to the free distribution of allowances, bill increases affecting trade-exposed industries could be a concern for states focused on retaining or attracting businesses. It could be particularly concerning to a state if such a customer had a greater incentive to relocate to another state or country with a less stringent carbon emissions policy. To protect such businesses, California and Europe have focused CO_2 allocations or bill rebates toward trade-exposed industries.[15]

- **Auction-Based Approaches**. Selling allowances by auction will produce the most economically efficient signals for generators to reduce their aggregate emissions to within the mass-based emissions cap while minimizing operating and investment costs. The state then has the opportunity to use the proceeds from the allowance auctions as a policy instrument to pursue a range of policy objectives.

Ultimately, the question around the distribution of allowances is simple: which parties will be awarded the substantial value associated with CO_2 allowances under the CPP, end use customers, independent power producers (IPPs), or integrated utilities? A structured process that is driven by policy objectives may help to balance competing priorities and stakeholder interests. If the primary objective is to meet the CO_2 emissions reductions while minimizing customer bills within the state, then we recommend allocating allowances or auction revenues directly to customers or to programs that directly benefit customers. These approaches would ensure that the entire value of CO_2 allowances would flow to in-state customers.

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14 Specifically, Analysis Group found that the "size of RGGI's positive economic benefits varies by state and region, in large part because the RGGI states spent their RGGI auction proceeds differently. Different expenditures have different direct and indirect effects in their economies and different impacts on their electric systems. For example, a state's use of RGGI dollars to pay for energy efficiency programs that reduce energy consumption in the electric sector, and to invest in renewable projects that have low operating cost, both served to lower electricity prices in wholesale power markets (compared to a 'no-RGGI' scenario). This mitigated the early-years' cost impact for electricity consumers by turning the RGGI program into a down payment on lower overall bills for electricity in the longer-term," and "there are multiple ways that investments in energy efficiency lead to positive economic impacts; this reinvestment thus stands out as the most economically beneficial use of RGGI dollars." See Hibbard, *et al.* (2015), pp. 7, 54.

15 California allocates allowances to certain industries for leakage prevention and transition assistance, see California Air Resources Board (2016) at §95891. EU ETS also allocates allowances to certain manufacturing industries, see European Commission (2016).

I. Overview of Allowance Distributions

A CO_2 allowance is a government-issued permit to emit one ton of CO_2 emissions. As a scarce resource, emissions allowances have an economic value that can be examined like other public funds. Policymakers will need to make choices about how these funds should be distributed in ways that best support the state's policy objectives. As a starting point, we suggest that policymakers should first examine the baseline economic implications of the Clean Power Plan (CPP) other carbon reduction programs, as applicable, when estimating the economic impacts on customers and producers before considering the impact of allowance distributions. Then policy makers can evaluate the second and separate question of which entities should be awarded allowances. Evaluating the primary allowance distribution alternatives then becomes a more straightforward question of how to allocate economic resources.

A. Framework for Evaluating Allowance Distribution Alternatives

We suggest that states follow a structured process that would first focus on the overarching policy objectives of the state to design the state implementation plan (SIP) and then later assess the relative merits of CO_2 distribution mechanisms. Figure 2 illustrates how such a process would start with clear policy objectives, then work to design a SIP that supports the best interests of the entire state (without examining impacts on individual entities). For example, one metric that could be used to examine the net economic benefits and costs of CPP and/or other carbon reduction programs to the entire state would be an adjusted production cost metric measuring: (a) production and investment costs, plus (b) net purchase costs (or sales revenues) from importing (or exporting) energy and CO_2 allowances. A state may also adopt a more comprehensive societal cost metric that includes the societal costs of CO_2 emissions, health impacts, or other externalities that are not accounted for in adjusted electricity production costs. A combination of these metrics could be adopted to measure the interests of the state; none of these metrics are directly affected by allowance distributions.[16]

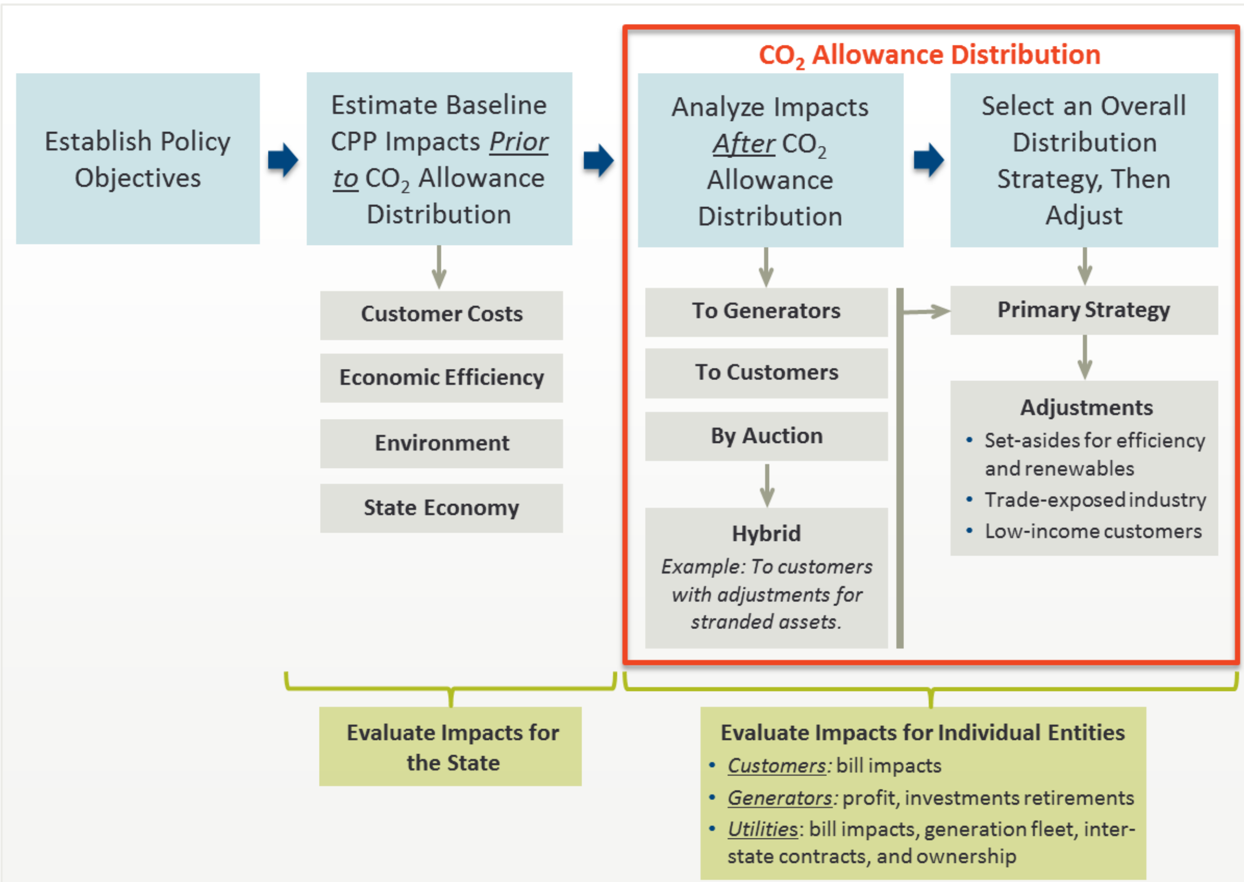
The subsequent question of how to distribute CO_2 allowances is primarily a question of determining wealth transfers among different constituencies within the state. This would involve estimating net impacts on customers' bills, generators' profitability, and utilities' costs. By deferring the examination of wealth transfers among interested parties to a later stage, policymakers may be able to focus more directly on achieving the best outcome for the entire state. This approach makes it less likely that a state would craft a suboptimal policy based on the concerns of a small number of vocal constituencies with concentrated interests. More than in

16 To first order, adjusted production costs will not be affected by allowance distributions, but this is not be strictly true in all circumstances. For example, some distribution approaches introduce incentives to invest in different resource types, or create the opportunity to transfer allowance values to out-of-state entities. We examine these potential effects in detail throughout this report.

other policy contexts, distribution of CO_2 allowances represents a later-stage opportunity to compensate adversely affected parties whose individual interests are not aligned with the best interests of the state.[17]

Policymakers can then select one of the three primary allowance distribution approaches as a starting point, determining whether allowances are freely allocated to customers, freely allocated to generators, or sold by auction. The state can then tailor that approach by using hybrid combinations of the primary options, allowance set-asides, or auction revenues as a policy instruments to further particular priorities.

Figure 2
Structured Process for Selecting CO_2 Allowance Distribution Approach Under a Mass-Based Plan



[17] In other words, we suggest that policymakers should attempt to pursue a Pareto optimal policy that will maximize the net benefits to the state and maintain the option to use CO_2 allowances to compensate adversely affected parties as needed.

B. Economic Implications Prior to Allowance Allocations

Before examining the range of allowance distribution mechanisms available, we suggest that states first analyze the baseline economic implications of CPP compliance on the major affected constituencies as the starting point. We describe here the primary economic implications of a mass-based plan for wholesale power prices, customer bills, generation owners, and integrated utilities.[18]

1. Wholesale Electricity Price Impacts

A key driver of the financial implications of the CPP for most parties will be wholesale energy prices. Wholesale energy market prices will increase under mass-based implementation plans because the CO_2 allowance price will be reflected in fossil plants' costs of generating power. This will increase the price at which generators are willing to sell energy into wholesale markets and in bilateral transactions. Regulated utilities will similarly consider the price of CO_2 allowances when making their own economic dispatch decisions. What may not be immediately obvious is that generators will increase their offer prices for selling power *even if they were awarded those CO_2 allowances for free.* A generator will only choose to emit CO_2 (and surrender the associated allowances) if it is possible to earn a greater profit from selling energy than from selling the CO_2 allowance itself.

Wholesale energy prices will increase by approximately the same amount regardless of how allowances are initially distributed. In fact, energy price impacts from a mass-based plan would be exactly the same under all allowance distribution approaches as long as the CO_2 distributions do not induce any incentives to alter economic dispatch, retirement, investment, or energy efficiency decisions away from lowest-cost decisions.[19]

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18 These same economic implications are partly a reflection of the state's regulatory structure and partly a reflection of economic fundamentals. These same consequences are described in other industry and academic literature including Litz and Murray (2016), p. 11, and Sijm, Neuhoff, and Chen (2006), p 4.

19 We do not discuss the impacts on wholesale capacity prices in this report, other than noting that the CPP may drive capacity prices higher or lower depending on the market in question and the details of how the CPP is implemented. In the short term, CPP could drive capacity prices higher if the CPP leads to coal plant retirements causing the market to become shorter on supply; alternatively, the CPP could drive prices lower in the short run if energy efficiency exceeds load growth and causes the market to become longer on supply. In the longer term, higher energy prices would result in lower capacity prices as new gas-fired plants earn more of their return from the energy market and so require lower capacity prices to enter. Capacity prices may be even lower in the long-run for any market that does not cover new gas CC units, as energy market revenues could increase for the units not covered and may induce an over-investment in new gas CC units. Other studies have also examined the impacts of not covering new CCs under CPP, see Burtraw, *et al.* (2016) and M.J. Bradley & Associates (2016), and Chang, *et al.* (2016).

2. Impacts on Customers and Generators in Retail Restructured States

Wholesale energy price increases will translate directly into retail rate increases in states with retail competition over a timeframe determined by the terms of retail service relationships. Some customers will be immediately exposed to wholesale prices; others will observe price increases over time as the wholesale price increases are eventually reflected in the retail rates.

For merchant generators in restructured states, the financial implications of the CPP also depend on changes in wholesale energy and capacity markets. The magnitude of these financial implications will vary greatly across states, but the directional impacts prior to considering allowance distribution will generally be consistent by asset class:

- **Coal:** Energy prices will increase, but generators' operating costs associated with purchasing CO_2 allowances will increase more. A coal plant's financial position will be degraded not only because it operates less, but also because it earns a lower profit margin on each unit of energy produced. These and other economic pressures will encourage the least competitive coal plants to retire over time.
- **Covered Gas CCs:** For covered gas CC plants, energy prices will typically increase more than the cost of purchasing allowances. Thus their financial performance will likely be enhanced by operating more and earning a greater profit margin when operating.[20]
- **Renewables and Nuclear:** Zero-emitting renewable and nuclear resources will benefit from higher energy prices and thus become more profitable. This may attract more investments in renewables (or attract the same quantity to meet renewable portfolio standards (RPS) but at a lower renewable energy credit (REC) premium) and retain some nuclear and hydroelectric plants that might otherwise retire.

For electricity customers, the overall effect of a mass-based emissions cap before considering CO_2 allowance allocations and any associated energy efficiency will include an increase in electricity bills. For merchant generators, the results depend on the resource type.

3. Impacts on Vertically Integrated Utilities and their Customers

In states relying on vertically integrated utilities, the baseline cost of service impacts from the CPP prior to considering allowance distributions will depend on the utility's resource mix and customer base. A coal-dependent utility would have increased costs from using CO_2 allowances and could potentially face stranded asset costs. A utility with a low-emitting fleet may find more

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20 There would be exceptions to this overall statement where covered gas CCs will become less profitable with a mass-based CPP implementation. For example, if new CCs and existing/new combustion turbines (CTs) are not covered by the rule, they would be dispatched more as they become seemingly less expensive to operate compared to covered CCs. In that case, energy prices would not rise as much, and capacity prices would fall. As a result, existing covered gas CCs would likely become less economic under the CPP.

opportunities to increase output beyond their own customers' needs, sell the excess power, and use the revenues to offset customers' bills. Utilities that procure power from independent power producers (IPPs) or other utilities will see that new bilateral contracts and market purchases reflect higher prices associated with CO_2 emissions costs. Utilities that source power from generation outside the state could have customer cost impacts driven by another state's CPP implementation plan. Some utilities own in-state generation but use it to serve out-of-state customers. All of these factors affect the baseline customer bill impacts of CPP prior to accounting for allowance allocations.

C. Primary Approaches to Distributing CO_2 Allowances

The three primary alternatives for distributing allowances are free allocations to generators, free allocations to customers, or auction-based allocations. These options are summarized in Table 1, along with descriptions of which entities would collect the value of the allowances. State policymakers can also combine these alternatives into hybrid approaches that reflect a combination of priorities. For example, a state may opt to allocate the majority of allowances to customers, but set aside a portion of the allowances as economic incentives for the development of clean energy resources or energy efficiency programs.

In retail restructured states, the choice of allowance distributions determines whether the economic value of the allowances will accrue to customers, to generators, or to policy programs. If the allowances are freely allocated to load serving entities (LSEs), then the allowances can be sold to generators, creating a revenue stream to benefit customers. If the allowances are freely allocated to generators, the value will flow to the private companies that own these generation assets. In an auction-based approach, policymakers can decide to allocate the resulting auction revenues directly to customers through bill offsets, indirectly to customers through efficiency or other programs, or toward other policy priorities.

In states relying on vertically integrated utilities to serve electricity customers, the question of allowance allocations may at first seem less consequential for customer bill impacts. In a hypothetical state with just one utility that owns all generation and serves all customers, there is little difference between allocating allowances to customers or generators. In either case, state regulators could require the utility to either surrender allowances for CPP compliance or sell them in whatever way will minimize the cost of service, thus passing the total value of allowances back to customers.[21]

[21] There is still some difference between generation and customer-based approaches however, in that customer-based allocations may provide more transparency in rate accounting such that it may be easier for the public utility commission to track the accounting of how allowances are sold and how allowance values are credited back to customers. For example, customer-based allocations to utilities can be combined with utility auctions for allowances with the full auction revenue being credited back to customers as proposed by Burtraw and McCormack (2016).

This simplified case is an exception however. More commonly, the state will have a mix of differently-situated utilities, and each utility's customers will be affected differently under alternative allocation options. A customer-based allocation could be structured to ensure that the entire value of CO_2 allowances goes to benefit in-state customers. However, a generation-based allocation may result in the value of some allowances flowing to out-of-state customers, utility shareholders, or to IPP company shareholders. Customers served by multi-state utilities could also be adversely affected by inconsistent state policies. For example, no allowance value would flow to customers located in a state that opts for generation-based allocations if they are served by a utility sourcing power from a state that opts for customer-based allocations.

Table 1
Mechanics of Primary CO_2 Allowance Distribution Options
And Description of Which Entity Accrues the Value of Allowances

Approach	Retail Restructured States	Traditionally Regulated States
To Generators	• Generators are awarded CO_2 allowances, which can be used for CPP compliance or sold on the bilateral market • Allowance value accrues to merchant generation owners	• Generation owners are awarded CO_2 allowances, which can be used for CPP compliance or sold on the bilateral market • Allowance value accrues to combination of: (a) in-state and out-of-state customers of generation-owning utilities, (b) shareholders of generation-owning utilities, and (c) independent power producer (IPP) company shareholders
To Customers	• Distribution company or retail service provider is awarded CO_2 allowances on behalf of their customers • Allowances are sold in the bilateral market, with revenues credited back to customer bills or programs • Allowance value accrues to customers	• Distribution company is awarded CO_2 allowances • Utility demonstrates how the value of CO_2 allowances are credited back to customers, either through: (a) bilateral sale of allowances with revenues credited to customers, or (b) transfer of allowances within the company for CPP compliance and demonstrated lowest cost of service • Allowance value accrues to customers
Via Centralized Auction	• State auctions CO_2 allowances to the highest bidder • Auction revenues accrue to customers by crediting against customers' bills or used for specific programs	• State auctions CO_2 allowances to the highest bidder • Auction revenues accrue to customers by crediting against customers' bills or used for specific programs

II. Design Considerations under Primary CO_2 Allowance Distribution Approaches

Once a primary allocations strategy has been selected, state policymakers have a number of specific design options to consider. When all CO_2-emitting resources are covered and the emissions cap is binding, the chosen approach to distributing allowances will not affect the realized level of CO_2 emissions reductions. Emissions reductions will be achieved at the lowest electric system costs if the allocations mechanism is structured in a way that avoids introducing incentives to deviate from least-cost investment and operating decisions. In this section, we discuss various factors that state policymakers may want to consider when deciding on allowance distribution approaches.

A. Direct Allocation to Generators

There are several options for how CO_2 allowances could be freely allocated to generators, with potentially large financial implications regarding which types of resources stand to benefit. If an allocation approach is updated as a function of future behavior, then the allocations will influence that behavior and thereby introduce incentives to deviate from lowest-cost investment and operating decisions. For example, if generators do not face a uniform marginal cost from emitting CO_2, the electric system costs associated with achieving a particular level of emissions reduction will not be minimized. Generation-based approaches can also introduce challenges in accommodating retirements and new investments. For example, existing plant owners could have an incentive to reinvest in aging plants that would otherwise retire. They may do so to keep receiving valuable CO_2 allowances that might otherwise be forfeited. In this section, we describe a few examples of allowance distribution approaches that may lead to inefficient outcomes that ultimately increase system costs.

1. Variations of the Generation-Based Approach

One generation-based allocation option is described in the Environmental Protection Agency's (EPA's) proposed federal implementation plan (FIP). The FIP does not cover new gas-fired CCs under the CO_2 allowance cap and thus will create economic incentives to shift CO_2 emissions to those non-covered resources. Recognizing this concern, the proposed FIP maintains a set-aside of allowances for allocating to renewable generation and existing gas-fired CCs.[22] These set-aside allowance allocations would directionally offset the incentives for CO_2 emissions leakage to new gas CCs, but we and others have found that the FIP will not be effective in mitigating the

22 Under this proposal, 5% of the allowances in each year are set aside for eligible renewable projects installed on or after January 1, 2013. Renewable energy set-aside must be onshore utility scale wind, solar, geothermal, or utility scale solar power; uprates to existing qualifying resource types are also eligible to receive allocations. The EPA also proposed an additional set-aside for output-based allocations to existing gas CCs operating above 50% capacity factor to offset the economic incentives to shift production and CO_2 emissions from existing CCs that must pay allowance costs to new gas CCs that face no allowance costs. The size of the output based allocations set-aside is based on the 2012 adjusted baseline CC capacity and an assumed increase of 10% capacity factor. See 80 Federal Register 64,966 at 65068, §62.16245; EPA (2015c).

concern.[23] The alternative option of covering new CCs under the mass cap would maintain parity between new and existing plants by imposing the same incentive to avoid CO_2 emissions.[24]

For states that choose *not* to cover new gas CCs, their options for how to allocate allowances may be somewhat restricted. The respective SIP will need to demonstrate some means of mitigating leakage to new gas CCs, with one option being to adopt the same allowance distribution approach as provided in the FIP once it is finalized. The EPA has not provided specific guidance on exactly what variations of this FIP proposal would be considered approvable. As we discuss further in a separate report, the set-asides will directionally mitigate leakage to new units, but the approach does not maintain incentives to retain existing non-emitting resources such as nuclear and hydro, and the magnitude of the set-asides is likely too small to equalize the incentives to invest in new renewable resources or increase the capacity factors of existing gas CCs.[25]

In contrast, states that do opt to cover new CCs will have total flexibility in how they decide to distribute allowances, and so have the ability to allocate in whatever way is most in line with their policy objectives. If opting for a generation-based allocations approach, there are a number of design decisions to determine which generators will be awarded allowances. Some of the options and associated considerations include:

- **Pre-CPP Historical Baseline or Forward-Looking Operations:** Free allocations to generators could be in proportion to a pre-CPP historical baseline or based on forward-looking operating information. Allocations that update based on future investment, retirement, or operating decisions will introduce incentives to change those behaviors away from least-cost decision-making as discussed in Section II.A.2.[26]
- **Generation- or Emissions-Based:** Generation-based allocations could be in proportion to generated MWh or emitted tons of CO_2. Allocating in proportion to emissions (either for past or future emissions) would tend to benefit the highest-emitting coal resources and thereby run counter to the policy goal of reducing CO_2 emissions. Emissions-based approaches would create a relative disadvantage for companies that engaged in early action to shift toward a low-emitting fleet. Allocations in proportion to MWh output are more technology-neutral, but if done on a forward-looking basis could tip investment

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[23] See Chang, *et al.* (2016), Burtraw, *et al.* (2016), and M.J. Bradley & Associates (2016).

[24] See a more complete discussion in our forthcoming paper, Chang, *et al.* (2016).

[25] The EPA has provided general guidance in the CPP that a state pursuing a mass-based plan approach must "demonstrate that the plan addresses and mitigates the risk of potential emission leakage to new sources." See 80 Federal Register 64661 p. 64887.

[26] In this context, we refer to "future" as being any future decisions that have not been made as of the time that the CO_2 allowance allocations policy is crafted, and "historical" as being based on any time period prior to the allocations policy being crafted. For example, an output-based approach that allocates a subsequent period's allowances based on the prior period's output would also be considered a future or forward-looking approach and would influence behaviors.

incentives toward baseload resources even if peaking plants are the lowest-cost resource type.

- **Qualifying Zero-Emitting Resource Types:** Allocating allowances only to covered fossil units would award allowances to the entities that need to use them for compliance. However, this may tip investment and operating incentives toward fossil plants and away from cleaner resources. Allocating allowances to fossil and clean energy resources in proportion to the same MWh output metric would equalize the incentives across these technology types. Awarding more allowances to clean energy than to fossil per MWh produced would create an additional reward for early action (if based on historical output); or could provide additional support to counter potential retirement of existing non-emitting resources such as nuclear or hydro and introduce additional economic incentives to produce energy from new clean sources (if based on updating future output).
- **Accommodating Generation Retirements and New Investments:** A generation-based allowance distribution approach needs to consider retirements and new investments as discussed further in sections II.A.3-4 below. This is a difficult aspect of generation-based allocations because if no updates are made, then incumbent, aging, and potentially even retired generators would have an economic advantage compared to new resources. However, any updates to allocations based on online status poses the risk of introducing unintended economic incentives.

2. Relative Economics and Dispatch of Different Generation Types

The electric system cost of achieving a specific level of fleet-wide CO_2 emission reductions will be minimized if every power plant faces the same marginal cost for each ton of CO_2 emitted.[27] To level the playing field for all generating technologies and create this uniform incentive to reduce CO_2 emissions on a fleet-wide basis, state policymakers would need to incorporate all CO_2-emitting plants into their mass-based plan, particularly new gas CCs.[28] If all power plants face the same CO_2 price, those costs will be incorporated into economic dispatch decisions in a way that achieves the required reductions most cost-effectively.

The same principle applies when considering the marginal incentives that can be introduced by generation-based CO_2 allocations. Allowance allocation that is updated as a function of future operating behavior will create incentives to change that behavior. If some allowances are

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27 This statement applies to achieving the greatest level of fleet-wide CO_2 reductions at lowest cost, including CO_2 emissions from resources that are not necessarily covered under CPP.

28 New gas CCs are the most important type of resource to cover under the mass-based plan because this is the resource type that will emit the most CO_2 and not be automatically covered under the CPP. Similar issues affect other non-covered resource types including gas CTs and small fossil units under 25 MW in size, although the total generation and emissions from these resource types would be lower than those from new gas CCs.

awarded in proportion to updating future MWh production, then a generator will factor the quantity and value of additional allowances that will be awarded into its dispatch decisions. The generator would subtract the expected value of those allowances from its energy offer price and thereby increase its likelihood of dispatch.[29] If only existing fossil plants were awarded allowances in proportion to MWh produced, then output from those plants would become relatively more economic than the output from new zero-emitting resources. The relative advantage in operations will translate into a relative incentive for investment.

If CO_2 allocations were awarded in proportion to updating future emissions output, perverse incentives could be created to *increase* output from higher-emitting resources even if that is counter to the emissions reduction goals. This concept is illustrated in Figure 3 below. The figure shows an example where CO_2 allocations could undermine incentives to pursue the least-cost CO_2 emissions abatement opportunity. The left-hand panel illustrates the marginal production costs of coal and gas CC plants if both face the same marginal CO_2 emissions cost of $14/ton; coal plants face a higher production cost that creates the incentive for coal-to-gas dispatch switching and cost-minimizing emissions reductions as one would expect under an emissions cap. In contrast, the right-hand panel assumes that the allowance price is the same, but that half of all CO_2 allowances are awarded to covered fossil units in proportion to their future realized CO_2 emissions.[30] Generators would still factor in the cost of purchasing (or not selling) a CO_2 allowance in a way that increases their offer prices. However, those generators would also subtract the expected value of future allowance allocations from their energy offer prices. Coal plants' offer prices would decline by more than gas CCs' because the coal plants would be awarded more allowances.[31] This behavior would encourage more generation from high-emitting plants, forgo low-cost in-state abatement opportunities, and induce generators to purchase more CO_2 allowances from other states.

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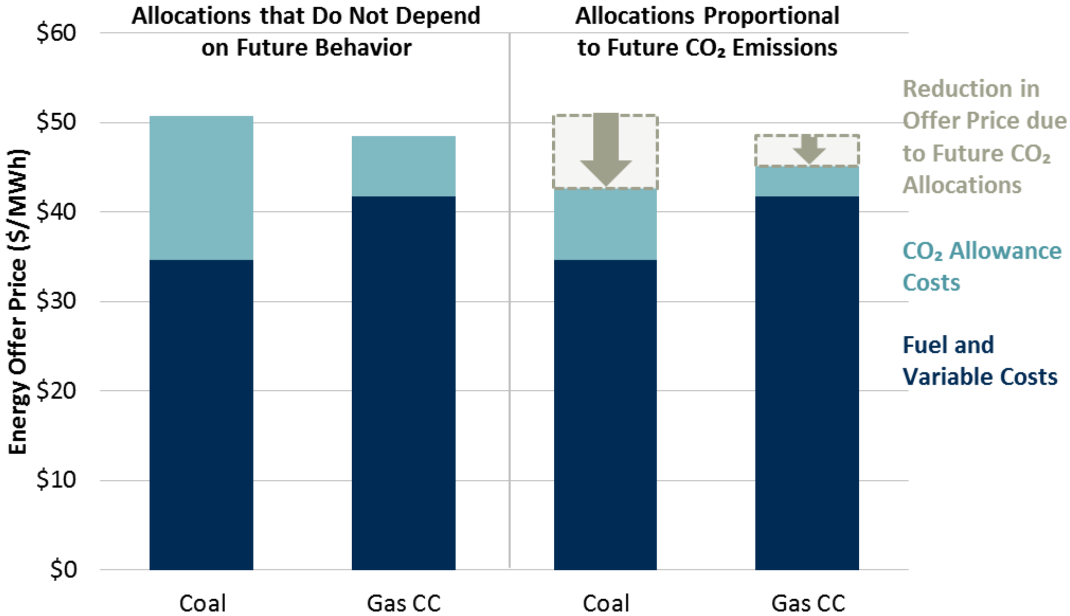
[29] The effect we are describing here is different from the previously-described effect of CO_2 emissions that do not update based on future behavior. Under both pre-CPP historically-based and updating future-based allocations, the marginal cost purchasing (or not selling) of a CO_2 allowance will be added into the generator's offer price. However, future (or updated) output-based allowance allocations introduce an additional incentive for a generator to reduce its offer price commensurate with the expected incremental CO_2 allowance awards.

[30] This assumption that CO_2 allowance prices stays the same could be approximately true for a small state that is part of a large national CO_2 trading pool. However, in a state not participating in multi-state CO_2 trading, the allowance price would not stay the same in the two contrasting examples. The allowance price would increase when there are greater incentives to increase coal output and thereby make it more challenging to reduce CO_2 emissions. The mechanism would then produce higher CO_2 and energy prices until sufficient incentives were created to adopt some other more costly approach to avoiding emissions.

[31] The magnitude of this negative offset is easy to estimate if the generator can accurately predict the value of the CO_2 allowances that will be awarded in the future, but the uncertain value of future allowances introduces a financial uncertainty for the generators, and therefore their offer prices and power prices that reflect these behaviors.

Figure 3
Illustrative Offer Price Impacts of Updating Future Emissions-Based Allocations
Assuming No Change to CO_2 Price in a Large National CO_2 Trading Pool



Sources and Notes:

Simplified example assumes a constant CO_2 allowance price, which is approximately accurate in the context of a state that is a price-taker in a larger national CO_2 exchange. The changes to operating and investment decisions would increase in-state CO_2 emissions and require more allowance purchases from other states.

If the state is not a price-taker or is not trading CO_2 allowances with other states, then the changes to operating and investment decisions would increase electric system costs and the CO_2 allowance price.

3. Retirement Decisions for Aging Generation

States will need to determine how to handle allowance allocations for aging generators that may be subject to retirement pressures. A seemingly logical, but potentially problematic, approach would be to cease awarding any allowances to generation units if they would retire and will no longer need CO_2 allocations for compliance. If CO_2 allowances would be forfeited by retiring an aging plant, this creates an incentive to keep uneconomic aging plants in service just to continue to receive future CO_2 allowances that could be very valuable. For example, consider a 500 MW coal plant that is no longer economic and would retire in the absence of CO_2 allowance allocations, but is in a state that has opted to award allowances sufficient to support operations at a 50% capacity factor. At a $20/ton CO_2 price, the CO_2 allowance allocations would amount to a $50 million per year revenue stream.[32] The plant owner would then have a substantial incentive to keep the uneconomic plant online beyond the end of its useful life, even if it would require incurring ongoing fixed costs and result in minimal net energy or capacity revenues. Generators

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[32] 500 MW × 50% × 8,760 hours × 10,300 Btu/kWh ÷ 10^3 × 220 lb-CO_2/MMBtu ÷ 2000 lb/ton × $20/ton-$CO_2$ = $50 million annually.

facing retirement pressures also have an incentive to stay online until allowance allocations are finalized, in the hopes that they could earn a share of the allowances.

Such incentives to defer the retirement of uneconomic plants will increase the electric system costs for achieving CPP compliance. The incremental investment in keeping an uneconomic existing coal plant would not contribute toward reducing emissions and so would contribute to higher total system costs compared to other allowance distribution options.

States have several options for avoiding these incentives by designing CO_2 distributions in a way that does not depend on retirement date, including: (a) adopting a customer- or auction-based allocations approach as discussed in later sections, (b) not awarding allowances to any plants that may be facing retirement pressures soon, for example plants above a specific age, and (c) ratcheting down CO_2 allocations as a pre-determined function of plant age and continuing allocations through that entire schedule even if the plant retires early. In its proposed FIP, the EPA has also introduced a mechanism for reducing (but not eliminating) the incentive to keep uneconomic plants online by continuing to award some allowances past the retirement date.[33]

4. New Renewable and Fossil Investment Decisions

If regulators wish to introduce additional incentives to invest in generation resources of a specific type, CO_2 allocations can be used to provide that incentive. For example, several RGGI states set aside some CO_2 auction revenues to be allocated to green energy programs, and the European Union Emissions Trading System (EU ETS) sets aside auction revenues for new clean energy technologies, such as carbon capture and sequestration.[34]

In general, investment incentives need to be carefully considered before allocating any CO_2 allowances to new fossil plants. If new generators are awarded CO_2 allowances, then investment decisions will be influenced by the expected present value of all future CO_2 allowance allocations, and not just by the economic competitiveness of the project. For example, consider a new 500 MW gas CC that would be awarded enough CO_2 allowances to support a 50% capacity factor over 20 years. At an allowance price of $20/ton, the net present value of those allowances would be equivalent to an approximately $165 million lump sum cash payment at the online date.[35] The value of these allowances could be large enough to shift investment incentives toward this type of fossil plant and away from renewables if the two resource types are not

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33 Under the FIP, allowances are allocated for each compliance period rather than on an annual basis, and generators are not considered retired until they have ceased operations for two complete calendar years. Generators are eligible to receive allowance allocations during the two years when the generator has ceased operations but is not yet considered retired by the EPA. EPA (2015c), p. 3 and 80 Federal Register 64,966 at 65026.

34 The RGGI states that allocate some auction revenues to renewable generation include Connecticut, Delaware, Maryland, and New York. See Section II.C.3 and World Bank (2014).

35 Assuming a 12.5% discount rate and assuming allowance prices increase at 2% inflation.

awarded the same quantity of allowances on a per MWh basis. Even MWh-based allocations can create uneconomic investment incentives by making baseload fossil plants appear more attractive than peaking plants, even at times when peaking plants might otherwise be the more desirable and economic resource type.

The incentives to influence investment decisions can be adjusted to favor one type of plant over another, but ultimately, these incentives cannot be avoided under an approach that freely allocates CO_2 allowances to new generators. Therefore, some regulators may prefer not to allocate CO_2 allowances to new generators even if it seems more equitable to award a similar quantity of allowances to new and existing plants of the same type. Allocations to customers or by auction do not introduce these concerns because neither existing nor new plants of any type would be awarded allowances for free.

B. Direct Allocation to Customers

One of the most attractive allowance distribution options for states is to distribute them to customers, for example, through their distribution utility. The allowances can either be used for CPP compliance by the utility serving those customers, or sold to other generators at the market price. In either case, under this option, the value of the allowance would be required to flow back to customers, possibly in the form of bill rebates, cost-effective energy efficiency investments, or other programs that benefit customers. Through the allowance allocation and subsequent retail ratemaking processes, state regulators may want to determine whether some classes of customers should be prioritized and how to maintain incentives for energy conservation in retail rates.

1. Variations of the Customer-Based Approach

In a customer-based allowance distribution approach, the state environmental agency and utility commission could coordinate to issue free allowances to LSEs or electric distribution companies (EDCs), most likely in proportion to their customers' energy consumption. In turn, the LSEs or EDCs would be directed to develop mechanisms to return the value of those allowances back to customers, a process that would be subject to the oversight and approval of state public utility commissions.[36] The primary requirement imposed on these allocations would be that CO_2 allowances would need to be somehow returned to benefit in-state customers. To ensure that outcome, states might stipulate that multi-state LSEs or EDCs would not be allowed to transfer allowances for the benefit of customers in other states unless a fair payment is made for the exchange.

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[36] For example, the EDC could conduct an auction with utility commission oversight as proposed by Burtraw and McCormack (2016). We discuss auction-based approaches more fully in the following Section II.C.

A number of design decisions would be involved in designing the allowance distribution mechanism itself (to determine which LSEs will be awarded the allowance values), and then later within ratemaking processes (to determine how the value will be credited back and to which customer classes). Design options include:

- **Allocations to Customer Representatives:** The relatively straightforward starting point for determining allocations among LSEs or EDCs is to award the allocations based on historical or future expected energy consumption. However, states may wish to make adjustments from this baseline to prioritize allocations to the customers of utilities that are most affected by stranded costs under the CPP or to utilities serving priority customer classes.
- **Programs for Returning Value:** The value of the CO_2 allowances could be returned to customers in the form of energy efficiency investments, bill rebates, rebate checks, displacing renewable energy investments that would otherwise be necessary to meet RPS standards, training programs for workers affected by coal plant closures, or other means. In California, utilities are required to offer allowances for sale in a state-administered auction and auction proceeds are applied toward several such programs.[37] For states with cost- effective incremental energy efficiency opportunities, these could reduce customer bills by more than a direct bill rebate.
- **Prioritizing Among Customer Classes:** Some decisions may be made to prioritize certain customer classes, either on a state-wide basis in the allocations process or else later in an individual entity's ratemaking process. For example, states may opt to prioritize low-income customers, commercial and industrial customers, and/or customers in trade-exposed industries.
- **Retail Rate Design:** One option is to apply bill rebates as a per-MWh volumetric credit. However, simple volumetric rebates have some disadvantages in that they could undermine incentives for energy efficiency and distributed generation (see the next section), benefit higher-income customers, and be inconsistent with inclining block retail rate approaches.[38] Thus, state regulators and utilities will need to consider how best to incorporate allowance benefits into retail rate design, just as they do today with any cost or value allocation in the standard retail ratemaking process.
- **Statewide Set-Asides:** A state may also opt to maintain a set-aside of CO_2 allowances that is not automatically allocated to individual LSEs, but kept in a state-wide pool and allocated later. For example, set-asides could be used to fund state-wide efficiency, renewables, or jobs programs as discussed further in Section II.C.3.

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37 See California Air Resources Board (2012).

38 Under inclining block rates, customers are charged more per kWh consumed at higher overall usage levels. This introduces greater economic incentives for energy efficiency from high-usage customers.

2. Maintaining Incentives to Pursue Energy Efficiency

Prior to accounting for the effect of allowance allocations and any associated energy efficiency investments, customer bills would increase consistent with the increases in wholesale prices or cost of service. It is economically efficient for customer bills to increase in the context of a carbon policy, because it introduces an incentive for customers to reduce energy consumption and the associated emissions. A volumetric bill rebate could undermine the incentive for customers to change consumption behavior, invest in energy efficiency, or invest in distributed generation.

Some bill rebate approaches can avoid undermining these incentives, such as applying lump sum or per-customer payments that are not directly linked to the customers' in-month consumption levels. For example, California refunds a portion of allowance values to residential customers through the California Climate Credit (also known as the "climate dividend").[39] This rebate is a twice-per-year, per-customer lump sum payment that is awarded in spring and fall seasons when retail bills are lowest. The size of the rebate is not tied to the magnitude of the customer's energy consumption and thus the customers' retail rates maintain the same high incentives to reduce energy consumption.

Direct investment in cost-effective energy efficiency programs is another option for reducing customer bills without undermining energy efficiency incentives. Many states regularly pursue cost-effective energy efficiency measures on behalf of customers and use benefit-cost studies to determine which set of efficiency programs will reduce bills sufficiently to more than offset program costs.[40] Revenues associated with CO_2 allowances could similarly be focused on reducing bills through energy efficiency investments.

3. Protecting Against Uneconomic Pressures in Trade-Exposed Industries

Prior to considering allowance allocations value, bill increases to commercial and industrial customers could be a concern to state regulators. An even greater concern may be focused on electricity-intensive and trade-exposed industries. An electricity-intensive user could be disadvantaged if faced with higher energy prices caused by a carbon policy while business competitors in other states or countries face no carbon policy or a less stringent policy.

The European and California cap-and-trade programs face economy-wide exposure to trade risk because their emissions caps cover not just the power sector but also other economic sectors including emissions-intensive manufacturing processes. Both the European and California

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39 See CPUC (2012) and CPUC (2016).

40 For examples and best practices for design of cost-effective energy efficiency programs, see National Action Plan for Energy Efficiency (2008). For examples of energy efficiency benefit-cost studies in Massachusetts, Wisconsin, and New Jersey, see Hurley, *et al.* (2008); Browne, Bicknell, and Nystrom (2015); and Rutgers Edward J. Bloustein School of Planning and Public Policy (2008).

programs allocate allowances or auction revenues as a means of offsetting the incentive to relocate business operations.[41] These are primarily direct allowance allocations to industries that emit GHGs such as through manufacturing processes, but California also applies the Emissions Intensive and Trade Exposed Return as an electricity bill rebate.[42]

C. AUCTION-BASED ALLOCATIONS

The third option for initial allowance distribution is to sell allowances in a competitive auction. Auctions are an economically efficient method for distributing CO_2 allowances. The resulting price will reflect the market's expectation of the marginal cost of avoiding CO_2 and entities that place the highest value on allowances will purchase them. With the auction, all covered CO_2 emitters would face the same emissions costs, with the result being to reduce covered emissions at the lowest cost. The state would determine how to use the revenues collected from the CO_2 auction in the public interest.

1. Variations of the Auction-Based Approach

Centralized auctions would sell allowances to the highest bidder. The state entity, utility, or third party conducting the auction would collect the auction proceeds. For states that over-comply by reducing CO_2 beyond what is required under the CPP, some of the allowances would be sold to out-of-state entities; the result would be more auction revenue to the state than allowance costs to in-state generators. Some states may face the barrier that legislation could be required to pursue an auction-based approach, potentially making this option infeasible. If feasible, the auction approach can provide an equitable distribution of allowances and support least-cost emissions reductions. Some of the design decisions for establishing CO_2 allowance auctions include:

- **Allocating Auction Revenues:** Revenues collected from the auctions could be applied toward energy efficiency programs, renewable resource investments, job training programs, customer bill rebates, or the state budget, as discussed further in Section II.C.3. Determining how to allocate these revenues in the public interest would require considering a broad range of stakeholders and interests, much like the process for allocating CO_2 allowances.

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41 See World Bank (2014).

42 Barker (2013).

42 See World Bank (2014).

42 Barker (2013).

- **Participation:** We recommend that auctions allow participation from any in-state or out-of-state entity, whether physical or financial.[43] This will result in the most accurate reflection of the market value of allowances.[44] Participation will also be influenced by the extent to which the state's CO_2 allowance market is linked to those of other jurisdictions, as discussed further in Section II.C.4 below.
- **Incorporating Sell Offers:** Most CO_2 allowance auctions sell only newly-minted allowances offered for sale by the auction administrator. However, it would also be possible to incorporate sell offers from market participants that hold excess allowances. This would create an opportunity for market participants to adjust their allowance holdings at relatively low transactions costs and support market liquidity and transparency.
- **Timing and Number of Auctions:** To avoid having one auction result set prices substantially higher or lower than market expectations for an entire year or multi-year compliance period, most auction-based systems release allowances in a series of auctions. For example, RGGI and California's Cap and Trade Program hold quarterly auctions, and countries in the EU ETS hold auctions multiple times per week.
- **Coordinating Auctions with Other States:** To avoid duplicating the auction design and administration efforts, states may wish to collaborate on jointly-cleared auctions among states within the same CO_2 allowance trading pool. Each state would offer its allowance for sale in the auction, and earn revenues for that quantity of allowances at the auction clearing price.[45] One option would be to consider joining one of the already-existing CO_2 auction structures in RGGI or California. Another option would be to coordinate a different subset of other states to design an auction structure that reflects the participating states' design goals and policy requirements. These states may wish to coordinate on the basis of consistent policy objectives and policy designs, for example with respect to covering new gas CC plants.

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43 Out-of-state entities requiring CO_2 allowances for CPP compliance would only participate as buyers in the auction if they were part of the same allowance trading pool.

44 If some entities were excluded, for example if only in-state physical entities were allowed to participate, then in-state entities would have incentives to procure more allowances than needed for business purposes in order to later sell those allowances to out-of-state entities. Similarly, excluding financial entities would create incentives for physical players to over-procure and then later sell the allowances bilaterally to the financial players that were not allowed to participate. Excluding some types of buyers would create excess transactions costs and may cause underpricing in the allowance auction that would allow qualified buyers to capture a profit from buying low in the auction and selling higher on the bilateral market.

45 This approach would also work if states opted to offer allowances in blocks at different price levels as discussed later in this section. The different allowance supply curves of multiple states would be added together to form an aggregate supply curve for allowances, as demonstrated when Québec linked with California's cap and trade program in 2014. See California Air Resources Board (2013).

- **Monitoring and Mitigation:** Auctions, like bilateral CO_2 markets, would need to consider whether some level of market monitoring and mitigation would be required to protect against the potential for any abuse of market power and market manipulation. The susceptibility to manipulation would be lowest with the widest participation of buy- and sell-side participants, if the state's CO_2 allowance market is linked to a national trading pool, and if some price stabilization measures are adopted as discussed below. In existing CO_2 markets, the primary monitoring and mitigation measure are rules that govern: (1) the maximum share of allowances that can be purchased by one entity in any one auction (25% in RGGI, 15% in California), and (2) the maximum share of allowances that can be held in account by any one entity (RGGI does not enforce a limit, California limits allowance holding to approximately 2.5–5% of the annual allowance budget).[46] *Ex post* market monitoring can also be used. For example the RGGI market monitor assesses and publicly reports on the competitiveness of every auction.[47]
- **Price Stabilization and Quantity Adjustment Mechanisms:** Allowance auctions can be combined with price stabilization and CO_2 allowance budget adjustment mechanisms, such that more allowances are sold if prices are high, as discussed further in Section II.C.4 below.

2. Economic Efficiency Implications

Auctions, when well-run, are an economically efficient way of distributing CO_2 allowances. Participants of the auctions will reveal the value that they place on the allowances. Those value expectations will evolve over time, particularly over the initial period while market participants acquire information about the scarcity of allowances across the trading pool and while secondary bilateral trading markets are being established. The market price for allowances in centralized auctions and the bilateral trading markets will provide price points that state regulators, utilities, generators, and others can use to inform investment and operational decision-making so that all participants can incorporate the same incentive to avoid each ton of CO_2 emissions. However, it is possible that deviations from these efficient pricing signals could be introduced in some cases if the allocation of auction revenues is not designed carefully.

3. Allocating Allowance Revenues

Some states will see using CO_2 allowance auctions to generate revenues as an advantage; other states will see it as a potential area of concern. Auction revenues can be used to support many

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[46] For each year, California sets a holding limit for allowances defined as: 0.1 × Base + 0.025 × (Annual Allowance Budget – Base), where Base is equal to 25 million tonnes of CO_2e. For 2016, the holding limit was equal to approximately 3% of the allowance budget. Exceptions to these requirements exist for large emitters that need to hold a larger quantity of allowances for physical compliance needs. See California Air Resources Board (2011) at § 95920 and Ramseur (2016).

[47] Regional Greenhouse Gas Initiative (2016c).

types of policy priorities, and unlike free allocations, auctions do not require the entities awarded the free allowances to engage in bilateral market sales to monetize their value. The state still has choices to make with the funds received from the auctions. Depending on the states' priorities and needs, funds could be used to invest in energy efficiency programs or renewable power development as a means of contributing toward future CPP compliance. The auction revenues could be directed toward customer bill rebates, either for all customers or targeted toward customers that are low-income, in trade-exposed industries, or greatly affected by stranded asset costs. Allowance revenues could also be used to support job retraining programs for displaced fossil fuel-sector workers, or even policy objectives outside the electricity sector, including reducing state taxes or supporting jobs programs.

Figure 4 below is an illustration of the different policy priorities pursued across the states participating in RGGI. Most of the RGGI funding is used to reduce customer bills through direct investments in energy efficiency programs, with some states using this as the only means of reinvesting auction revenues. Maryland allocates most of its auction revenues toward direct customer bill assistance. Other states use the revenues or direct allocations to support renewable energy or other greenhouse gas reductions. Some states, such as New Jersey when it was part of RGGI, allocated auction revenues toward the state budget.[48]

To evaluate the relative benefits and costs of these programs, RGGI states commissioned two studies evaluating the performance over the 2009–14 compliance periods. The studies found that the $2.0 billion in auction revenues were used to create substantial net benefits within the participating states compared to a scenario where RGGI did not exist.[49] Net effects of wholesale energy price impacts, bill assistance, and energy efficiency programs were to reduce customers' energy and natural gas bills by $2.3 billion.[50] The studies estimated $2.9 billion in net economic

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48 See Hibbard, *et al.* (2015), p. 25; Schneider and Elliott (2012), p. 7; Feller (2011); and Baxter (2011).

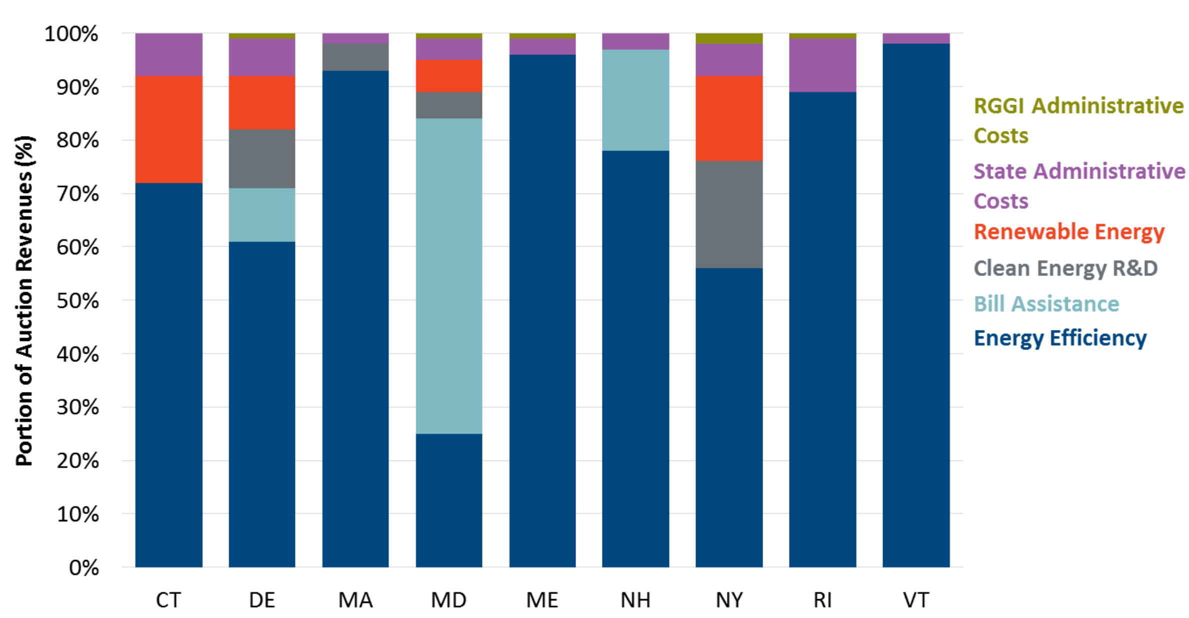
49 These reported numbers are the results of two different studies covering the compliance periods 2009–2011 and 2012–2014, aggregated in 2015$. Customer benefits and net electric system benefits in the second compliance period were lower than in the first compliance period primarily because natural gas and electricity prices have been lower, and so there are lower electric system and customer benefits associated with energy efficiency and renewables. None of the reported benefits include any estimated value from avoiding CO_2 emissions. See Regional Greenhouse Gas Initiative (2016a), Hibbard, *et al.* (2015).

50 This reported net customer bill benefit accounts for the effect of RGGI CO_2 allowance prices in increasing wholesale electricity prices, as well as the offsetting price impacts of renewable energy and energy efficiency investments to reduce wholesale electricity prices. These net customer bill impacts exceed the total RGGI auction revenues and program funding primarily because the states estimate that energy efficiency programs avoid enough energy consumption that they save more in customer bills than the programs cost to fund. A number of other academic and industry studies similarly find that energy efficiency tends to be under-invested by end use customers, and so can offer net benefits in excess of costs from the customer's perspective. See Gerarden, Newell, and Stavins (2015) for a review of academic studies on suboptimal investments in energy efficiency. Benefit-cost studies in

Continued on next page

benefits and 30,000 new job years.[51] These benefits were achieved even while RGGI, combined with other state programs and broader economic factors, has reduced CO_2 emissions from the electricity sector by more than 40% relative to 2005 (a reduction that has far exceeded the original reduction targets contemplated under RGGI).[52]

Figure 4
Portion of RGGI Auction Revenues Allocated to Various Policy Priorities (2008 to 2013)



Sources and Notes:
Cumulative investments from 2008 to 2013, see Regional Greenhouse Gas Initiative (2015a).

A similar analysis of California's AB 32 examined the economic impacts of different options for using auction proceeds.[53] That study found that investments in energy efficiency and clean transportation created the most job growth among the options studied, while a per-capita dividend had the greatest impact on increasing incomes.

Continued from previous page

Massachusetts, Wisconsin, and New Jersey have found some energy efficiency programs to be a net benefit to customers, see Hurley, *et al.* (2008); Browne, Bicknell, and Nystrom (2015); and Rutgers Edward J. Bloustein School of Planning and Public Policy (2008).

51 These net economic benefits include net benefits accrued to customers and the net economic benefits stimulated by the programs funded, but are offset by the net loss in profits to traditional thermal generators. No environmental benefits associated with CO_2 emissions reductions are included in this number.

52 Regional Greenhouse Gas Initiative (2016a).

53 Saha and Mazurek (2013).

4. Price Stabilization and Allowance Budget Adjustment Mechanisms

Allowance auctions can also be used to induce price stabilization and to adjust the quantity of allowances released consistent with state policy goals and as a function of CO_2 market conditions. For example, both RGGI and the EU ETS introduced CO_2 budget caps that were higher than realized emissions levels in their initial compliance periods, resulting in a growing bank of accumulated allowances and very low allowance prices.[54] This outcome indicated that there was minimal incremental cost to achieving further CO_2 reductions and spurred various efforts to reduce future years' allowance budgets. In light of this experience, RGGI and California introduced mechanisms in their auctions to automatically adjust allowance budgets as a function of market conditions and provide more stability to CO_2 allowance prices.

While price stabilization mechanisms are possible under the CPP and other carbon reduction programs, states will not have complete flexibility to introduce such mechanisms because the carbon-reduction standards must be met regardless of the realized allowance price. States do have the options to: (a) create and release fewer allowances than stipulated in the EPA mass standard, (b) adjust the timing of when those allowances are released, and (c) bank allowances that were not released and save them for use in future compliance periods when the supply of allowances may be tighter and CO_2 reductions more costly.[55] Variations of price stabilization mechanisms include:

- **Reservation (Floor) Price:** Both RGGI and California incorporate a reservation price or floor price in their auctions, representing the minimum price that they are willing to accept to sell an allowance. These prices are currently set at $2.10/ton of CO_2 in RGGI and $12.73/tonne of CO_2e in California.[56] States could similarly incorporate a reservation price or a series of reservation prices that reflect increasing quantities that can be sold at higher prices. The result would be that fewer allowances would be issued via auction if prices are low (avoiding very low and zero price outcomes), but more allowances would be issued if prices are high (mitigating against high price outcomes). If fewer allowances are issued, the state can either: (a) permanently retire all or a portion of the unsold allowances, which would be a reflection of the state's willingness to forgo auction revenues to achieve greater levels of CO_2 reductions in line with environmental policy goals, or (b) save all or a portion of the unsold allowances in a reserve that is banked and

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54 EUR-Lex (2003).

55 Unlimited banking of allowances is allowed under the CPP. See 80 Federal Register 64661 at.64890, VIII.J.2.c.

56 We report the California reservation price in terms of metric tonnes of CO_2e (or CO_2 equivalent) based on the definition of the traded product, which includes both CO_2 and other greenhouse gases. Regional Greenhouse Gas Initiative (2016b); California Air Resources Board (2015).

can be issued in later auctions when prices and auction revenues are higher.[57] The quantity of allowances to permanently retire could also be made a function of the accumulated bank of privately-held allowances, so that the total private plus public bank of allowances is never more than some fraction of any one year's total allowance budget.

- **Cost Containment Reserves:** Both RGGI and California incorporate cost containment reserves that release greater quantities of allowances when prices are high, as illustrated in Figure 5.[58] Similar to the price floor, these reserves reflect a willingness to relax CO_2 abatement goals if the costs of achieving more reductions exceed a specified limit in a given year. Under CPP mass-based plans, states will have the option to release more allowances in any one auction to mitigate high allowance prices, though this is constrained by the total budget cap for the compliance period. One way to define the number of allowances in reserve is to benchmark to the quantity of unsold banked allowances from prior auctions and offer some fraction of the unsold bank in the reserve. The price of the allowance reserves would be a function of the willingness to pay to reduce CO_2 emissions and the tolerance for price volatility.[59]
- **Price Cap:** The EPA does not allow for an alternative payment rate that could be paid in lieu of physical compliance, nor does it allow for a high price at which allowances exceeding the total state budget for the compliance period could be released.[60] Thus, it is not possible to cap the prices that generators would need to pay to achieve CPP compliance.[61] However, it would be possible to implement a "soft" cap associated with the highest price level on the cost containment reserve where additional allowances from the state bank of reserves can be issued.

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[57] RGGI retires all unsold allowances, whereas California carries forward up to 25% of unsold allowances and retires them only if they remain unsold in the next two quarterly auctions. See California Air Resources Board (2012).

[58] For California's "Allowance Price Containment Reserve" see California Air Resources Board (2012). For RGGI's "Cost Containment Reserve" see Regional Greenhouse Gas Initiative (2015b).

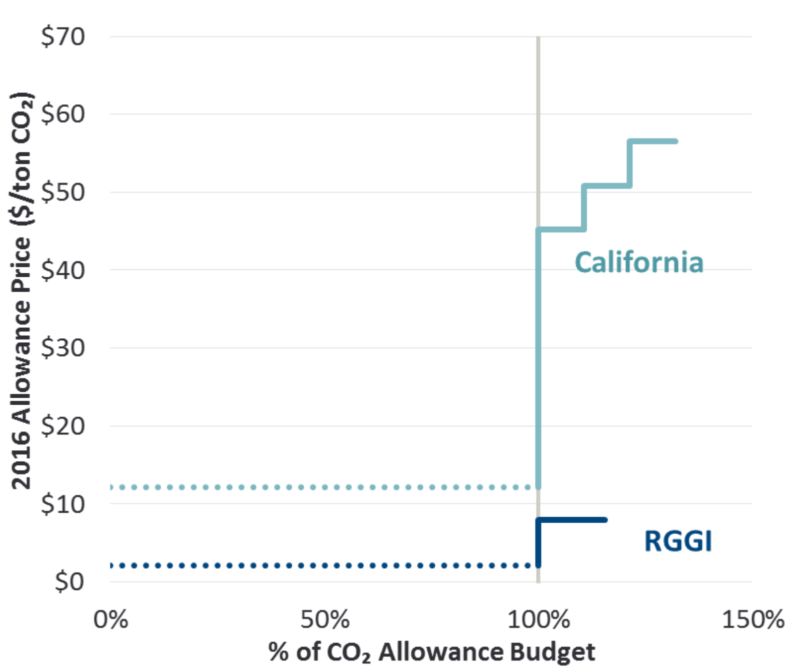
[59] For additional explanation and lessons learned on the performance of RGGI's cost containment reserve, see Burtraw (2016) and Regional Greenhouse Gas Initiative (2016e).

[60] The EPA has explicitly excluded the option to allow for an alternative compliance rate that suppliers could pay in lieu of submitting a CO_2 allowance for compliance. 80 Federal Register 64,661 at 64891. This type of mechanism is often used in state RPS standards to prevent compliance costs from exceeding policymakers' determination of the maximum willingness to pay to achieve the policy goal.

[61] It is still possible to place a cap on the auction price and likely all auctions will place some administrative cap on bid levels that would likely be higher than any foreseeable CO_2 market price. If this administrative cap is lower than the price for CO_2 allowances on the secondary market, then demand for allowances at that cap will exceed the quantity of supply offered. In that situation the state would limit the revenues it earns from the auction and need to apply a rationing rule to determine which of the bidders would be awarded the allowances. The winning bidders could then remarket the allowances for a profit on the bilateral market, resulting in the allowance value being privately captured rather than contributing to funding public policy programs.

- **Regional or National Trading Pool:** A final approach to enhancing price stability is to join the state to a regional or national trading pool. The much larger trading pool market would influence offers into the state allowance auction and result in substantially greater price stability that would be realized without interstate trading.[62]

Figure 5
RGGI and California Cost Containment Reserves for Compliance Year 2016



Sources and Notes:
California Air Resources Board (2012), p. 21 and Regional Greenhouse Gas Initiative (2016d).

III. Selecting a Strategy Consistent with Policy Objectives

When selecting among the primary allowance distribution options, state policymakers can evaluate the advantages, disadvantages, and stakeholder impacts of each approach. After weighing these considerations, the state can choose a primary strategy that most closely reflects its policy objectives, and make adjustments as appropriate. We provide here a summary of these

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62 The decision of whether to link a state's allowance program to the national or regional trading pool would need to consider a number of other factors beyond price stability, including: (a) the economic benefits and avoided costs that can be achieved in larger trading pools that enable least-cost CO_2 abatement across a greater geography; (b) the cost-savings and efficiency benefits from equalizing energy prices and economic dispatch incentives with neighboring states that are major electricity trading partners; and (c) the state's interest in joining a trading pool only with other states that have similarly stringent CO_2 policy objectives, *e.g.*, to avoid introducing incentives to shift CO_2 emissions from states that do cover new gas CCs to states that do not.

considerations and several examples of hybrid approaches that states could tailor to suit particular circumstances.

A. Relative Advantages of the Primary Allowance Distribution Options

Each of the primary allowance distribution options has advantages and disadvantages, as discussed in detail in the prior sections and summarized in Table 2 below. The relative importance of each potential advantage or disadvantage depends on the particular state's policy objectives. If the allowance allocations introduce incentives that influence operational, investment, or retirement decisions, the net compliance costs to a state can be different across allowance allocations mechanisms. If carefully designed and implemented, any of these allowance allocations approaches can be set up to avoid incentives to deviate from cost-minimizing behavior (as discussed in more detail in Sections II.A-B above). If no unintended incentives are introduced, then the direct impacts of CPP to all affected parties will be identical regardless of the CO_2 allowance distribution mechanism. The primary differences across mechanisms would then be associated with wealth transfers based on which entities are awarded the allowances.

Table 2
Advantages and Disadvantages of Primary CO_2 Allowance Distribution Options

Approach	Advantages	Disadvantages
To Generators	• Method described in the proposed FIP • State policymakers can direct allowances to generators they wishes to compensate, be they incumbent fossil generators or new low-carbon generation	• Uncertainty over finalization of FIP • Customer bills will increase more than if customers received the allowances or auction revenues • Transfer payment from customers to generators • Some variations distort incentives away from lowest-cost investment solutions, *i.e.*, the value of any awarded CO_2 allowance may be factored into decisions regarding whether to invest in gas CCs or renewables • Some variations create incentives to uneconomically postpone fossil retirements to keep obtaining the allocated CO_2 allowances • Variations updated with future generation output can create dispatch inefficiencies as generators wish to produce more power to increase their allowance allocations
To Customers (via Distribution Company or Load-Serving Entity)	• Reduces customer bill impact through bill rebates or efficiency investments • Avoids operational and investment inefficiencies with some generation options • Can be used to protect trade-exposed industries that may be inefficiently disadvantaged by power price increases • Can be used to protect low-income customers • Can be used to mitigate impacts for customers affected by stranded asset costs	• Variations using volumetric bill rebates may undercut some of the incentive to pursue energy efficiency and distributed generation
Via Centralized Auction	• Auction revenue can support policy programs such as energy efficiency, renewables, bill rebates, state tax reductions, or worker retraining • Can follow lessons learned and best practices from other CO_2 auctions including Northeast's RGGI and California's AB 32 • Avoid the static and dynamic inefficiency problems with some types of generation and customer-based allocations	• May require state legislation to pursue in some states • The determination of how to allocate revenues collected from an auction may become politically contentious

B. Impacts on Key Stakeholders

In retail restructured states, it is relatively straightforward to evaluate the interests of individual parties. Customers will benefit from direct customer allocations, merchant generation owners will benefit from generation-based allocations, and the state will determine distribution of revenues from auctions. For retail restructured states that place highest importance on customer costs, either a customer-based or an auction-based approach would be preferred.

In traditionally regulated states relying on vertically integrated utilities, evaluating the implications for customers, generators, and utilities is more complex. Each utility and customer group's net position will depend on the utility's portfolio of generation, contracts, and cross-state relationships. For regulators that are most concerned about mitigating customer costs, we suggest that the most important issues to focus on include:

- **Exposure to Stranded Costs:** Some utilities' customers may face higher stranded costs, particularly if sourcing energy from coal plants whose investment costs are not yet recovered but that may become uneconomic to continue operating. Any customer, generator, or auction-based CO_2 allocation option can be structured to offset stranded cost impacts on customers. However, we caution that some generation-based approaches might incentivize utilities to keep an uneconomic plant online, which would increase the total cost of service going forward.
- **Purchase-Dependent Customers:** Utilities and public power entities that procure some of their power needs through bilateral contracting or market purchases will be subject to price increases as prior contracts expire, consistent with the price increases experienced in wholesale energy markets. These customers' interests are best served by direct allocations to customers or via allocation of auction revenues.
- **Independent Power Producers:** Many traditionally regulated states have a subset of generation owned by IPPs. Generation-based CO_2 allocations awarded to these generators will flow to their investor owners and not to customers.[63]
- **Utilities Sourcing Generation from Out of State:** For utilities that serve in-state customers from out-of-state generation, their net position in CO_2 allowance allocations will depend on another state's CPP and allowances approach. These customers could be left with no allowances to offset bills if the external state opts for a customer-based approach, and thus a workable approach may require some level of coordination between the two states.

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63 The flow of allowance value to IPP owners could happen immediately, or may happen only after existing contracts with utilities have expired and would depend on the specifics of each case. For example, some bilateral contracts could conceivably have anticipated the possibility of CO_2 allowance allocations and stipulated how any such allocations should be handled. Another possibility is that contract prices would be too low for the IPP to stay in business absent either a generation-based CO_2 allocation or a renegotiation of contract terms.

- **Utilities Serving Customers in Other States:** For utilities that use in-state generation to serve out-of-state customers, generation-based allocations would flow to those out-of-state customers rather than in-state customers. Again, coordination efforts may be required to achieve some level of consistency across states.

Overall, if a traditionally regulated state wishes to ensure that the entire value of CO_2 allowances will ultimately be returned to in-state customers, then we recommend using either customer-based or auction-based allocations. Under generation-based approaches, some fraction of the allowance value may flow to out-of-state customers or to IPPs. Allocations to in-state customers are likely to be the most feasible approach to achieving a reasonable level of consistency for multi-state utilities, given that regulators could be reluctant to allow those utilities to transfer allowances to the benefit of customers in other states.

C. Examples of Hybrid Approaches that Meet Policy Priorities

We now offer in Table 3 a few examples of hybrid allowance allocation approaches to illustrate that while states may focus on one particular allowance allocation approach as a starting point, many may find that combining multiple approaches would be the best way to manage different policy objectives and stakeholder interests. Recognizing that unlimited combinations can form states' hybrid approaches, our examples are intended to reflect specific hypothetical situations rather than to provide a comprehensive or exhaustive list of hybrids.

Table 3
Examples of Hybrid Allowance Distribution Approaches Tailored to Policy Objectives

<table>
<tr><th>Example</th><th>State Context</th><th>Allowance Distribution</th></tr>
<tr><td>Generation and Auction-Based to Support a Renewables Export Strategy</td><td>

- Example of a traditionally regulated state that historically relied on coal generation, but has an aging fleet that is becoming less economic
- State or utility strategy is to harvest wind resource potential for use within the state and for export to regional power and REC markets
- CPP mass budget exceeds expected in-state CO_2 emissions after retirements proceed
- Most allowances awarded to fossil generators, but no allocations to plants above 25 years' age
- Allocations on an updating basis to new renewables to support investment
- State or utility sells remaining allowances in competitive auction primarily to out-of-state parties, creating net revenues used to offset customer bills
- Effect is to harvest lower-cost wind resources and CO_2 abatement opportunities that can be exported to other states, and return part of that value to in-state customers

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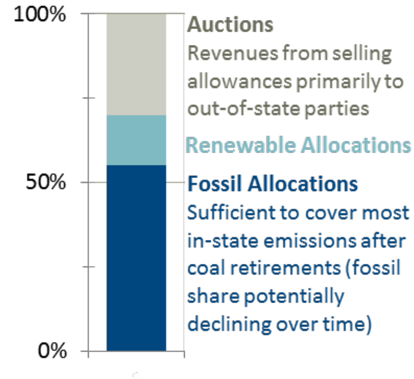

</td></tr>
<tr><td>Customer-Based with Adjustments for Stranded Asset Costs</td><td>

- Example of a traditionally regulated state where some utilities' customers face much higher cost impacts from CPP and stranded assets
- Primary strategy for most CO_2 allocations is in proportion to expected energy consumption of each utility
- Some allowances are set aside to award additional allocations to the subset of customers most adversely affected by the cost of stranded generation assets

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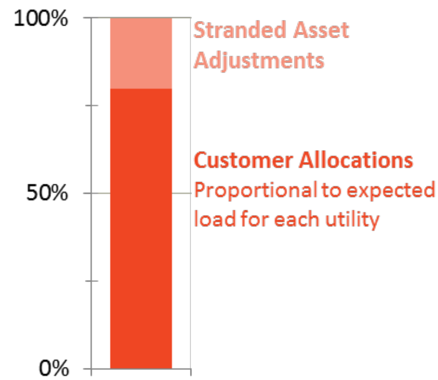
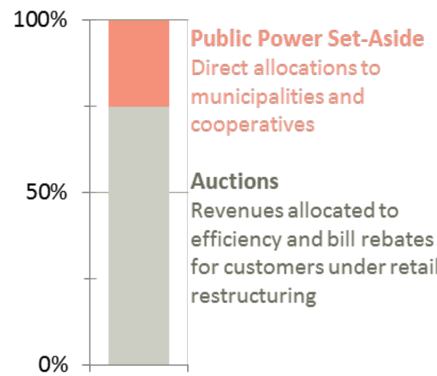


</td></tr>
<tr><td>Auction-Based with Customer-Based Allocations for Public Power</td><td>

- Example of a retail restructured state where most customers are exposed to wholesale power price increases, but a subset of customers are served by public power municipalities and cooperatives
- State opts for an auction with allowance revenues used to offset customer bills through energy efficiency and bill rebates
- State sets aside a proportional share of allowances for direct allocation to public power entities not under state ratemaking oversight, who use or sell allowances on behalf of their customers

</td><td>



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</table>

IV. Recommendations

A structured process that is driven by policy objectives may help to balance competing priorities and stakeholder interests when designing an allowance distribution approach. We recommend that states first design a CPP compliance plan or other carbon reduction programs that support the best interests of the entire state, and then later address the question of how to distribute the allowances.

Regardless of what primary allocations approach is selected, state policy makers will have a number of design choices for how to best meet the state's policy interests. Under generation-based approaches, we recommend avoiding free allocations that would update based on plants' future output or emissions. We also recommend that free allowance allocations not be updated based on future plant investment or retirement decisions, except when a state explicitly intends to create incentives for additional generation output from a particular resource type. Otherwise, allowance allocations may introduce unintended incentives to deviate from least-cost decision-making in ways that may not always align with policy objectives.

Under customer-based approaches, we recommend that allocations be designed to award the value of allowances to customers or policy programs without undermining the incentives for energy efficiency. This can be achieved through direct investments in energy efficiency, lump-sum rebates, or other policy programs that benefit customers. Auction-based approaches provide the most flexibility in how the state can use the auction proceeds in the public interest.

The question of which parties will be awarded the substantial value of CO_2 allowances under the CPP can become divisive and has the potential to create unnecessary costs for customers if not managed well. Thus, if the primary objective is to meet the CO_2 emissions reductions while minimizing customer bills and societal costs, then we recommend allocating allowances or auction revenues directly to customers or to programs that directly benefit customers. Such customer-based approaches would ensure that the entire value of CO_2 allowances would flow to in-state customers.

List of Acronyms

AB 32	Assembly Bill 32
CAA	Clean Air Act
CC	Combined-Cycle
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPP	Clean Power Plan
CT	Combustion Turbine
D.C.	District of Columbia
EDC	Electric Distribution Company
EGU	Electric Generating Units
EPA	Environmental Protection Agency
ERC	Emissions Rate Credit
EU ETS	European Emissions Trading System
FIP	Federal Implementation Plan
GHG	Greenhouse Gas
GWh	Gigawatt Hour
IPP	Independent Power Producer
kW	Kilowatt
LSE	Load Serving Entity
MMBtu	One Million British Thermal Units
MW	Megawatt
MWh	Megawatt Hour
NGCC	Natural Gas Combined-Cycle
NOx	Nitrogen Oxide
NRDC	Natural Resource Defense Council
REC	Renewable Energy Credit
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standard
SIP	State Implementation Plan
SO_2	Sulfur Dioxide

Bibliography

Barker, David T. (2013), Prepared Direct Testimony of David T. Barker, San Diego Gas & Electric Company, before the Public Utilities Commission of the State of California, Application 13-08-___, August 1, 2013. Posted at: https://www.sdge.com/sites/default/files/regulatory/BARKER-PUBLIC-8.1.13-final.pdf

Baxter, Christopher (2011), "Gov. Christie announces N.J. pulling out of regional environmental initiative," *NJ Advance Media for NJ.com*, May 28, 2011. Posted at: http://www.nj.com/politics/index.ssf/2011/05/gov_christie_to_announce_nj_pu.html

Browne, Tyler, Charles Bicknell, and Scott Nystrom (2015), *Focus on Energy Economic Impacts 2011–2014*, Cadmus, December 2015. Posted at: https://focusonenergy.com/sites/default/files/WI%20FOE%202011%20to%202014%20Econ%20Impact%20Report.pdf

Burtraw, Dallas (2016), "Evaluating Experience with the Cost-Containment Reserve & Ideas for the Future," Resources for the Future, April 29, 2016. Posted at: http://www.rggi.org/docs/ProgramReview/2016/04-29-16/Burtraw_on_RGGI_CCR_April_29th.pdf

Burtraw, Dallas, Joshua Linn, Karen Palmer, Anthony Paul, Kristen McCormack, and Hang Yin (2016), *Approaches to Address Potential CO_2 Emissions Leakage to New Sources under the Clean Power Plan,* Resources for the Future, January 21, 2016. Posted at: http://www.rff.org/files/document/file/RFF-Rpt-CPPCommentstoEPA160121_1.pdf

Burtraw, Dallas and Kristen McCormack (2016), *Consignment Auctions of Free Emissions Allowances under EPA's Clean Power Plan,* June 2, 2016. Posted at: http://www.rff.org/research/publications/consignment-auctions-free-emissions-allowances-under-epa-s-clean-power-plan

California Air Resources Board (2011), "Article 5: California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms," October 20, 2011. Posted at: http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf

California Air Resources Board (2012), "Chapter 5: How Do I Buy, Sell, and Trade Compliance Instruments?," December 2012. Posted at http://www.arb.ca.gov/cc/capandtrade/guidance/chapter5.pdf

California Air Resources Board (2013), "Linkage Readiness Report," November 1, 2013. Posted at: http://www.arb.ca.gov/cc/capandtrade/linkage/arb_linkage_readiness_report.pdf.

California Air Resources Board (2014), "Auction Notice," December 2014. Posted at http://www.arb.ca.gov/cc/capandtrade/auction/feb-2015/notice.pdf

California Air Resources Board (2015), "California Cap-and-Trade Program and Québec Cap-and-Trade System: 2016 Annual Auction Reserve Price Notice Issued on December 1, 2015." Posted at: http://www.arb.ca.gov/cc/capandtrade/auction/2016_annual_reserve_price_notice_joint_auction.pdf

California Air Resources Board (2016), "Final Regulation Order Article 5: California Cap on Greenhouse Gas Emissions And Market-Based Compliance Mechanisms," Unofficial Electronic Version, March 2016. Posted at: http://www.arb.ca.gov/cc/capandtrade/capandtrade/unofficial_ct_030116.pdf

California Public Utilities Commission (2016), "California Climate Credit—FAQ." Posted at http://www.cpuc.ca.gov/General.aspx?id=6571

California Public Utilities Commission (2012), *2012 Annual Report*, submitted February 1, 2013. Posted at: http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Annual_Reports/CPUC2012AnnualReport.pdf

Chang, Judy, Kathleen Spees, Metin Celebi, and Tony Lee (2016), *Covering New Gas-Fired Combined-Cycle Plants under the Clean Power Plan: Implications for Economic Efficiency and Wholesale Electricity Markets*, 2016. Forthcoming.

Chupka, Marc, Metin Celebi, Judy Chang, Ira Shavel, Kathleen Spees, Jurgen Weiss, Pearl Donohoo-Vallett, J. Michael Hagerty, and Michael Kline (2016), "The Clean Power Plan: Focus on Implementation and Compliance," The Brattle Group Issue Brief, January 2016. Posted at: http://www.brattle.com/system/news/pdfs/000/000/983/original/The_Clean_Power_Plan_-_Focus_on_Implementation_and_Compliance.pdf?1452529927

E&E Publishing (2016) "E&E's Power Plan Hub: Supreme Court Stay Response," Posted at: http://www.eenews.net/interactive/clean_power_plan

EPA (2015b), "EPA Fact Sheet: Carbon Pollution Standards," September 14, 2015. Posted at: https://www.epa.gov/sites/production/files/2015-11/documents/fs-cps-overview.pdf.

EPA (2015c), "Analysis of the Clean Power Plan," December 8, 2015. Posted at: https://www.epa.gov/airmarkets/analysis-clean-power-plan

EPA (2015c), "Allowance Allocation Proposed Rule Technical Support Document (TSD)," EPA Office of Air and Radiation Memorandum to Docket EPA-HQ-OAR-2015-0199, August 2015. Posted at: https://www.epa.gov/sites/production/files/2015-11/documents/tsd-fp-allowance-allocations.pdf

EPA (2016), *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, April 15, 2016. Posted at: https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf.

EUR-Lex (2003), "Commission Staff Working Document Executive Summary of the Impact Assessment Accompanying the document Proposal for a Decision of the European Parliament and of the Council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC. Posted at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014SC0018

European Commission (2016), "Climate Action, Allocation to industrial installations." Posted at: http://ec.europa.eu/clima/policies/ets/allowances/industrial/index_en.htm

Exelon (2016), "Comments Of Exelon Corporation On U.S. Environmental Protection Agency's Proposed Federal Plan Requirements For Greenhouse Gas Emissions From Electric Utility Generating Units Constructed On Or Before January 8, 2014; Model Trading Rules; Amendments To Framework Regulations," Exelon comment, January 21, 2016.EPA (2015a), *Regulatory Impact Analysis for the Clean Power Plan Final Rule,* October 23, 2015.

Federal Register, Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule, 80 Fed. Reg. 64,661 (October 23, 2015) (to be codified at 40 C.F.R. pt. 60) – 80 FR 64661. Posted at https://federalregister.gov/a/2015-22842

Federal Register, Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations; Proposed Rule, 80 Fed. Reg. 64,966 (October 23, 2015) – 80 FR 64966. Posted at: https://federalregister.gov/a/2015-22848

Feller, Jessie (2011), "Regional Greenhouse Gas Initiative: Its Importance for the Northeast's Future," Regional Plan Association, June 2011. Posted at: http://www.rpa.org/pdf/RPA-RGGI.pdf

Gerarden, Todd D., Richard G. Newell, and Robert N. Stavins (2015), *Assessing the Energy-Efficiency Gap*, Cambridge, Mass.: Harvard Environmental Economics Program, January 2015. Posted at: http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-15-07.pdf

Hibbard, Paul J., Andrea M. Okie, Susan F. Tierney, and Pavel G. Darling (2015), *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States: Review of RGGI's Second Three-Year Compliance Period (2012–2014)*, The Analysis Group, July 14, 2015. Posted at: http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf

Hurley, Doug, Kenji Takahashi, Bruce Biewald, Jennifer Kallay, and Robin Maslowski (2008), *Costs and Benefits of Electric Utility Energy Efficiency in Massachusetts*, Synapse Energy Economics, Inc., August 2008. Posted at: http://www.synapse-energy.com/sites/default/files/SynapseReport.2008-08.0.MA-Electric-Utility-Energy-Efficiency.08-075.pdf

Litz, Franz and Brian Murray (2016), "Mass-Based Trading under the Clean Power Plan: Options for Allowance Allocation," Duke Nicholas Institute Working Paper NI WP 16-04, March 2016. Posted at: https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_16-04_0.pdf

M.J. Bradley & Associates (2016), "EPA's Clean Power Plan Summary of IPM Modeling Results," M.J. Bradley & Associates presentation, January 13, 2016.

National Action Plan for Energy Efficiency (2008), Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers. Energy and Environmental Economics, Inc. and Regulatory Assistance Project, November 2008. Posted at: https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

NRDC (2016), "Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations; Proposed Rule," NRDC comment, January 21, 2016.

Ramseur, Jonathan L. (2016), *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress*, Congressional Research Service 7-5700, April 27, 2016. Posted at: https://www.fas.org/sgp/crs/misc/R41836.pdf

Regional Greenhouse Gas Initiative (2016a), *RGGI States' Comments on Proposed Federal Plan and Model Trading Rules for the Clean Power Plan*, Docket ID No. EPA-HQ-OAR-2015-0199, January 21, 2016. Posted at: http://www.rggi.org/docs/PressReleases/RGGI_Joint_Comments_CPP_FP_MR.pdf

Regional Greenhouse Gas Initiative (2016b), "Upcoming Auctions." Posted at: http://rggi.org/market/co2_auctions/upcoming_auctions

Regional Greenhouse Gas Initiative (2016c), "Market Monitor Reports." Posted at: http://rggi.org/market/market_monitor

Regional Greenhouse Gas Initiative (2016d), "The RGGI CO_2 Cap." Posted at: http://www.rggi.org/design/overview/cap

Regional Greenhouse Gas Initiative (2016e), "Collaborative for RGGI Progress Backgrounder on the Cost Containment Reserve," April 2016. Posted at: http://www.rggi.org/docs/ProgramReview/2016/04-29-16/Collaborative_Backgrounder_on_the_CCR.pdf

Regional Greenhouse Gas Initiative (2015a), *Investment of RGGI Proceeds Through 2013*, April 2015. Posted at: http://www.rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf

Regional Greenhouse Gas Initiative (2015b), "CO_2 Allowance Auctions Frequently Asked Questions," January 12, 2015 Posted at http://www.rggi.org/docs/Auctions/27/RGGI_%20CO2_%20Allowance_%20Auction_%20FAQs_January_12_2015.pdf.

Rutgers Edward J. Bloustein School of Planning and Public Policy (2008), *Cost-benefit Analysis of the New Jersey Clean Energy Program Energy Efficiency Programs*, January 9, 2008. Posted at: http://ceeep.rutgers.edu/wp-content/uploads/2013/11/costbenefitclean.pdf

Saha, Bansari, and Jan Mazurek (2013), "Modeling the Economic Impacts of AB 32 Auction Proceeds Investment Opportunities," December 1, 2013. Posted at http://www.icfi.com/insights/reports/2013/modeling-economic-impacts-of-ab-32-auction-proceeds-investment-opportunities

Schneider, Jordan and Matt Elliott (2012), *Benefits of the Regional Greenhouse Gas Initiative: How Cutting Pollution Protects New Jersey's Environment, Builds the Economy, and Reduces Energy Costs*, Environment New Jersey Research & Policy Center, February 2012. Posted at: http://www.frontiergroup.org/sites/default/files/reports/Benefits-of-RGGI.pdf

Sijm, Jos, Karsten Neufoff, and Yihsu Chen (2006), "CO2 Cost Pass Through and Windfall Profits in the Power Sector," CWPE 0639 and EPRG 0617, June 19, 2006. Posted at: http://www.eprg.group.cam.ac.uk/wp-content/uploads/2008/11/eprg0617.pdf

Southwest Power Pool (2013), *Regional Cost Allocation Review*, October 8, 2013. Posted at: https://www.spp.org/documents/37781/rcar%20report%20final%20clean.pdf

Stohr, Greg and Jennifer A. Dlouhy (2016), "Obama's Clean-Power Plan Put on Hold by U.S. Supreme Court," *Bloomberg Politics*, February 9, 2016. Posted at: http://www.bloomberg.com/politics/articles/2016-02-09/obama-s-clean-power-plan-put-on-hold-by-u-s-supreme-court

World Bank (2014), *State and Trends of Carbon Pricing 2014*, May 2014. Posted at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/05/27/000456286_20140527095323/Rendered/PDF/882840AR0Carbo040Box385232B00OUO090.pdf

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