ISSUE BRIEF 4

SCOPE AND POINT OF REGULATION FOR PRICING POLICIES TO REDUCE FOSSIL-FUEL CO_2 EMISSIONS

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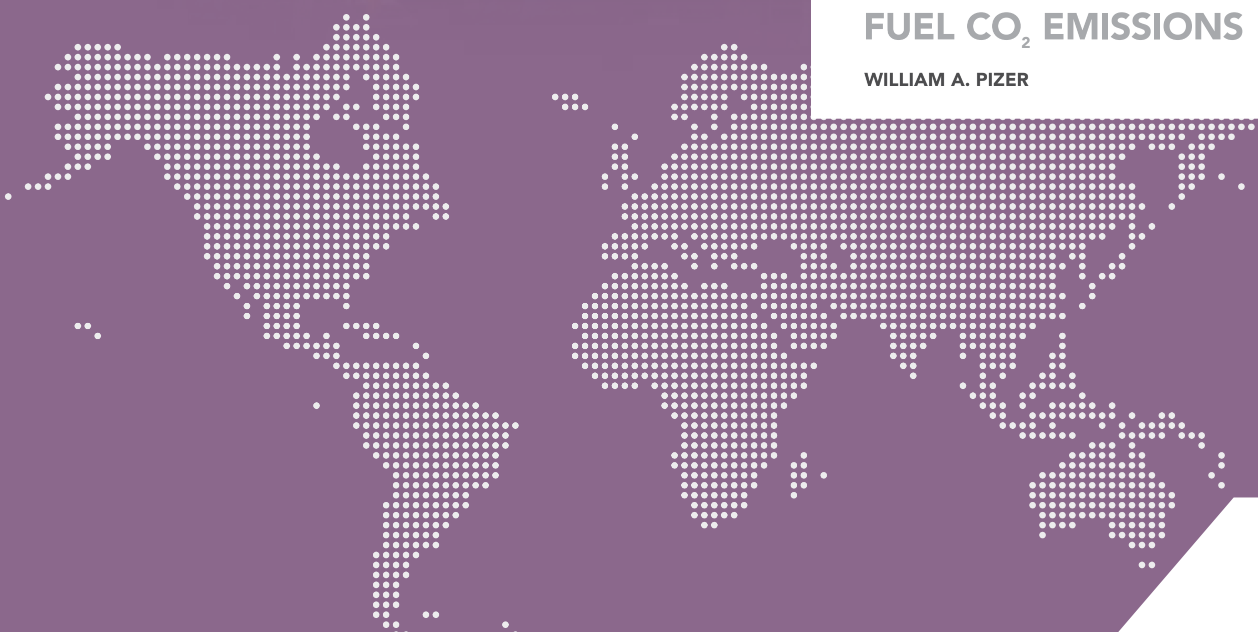

SCOPE AND POINT OF REGULATION FOR PRICING POLICIES TO REDUCE FOSSIL-FUEL CO_2 EMISSIONS

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SUMMARY

This issue brief examines the choice of what emissions to include—and where to regulate them—under a tax or tradable allowance policy to reduce fossil-fuel carbon dioxide (CO_2) emissions. A companion brief (Issue Brief # 14) examines options for regulating non-CO_2 greenhouse gases (GHGs) and non-fossil CO_2 emissions. Several points emerge from this discussion:

A regulatory program that establishes a price on CO_2 emissions—either through a tax or tradable permit system—will achieve the most reductions at the least cost when it covers as many emissions as possible under a single program with one price. Broader coverage also mitigates the tendency for emissions to shift to uncovered sources over time, raising the profile of any excluded emissions sources (that is, leakage).

- The argument for a broad-based, single-price program is grounded in cost considerations. Other policies, however, are often proposed instead of, or in addition to, a pricing policy. These proposals are often motivated by a desire to pursue more popular technologies, to guarantee certain technology outcomes or emissions-reducing actions within a sector, and to shield some fossil-energy users from higher energy prices.

- A program to price CO_2 emissions that focused on large emission sources (for example, sources that emit over 10,000 metric tons of CO_2 annually) could cover just over half of U.S. GHG emissions by regulating roughly 13,000 facilities. A program focused solely on the electricity sector would cover roughly one-third of U.S. emissions and involve 2,000–3,000 facilities.

- An upstream tax or emissions-trading program could effectively cover almost all fossil-energy CO_2 emissions by regulating approximately 3,000 entities, including refineries, natural gas pipelines or processors, coal mines, and importers.

- While regulatory programs for other forms of pollution have traditionally focused on emitters, the unique nature of CO_2 emissions makes it possible to regulate effectively at any point in the fossil-fuel supply chain. The vast majority of CO_2 emissions result from the combustion of fossil fuels. Because these emissions do not depend on the combustion technology used or on other operating parameters, and because there is limited opportunity to reduce emissions other than by burning less fuel, downstream emissions can be calculated with relative ease and accuracy based on the quantity of fuel produced or processed and its carbon content. Thus, fuels can be regulated as a proxy for emissions at any point in the chain from production to processing to distribution and final consumption. Important adjustments must be made for imported and exported fossil resources and fuels, sequestered emissions (including carbon capture and storage), or uses of fossil fuels that do not result in emissions.

- A concern frequently raised about upstream regulation of CO_2 emissions is that fossil-fuel users will respond more strongly to direct incentives for reducing emissions than they will to higher fossil-fuel prices. There is a psychological appeal to this logic, but basic economic theory and business pressure to minimize cost argue against it.

- While existing tradable permit programs have traditionally allocated free permits to regulated sources, there is no reason why CO_2 permits cannot be allocated to other actors throughout the fossil-fuel supply chain that are directly or indirectly affected by regulation. Decisions about how to allocate permits or allowances need not be tied to decisions about which entities will be required to submit permits or allowances under a trading program.

- For a *given* set of design choices concerning permit allocation and program coverage, the decision about where to regulate does not generally change the economic burden imposed on different actors in the fossil fuel supply chain. Important caveats may apply in situations where products are not competitively priced (as, for example, in regulated utility markets). In addition, point of regulation does affect which entities bear the administrative burden of demonstrating compliance under a tradable permits program (in a well-designed program, however, administrative costs should be relatively small).

Key Choices

A high-level question that arises early in designing a market-based climate-change mitigation policy for the United States is how to define the scope of economic activities regulated under the policy, particularly with respect to fossil energy CO_2 emissions. Entities involved in generating emissions that are covered by a market-based policy (including entities upstream and downstream of the entity that is actually regulated) face a common incentive to reduce emissions; entities involved with the production of emissions that are not covered do not. This issue brief outlines the basic motivations for including and excluding various emissions sources, along with different regulatory options for including sources in a market-based emissions-reduction program.

Motivation

A principal motivation for market-based policies—taxes or tradable permits—is that they encourage the most reductions at the lowest cost compared to other policy architectures.[1] Among market-based policies, those that include more emissions sources can deliver larger reductions at even lower costs. Broader coverage implies more opportunities—including possibly very cost-effective opportunities—to reduce emissions. Broad coverage also avoids the tendency for emissions to shift over time to sources that are not covered under the trading program. This is referred to as emissions leakage. Finally, broad coverage may satisfy a desire for fairness—that is, ensuring everyone is part of the policy—though it is worth noting that this desire could also be satisfied by a less-efficient, sector-by-sector approach (and is, in any case, a much more subjective goal).

Reducing GHG emissions enough to limit future climate impacts could eventually cost the world economy as much as 1–3 percent of gross product according to recent assessments by the Intergovernmental Panel on Climate Change (IPCC) and other studies.[2] All of these studies assume cost-effective global efforts to reduce emissions in which all emission sources face the same market price for CO_2. If future mitigation efforts focus on a smaller number of sources or use less-efficient policies, costs could rise significantly—perhaps by a factor of ten.[3] A sector-by-sector approach that tackles various emissions sources with distinct policies risks precisely this outcome.[4] Even though such an approach may "cover" all emissions, it does not do so in a way that encourages least-cost reductions across all sectors.[5]

Distinct from the issue of cost is the concern that, over time, excluding some fuels and sources from regulation could gradually encourage leakage as CO_2 prices rise. A program that only covered electricity-related emissions, for example, could encourage households and businesses to shift to direct use of fossil fuels.[6] While policies with partial coverage may not create significant leakage problems in the short run because the price incentive is not sufficiently high, this may change over time as policies evolve to achieve deeper reductions and incentives for regulated sources to avoid emissions rise

1 Alternate, technology-based regulations are discussed in a companion issue brief on technology deployment options.

2 See companion issue brief on costs and Intergovernmental Panel on Climate Change, 2007. *Report of Working Group III, Summary for Policymakers.*

3 See Pizer, W. et al, 2006. Modeling Economywide versus Sectoral Climate Policies Using Combined Aggregate-Sectoral Models, *Energy Journal* 27(3): 135-168. The authors find that mitigation costs double when only electricity and transportation are included, and increase by a factor of ten when standards for fuel economy and renewable portfolios are used in those sectors.

4 Consider, for example, the suite of actions being considered in California under AB32, http://www.arb.ca.gov/cc/ccea/ccea.htm.

5 Sector-by-sector regulations lead to higher costs for three reasons. First, absent emissions pricing of some sort in all sectors, there will not be an efficient balance of conservation and mitigation. Second, it is unlikely marginal costs will be balanced, leading to expensive reductions in one sector while cheaper abatement opportunities go unrealized in another. Third, absent emissions pricing, there will be a weaker incentive to innovate. See Issue Briefs #10 and #5 on technology deployment policies and different forms of regulation, respectively, for additional details.

6 There is already anecdotal evidence, for example, that high oil and gas prices are encouraging some households to consider switching to coal. See Howe, Peter, 2005. Fuel prices usher in new coal age. *Boston Globe*, October 24.

accordingly. These two points suggest that including as many sources as possible under a single program is an important design objective for market-based emission-reduction policies. At the same time, there is often pressure to exclude various sectors and emissions sources from these policies—for different reasons. Emissions from some sources may be small and/or expensive to mitigate, administrative costs for including some sources may be high, and international competitiveness concerns may argue for exempting some firms or sectors, particularly if they compete with overseas producers that do not face similar carbon constraints (competitiveness impacts and potential responses are discussed in Issue Briefs #7 and #8). Some sectors may prefer to be regulated separately in order to seek a more tailored—and perhaps less onerous—result. In addition, tailored approaches might be appealing because they more directly promote popular technologies or emissions-reducing activities and result in less obvious price increases for end users. Finally, some sectors may be sufficiently vocal and recalcitrant that their inclusion in a mandatory regulatory program is simply considered not worth the political effort.

There is also the view that different sectors or sources face different hurdles that are best addressed through distinct policies. Passenger vehicles require fuel economy standards, aircraft require aircraft regulations, power plants require power plant standards, etc. This line of thinking tends to ignore a basic tenet of market-based policies: that, given an aggregate emissions objective, the private sector is best suited to determine the least-cost combination of measures required to achieve that objective. Instead, this view assumes government can design a cheaper approach through targeted regulation. Economists tend to find the latter argument unconvincing: decades of research suggest that broad, market-based policies can substantially reduce costs relative to targeted regulatory approaches.[7]

A desire to minimize costs and avoid leakage problems provides the primary motivation for thinking carefully about what to include in a uniform market-based policy as society pursues gradually deeper emissions reductions. Whether exclusion means that some sources are covered by a separate policy, or are simply excluded from regulation completely, may matter for leakage, but not for our central conclusion about costs—indeed, the largest unnecessary costs arise not from excluding some sources but from addressing them with poorly designed, inflexible regulation.

7 See Stavins, R. forthcoming. Market-Based Environmental Policies: What Can We Learn From U.S. Experience (and Related Research)? *Moving to Markets in Environmental Regulation: Lessons from Twenty Years of Experience*, eds. Jody Freeman and Charles Kolstad. New York: Oxford University Press.

Deciding what Sources to Include—the Traditional Approach

The traditional approach for regulating air emissions is to focus on emitters; this is the model used in the Acid Rain trading program, the NOx budget and SIP call programs, and the EU Emissions Trading Scheme.[8] In this model, emitters are required to surrender allowances in proportion to their measured emissions. A fixed number of allowances are issued, thereby effectively limiting total emissions from covered sources while still giving individual emitters the flexibility to trade allowances and implement the most cost-effective compliance strategy.

Under the traditional approach, program coverage is generally limited to relatively large sources because the administrative burden of monitoring emissions and allowance obligations (or collecting a tax) on increasingly smaller sources quickly becomes prohibitive. In practice, two models for applying this approach to CO_2 emissions have emerged: one model focuses solely on the electricity sector, the other focuses more broadly on large emitters (those that emit, for example, more than 10,000 tons of CO_2 annually and/or sources in certain energy-intensive sectors).

The electricity-only model for CO_2 has appeared in a variety of market-based U.S. climate policy proposals, first as part of an effort to develop multi-pollutant regulations for power plants earlier this decade,[9] and more recently as the basis of the multi-state Regional Greenhouse Gas Initiative that is currently being implemented in the Northeast.[10] Part of the appeal of this approach is that the electricity sector has considerable experience with emissions trading; in addition, a growing number of companies within this sector have begun to support greenhouse gas regulations so as to achieve some measure of investment certainty. Applied in the United States, an electricity-only climate policy would cover about one-third of overall emissions and involve 2,000–3,000 sources.

In contrast, the EU Emissions Trading Scheme adopts the large source model, regulating electricity generators as well as large industrial sources. Applied domestically, this approach would cover about half of U.S. emissions and involve perhaps 13,000 sources.[11]

8 See http://www.epa.gov/airmarkets/progsregs/arp/s02.html, http://www.epa.gov/airmarkets/progsregs/nox/index.html, and http://ec.europa.eu/environment/climat/emission.htm. See also Ellerman, A.D. and B. Buchner, 2007. The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy* 1(1):66-87.

9 Proposed policies would have covered SO2, NOx, mercury, and CO_2 in one program. See various legislative analyses at http://www.epa.gov/air/oaq_caa.html/. Interestingly, the policies never proposed to allow trading across pollutants, something that economists have suggested for some time.

10 See www.rggi.org and Burtraw, D., D. Kahn, and K. Palmer, 2006. CO_2 Allowance Allocation in the Regional Greenhouse Gas Initiative and the Effect on Electricity Investors, *Electricity Journal* 19(2), 79-90.

11 Data on numbers of sources are discussed at greater length in Issue Brief #1 on emissions and emission sources.

Alternative Regulatory Approaches that Provide Broader Coverage

An alternative to the traditional smokestack-oriented approach is to regulate upstream—that is, to regulate the production, processing, or distribution of fossil fuels.[12] Entities that initially produce (or process / transport) a fossil fuel in the United States would be required to surrender allowances in proportion to the carbon content of the fuels they handle. As with the traditional model, a fixed number of allowances are issued so as to limit the total volume of CO_2 ultimately released by the combustion of fossil fuels. In contrast to traditional regulatory programs, where emitters face both a fuel price and an emissions price, the price of emissions under an upstream system would be bundled with fuel prices.

For most conventional air pollutants, an upstream approach would have serious drawbacks. First, most of these emissions can be addressed through end-of-pipe pollution controls. Second, downstream emissions of these pollutants are not a simple function of the properties of the fuel consumed—rather, eventual emissions depend on a variety of factors including the type of combustion technology and post-combustion pollution controls used. Thus accurate measurement is only possible at or near the actual emissions source. CO_2 emissions from fossil-fuel combustion are different. The only end-of-pipe control option for these emissions is carbon capture and storage—a technology that, if applied, would be readily amenable to a post-combustion crediting scheme. Moreover, the carbon content of fuels is easily measured at any point in the supply chain and provides an accurate proxy for eventual CO_2 emissions. In fact, the EU program regulates on the basis of fuel use rather than actual emissions measurement.[13]

It should be noted that an upstream program requires a few critical adjustments to avoid perverse incentives: imports of fossil fuels must be covered and exports must be credited. In addition, CO_2 capture and storage must be credited. Further, any uses of fossil fuels as feedstocks (for example, in the manufacture of plastics or road asphalt) that do not result in emissions need to be credited. All of these adjustments, however, are relatively straightforward.

Because of this flexibility in choosing the point of regulation for CO_2 emissions, a variety of approaches have been proposed, some of which regulate all emissions upstream and some of which use a hybrid model in which certain sectors or fuels are regulated upstream, while others are regulated midstream or downstream. The advantage of an upstream approach is that it provides broad emissions coverage while regulating a relatively small number of entities. Emissions from hundreds of millions of vehicles, households, and small businesses can be effectively captured by a program that regulates a few thousand petroleum refineries, natural gas pipelines or processors, and coal mines. As noted at the outset, broad coverage under a single regulatory program is often an important policy design objective because it will produce emissions reductions at lower cost.

A common concern about regulating fossil energy producers instead of end-use emitters is that this approach weakens incentives for mitigation. The logic goes that fuel producers can do little to reduce emissions (other than sell less fuel) and hence will not respond to regulation, whereas end users—who are actually in a position to change behavior and reduce emissions—will respond less strongly to regulation if the costs of emitting are simply bundled with fuel prices. While this view may seem intuitively reasonable, however, economic theory and the pressure to minimize costs and maximize profits argue strongly against it.

In fact, economic theory argues that the decision about where to regulate should have little or no bearing on the incentives faced by different entities under a market-based program. After all, the basic premise of market-based policies is that price drives behavioral change. If upstream fuel suppliers are regulated, they will pass emissions costs to downstream end-users in the form of higher fuel prices.[14] Higher prices will encourage end users to reduce their consumption of fossil fuels. Because reducing fuel use is, in most cases, the only real option for reducing energy-related CO_2 emissions, an incentive to reduce emissions is an incentive to reduce fuel use and vice versa. (The exception, of course, is post-combustion carbon capture and storage, but this technology is likely to be an option only for large point-source emitters, such as electric power generators and can be addressed with a crediting program.) While there are strong reasons to believe that theory holds up in practice on this point, we return to the question of whether upstream regulation is just as effective as downstream regulation at delivering emission-reduction incentives below.

12 This approach has some parallels to the lead phase-down program in which refineries were regulated based on the lead content of the gasoline they produced, rather than vehicle emissions being regulated directly. The key difference is that lead was an additive in gasoline, not an intrinsic part of the fuel itself.

13 That is, CO_2 emissions are not directly measured in the EU ETS. Rather, fuel use is measured and emission factors are applied. See Kruger, J. and C. Egenhofer, 2006. Confidence through compliance in emissions tradin markets, *Sustainable Development Law and Policy* 6(2), 2-13 (Climate Law Special Edition).

14 It is also possible that regulating CO_2 would lead to lower prices for fossil-fuel producers (versus increases for end users). Empirical evidence suggests this is likely to be a very small effect; see, for example, Energy Information Administration (2007), Energy Market and Economic Impacts of S.280, the Climate Stewardship and Innovation Act of 2007, and other studies, showing a minimal impact on fossil-fuel producer prices.

Table 1 Summary of the three broad regulatory models policymakers can consider in designing a market-based regulatory program for limiting CO_2 emissions.

	Potential coverage *(as percent of total U.S. CO_2 emissions from fossil-fuel combustion)*	Likely number of sources	Examples
Emissions sources / fossil fuel users	Electric power plants and large manufacturing facilities; ~50% of U.S. emissions	2,000–3,000 sources in the electric power sector; 10,000 sources in manufacturing	Acid rain program, EU ETS, Feinstein-Carper S. 317 (110th Congress)
Fossil fuel manufacturers / distributors	Entire economy / nearly 100% of U.S. emissions	3,000 coal mines, refineries, natural gas processors / pipelines	Lead phase-down in gasoline; Bingaman S.A.868 (109th Congress)
Hybrid *(some emissions sources covered directly; others covered via regulation of fuel distributors)*	Likely scenario for this approach would cover electric power, large manufacturing facilities, and transportation ~75% of U.S. emissions	13,000 downstream sources plus around 150 refineries	Lieberman-McCain S. 280 (110th Congress).

To summarize: policymakers face a unique set of choices and opportunities when regulating energy-related CO_2 emissions compared to conventional air pollutants. As with most programs designed for the latter, policymakers can focus regulation on emitters. In the case of CO_2 this will necessarily mean focusing on large point sources and excluding numerous small emissions sources because it would be too expensive to monitor their emissions and verify compliance. As a result, this approach would fail to capture as much as half of U.S. emissions. Instead, policymakers have the option to regulate fossil-fuel producers and distributors on the basis of the fuel they deliver into the energy system for eventual sale to end-users. This approach provides an opportunity to cover the great majority of emissions from small sources—including vehicles, households, and small businesses—by focusing on a much smaller number of upstream entities.

Several design considerations are relevant in comparing these approaches:

1. **Coverage.**
   More coverage in a single market-based system lowers cost and reduces potential for emissions leakage.
2. **Number of regulated facilities and their ability to manage compliance with a market-based program.**
   Fewer regulated facilities mean lower administrative costs; more sophisticated management means a more efficient market.
3. **Equity and fairness.**
   This objective does not require a single economy-wide program, but does suggest that no sector or area of emissions-related activity should be exempt from the effort to mitigate emissions. While economics can shed light on the magnitude and distribution of cost burdens, it is not helpful in establishing what is fair.
4. **Durability.**
   How well will a particular policy configuration work in the future as societal objectives evolve? Except to note that broad coverage may become more important as society seeks deeper emissions reductions in the future, economic analysis offers little clear guidance.

2. Questions Concerning Allocation and the Distribution of Cost Burdens

Because past tradable permit programs have awarded most free allowances to directly regulated entities, the issue of allowance allocation is often explicitly or implicitly bound up with discussions about where to regulate. The critical point here, however, is that any free allocation of allowances need not be tied to the question of which entities will be required to surrender allowances. This point is important because if one assumes a direct connection between free allocation and point of regulation, the decision about where to regulate becomes tied to the distribution of potentially billions of dollars worth of assets. This would potentially distort a design choice that should be based primarily on maximizing program coverage and other considerations. A related point is that the burden of regulation—that is, whose fortunes diminish as a result of emissions constraints—does not necessarily fall on the economic actors that are being directly regulated. Entities that are required to submit allowances or pay an emissions tax under a market-based regulatory system can usually pass some if not most of these costs forward (to their customers) or back (to their suppliers). More generally, point of regulation does not affect the distribution of associated cost burdens, with some important caveats, for reasons discussed in more detail below.

While it is somewhat obvious that allowances in a cap-and-trade system do not *need* to be freely allocated to regulated entities, this was the approach generally taken, as noted above, in all the fully operational emissions-trading programs that exist today.[15] Despite historic precedents, however, recent climate proposals show a growing interest in auctioning significant numbers of allowances, rather than giving them away. And in a few cases, recent proposals would give free allowances to businesses that are not directly regulated.[16] Why?

This change in thinking about allocation reflects a more sophisticated understanding of what happens when a price is put on CO_2 emissions associated with fossil-fuel use. First, users of fossil fuels face higher production costs as fuel prices rise to reflect the carbon price signal. Second, demand for fossil fuels can drop as a result of higher prices and/or underlying fossil-fuel prices can fall, shifting some of the cost of regulation onto fossil-fuel producers.[17] Third, prices for products made with fossil fuels—especially electricity—may rise shifting some of the cost burden onto consumers.[18] In the latter case, higher market prices for electricity may benefit non-fossil electric generators that do not face higher fuel or emissions costs under a CO_2 trading program, such as nuclear or renewable electricity producers.[19] Even mostly fossil-fuel based companies can benefit, however, if they can pass most of their emissions costs on to consumers and have simultaneously received an allocation of free allowances. In that case, the asset value of free allowances can exceed, perhaps substantially, the actual cost burden imposed on allowance recipients under the regulatory program. This phenomenon was observed in some European electricity markets where, in response to the EU ETS, a close correlation emerged—not only between wholesale electricity prices and allowance prices, but also between the stock value of some power companies and allowance prices. That is, stock prices for some power companies rose with higher allowance prices and fell with lower allowance prices.[20] Because these companies could pass most of the opportunity cost of using allowances through to consumers in the form of higher prices and because they had been given free allowances to start with, they were actually better off when allowance prices were high. Evidence from the EU ETS, perhaps more than any other recent development, has changed current thinking about allocation and provoked a more nuanced approach to the question of who should receive free allowances.[21]

A desire to minimize costs and avoid leakage problems provides the primary motivation for thinking carefully about what to include in a uniform market-based policy as society pursues gradually deeper emissions reductions.

The issue of allocation is discussed at length in a companion issue brief (Issue Brief #6) on that topic (as well as in Issue Brief #11 concerning the electricity sector) but two relevant points are worth making here. First, there is a trend toward moving free allocation away from regulated emitters and toward a more nuanced notion of burden, taking into account the ability of regulated firms to pass emissions costs forward or back. Second, the fact that costs can be passed forward and back along the energy supply chain generally implies that the

15 That is, the Acid Rain trading program, the NOx Budget Program and SIP Call, and the EU ETS. See references in footnote 7.

16 Many states in the Regional Greenhouse Gas Initiative propose auctioning all permits; among the half-dozen cap-and-trade proposals in the 110th Congress, free allocation accounts for between 50 and 85 percent of initially available allowances and is, in many cases, phased out over time

17 As noted in an earlier footnote, the principle impact on upstream suppliers is lower demand; prices received by fossil-fuel producers are not estimated to change much in response to near-term climate regulations.

18 We discuss the many issues surrounding electricity in Issue Brief #11. The question of whether other sectors can pass through costs, especially where firms face international competition, is the subject of a pair of issue briefs on competitiveness impacts and policy options (Issue Briefs #7 and #8).

19 This benefit to nuclear and renewable generators can be viewed as an appropriate reward for cleaner generation. More generally, questions of fairness and equity are extremely subjective; here we try to simply note where burdens exist, not where they should exist.

20 See Sijm, J, K. Neuhoff, and Y. Chen. 2006. CO_2 cost pass-through and windfall profits in the power sector. *Climate Policy* 6(1), 49-72.

21 See revised allocation recommendations by the National Commission on Energy Policy, http://www.energycommission.org/site/page.php?report=32.

distribution of economic burden is the same, regardless of who is regulated—the emitter, the fuel distributor, or the fuel producer. That is, requiring either producers or distributors of fossil fuels to surrender allowances based on the carbon content of the fuels they handle generally raises the price of those fuels by the value of associated allowance. Thus, the outcome is the same as in a system where the downstream end user has to buy emissions allowances to satisfy a direct compliance obligation.

One caveat to this observation that the point of regulation does not really matter, except in terms of emissions coverage and administrative complexity, relates to the structure of markets along the fossil-fuel supply chain.[22] In some cases, long-term fuel supply contracts may not allow for a price adjustment in response to a new upstream allowance requirement. In the case of western coal, the market power of railroads may affect the ability of western suppliers to pass along higher prices associated with upstream CO_2 regulation to eastern utilities without some of that price increase being captured by the railroad. Finally, pipeline companies with regulated tariff rates that do not own the fuel they transport may not be easily able to pass through the cost of CO_2 allowances. While none of these obstacles is insurmountable, especially over time, they serve to underscore two points. First, the basic notion that point of regulation does not affect the distribution of regulatory cost burdens depends on a central assumption: that prices are set by a competitive market. Second, where this is not the case, policymakers will need to address or work around impediments to cost pass-through to ensure that incentives for reducing emissions under a tradable permits system are properly transmitted up and down the energy supply chain.

The choice of where to regulate does, of course, affect the distribution of cost burdens in one obvious way: administrative costs related to a tradable permits program will fall largely on the entities that are being directly regulated.[23] Regulated businesses have to obtain and surrender allowances (or pay taxes), and document fuel carbon content or emissions to demonstrate compliance. While small relative to either the cost of allowances or the cost of reducing emissions, these administrative costs could be burdensome to small businesses. Perhaps more burdensome for some businesses will be the need, under a tradable permit system, for some sophistication in managing permit holdings in advance of compliance: permits or allowances are market assets that can rise and fall in value (sometimes quite dramatically). Managing them in an intelligent way to minimize compliance costs can require a variety of financial market skills quite different from those required to comply with ordinary environmental regulations (to some extent, such skills will also be required of businesses that are indirectly impacted by the regulation, even if they are not directly involved in handling allowances themselves).[24] While there is no shortage of external financial market expertise that could (and eventually will) be brought to bear to help companies navigate carbon permit markets, matching everything up can take time. Recent proposals that seek as a first step to cap only electric-sector emissions may be motivated by this concern. Electric utilities have experience with emissions trading under other regulatory programs so proponents of this approach may be weighing the desire for knowledgeable participants against the competing desire for greater coverage. Of course, any future expansion of a utility-only program to cover more sources would eventually require firms in other sectors to acquire similar expertise.

Policymakers have the option to regulate fossil-fuel producers and distributors on the basis of the fuel they deliver into the energy system for eventual sale to end-users. This approach provides an opportunity to cover the great majority of emissions from small sources—including vehicles, households, and small businesses—by focusing on a much smaller number of upstream entities.

22 The general point that regulating at different points does not affect "who really pays" was established decades ago in the context of tax policy. See Musgrave, R. A. and P. B. Musgrave, 1980, *Public Finance in Theory and Practice.* McGraw-Hill: New York.

23 There is also the burden on regulators; but again, for market-based policies this is typically small. An office of 100 operates the current U.S. acid rain trading program.

24 This was recently discussed in the context of the EU ETS. See Kambayashi, S. 2007. Lightly carbonated: European companies are not yet taking full advantage of carbon markets. *Economist*, August 2. Lack of experience in managing allowance holdings has likely contributed to the volatility observed in a number of trading programs during the early phases of implementation. As such, it provides a further argument for cost-containment mechanisms; see Issue Brief #5 on various forms of regulation.

Lingering Issues

A few final points concerning the scope of a market-based CO_2 program and point of regulation do not fit neatly into the discussion so far: these include the idea of expanding the range of covered sources over time and recent proposals for regulating "load-serving entities" in the power sector.

Taking the first issue (expanding program coverage over time), one option clearly is to start with emission sources that are relatively easy to regulate and include additional sources over time—such an expansion would likely be necessary if more stringent targets are to be met over time. This was basically the model used for the EU ETS. While focusing initially on the largest sources and on sources that have experience with trading programs has some appeal, for the reasons noted above, this approach raises a tricky practical question: How easy is it to create the necessary political momentum to add smaller and perhaps more resistant sources *after* the largest and most amenable sources are in? A related question is whether it might be possible to create a hybrid program that adds numerous small sources by regulating a small number of upstream fuel distributors *after* a program initially focused on large downstream emitters is implemented. If either outcome is unlikely, there may be a stronger argument for including more sources from the outset by using an upstream approach. Although it may be tempting to choose whatever regulatory approach seems most politically expedient in the interests of initiating a mandatory policy without further delay, policymakers should keep in mind that the core architecture of the program is important for its long-term environmental success. A program that cannot evolve to deliver needed emissions reductions at a reasonable cost could be a serious handicap over time. On the other hand, if a phased expansion of the program over time seems likely to be more feasible politically than starting with a broad-based approach there may be little reason to hold up progress with sources that are ready to go.

A somewhat related question is whether recent proposals to regulate load-serving entities in the electric power sector—versus power generators or other entities further upstream—are appropriate for cap-and-trade programs at the state or regional level. This approach is being considered in California as a response to serious concerns about leakage.[25] California imports 20 percent of its electricity so failure to address the emissions associated with power imports creates the distinct potential for out-of-state emissions to rise once constraints are imposed within California. A proposed solution is to make the companies that procure wholesale electricity for sale in the California market responsible for the emissions associated with that electricity regardless of where it is generated. There are some potential problems with this approach. One is that it runs the risk of double counting emissions if another jurisdiction selling power to California enacts a similar regulatory program for limiting CO_2 emissions. In that case, California would need to work with the exporting state to ensure that emissions are not double-counted and double-charged—once when they occur and again when the power is sold into California. A second problem is the difficulty of accurately assigning emissions between buyers and sellers in a competitive wholesale market (discussed in Issue Brief #11 on the electricity sector). In general, regulating load-serving entities would seem to be a poor model for covering electric-sector emissions at the national level, where leakage is not a problem and where wholesale competition is more important.[26]

Just as starting with a narrow program may be appropriate if coverage can be expanded over time, locating the point of regulation for electric-sector emissions at the load-serving entity may make sense in the context of a state or regional program, provided this does not interfere with implementing a more appropriate program architecture at the federal level. The risk is that momentum and familiarity may carry early decisions for some time, even if much better options exist.

25 This approach has been proposed by the California Public Utilities Commission; see http://www.cpuc.ca.gov/static/energy/electric/climate+change/_index.htm.

26 A different question is whether load-serving entities might receive free allocations—this question is likewise discussed in Issue Brief #11.

ISSUE BRIEF 5

EMISSIONS TRADING VERSUS CO_2 TAXES VERSUS STANDARDS

IAN W.H. PARRY AND WILLIAM A. PIZER

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EMISSIONS TRADING
VERSUS CO_2 TAXES VERSUS STANDARDS

Ian W.H. Parry and
William A. Pizer

SUMMARY

Much attention has focused on the design of a trading program for carbon dioxide (CO_2) emissions, but a more fundamental question is whether emissions trading is really the best regulatory model. In particular, are there potential advantages or disadvantages to a CO_2 tax versus a cap-and-trade program? What about more traditional forms of regulation? This issue brief compares and contrasts these policy approaches, and offers the following observations:

- There are many similarities between CO_2 taxes and tradable allowances or permits. Both reduce emissions by associating a uniform price with emitting activities at any point in time, leading to efficient, low-cost emission reductions. Both can be administered on upstream fossil-fuel producers (based on the carbon content of fuels) to capture economy-wide emissions, or on downstream emitters to capture emissions from large sources. And both can incorporate incentives for carbon sequestration and other offset activities.

- Taxes generally fix the price of emissions, and leave the annual level of emissions uncertain; in contrast, tradable permits generally fix the level of emissions, and leave the price uncertain. Because climate change hinges on the long-term accumulation of global emissions, a predictable price tends to have advantages—for both the environment and the economy—over fixing the level of U.S. emissions for a short time horizon of several years. Over longer horizons, as nations converge on a common target for stabilizing atmospheric greenhouse gas (GHG) concentrations and as international participation in global emission-reduction efforts grows, fixed emissions targets become increasingly advantageous.

- Taxes generally raise government revenue, while tradable permits—at least traditionally—have not. New government revenue, if used to cut other taxes or provide valuable public goods, generates additional economic benefits that are not achieved under a traditional system of tradable permits in which the majority of permits or allowances is allocated for free to regulated entities. On the other hand, the allocation of free permits or allowances under an emissions-trading regime can be tailored to address concerns about an otherwise unequal distribution of regulatory cost burdens across firms and regions.

- These traditional differences between a tax and trading policy are easily blurred in a hybrid emissions trading system where some allowances are auctioned to raise government revenue and where banking and a safety valve (or perhaps borrowing) stabilize prices. Recent proposals for a Federal Reserve-like body to monitor allowance markets address this same issue.

- A few differences between these two types of policies are more immutable. For example, emissions trading does require additional institutions, though experience

suggests that these institutions are likely to arise quickly and for the most part inexpensively. Another difference is that a CO_2 tax tends to reframe the debate in terms of revenue and fiscal policy.

- Traditional forms of regulation—technology and performance standards—represent an alternative to emissions trading or CO_2 taxes, but can be much more costly because they do not allow the flexibility to shift efforts toward the cheapest mitigation opportunities. As a complement to emissions trading or CO_2 taxes, however, flexible standards can address possible additional market failures and potentially lower costs.

Similarities Between CO_2 Taxes and Emissions Trading Programs

A CO_2 tax imposed upstream in the fossil-fuel supply chain (with rates reflecting the amount of CO_2 that will be emitted when the fuel is later combusted in automobiles, during electricity generation, and so on) minimizes the number of entities subject to the tax and therefore has administrative advantages. Roughly speaking, the tax would be passed forward into the price of coal, natural gas, and petroleum products and therefore ultimately into the price of electricity and other energy-intensive goods. These higher energy prices would encourage the adoption of fuel- and energy-saving technologies across the economy and promote switching from carbon-intensive fuels like coal to natural gas and renewable fuels. In these regards, a CO_2 tax closely resembles an upstream emissions-trading system, where the price of allowances is passed forward in the form of higher fuel prices.

Neither policy has to be implemented upstream: CO_2 taxes and emissions-trading programs can be implemented anywhere in the chain from fossil-fuel production (upstream) to ultimate fuel combustion (downstream).[1] Upstream programs, however, are typically more efficient—in the sense that they lead to lower costs per ton of emissions reduced—because they can encompass virtually all emissions sources with minimal administrative burden, thereby maximizing low-cost mitigation opportunities. In contrast, downstream programs necessarily exclude small sources, as does the European Union's Emissions Trading Scheme (EU ETS). And either a tax or tradable-permit program, upstream or downstream, can—via offset and crediting programs—incorporate incentives for downstream carbon capture and storage at industrial facilities, for forestry expansion on farmland, and for other downstream activities.

1 See Issue Brief #4 on scope and point of regulation. That issue brief discusses issues related to upstream versus downstream regulation.

Potential Advantages of a CO_2 Tax

Carbon taxes have several advantages over traditional emissions-trading systems, but as discussed later, some of these advantages can be partly captured through modifications to the cap-and-trade approach.

One potentially important advantage of a CO_2 tax is that it establishes a well-defined price for emissions of CO_2 and other greenhouse gases. The price may rise over time, but it is known. In contrast, allowance or permit prices under a cap-and-trade system can be volatile because the supply of allowances is fixed, whereas demand will vary considerably at different points in time. Changes in energy demand, fuel-price fluctuations (like, spikes in natural gas prices), and a variety of other factors can cause demand for allowances to fluctuate significantly. Price volatility in allowance markets may in turn deter both long-term capital and R&D investments in low-carbon technologies that have high up-front costs. The long-term payoffs of making such investments will be very uncertain if the future price of CO_2 is unknown.

Moreover, it typically makes economic sense to allow nation-wide emissions to vary on a year-to-year basis because prevailing economic conditions affect the costs of emissions abatement. This flexibility is inherent in a CO_2 tax because firms can choose to abate less and pay more tax in periods when abatement costs are unusually high, and vice versa in periods when abatement costs are low. Traditional cap-and-trade systems do not provide this flexibility because the cap on economy-wide emissions has to be met, whatever the prevailing abatement cost. Intuitively, imposing strict limits makes economic sense only if (1) we are rapidly approaching a threshold in atmospheric greenhouse gas concentrations beyond which there is a risk of dangerous and extremely costly climate change impacts and (2) strict emissions limits can be globally enforced. It is worth noting that most trading programs do allow banking—that is, firms can save unused allowances for use in future compliance periods—and thus provide some flexibility, especially if initial targets are sufficiently generous for a long enough time to allow a bank to emerge. The topic of borrowing is discussed below.

Another potentially important advantage of CO_2 taxes is that they directly raise revenues for the government, whereas under past emissions trading systems, the government has traditionally given away free allowances. At current emissions levels, for example, a tax of $10 per ton of CO_2 on all greenhouse gases would raise about $70 billion of revenue per year for the federal government, or about 9 percent of federal personal income taxes. This extra revenue could be used to lower the rates of other taxes, such as those on individual income, thereby producing important benefits for the economy. (Such a "tax swap" was implemented by the United Kingdom in conjunction with its 2001 climate change levy, and was proposed in the 110th Congress by Representative John Larson (D-CT) in H.R. 3416.) Income taxes cause a variety of distortions in the economy. For example, by taxing away some of the returns to working and saving, income taxes deter some people from joining the labor force and encourage others to consume too much of their income. Income taxes also induce a bias away from ordinary spending towards items that are deductible from taxes (owner-occupied housing and employer-provided medical insurance, for example). These economic distortions could be reduced if CO_2 tax revenues were used to lower income taxes.

Even if the revenue from a CO_2 tax is not used to cut other taxes, it could still flow to a variety of important uses—including to fund energy R&D; support climate-change adaptation efforts; or provide assistance to stakeholders, communities, and/or low income families adversely affected by the policy. Weighing against this revenue-raising advantage is the risk that the government will spend the additional revenue on programs that cost more than the benefits they provide, thereby in effect increasing the societal cost of the CO_2 tax relative to the cost of a comparable cap-and-trade program with free allowance allocation.

Aside from possible differences in economic efficiency, revenue to the government (and its potential uses) is likely to have different distributional consequences—in terms of costs and benefits to various individuals and firms in the economy—than a free distribution of allowances. Under the latter approach, benefits flow primarily to the recipients of free allowances—typically businesses and their shareholders and/or regions of the country with higher emissions. Revenues that flow to government as the result of a tax can be redistributed more broadly across the population: for example, to lower tax rates for all income groups. Critical questions, therefore, include the degree to which the burden of a market-based CO_2 program is broadly spread across society (or, conversely, concentrated among a particular group of carbon-intensive businesses or regions) and how the government could, and would, spend any tax revenues.

Finally, emissions trading systems require new institutions to function effectively; that is, they require smoothly running markets where firms can buy and sell permits or allowances and obtain information about permit prices now and in the future. Experience with existing trading programs, such as the U.S. SO_2 trading program, has shown that these institutions can arise quickly and for the most part inexpensively. Some emissions-trading markets have witnessed exceptional volatility during their inception. For example, allowance prices in the U.S. NOx budget program skyrocketed in the wake of uncertainty about whether Maryland, a net supplier of allowances, would enter the program on time. In the EU ETS, permit prices crashed spectacularly after emissions data pointed to an excess of CO_2 permits rather than the expected shortage.

Hybrid Trading Schemes

The problem of allowance price volatility under a cap-and-trade system can be partly addressed by cost-containment mechanisms, such as a "safety valve," coupled with allowance banking. With a safety valve, firms can buy an unlimited number of additional permits from the government at a pre-determined, possibly escalating price. The safety valve essentially functions as a cap on permit prices; it is most likely to be triggered when demand for permits and abatement costs are high. Allowance banking allows firms to hold over some allowances, in periods when the demand for permits is slack because abatement costs are low, for use in future periods when permit prices are expected to be higher again. In effect, this mechanism creates a floor under permit prices.

As an alternative to a safety valve or price cap mechanism, allowance borrowing has recently entered the U.S. policy debate. Legislation introduced in the 110th Congress by Senators McCain and Lieberman would allow firms to borrow up to 25 percent of their allowance obligation in a given year for up to five years (paying 10 percent interest annually). Borrowed allowances would be deducted from the allowance pool available in future years. Coupled with somewhat clear expectations about future prices, this mechanism could provide flexibility similar to a tax. Without clear expectations about future prices, however, borrowing would tend to dampen short-term volatility while leaving the market open to fluctuations based on longer-term expectations about the cap and prices.

The second potential advantage of a tax—that it raises revenues for government—can also be achieved by a cap-and-trade program if allowances are auctioned instead of being distributed for free (conversely, the revenue-generating properties of a CO_2 tax could be offset by including rebates or exemptions). Although auctioning 100 percent of allowances would mimic the revenue advantages of a CO_2 tax, partial auctions or—as suggested by the recent U.S. Climate Action Partnership proposal—a gradual transition to auctions, offer a spectrum of possibilities.

Potential Disadvantages of a CO_2 Tax

CO_2 taxes have several practical disadvantages. One is simply political resistance to new taxes; for example, despite a major effort, the first Clinton administration failed to enact an energy tax motivated on environmental grounds. Nonetheless, a CO_2 tax should not be ruled out entirely on this basis: it is always difficult to predict what policies may or may not be viable in the future, especially under different political leadership and likely greater public awareness of, and concern about, both global warming and the federal debt.

Another concern (noted earlier) is that revenues from a CO_2 tax (or auctioned allowances) might be spent inefficiently or even wasted. This could occur, for example, if revenues go toward special interests, rather than substituting for other taxes or addressing important social needs. In principle, legislation accompanying a CO_2 tax could specify how the new revenue must be used, thereby avoiding the risk that it would be dissipated among competing special interest groups. This approach would require political will, as would—more generally—any effort to pursue a fiscally focused climate policy in which environmental objectives are pursued in a manner that maximizes broader public-good objectives. A shift in focus to a policy approach motivated by revenue and fiscal considerations, as well as by environmental concerns, could have important implications—not only in terms of the jurisdiction of agencies and Congressional committees, but also in terms of the broader debate. At first blush, it might appear that such a shift could increase the political difficulty of achieving desired environmental objectives. On the other hand, a more transparent airing of the energy price implications of a trading program or carbon tax—and of the offsetting social benefits that could be achieved by re-directing revenues raised by the policy for other public purposes—could help to build better understanding of, and deeper support for, the policy among the public and some private-sector stakeholders.

Of course, policymakers may wish to compensate the industries most affected by the carbon regime or ease the transition for firms and workers facing adjustments. Compensation can be provided in a straightforward way under an emissions-trading regime by granting free allowances to particular firms or groups.[2] Compensation can also be provided under a CO_2 tax regime, although legislatively, this is more complex.

Finally, policymakers may wish to reduce emissions in a gradual fashion by setting progressively more stringent targets each year, perhaps because atmospheric CO_2 concentrations are already judged to be dangerously high, or because steady progress on emissions reductions more effectively communicates America's seriousness about tackling climate change to the international community. A traditional cap-and-trade system with no safety valve is best tailored to achieving defined emissions targets; in contrast, progress on emissions reductions is less certain under a CO_2 tax because emissions will vary from year to year with economic conditions. A cap-and-trade program with a safety valve represents a potential compromise between these approaches: the safety valve limits allowance prices and emissions-abatement costs, but the trigger price for the safety valve can be steadily increased over time, providing more certainty about emissions levels over the longer term.

What About Recent Proposals for Federal Reserve-like Oversight of Carbon Markets?

In July 2007, a new proposal emerged in Congress for government oversight of carbon markets via a new body, much like the Federal Reserve. Like the Fed, this body could intervene in response to unexpectedly high (or low) prices or to curb excessive price volatility.[3] The basic idea is that this type of oversight would deliver some of the market-stabilizing benefits of a safety valve while providing greater confidence in the achievement of longer-run emissions goals. Although this proposal does not eliminate the trade-off between price and emissions certainty, it introduces an additional nuance into the current debate about cap-and-trade proposals with and without explicit cost caps.

At the same time, empowering an outside agency to intervene in the market poses risks. Designed or operated poorly, such oversight could exacerbate volatility. For

2 See Issue Brief #6 for a longer discussion of the allocation issue.
3 See http://www.senate.gov/~warner/pressoffice/statements/20070802a.htm and http://www.nicholas.duke.edu/institute/carboncosts/.

example, consider a provision that requires prices to remain above a particular threshold for a period of time before intervention occurs. As permits trade above the threshold, it becomes increasingly likely that the government will intervene to lower prices. At that point, allowance buyers begin waiting for the intervention—who wants to buy now if prices are going to be lower in the future? As demand falls, prices drop, the likelihood of intervention recedes, and therefore prices begin to rise again. In this scenario, the prospect of intervention could have the perverse effect of *increasing* price volatility and market instability. Alternatively, if interventions are quantitatively limited, the most valuable role of the outside agency—addressing a truly exceptional shortage—is compromised.

In sum, the idea of an independent oversight body for future carbon markets is likely to be the subject of additional discussion and elaboration as Congress debates different climate policy proposals going forward. On the one hand, this approach may provide additional opportunities to fine tune the balance between emissions and cost uncertainty in a tradable permit program. At the same time, however, the implications of such a mechanism must be carefully evaluated and important design questions considered in terms of minimizing any additional political or market risks associated with potential intervention.

Is There Any Role for Traditional Regulation?

From a cost-effectiveness standpoint (that is, in terms of minimizing cost per ton of emissions reduction achieved), market-based instruments like CO_2 taxes and emissions trading systems, applied to all emissions sources, are typically superior to traditional regulation. (Examples of traditional regulation include facility-specific pollution-control requirements, limits on emissions per kilowatt-hour of electricity generation, fuel economy requirements imposed on new vehicles, or regulations on fuels). Under market-based policies, the marginal cost of abatement is equalized across all sectors of the economy, across all firms within a sector, and across all opportunities for abatement. The least expensive abatement options are implemented first, such as substituting less carbon-intensive fuels for more carbon-intensive fuels, adopting energy-efficient technologies, and conserving energy at the household level by, for example, driving less and reducing residential heating and cooling loads.

Nonetheless, traditional regulations—such as technology standards that dictate the use of a particular technology or manner of operations, and performance standards that limit emissions generated per unit of economic output or activity—are frequently proposed as alternatives or complements to emissions taxes or tradable permits.[4] The cost of such regulations is often less visible: emissions control requirements or performance standards raise the cost of certain goods and activities, resulting in price increases and income reductions that are not obviously tied to CO_2 emissions. Traditional regulation can also modify specific behavior directly, without appealing to incentives, and target preferred technologies or mitigation actions. No money is exchanged in the form of taxes paid or allowances traded—changes in behavior are simply required by law. While some view these features of traditional regulation as advantageous, they come at the cost of higher—perhaps much higher—costs.[5] Thus, while imposing sector- or source-specific requirements might appear to reduce the cost of emissions abatement (by avoiding effects on energy prices completely or by reducing demand for allowances and hence lowering allowance prices), the total cost to society—taking into account the less transparent costs of traditional regulation—is likely to be higher than if the same overall result were achieved with a market-based program only.

Unlike market-based instruments, performance or technology standards typically do not impose an economywide carbon price and therefore fail to meet the conditions for efficiently distributing the burden of emissions reductions across different firms, households, and mitigation options. In contrast to minimum performance standards that must be met by every facility or product, *tradable* performance standards offer some ability to equalize marginal costs. Facilities or products that beat the standard cheaply generate credits used to offset excess emission rates at facilities or by products that miss the standard, achieving the standard on average at a lower cost. However, even tradable performance standards often overlap coverage in some areas, exclude coverage in other areas, and always fail to provide proper incentives for conservation. For example, tradable performance standards for the power sector and efficiency standards for appliances would overlap, as would a tradable fuel-economy standard for cars and a renewable or carbon-based fuel standard for gasoline. In the case of industrial facilities, where facility output is not

4 See, for example, recent proposals in California (http://www.arb.ca.gov/cc/ccea/ccea.htm) and the bill introduced by Senators Sanders and Boxer (S. 309, http://www.sanders.senate.gov/news/record.cfm?id=269618).

5 One estimate found that using fuel economy standards for light-duty vehicles and a renewable portfolio standard in the electricity sector would cost ten times as much as an economywide tradable permit system. See Pizer, W. et al, 2006. Modeling Economywide versus Sectoral Climate Policies Using Combined Aggregate-Sectoral Models, *Energy Journal* 27(3), 135-168.

easily defined on a consistent basis, it would be difficult as a practical matter to develop output-based performance standards that could be applied to a diverse population of sources.

Finally, performance standards do less to promote conservation than market-based instruments. Both types of regulation lead to emissions reductions, the cost of which raise the price of emissions-intensive goods, like motor fuel and electricity. Market-based instruments like taxes and emissions trading, however also associate a cost with the remaining emissions that *do* occur, further raising the price of these goods. While this may seem like a bad thing for consumers, it is precisely that price increase that encourages the right amount of conservation—such as driving less or using less electricity. For example, vehicle fuel-economy standards reduce emissions per mile traveled, but do not generate incentives to reduce driving (on the contrary, drivers of more efficient vehicles face lower costs per mile traveled and hence weaker incentives to reduce driving). While avoiding the increase in fuel prices that would accompany a cap-and-trade program or emissions tax might seem desirable on the surface, pursuing the same carbon-reduction objectives via product performance standards means higher costs and lower income somewhere else.

While economic analyses reach uniformly negative conclusions about the cost-effectiveness of traditional regulations as an *alternative* to emissions taxes or tradable permits, for the reasons discussed above, an economic argument can be made for performance standards as a *complement* to a market-based carbon regime, either to address additional market failures and/or because the price incentive for reducing CO_2 emissions under the market-based regime does not reflect the full value of those reductions to society. Examples of market failures that might be amenable to traditional regulatory approaches include the possibility that purchasers may undervalue more energy-efficient vehicles or appliances, or that efforts to develop new technologies may generate substantial public benefits (in the form of new knowledge) that are not appreciated by the firm conducting the research.[6] Finally, the inability to price greenhouse-gas reductions appropriately may arise from political opposition to higher energy prices and/or concerns about the international competitiveness of energy-intensive industries.

6 The latter point is discussed at length in Issue Briefs #9 and #10, concerning technology policy.

Conclusion

Significant differences exist between emissions taxes and trading programs. In particular, emissions taxes will generate revenue and set prices, whereas trading programs have traditionally distributed most allowances for free and fixed emissions. Recent proposals for emissions-trading programs with allowance auctions and safety valves (and other mechanisms), however, suggest that many of the key features of a CO_2 tax can be partly included in a trading program. The same is not true for a tax: it is not possible to create fixed emissions limits without resorting to emissions allowances or permits. And whereas tax revenues can be redistributed, industry stakeholders have frequently responded to carbon-tax proposals by seeking exemptions or voluntary agreements in lieu of taxes. Politically, this represents a very different challenge than adjudicating competing claims for allowance allocations. Many other program design questions—such as point of regulation and whether to include offsets and other crediting mechanisms—have always applied equally to emissions taxes and trading systems.

What, then, are the fundamental differences between the major policy options? Emissions-trading programs do require additional institutions: markets, brokers, and information tools to function effectively and manage risk. These institutions tend to arise quickly and inexpensively but there is generally some risk of excess volatility, especially in the early phases of implementation. A tax approach does tend to reframe the traditionally environmental issue as, at least partially, a revenue issue—with attendant political, jurisdictional, and institutional consequences. Of course, similar issues are likely to arise in connection with revenue-generating allowance auctions. All this suggests that designing a CO_2-reduction policy is more usefully viewed as a matter of selecting different program features along a continuum than as a simple dichotomous choice between taxes and tradable allowances. In that selection process, trade-offs must be made between emphasizing certainty about prices versus certainty about emissions and between raising revenue versus compensating some stakeholders through the free distribution of allowances.

The comparison between a market-based approach (whether taxes or tradable allowances) and traditional regulation is much simpler. While there is possibly an economic rationale for traditional regulations as a *complement* to a market-based policy when other market failures exist (or when the emissions price under a market-based system is constrained for political or other reasons to be less than its social value), there is no economic rationale for such regulations as an *alternative* to, or substitute for, market-based programs. Traditional regulation is always more expensive because it: (1) generally fails to trade low-cost reductions off against high-cost reductions, (2) tends to provide overlapping incentives for reductions from some types of sources while excluding others, and (3) often fails to provide proper incentives for conservation. Nonetheless, the desire to pursue preferred technologies or mitigation activities and to reduce the obvious price impact on energy end-users (even recognizing that the result is likely to be higher costs elsewhere) often means that substantial support exists for traditional types of regulation in some sectors of the economy.

Table 1 Comparison of Policy Instruments

	CO_2 tax	Cap and trade	Traditional regulation *(e.g., source-specific emissions standards)*
Certainty over CO_2 price or cost?	Yes. The tax establishes a well-defined price.	No. But price volatility can be limited by design features, such as a safety valve (price cap) or borrowing.	No.
Certainty over emissions?	No. Emissions vary with prevailing energy demand and fuel prices.	Yes, in its traditional form (over capped emissions sources). No, with the use of additional cost containment mechanisms.	No; regulating the rate of emissions leaves the level uncertain.
Efficiently encourages least-cost emissions reductions?	Yes.	Yes.	No, but tradable standards are more efficient than non-tradable standards.
Ability to raise revenue?	Yes. Results in maximum revenue generation compared to other options (assuming cap-and-trade alternative includes substantial free allocation of allowances).	Traditionally—with a largely free allocation—no. Growing interest in a substantial allowance auction suggests opportunity to raise at least some revenue now and possibly transition to a complete auction that generates maximum revenue in the future.	No.
Incentives for R&D in clean technologies?	Yes. Stable CO_2 price is needed to induce innovation.	Yes. However, uncertainty over permit prices could weaken innovation incentives.	Yes and no. Standards encourage specific technologies, but not broad innovation.
Harm to competitiveness?	Yes, though if other taxes are reduced through revenue recycling, competitiveness of the broader economy can be improved.	Yes (as with a tax), but giving firms free allowances offsets potentially harmful effects on profitability.	Somewhat. Regulations increase the cost of manufacturing but, unlike taxes or tradable permits, do not raise the price of fossil energy.
Practical or political obstacles to implementation?	Yes. New taxes have been very unpopular.	Yes. Identifying a reasonable allocation and target is difficult.	Yes. Setting the level of the standard is difficult.
New institutional requirements?	Minimal.	Yes, but experience with existing trading programs suggests that markets (for trading permits and exchanging information across firms and time periods) arise quickly and relatively inexpensively.	Minimal (unless tradable).

ISSUE BRIEF 6

ALLOWANCE ALLOCATION

RAYMOND J. KOPP

6

ALLOWANCE ALLOCATION

Raymond J. Kopp

SUMMARY

This issue brief provides an overview of concepts and policy decisions related to the allocation of emissions allowances or permits under a cap-and-trade program for limiting greenhouse gas (GHG) emissions. Allocation decisions distribute the wealth embodied in emissions allowances and therefore have economic impacts that can affect the net cost of the program to individual stakeholders and to society as a whole. Allocation decisions do not, however, affect the environmental performance of the program—that is, they do not change the overall level of emissions reductions achieved by the policy.

- Allowances associated with a cap-and-trade system represent an asset with potentially considerable monetary value, perhaps $100 billion or more annually. The value of these allowances or permits is not a measure of the cost associated with meeting the cap, but rather a wealth transfer from those who pay higher energy or emissions prices under the cap-and-trade program to those who hold allowances.

- While the U.S. Acid Rain program allocated sulfur dioxide (SO_2) allowances gratis (for free) to regulated entities (in that case, electric utilities), cap-and-trade systems need not adopt this approach. Permits can be allocated gratis to entities other than those that are directly regulated under the program (including, for example, households or state government). Moreover, allowances need not be allocated gratis: they can be sold by the government, which can retain resulting revenues for other purposes.

- Allocation decisions can affect both the efficiency (overall cost of meeting the cap) and the equity (distribution of the cost) of a cap-and-trade program. Generally, auctioning allowances and using the revenues to lower taxes, or offset particularly distorting taxes, increases efficiency and lowers the overall cost of the program to society. Awarding free allowances to certain stakeholders can address distributional concerns, but can sacrifice some efficiency.

- Allocation can alter economic incentives and the behavior of firms. For example, an output-based, updating approach could award free allowances to firms on the basis of output. For example, free allowances could be distributed to firms within the electric-power sector on the basis of their share of total sector-wide electricity output. Because this approach rewards firms for producing a larger share of output, free allowances will act as an output subsidy, effectively incentivizing firms to produce more. This outcome may or may not be desirable depending on the sector and the policy goals being pursued.

- Allocation to new entrants and retiring sources can be dealt with in a number of ways. However, care must be taken to ensure that the allocation methods used do not alter forward incentives for investment and retirement in ways that may

not be immediately obvious but that lead to suboptimal technology choices (either in terms of encouraging new investments in carbon-intensive technologies or delaying the retirement of uneconomic facilities).

- Arguments for free allocation are typically rooted in equity concerns: the desire to compensate sectors or regions that will otherwise bear a disproportionate share of the cost of regulation, or to blunt immediate impacts on the competitiveness of U.S. firms. As the economy adjusts to GHG constraints over time, these arguments become less compelling while the potential for economic distortions as a result of free allocation tends to grow, making it prudent to phase out free allocation in favor of auctioning allowances.

Overview of Discussion

While many important design features must be addressed in setting up a cap-and-trade system for greenhouse gas emissions, allocation has emerged as a critical challenge in the policy debate. This is unquestionably due to the enormity of the financial assets at stake: under current proposals, tens of billions of dollars per year—perhaps $100 billion dollars or more per year—could be divided up and given away under an emissions trading program. While allocation decisions are first and foremost distributional decisions (who gets what), two key economic concerns are relevant: (1) the risk of unintended consequences from tying allocations to some change in behavior, and (2) using allocation to mitigate costs imposed on particularly vulnerable sectors, households, or regions.

Cap-and-Trade Systems Change Prices and Create Wealth and Obligations

Cap-and-trade systems simultaneously change prices and create assets and liabilities. Entities that are directly regulated under the cap—including producers and processors of fossil fuels in an upstream system—face new liabilities in the form of the obligation to surrender allowances. Matching those liabilities are the new assets created in the form of emissions allowances. These allowances can be given to entities at no charge (whether those entities are directly regulated or not) or held by the government and auctioned. Energy prices downstream of regulated entities will typically adjust to reflect the opportunity cost of surrendering associated allowances, which in turn is a function of carbon dioxide (CO_2) content. Importantly, however, the method by which allowances are allocated will have no impact on the performance of the cap-and-trade system in terms of its ability to achieve targeted emissions reductions.

The wealth embodied in allowances can be substantial. If an economywide cap-and-trade program were instituted in the United States and allowance prices were in the range of $10 per ton of CO_2-equivalent (CO_2e), the total value of allowances circulating under the program would be approximately $50 billion dollars annually. At higher prices on the order of $25/ton CO_2e (akin to expected prices on the European Union CO_2 market for 2008–2012), the value of allowances would be more than $100 billion dollars annually, or slightly less than 1 percent of U.S. GDP.

The value of all allowances is *not* a measure of the economic cost of the regulatory program. Rather, allowance value reflects a *transfer* from those paying higher energy or emissions costs as a result of the cap-and-trade program to whatever entities initially receive the allowances (note that the receiving "entity" can be U.S. taxpayers, if allowances are auctioned to raise money for the federal treasury). What, then, is the cost of the regulatory program itself? It is the sum of the cost associated with each ton that has to be reduced to meet the emissions cap. In turn, the price of allowances depends on the cost of the marginal—or last, most expensive—ton reduced. A quick numerical example may be helpful here: suppose the economy generates ten tons of emissions before we impose a cap of seven tons. The three tons that must be reduced cost $1, $5, and $10, respectively. Here the *cost* of the program is $16 ($1 + $5 + $10). The *marginal* cost of the last, most expensive ton is $10; this sets the market price of allowances in our cap-and-trade program. Finally, the total value of the seven allowances will be $70: 7 tons x $10/ton. There is generally no simple relationship between program costs and the value of the allowances, though for the CO_2 policies currently under consideration in the U.S. Congress, costs are significantly smaller than the value of the allowances.

Allowance Allocation Options

Allowance allocation can affect two important economic dimensions of a cap-and-trade program: efficiency and equity. Efficiency refers to the overall economic cost of meeting the emissions cap, while equity refers the distribution of that cost across all sectors and households in the economy. Generally, pursuing equity objectives means sacrificing some efficiency. Several approaches can be used to determine the initial allocation of allowances under an emissions trading program.

Allowances can be given for free to entities that are especially affected by the policy—whether those entities are directly regulated (that is, required to surrender allowances) or not. The entities most burdened by the trading program will be those that are least able to pass associated costs—either the direct cost of surrendering allowances or the higher cost of energy under a system that regulates emissions upstream—through to their customers. These issues of cost "pass-through" are discussed further in Issue Briefs #7 and #8, which examine concerns about competitiveness, and in Issue Brief #11, which addresses cost and allocation issues specific to the electricity sector.

Allowances can be distributed to individual entities on the basis of past or current behavior. Alternatively, allowances may be simply auctioned and the revenue retained (and ultimately re-distributed) by the government. Any combination of the above methods can be employed.

In the case of the national SO_2 trading program established under the acid rain provisions of the Clean Air Act, the vast majority of allowances were given for free to those entities with emissions that were regulated under the cap. This same model was used in the eastern states' nitrogen oxides (NOx) trading program and in the first phase of the European Union Emissions Trading Scheme (EU ETS). Nonetheless, there is no economic reason why the question of how allowances should be allocated cannot be separated from the question of how compliance obligations should be assigned—that is, there is no reason why allowances cannot or should not be provided to entities other than those directly regulated under an emissions trading program. In fact, where most of the costs of compliance are passed through to entities that are *not* directly regulated (typically in the form of higher energy prices), equity considerations may argue for an allocation focused on compensating downstream energy users.

In that case, recipients of free allowances would sell those allowances to entities that do face a direct compliance obligation. An emissions allowance can be thought of as just another input—like capital or labor—that the regulated entity needs to produce its intended product. Regardless of how allocation occurs, the allowances must eventually find their way into the hands of the regulated entities.

In the simplest case, the government may give allowances free of charge (gratis) to regulated or unregulated entities, or sell allowances to the regulated entities. To date, most existing trading programs—including the U.S. SO_2 and NOx programs as well as the EU ETS—have allocated most allowances for free to regulated entities. This gratis allocation transferred the wealth represented by the permits from the government to regulated entities, thereby affecting the equity of the program. Yet economists regularly point out that selling allowances and using the revenue to cut other taxes (or avoid tax increases) can substantially lower overall program costs. Thus, in the case of the U.S. SO_2 and NOx programs as well as the EU ETS, concerns about compensating regulated industry appear to have trumped efficiency considerations.

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Interestingly, the allowance allocation plans that have been announced for Phase 2 of the EU ETS, as well as the allocation approaches that have been proposed for the northeastern states' Regional Greenhouse Gas Initiative and in several draft bills introduced in the 110th Congress, rely on a mix of gratis allocation to different entities and allowance sales (auctions). Perhaps even more interesting, some Congressional proposals feature gratis allocations to entities such as states and energy-intensive commercial enterprises that are not directly regulated under the proposed policy. This change in thinking with regard to allocation policy might be taken to reflect a greater preference for efficiency. But since these proposals generally do not propose to use allowance-auction revenues to reduce taxes or displace existing distortionary taxes, their break with past allocation precedents is more likely to reflect different equity priorities.

As soon as allowances are seen as representing wealth—perhaps a considerable amount of wealth—it becomes obvious that how this wealth is distributed via the allowance allocation method will alter the relative well-being of individual firms and stakeholder groups in the economy. Allocation can also, however, alter the behavior of the aggregate economy and the pattern of GHG emissions going forward *if* the allocation is dependent on current or future behavior (in contrast to an allocation based entirely on historic behavior). This is because an allocation based on future actions or behavior inevitably creates incentives for those actions or behaviors. Since those actions or behaviors in turn can affect the efficiency of the cap-and-trade program, it is imperative that the incentive properties of any updating allocation method be well thought through as later discussion of an example from the EU ETS illustrates.

Using Gratis Allocation to Mitigate the Costs of the Emissions Reduction Program to Individual Entities

As noted above, equity and other distributional objectives can be achieved through the allocation of allowances. An example is provided by draft legislation (S. 1766) introduced in the 110th Congress by Senators Bingaman and Specter. This proposal would allocate a portion of the permits for free to both regulated and unregulated entities in the energy and manufacturing sectors, as well as to states. In addition, it would steadily increase the portion of allowances auctioned relative to the portion being distributed gratis (specifically, the portion of allowances auctioned increases from 12 percent of the total allowance pool in 2012 to 26 percent by 2030). Revenues from auctioning allowances would be used to fund technology development, climate-change adaptation, and assistance to low-income households. Other legislative proposals in both the House and Senate follow the Bingaman/Specter approach and use allowance allocation for a variety of purposes besides compensating regulated industry, including to provide credits for early reductions, to promote CO_2 sequestration on agriculture lands, to provide adaptation assistance to communities and ecosystems that are particularly vulnerable to the effects of climate change, to subsidize energy costs for low-income households via a direct allocation to states, and to establish a dedicated source of funding for low-carbon technology R&D and commercialization activities.

While it is feasible to use allocation as the Bingaman/Specter bill proposes (that is, to distribute the cost burden imposed by the cap more equitably), doing so effectively requires good information about which sectors, households, and regions of the country will bear the cost of meeting the emissions cap. Unfortunately, this information is not readily available in a reliable and objective form; moreover, due to the magnitude of the wealth embodied in allowances, there are massive incentives for sectors, households, and regions to claim significant costs in an attempt to capture a larger share of the available allowance pool.

Gratis Allocation: Grandfathering Based on Emissions

Suppose a decision has been made to allocate allowances for free to a particular sector. How might allowances be allocated within that sector? As has already been noted, gratis allocation to regulated entities has been the norm in emissions trading programs to date, and the simple method applied to distribute allowances to individual firms has usually involved the concept of "grandfathering." Each regulated entity receives a share of the total allowance pool that is equal to its share of total emissions from all regulated entities in a defined baseline year (equivalently, the emissions of each regulated entity in the baseline year are multiplied by the ratio of the emissions cap to total emissions in the baseline year).

Gratis Allocation: Grandfathering Based on Output

Grandfathering is a straightforward allocation method, but it relies on past behavior, thereby granting the greatest number of allowances to the historically largest emitters. Grandfathering can also be used in an allocation method that does not reward past emissions but is instead based on past output. That is, each regulated entity within a sector receives a share of the total allowance pool that is equal to its share of total sector-wide output (rather than emissions) in a given baseline year. Thus, the entity with the highest historic output captures the largest share of allowances, not necessarily the entity with the highest emissions.

To date, grandfathering allocations has awarded free allowances only or primarily to regulated entities, but the grandfathering approach can also be applied more broadly to distribute allowances to entities that are not directly regulated. For example, allowances could be awarded to large energy consumers to offset the impacts of higher energy prices. In such cases, allowances might be allocated on the basis of historical output or labor input or some other metric related to the entity's ability to pass along higher energy costs.

Gratis Allocation: Output-Based Updating

Any grandfathering approach to allocation is based on past behavior and therefore generally does not take into account changes that occur in a sector over time. A method that does take change into account is output-based updating, which is the dynamic analog to output-based grandfathering. In the updating case, output shares are recalculated over time, and successive allocations are revised to reflect each entity's changing share of sector-wide output.

While updating sounds like an improvement over static allocation, it brings with it new issues. Because regulated entities know their future allowance allocation will be tied to output, and allowances are valuable, this approach creates incentives for firms to increase their share of output so they can increase their share of allowances. Incentives to increase output have two implications. First, as firms compete to increase output and capture a larger share of the allocation, output prices fall (with the allocation acting like a subsidy on output). Second, as prices fall, consumers have a smaller incentive to reduce their consumption of the goods and services produced by the regulated sector. While lower prices may be good thing for consumers, the fact that conservation is not fully incentivized increases the overall cost of the cap-and-trade program.

From the standpoint of economic efficiency and environmental effectiveness, however, what matters most is the effect the allocation method has on the future behavior of entities in the economy.

Gratis Allocation: Changing Incentives

There is no limit to the variety of approaches and methodologies that could be used to distribute free allowances to different entities and stakeholder groups. Many forms of allocation have been and will be proposed to achieve some economic and/or political objectives. From the standpoint of economic efficiency and environmental effectiveness, however, what matters most is the effect the allocation method has on the future behavior of entities in the economy. As should be evident from the foregoing discussion, this effect may not be immediately apparent.

Under the EU ETS, for example, a regulated entity loses its allocation if it closes a regulated facility. This seems like a reasonable rule—no emissions, no allocation. But the effect of this rule is to create forward-looking incentives to keep inefficient and perhaps highly emitting facilities operating just so the parent firm can claim allowances. This outcome would likely not be desirable in the power sector, but could be viewed as advantageous for sectors that are subject to external competitive pressures; in this case, keeping facilities from closing and moving abroad would likely be viewed as a good outcome.

Allocation to New and Retiring Sources

One of the more challenging issues that arises in designing an allocation methodology is how to handle the entry of new sources and the retirement of existing sources. Where will new sources get allowances and what happens to the allowances given to retiring sources that no longer need them? If allowances are auctioned, new entrants and retiring sources pose no special problems—new entrants buy allowances like all existing sources, while retiring sources should be holding no excess allowances.

The problem of accommodating new and retiring sources comes about when some or all allowances are allocated gratis. In this case, the government is transferring wealth to the private sector. If new entrants are not afforded the same wealth transfer as existing sources, they may be disadvantaged. Similarly, retiring sources benefit if they are able to retain their allocations after ceasing operation.

There is no single view on how to treat this issue. As noted

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previously, the EU ETS sets aside allowances for future allocation to new entrants and reclaims allowances from retiring sources. In contrast, the current U.S. SO_2 program has a very limited allowance set-aside for new entrants and allows retiring entities to retain their allowances. In some recent climate-policy proposals in the United States, allocations to new entrants are conditioned on the achievement of certain performance standards. For example, new coal-fired power plants might be required to achieve the same emissions level as integrated gasification combined-cycle plants to qualify for allowances from a reserve pool or set-aside for new entrants.

As already noted, the problem with setting allowances aside for new entrants and reclaiming allowances from retiring sources lies in the incentives this creates for future business behavior. Tying allowances for new entrants to the achievement of certain technology benchmarks can favor technology in unintended ways and on grounds other than curbing GHG emissions. Obviously, the concern about creating incentives that distort future behavior in undesirable ways diminishes in importance over time under a policy that gradually shifts to auctioning all or most allowances, as was recently proposed by a coalition of business and environmental groups known as the U.S. Climate Action Partnership.

Conclusion

Deciding how to allocate emissions allowances under a CO_2 cap-and-trade program amounts to deciding how to distribute an asset worth, in aggregate, tens (if not hundreds) of billion dollars per year. It is a hard distributional question that in some sense begs a legislative answer. Congress has typically been the authority best equipped to adjudicate questions of a fundamentally distributional nature. At the same time, analysis can inform important economic questions. First, the impact of a cap-and-trade program is not as obvious as it might seem: regulated businesses do not necessarily bear the brunt of program costs. More to the point, regulated entities need not be the only entities that receive free allocations. Second, there is growing interest in using auctions to distribute a large share of allowances (and, in some recent proposals, eventually most or nearly all allowances). This change in thinking about allocation has come about for a variety of reasons: one rationale is that using auction revenue to cut other taxes (or to avoid tax increases) can substantially reduce the cost of the climate policy. Finally, it is very important to consider how allocation rules can spur future behavior in possibly unintended ways. Unintended changes in incentives and behavior have the potential to significantly raise the cost of the climate program.