

Consignment Auctions of Free Emissions Allowances under EPA's Clean Power Plan

Dallas Burtraw and Kristen McCormack

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

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Abstract

The initial distribution of emissions allowances is usually thought to be independent of the emissions outcome, but free allocation can affect the efficiency and fairness of allowance trading. Inefficiency may result from thin allowance markets, poor price discovery, and regulatory or organizational complexities that hinder recognition of opportunity costs and innovation. Concerns about fairness may result from lack of access to allowances for some entities and lack of transparency with respect to transfers of substantial value in the program. We explore the role of consignment auctions in mitigating these concerns. These revenue-neutral auctions return revenue to the original allowance holders, whose compliance obligations can be met by reacquiring allowances through purchase. Consignment auctions have minimal administrative costs and do not necessarily involve government. Experience indicates that they can play an important role in a new market. EPA and states could consider consignment auctions in planning for the Clean Power Plan.

Key Words: climate change, Clean Air Act, Clean Power Plan, emissions markets, cap and trade, allocation, environmental markets

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Consignment Auctions of Free Emissions Allowances under EPA's Clean Power Plan

Dallas Burtraw and Kristen McCormack*

Executive Summary: Relevance for States under the Clean Power Plan

Mass-based compliance is expected to play a prominent role in state plans to comply with the requirements of the Clean Power Plan. Under this structure, a number of emissions allowances would be created, each corresponding to a unit of carbon dioxide (CO₂), and entities could sell or buy allowances until they reach the lowest-cost way of reducing pollution.

An important feature of mass-based compliance is the initial distribution of allowances. Economists often favor the use of auctions to distribute allowances, but EPA's proposed model rule for a mass-based approach suggests giving allowances away for free. Ten percent would be distributed to promote program goals and ninety percent would go to existing emitters based on their historic share of electricity generation.

Free allocation has been a feature of many previous emissions trading programs, sometimes with the rationale of providing compensation to the affected industry or achieving political buy in. The initial distribution of emissions allowances is usually thought to be independent of the emissions outcome. Depending on the context, however, free allocation can either improve or threaten the perceived fairness and efficiency of allowance markets. Allowances constitute an enormous source of wealth, so their initial distribution affects who bears the burden of the program. Transparency of the allocation and the process by which the allocation is determined is critical to perceived fairness. Some firms may worry about the availability of allowances, especially in small markets. On the other hand, firms that receive a large allocation relative to their compliance needs may not engage in the market for years, resulting in a thin trading market. Consequently, there may not be a clearly identified market value of emissions allowances, especially in newly created markets. An unclear market price may make firms reluctant to trade, especially if they face regulatory scrutiny for the recovery of their costs. Poor price discovery or thin markets prevent firms from recognizing the opportunity

* Burtraw is the Darius Gaskins Senior Fellow and Kristen McCormack is a research assistant at Resources for the Future. We appreciate comments from Nicholas Bianco, Tomas Carbonell, Franz Litz and Karen Palmer. All errors and content are the responsibility of the authors. This research was partially supported by the Energy Foundation and the National Renewable Energy Laboratory.

costs of using emissions allowances. This could raise the cost of the program and potentially undermine its long term success.

In this paper we explain that consignment auctions offer a simple, virtually zero-cost, market-based remedy that mitigates many of the issues that may surface with free allocation. Consignment auctions are revenue-neutral. Recipients of free allowances are required to sell all or some of those allowances, receiving revenue in return, and to repurchase what they need for compliance. This approach ensures that all allowances enter the market. In doing so, it improves the transparency of the program, the functioning of the market, and the ability of firms to recognize and act upon the least expensive opportunities for compliance.

Experience demonstrates the ability of consignment auctions to stabilize new markets. For example, in the early years of the well-known sulfur dioxide (SO₂) trading program, prices of the few trades that occurred varied widely, reflecting uncertainty about the cost of compliance and causing other firms to be reluctant to enter the market. However, the program required an annual consignment auction of a small portion of the allowances, which ultimately proved to be a key element of the program's success. Firms surrendered allowances to the market and received the revenue from their sale, thereby achieving the compensation objective of free allocation. The auction immediately revealed a stable price that facilitated the subsequent development of an active market and a reduction in compliance costs across the industry. A consignment auction also is currently in place for all of the allowances directed to investor owned electric utilities in California's CO₂ emissions trading program.

Firms should not be disadvantaged under a consignment auction; indeed, they can expect benefits. The identification of a clear market price will reduce uncertainty associated with compliance planning and will help in recovering costs for utilities operating in states with regulatory oversight of generation activities. In fact, the auction price may be easier to observe than the price in a secondary market. The consignment auction also can provide for guaranteed repurchase of allowances that are necessary for compliance, which removes any risk for small firms that do not have other compliance options.

A consignment auction is simple to run, and the government does not need to be involved. In fact, the first decade of auctions under the SO₂ trading program were run at zero cost by the Chicago Board of Trade, and two other firms also offered to run the program for free. In California the consignment auction is run independently by the Western Climate Initiative, Inc. Revenue neutrality and independence from government may be important in avoiding the need for legislation, which might be required for a revenue-raising auction.

Economists favor auctions for a number of reasons, including the ability to raise revenue. A consignment auction does not raise revenue, but it captures many of the other advantages that are associated with using auctions to initially distribute emissions allowances. Even a small consignment auction inoculates a trading program against many procedural, fairness and efficiency issues that could be associated with free allocation. There are long-term benefits to reducing even short-term inefficiencies, such as improved long-term capital decisions, lower allowance prices and improved market competition, which make future programs and policies more politically feasible. We suggest the states that use mass-based compliance consider a role for consignment auctions for all or some of allowances that are distributed for free and EPA consider providing guidance by including this feature in its model rule.

Introduction

The Clean Power Plan requires that states develop plans to reduce carbon dioxide (CO₂) emissions from electricity generation, and it provides them with three “trading ready” options to facilitate interstate trading. One is an emissions rate standard (in pounds per megawatt hour) that specifies goals for existing affected coal and gas generation units. A second option translates the rate standard into a mass-based equivalent (in tons), creating an emissions budget for the state’s affected sources. EPA can require only that states regulate existing affected (“covered”) sources under the Clean Power Plan. If states choose not to cover new sources, this approach is likely to create an incentive to shift generation to new sources. A third option is for states to cover new sources. If they do so, they are awarded additional emissions in their state budgets. Under each of these approaches, states may trade with other states using a similar approach (rate or mass).

If states choose the second option, covering only existing sources, they must have measures in place to mitigate potential leakage from covered existing sources to uncovered new sources. EPA has proposed a model rule and federal implementation plan for existing emitting sources that distributes a small share of emissions allowances to new renewables and existing natural gas units to incentivize production from those sources and to reduce leakage.

However, the substantial majority, about 90 percent, of allowances under the proposed model rule would be initially distributed for free using what is commonly called “grandfathering” allocation. Under this approach, existing affected coal and gas units would receive a number free allowances based on their share of the total electricity generation in the year 2012. Because this approach is based on historic output it does not provide an incentive to increase production and offers no protection against leakage. EPA’s suggestion to grandfather a

substantial share of allowances is ostensibly a placeholder for state allocation decisions but the suggestion may be a sticky one and has been treated as a default in many conversations.

There is nothing new in EPA's proposal to allocate most allowances according to historic shares of electricity generation; this approach has been used for at least part of the allocation in most previous emissions trading programs. Further, the initial distribution of emissions allowances is usually thought to be independent of the emissions outcome. However, free allocation can raise concerns about the efficiency and fairness of the allowance trading program. We describe the potential disadvantages of free allocation, which involve aspects of market efficiency, economic efficiency, cognitive behavior, organizational behavior, compliance choices, fairness and transparency. Inefficiencies, reduced innovation, or perceived unfairness may affect confidence in the market and ultimately may influence the success of the program.

To mitigate some of these concerns, we propose EPA and the states consider the use of a nearly zero-cost remedy: a requirement that recipients of free allowances consign at least some of their initial allocation for auction into the market with revenues returning pro rata to their original owners. In the same market, these entities repurchase the allowances they require for compliance. Hence, in a consignment auction, the initial holders of emissions allowances capture all the value of allowances originally allocated to them for free, and they have the opportunity to acquire allowances they require for compliance.

Because entities make and lose no money from allowances they sell and repurchase in consignment auctions, the importance of this element of market design may be unintuitive. The merits of consignment auctions stem from the fact that market imperfections and cognitive and organizational complexities may hinder the development of a fair and efficient market. Consignment auctions ensure that all of the allowances enter the market instead of solely being used directly for compliance. They also bring all firms into the market in its early stages instead of allowing them to bank allowances, potentially not engaging in a market transaction for years. In doing so, they catalyze early and salient price discovery and market liquidity (Burtraw et al. 2011). The ease and transparency of the price discovery process enables cap-and-trade programs with free allocation to capture some of the benefits of an auction-based mechanism of allowance distribution.

Consignment auctions produce a market summary of all the information that is available privately. In doing so, the consignment auctions boost confidence in the functioning of the market, which will help firms trust the market process as a way of minimizing their costs of compliance. They also alleviate concerns that regulatory scrutiny may punish transactions that

turn out to be ex post uneconomic. These features help boost the perceived fairness of cap and trade overall, as well as the process that is used to achieve regulatory outcomes. Further, consignment auctions provide a clear signal of the opportunity cost of emissions allowances that may increase the salience of the allowance price within the firm, frame trading in a way that reduces managerial and behavioral barriers to an efficient distribution of allowances, and help promote innovation.

These auctions may be particularly important in new programs and programs with a small number of allowances and trading partners. Under the Clean Power Plan some states may not be engaged in large multi-state markets, and states required to adopt a federal implementation plan may not be initially connected to other markets. If a federal plan is based on the mass-based standard and involves some element of free allocation, a built-in consignment auction could protect these states from adverse outcomes.

Consignment auctions are not a new policy. In the sulfur dioxide (SO₂) trading program, in which allowances were freely allocated under Title IV of the Clean Air Act, revenue-neutral consignment auctions are given credit for important early attributes of the program's success. California's existing CO₂ cap-and-trade program also includes a "monetization requirement" that involves using consignment auctions for a majority of allowances distributed to the electricity sector (17 CCR § 95892). A consignment auction eliminates any ambiguity about whether the auction could be construed as a tax (Peskie 2016). Typically a consignment auction is implemented independently of the government and the government does not handle the revenue.¹

Some of the benefits of consignment auctions would be concentrated at the beginning of the program, while others would accrue over a longer time frame. Importantly, there are long-term benefits to reducing even short-term inefficiencies that include improved long-term capital decisions, lower allowance prices, and enhanced market competition, which make future programs and policies politically more feasible (Hausker 1992). To provide a safeguard against those outcomes and to ensure the success of the Clean Power Plan, EPA could encourage a role for consignment auctions in programs involving free allocation and could incorporate consignment auctions as a feature of the model rule and federal plan. States could also consider this feature as an element of their compliance plans. This would apply equally well to states that cover only existing sources and to those that also cover new sources.

¹ Approximately sixteen states require that new taxes be approved by a supermajority of the legislature (Peskie 2016).

In the next section we describe how consignment auctions operate and how they have worked in the past. Next, we describe the value of increased transparency and reduced uncertainty in the identification of a market price. We also discuss how this affects the efficiency and perceived fairness of the market. We then review obstacles to efficient decision making at the regulatory, organizational and individual level and describe how the attributes of a consignment auction for emissions allowances helps overcome these barriers. We conclude with key takeaways for EPA and states.

Using Consignment Auctions to Facilitate a New Emissions Market

A consignment auction is a small addition to the design of an emissions market. The entity (firm or other party) that receives free allowances submits them to an organization that runs an auction. Based on the auction, a price per allowance is determined. The entity that was the original holder of the allowances is fully reimbursed because it receives funds from the auction equal to the allowances that were submitted multiplied by the auction price. The entity could choose to buy allowances in that auction as well, and would pay a net cost of zero on allowances that it submitted and repurchased. This simple mechanism offers numerous benefits when emissions allowances are distributed for free.

Two central components of an efficient allowance market are early discovery of an allowance price close to the long-term equilibrium and early, as well as sustained, market liquidity. These components are essential to ensuring efficient long-term investment planning and the use of allowances for their highest-valued purpose in the market (Hahn and Noll 1982).

In a system involving free allocation of emissions allowances, a portion of those freely allocated allowances may be used directly for compliance and therefore may never enter the market. If this occurs on a large scale, the lack of visible and plentiful transactions can be expected to hamper the discovery of the market price of an emissions allowance that reflects the marginal cost of abatement (Stavins 1995, Hahn and Stavins 2010). Firms that do wish to engage in the market are presented with the burden of identifying the opportunity cost of investments and emissions reduction activities and finding market opportunities in an area that is not their core business. Successive bilateral trades in a thin (illiquid) market may lead to wide variance in prices that reinforces a firm's reluctance to engage in transactions. These factors may reinforce the infrequency of trades and result in lower market participation of trading partners (Hahn and Noll 1982). Fewer trading partners may be detrimental to the development of a liquid market in which money can be easily converted to allowances and allowances to money (Holt et al. 2007).

The illiquidity of the market may be exacerbated due to banking, because with banking some firms may retain their freely allocated allowances and not engage in the market for years. This outcome was observed in the SO₂ trading program, where free initial distribution of allowances was coupled with increasing stringency for compliance over time, with the intent to encourage early emissions reductions and banking of allowances. The incentive to bank early emissions allowances was supplemented by an allocation of bonus allowances to firms for preferred compliance choices. The result was that some firms could go it alone and not engage in the trading of allowances, an approach that has been described as autarchy, meaning that many firms were able to plan for compliance without relying on the market (Burtraw 1996). The thin market posed a concern for other firms that needed to purchase allowances or to guarantee access to allowances in order to acquire project financing (Hausker 1992). The secondary market soon became liquid following the administration of the first two consignment auctions and within three to four years trading became accepted and widespread (Kruger and Dean 1997). Nonetheless, the thin market early in the program appears to have increased the overall cost of the program because the marginal cost of abatement differed among firms during the first few years of compliance (Carlson et al. 2000, Ellerman et al. 2000).

A primary reason the auction was included in the legislation was to address the concern of independent power producers that new entrants into electricity generation would not have access to allowances if the incumbent generators “hoarded” allowances or if, for some other reason, the secondary market was not liquid (Hausker 1992). Ultimately, observers noted that the consignment auction performed two other valuable and unanticipated functions. First, it primed the pump for trading, so to speak, by forcing a redistribution of some allowances. Second, as a consequence of the pump priming, the auction contributed to price discovery at a time when expectations about compliance costs were varied across the industry (Hausker 1992, Ellerman et al. 2000). Hence, the consignment auctions played an important role in the transition from autarchy to a liquid market with stable prices in the SO₂ program.

A majority of allowances in the SO₂ program were allocated for free to incumbent generators under Title IV, but the program required that 2.8 percent of the allowances issued every year be allocated through a revenue-neutral consignment auction. Private allowance holders also could consign allowances for sale in the auction. The proceeds from the auction were returned to industry or other sellers in proportion to their original ownership. The administrative costs of the SO₂ auction are trivial. For several years the auction was run independent of the government and at no cost by the Chicago Board of Trade, although two other

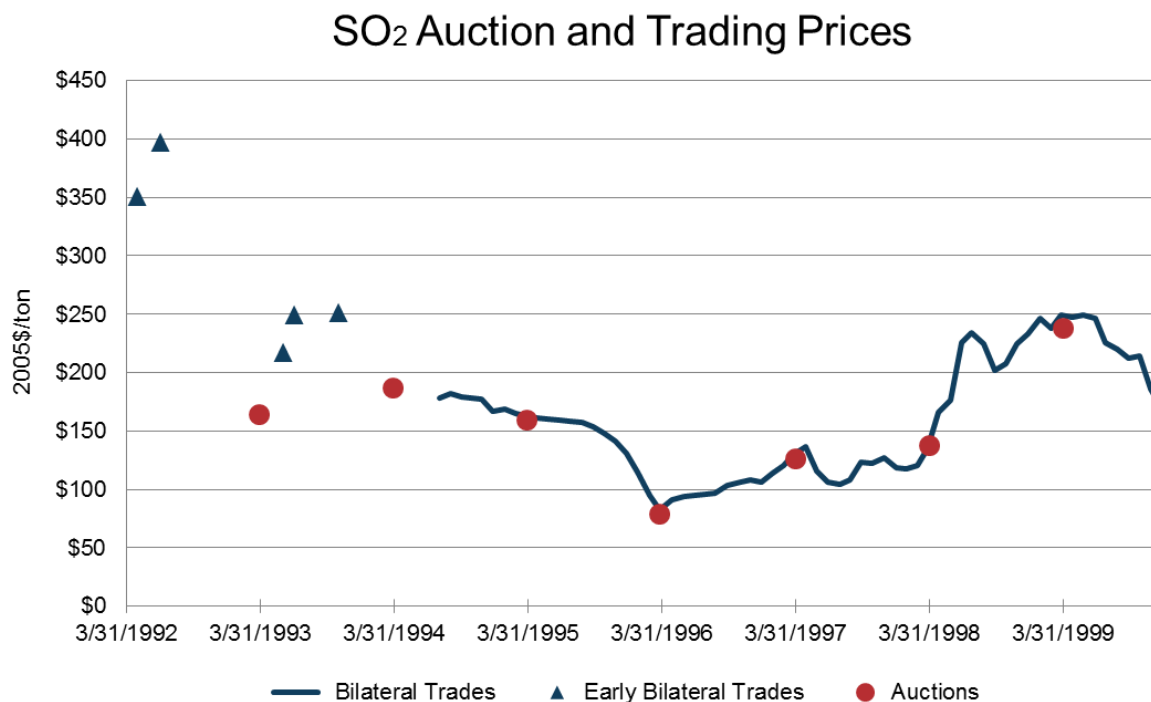
firms also offered to run the auction at no cost. EPA took over the operation of the auction in 2006, which EPA staff informally estimate involved one month full-time equivalent of staff time.

The annual auctions beginning in March 1993 show that the bid schedule of participants was quite steep in 1993, indicating a wide variation in opinions about compliance costs. Figure 1 illustrates that by 1994, that schedule had flattened out considerably, and by 1995 and beyond, the schedule was almost flat, suggesting widespread consensus on the price at which allowances were likely to be sold. The first auction in 1993 achieved a clearing price of \$131 per ton, substantially below previous estimates of compliance costs and the prices of bilateral trades that had been reported in the trade press. In 1994, the spot-market clearing price of \$150 was still 10 percent lower than the prevailing cost of bilateral transactions. Both of these results contributed to a short-term criticism that the auction was not properly reflecting the value of emissions allowances. However, by August 1994, the prices reported by the three brokerage firms for allowances traded in the spot market were almost identical to the level established by the 1994 auction (Holt et al. 2007). In retrospect, it appears that the auction contributed importantly to price discovery and set the context for an active secondary market (Ellerman et al. 2000).²

By 1995, the secondary market had matured considerably. The pattern of prices in virtually every year after 1995 reveals that the auction price has been nearly coincident with the spot-market prices in the surrounding months, or it has been in line with a trend in prices. This evidence suggests that the allowance auction has not disrupted price-setting behavior in the spot market and, furthermore, that the auction reflects willingness to pay in a similar manner to the spot market. Although the auction included a small portion of all allowances, it was relatively large compared with allowance trading activity in the spot market in the early years of the program because most allowances were allocated directly to the firms that need them for compliance.

² In a paper comparing free allocation with a consignment sale to a revenue-generating auction, Dormady and Healy (2015) find that a revenue-generating auction outperforms free allocation with a consignment sale. The authors do not make the comparison between free allocation with and without a consignment sale that we make here. Khezr and MacKenzie (2016) find that a consignment auction may lead to a price above that of a revenue-raising auction in the sale of multiple units, such as emissions allowances, but the revenue-raising auction equilibrium price is below the efficient price, so the welfare effects are ambiguous. In an laboratory experiment, Holt and Shobe (2016) find that consignment of only a share of the allowances may lead to a higher price than with consignment of all allowances, which they associate with the competitive equilibrium.

Figure 1. Auction and Bilateral Trading Prices from 1992 to 1999



Auction price data: “SO₂ Allowance Auctions: Annual Auctions,” <https://www.epa.gov/airmarkets/so2-allowance-auctions#tab-2> (accessed May 11, 2016). Spot market price data: Figure 7.1 (Ellerman et al. 2000).

The importance of consignment auctions in improving the market functioning of the SO₂ program was recognized in the process of designing California’s cap-and-trade program (Committee 2010, Burtraw and Szambelan 2012). In California, allowances associated with the electricity sector are directed to local distribution companies, which are the retail companies that send consumers their electricity bills. About one-third of consumers in the state are served by publicly owned utilities that may use allowances directly for compliance. About two-thirds of consumers are served by private investor owned utilities that are regulated by the Public Utilities Commission. Investor owned utilities are required to consign their allowances to auction. In addition, any other entity can voluntarily do so. Investor owned utilities own a small amount of emitting fossil resources and may purchase allowances at the auction sufficient for their compliance obligation. Most electricity sector emissions come from facilities owned by other companies that rely largely on the auction to obtain allowances. The revenue from the auction is returned in proportion to the original holders of allowances, and the utilities are directed to use that value “for the benefit of ratepayers.” The allowance value is used for various purposes including a large portion that appears as a dividend payment once every six months on customer bills. Hence, in California the auction provides a way to ensure a liquid market and to direct

allowance value to intended uses. The auction is run independently by the nonprofit Western Climate Initiative, Inc.³

In addition to facilitating a liquid market and price discovery, consignment auctions may also reduce transaction costs that can substantially hinder the development of an efficient carbon market and prevent the functioning of allowance markets (Stavins 1995, Hahn and Stavins 2010, Liu et al. 2012). Increasing the number of trading partners and the availability of information may reduce uncertainty and “search and information” costs (Stavins 1995). Consignment auctions serve both of these functions because they establish a structure for trading that formally facilitates and provides information about transactions. Consignment auctions therefore may serve a brokerage role, relieving firms of some of the burden of coordinating trades, which may also be reflected in a reduction in private brokerage fees.

Increasing Transparency and Perceived Fairness

A market for tradable emissions allowances is a special type of market because the scarcity value of the allowances is imposed by the regulator. Scarcity determines the economic value of allowances, and the initial distribution of allowances determines how that value is distributed into the economy. The perceived fairness of that outcome will influence public support for the program. Transparency in how value is created, who collects that value, and who bears the cost of the program can be expected to play prominently in the perceived or actual fairness of distributional outcomes. The virtue of an auction is that it makes the allocation transparent and avoids an administrative determination of the initial distribution of allowances (Binmore and Klemperer 2002).

An auction achieves transparency by providing a record of sellers and purchasers and a visible price, so that the flow of allowance value is apparent. Transactions are easy to monitor, interpret, and report. This enables the government to provide trading partners and the public with equal access to information, and it may help the government more easily monitor the success of the market structure and identify any problems that need addressing. For example, outcomes of an auction are taken as important evidence about the state of the market by monitors in existing trading programs.

³ California provides information on allowance consignment requirements and auction participation in its [Guidance for Allowance Consignment to Auction](#). (Accessed 26 May 2016.)

Consignment auctions also equalize potential differences in access to allowances that may exist among firms. Smaller market participants, which have less capacity to coordinate trades and may not be willing or able to engage with private brokers, may face especially high barriers to trade in the absence of these auctions. Minimum volume requirements, for example, may have limited the use of brokers by small participants in the EU Emissions Trading Program (ETS) (Convery and Redmond 2007). In addition, firms without the opportunity to conduct intrafirm trades may face higher transaction costs (Jaraitė-Kažukauskė and Kažukauskas 2015). By providing equal access to information and allowances, consignment auctions may therefore increase the perceived procedural fairness of the program. The role of consignment auctions in improving the functioning of markets and increasing perceived fairness is especially relevant in states where the new source complement is adopted in conjunction with free allocation (if new sources do not receive an allocation).

Consignment auctions may be designed in a way that explicitly protects firms that receive free allowances and are concerned about retaining some number of allowances for compliance. This may be especially important for small firms that lack expertise on the auction process and may worry about their ability to acquire their necessary allowances. A feature of auctions for US Treasury bonds could be adapted in a consignment auction to enable firms with this concern to submit infinite bids for a portion of their consigned allowances, which guarantees that some portion of their consigned allowances is returned to them. The consignment auction may also follow the procedure used in US Treasury auctions and limit single entities to a maximum percentage of the allowances for sale at a given auction. Other features of the design of auctions may be introduced to influence the outcome of the sale and to meet program objectives, such as disclosure of the beneficial interest of market participants or the introduction of a minimum reserve price to serve as a price floor.

Improving the Recognition of Opportunity Cost in Compliance Decisions

The economic efficiency of market-based regulations requires decisions made by regulators, firms, and individuals to be based on recognition of the opportunity cost of using allowances for compliance in contrast with measures to reduce emissions. However, regulatory rules, which for example govern cost recovery in the electricity sector, may impart incentives that distort market signals or alter the risk-reward payoff of buying or selling allowances. The decisionmaking behavior within firms may introduce similar distortions that are manifest in the inability to recognize fully the various opportunity costs in planning for compliance with environmental regulations. Even at the individual level, behavioral elements such as the

endowment effect, where one overestimates the value of something in one's possession, may obscure recognition of opportunity costs and inhibit market activity. Hence, even in a functioning market with transparent price information, barriers at the regulatory, firm, or individual level may inhibit efficient transactions. We suggest consignment auctions may help mitigate these barriers.

Regulatory Barriers

One type of barrier may arise from the regulatory structure of the electric power sector. Regulated electricity providers may be discouraged from completing transactions because doing so puts them at greater risk for regulatory challenges (Hausker 1992). Regulatory reviews for recovery of costs often penalize utilities for uneconomic transactions but rarely reward them for economic ones. Ex post movements of prices in commodity markets are sometimes the basis for such reviews, thereby imposing asymmetric incentives for firms. State public utility commissions often prevent investors from profiting from allowance sales, so utilities have little incentive to risk regulatory scrutiny if the sale of allowances turns out to be uneconomic ex post (Bohi and Burtraw 1992). Therefore, utilities may engage in fewer transactions than would be efficient. If regulatory authorities are required to approve compliance plans before trades are conducted, delays may also prevent efficient transactions from occurring.

Consignment auctions may sidestep the disincentive for regulated firms to engage in economic transactions and any potential regulatory-imposed delays in transactions by requiring utilities to sell the allowances they are freely allocated and repurchase the allowances they need for compliance. Reducing these delays may decrease transaction costs for firms (Stavins 1995). In addition, because transactions must be made, this program design may normalize trading for entities receiving free allowances and may limit the perceived risk of regulatory scrutiny regarding uneconomic transactions that ex post turn out to be uneconomic.

Barriers Stemming from Organizational Behavior

When a firm is endowed with a scarce operating license such as an emissions allowance, the value of that endowment may not be properly recognized and acted on by the firm. As noted above, regulatory rules may contribute to that outcome by discouraging firms from making efficient decisions. The decisionmaking processes within organizations, as well as individual decisionmaking processes, which we discuss in the next section, may also contribute, especially when information and resources needed to make decisions are limited. Bounded rationality, first termed by (Simon 1955, 1979), refers to the notion that individuals have a limited capacity to

make “rational” decisions due to cognitive constraints, finite time, and lack of complete and free information. In the presence of these constraints, individuals act not as optimizers but as “satisficers,” engaging in the decisionmaking process until a decision is made that meets a certain threshold of criteria. Deviation from rational behavior is not necessarily normatively inferior to a strict adherence to rational choice theory; costs of time and the delay in decisionmaking, costs of information, and cognitive and computational costs all may prevent rational theory from being an optimal, or indeed a possible, decisionmaking framework (Simon 1955, Radner 1996).

While bounded rationality is typically thought of as applying to individuals, it also occurs at the level of the firm, whose organization introduces additional limits on decisionmaking. In a firm, decisions are simplified through satisficing of individual agents, the creation of concrete achievable goals, and the division of decisionmaking among agents in a network of communication (Simon 1979). Radner (1996) highlights two ways in which bounded rationality may explain why organizations, especially large ones, deviate from the behavior predicted by rational choice theory.⁴ First, the decisionmaking of individual actors is constrained, and information within a firm is necessarily decentralized. Therefore, communication costs lead to decentralized decisionmaking in which only some information is used to inform each decision. Second, the structure of the firm and the limited information of its workers pose too complex a problem for the organizer of the firm to solve in a way that can be modeled by rational choice theory. A consignment auction may address this constraint by offering transparent information about the opportunity cost of emissions and the use of emissions allowances.

In addition to these organizational constraints, workers in an organization have objectives that differ from the objectives of the firm manager and the firm owner (Simon 1979, Radner 1996, Malloy 2001). The decision to focus on one objective over another is itself a resource-allocation decision made by the firm and by individual managers (Malloy 2001). Malloy (2001) notes that, for an abatement opportunity to be acted on, the person managing environmental decisions (the “gatekeeper”) must recognize the opportunity as worthy of attention given her personal objectives, which are likely narrowly defined as meeting compliance while minimizing costs. If it is not considered a mandatory compliance cost, the opportunity must also out-compete

⁴ Radner contrasts *costly rationality*, in which costs of information and communication prevent all relevant information from being known, with *truly bounded rationality*, in which the implications of knowledge are complex and difficult to interpret.

other investments in the firm's "internal capital market." Various case studies indicate that firms face a two-edged constraint on investments that are aimed at what might be perceived as secondary goals, such as emissions reduction in contrast to the primary goal of market share. In times when economic activity and sales are low, firms do not have unassigned revenues; in times when economic activity and sales are high, firms have to compete furiously for market share. The payoff to managers and chief executive officers is typically much more closely tied to visible short-run measures of market share than to longer-run issues associated with compliance planning (Sorrell et al. 2004). Abatement opportunities in firms receiving free allowances may suffer both because they represent a diversion of revenue away from measures that would further strategic goals and because they are not seen as necessary for compliance (Malloy 2001).

Consignment auctions may change the way allowance market decisions are made in the firm. By requiring firms to become involved in the allowance market, consignment auctions may make the decision to buy or sell allowances more salient to higher organizational levels.⁵ In the SO₂ market an evolution was observed anecdotally in the behavior of many utilities. As utilities saw the market develop around the emergence of a stable allowance price, compliance planning moved from a responsibility left strictly with environmental management to one that also involved strategic planning, and allowance usage came to be viewed as a cost similar to fuel costs. This evolution occurred over time; imperfect compliance planning and additional costs were associated with the early years of the SO₂ program before these systems were fully mature (Carlson et al. 2000, Ellerman et al. 2000). It is possible that consignment auctions serve to redefine the objectives of the firm's "gatekeeper" to include compliance planning, which would involve minimizing the number of allowances repurchased in order to maximize profits. Beyond this increase in salience, just as consignment auctions may alleviate regulatory scrutiny on the level of the firm, they may also alleviate concerns of organizational scrutiny of the decisionmaker, who may otherwise be motivated to preserve the status quo (Malloy 2001).

Studies of innovation in firms under cap-and-trade programs provide some evidence that the allowance price may be less salient in firms receiving free allowances. Dardati and Riutort

⁵ Mallow (2001) notes that moving the actual decision to a manager level may not be desirable: "Capturing the production-department manager's attention for a modest cost reduction may be difficult. To the extent that the overhead account is associated instead with higher organizational levels, such as the division, group, or corporate level, the mitigation is likely to be less and less pronounced." A distinction in the SO₂ program is that involvement of higher organizational levels enabled consideration of a broader range of potential compliance activities, such as engaging in the allowance market.

(2015) note that overall capital expenditures under the US SO₂ program were higher in firms receiving free allowances, especially in smaller firms, possibly because allowances lessened financial constraints. This study focuses on overall capital expenditures rather than environmental innovation. In a study of the EU ETS, Martin, Muûls, and Wagner (2013) find that firms receiving free allowances engaged in less environmental innovation than other firms and also anticipated that future policy would be less stringent.

Barriers from Suboptimal Framing of Decisions by Individuals

Individuals behaving in a boundedly rational way may make decisions based on rules of thumb, or “heuristics,” and other behavioral phenomena (Simon 1979). Recognizing the inadequacy of rational choice theory to capture human behavior, additional economic theories of human behavior have emerged in the last several decades. An essential component of prospect theory, one of the central theories of behavioral economics, is the idea that a value function that represents utility (well-being) under gains and losses is concave for gains and convex for losses. This asymmetry implies that individuals may have different attitudes toward potential gains and losses, and it introduces a special weight on regret and other aspects of human behavior (Kahneman and Tversky 1979, Kahneman et al. 1991).

Based on these behavioral phenomena, consignment auctions may be important not only because they make the allowance price more salient to firms but also because they frame the sale or acquisition of allowances in a different way. For example, the endowment effect, status quo bias (Hahn and Stavins 2010), and loss aversion (Kreutzer 2006), stem from the shape of the value function and all may pose barriers to transactions in firms receiving free allowances (Kahneman and Tversky 1979, Kahneman et al. 1991). In the case of cap and trade, receiving free allowances may affect how the value of those allowances is perceived. People may experience loss aversion, in which one is more averse to losing something (in this case, an allowance) than to gaining it, and status quo bias, in which, because of aversion for losses and less-than-equivalent desire for gains, there is a tendency to favor the status quo. In addition, as noted by Thaler (1980), out-of-pocket costs are perceived as losses, while opportunity costs are perceived as forgone gains, leading to an overestimate of the value of items in one’s possession. Firms receiving allowances for free may therefore exhibit this endowment effect and fail to sell as many allowances as would be efficient.

Importantly, however, the endowment effect does not apply to situations when goods are expected to be resold (Kahneman et al. 1990, Kreutzer 2006). Kreutzer (2006) suggests that the ability to convert allowances to cash through market transactions may therefore mitigate the

endowment effect. Following this logic, a consignment auction would be expected to reduce the endowment effect in two ways. First, by ensuring the liquidity of the market, it would create an assurance of the ability of firms to engage in this allowance-to-cash conversion; and second, by requiring that firms receiving free allowances immediately sell and repurchase allowances in consignment auctions, it would build an anticipation of resale into the process of receiving free allowances, even if some allowances would need to be repurchased for compliance.

Observing these behavioral phenomena empirically is challenging, but several studies provide evidence that they may be important to understanding behavior in an allowance trading market. A study by Hennlock, Löfgren, and Wollbrant (2016) examines the abatement choices made by managers and senior advisors of Swedish firms involved in environmentally hazardous activities. When asked to make abatement decisions in response to economically equivalent price or performance incentives, participants exhibited attentional and judgment biases, focusing on different factors depending on how the policy choice was presented. This study highlights the importance that the framing of a policy can have on the salience of different factors that go into making decisions.

Other studies have examined whether there is a relationship between the initial allocation of allowances in a cap-and-trade program and the equilibrium distribution. The “independence property” in standard economic theory holds that in an efficient market with well-designed property rights, emissions should be independent of the initial allocation (Hahn and Stavins 2010). Some studies support or do not reject the independence property (Reguant and Ellerman 2008, Fowlie and Perloff 2013). However, there is some evidence of violations of the independence property. A laboratory experiment conducted by Murphy and Stranlund (2005), for example, examines whether the likelihood of failing to be in compliance with a rule is independent of the initial allowance allocation. In a simulated emissions trading market, they find that net sellers of allowances tended to sell fewer allowances than would be expected in an efficient market. Net sellers also had fewer compliance violations than net buyers.

Key Takeaways

We find consignment auctions to be a simple element of good design for cap-and-trade programs that involve free allocation. This paper highlights benefits of consignment auctions that fall within three broad categories: directly improving the functioning of the market, increasing transparency and fairness, and reducing obstacles to trade introduced by regulatory barriers and organizational and individual behavior. The key reason these benefits can be achieved in consignment auctions is that they bring to the market all the information that is available

privately to market participants. Consignment auctions may be particularly important in new programs and programs with a smaller number of allowances and trading partners, a situation that could occur under the Clean Power Plan if some states are not be engaged in large multi-state markets or are required to adopt a federal implementation plan.

The role that consignment auctions may have in reducing program inefficiencies could have long-term effects. Inefficiencies, even short-term inefficiencies, may lead to suboptimal long-term investment decisions. Further, inefficient programs may provide erroneous information to policymakers about the cost of abatement and may therefore beget political opposition to program goals.

The benefits of a consignment auction come at very little cost or risk to states or firms, which receive the same value under free allocation as they do under free allocation with consignment auctions. Indeed, both firms receiving and firms not receiving free allowances may benefit from reduced transaction costs compared with bilateral market transactions (especially in the absence of a well-identified market price) and the increased salience of the allowance price that results from the requirement of consignment auctions. Because of the expected benefits of consignment auctions, we recommend that EPA consider revising the model rule and federal plan to prescribe a plan for cycling ideally all, or at minimum a portion of, freely allocated allowances through consignment auctions.

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