



Report to the Chairman, Committee on
Finance, U.S. Senate

February 2010

CLIMATE CHANGE

Observations on Options for Selling Emissions Allowances in a Cap-and-Trade Program



Accountability * Integrity * Reliability



Highlights of [GAO-10-377](#), a report to the Chairman, Senate Committee on Finance, U.S. Senate

Why GAO Did This Study

Congress is considering proposals for market-based programs to limit greenhouse gas emissions. Many proposals involve creating a cap-and-trade program, in which an overall emissions cap is set and entities covered by the program must hold tradable permits—or “allowances”—to cover their emissions. According to the Congressional Budget Office (CBO), the value of these allowances could total \$300 billion annually by 2020. The government could either sell the allowances, give them away for free, or some combination of the two.

Some existing cap-and-trade programs have experience selling allowances. For example, member states participating in the European Union’s (EU) Emissions Trading Scheme (ETS) have sold up to about 9 percent of their allowances, and the amount of auctioning is expected to increase significantly starting in 2013. In the United States, the 10 northeastern states participating in the Regional Greenhouse Gas Initiative (RGGI) have auctioned about 87 percent of their allowances.

This report is part of GAO’s response to a request to review climate change policy options. This report describes the implications of different methods for selling allowances, given available information and the experiences of selected programs. GAO reviewed relevant literature and interviewed program officials from the EU and RGGI, economists, and other researchers. This report contains no recommendations.

View [GAO-10-377](#) or [key components](#). For more information, contact John B. Stephenson at (202) 512-3841 or stephensonj@gao.gov.

CLIMATE CHANGE

Observations on Options for Selling Emissions Allowances in a Cap-and-Trade Program

What GAO Found

The method of selling emissions allowances can have significant implications for a cap-and-trade program’s outcomes, and therefore, it is important that the method be chosen based on well-defined goals. Goals often cited by program officials and economists include: maintaining simplicity and transparency, maximizing participation, promoting economic efficiency, generating a price that reflects the marginal cost of reducing emissions, avoiding market manipulation, raising revenues, and minimizing administrative costs. According to program officials, it is important to identify goals prior to choosing a sales method, as tradeoffs may exist. Some goals may also be interrelated—for example, a simple and transparent design may boost participation and reduce the risk of market manipulation.

Once goals are identified, policymakers face a number of choices regarding the design of a sales mechanism. Existing programs have used different mechanisms to sell allowances, including direct sales through exchanges and auctions. EU officials described exchange-based sales as effective and easy to implement, although they and other economists questioned whether this approach would be suitable for selling a high volume of allowances. Program officials also reported that auctions, the more commonly used sales mechanism in the EU and RGGI, effectively distributed allowances to program participants. However, some economists noted that auctions are not “one size fits all,” and should be designed to take into account market characteristics, such as the number of potential buyers.

Using auctions to sell allowances would entail a number of other design choices. For example, policymakers could decide to utilize existing auction infrastructure, such as that used in exchanges or government auctions, or develop a new platform. Choices must also be made regarding the auction format and other design elements.

- **Auction format:** The auction format determines, among other things, the price that winning bidders pay for allowances and the number of bidding rounds. To date, ETS and RGGI auctions have used a single round format in which each participant that bids above a certain price receives allowances at that price. Program officials expressed general satisfaction with this format, and economists noted that its relative simplicity may encourage participation. However, some economists also recommended that policymakers consider other formats as well, such as multiple-round auctions, given that experience with large-scale allowance auctions has been limited to date.
- **Other auction design elements:** Apart from the auction format, other elements may affect outcomes, including: participation requirements, the frequency and timing of auctions, measures that establish lower or upper limits on allowance prices, and rules governing auction monitoring and the reporting of results.

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Abbreviations

CBO	Congressional Budget Office
CRS	Congressional Research Service
ETS	Emissions Trading Scheme
EU	European Union
GDP	Gross Domestic Product
NAP	National Allocation Plans
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing Power Parities
RGGI	Regional Greenhouse Gas Initiative

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United States Government Accountability Office
Washington, DC 20548

February 24, 2010

The Honorable Max Baucus
Chairman
Committee on Finance
United States Senate

Dear Mr. Chairman:

Concerns about the effects of climate change have led the Congress to consider legislation that would limit emissions of greenhouse gases nationwide. Elevated concentrations of greenhouse gases in the atmosphere as a result of human activities could increase global temperatures and affect ecosystems, agricultural production, infrastructure, and human health. Among greenhouse gases produced by human activity, carbon dioxide is emitted in by far the largest volume, mostly as a result of the combustion of fossil fuels for electricity, transportation, and industrial processes.¹ Many of the legislative proposals to limit greenhouse gas emissions would create a cap-and-trade program under which the government would place an overall cap on emissions and issue tradable permits. Entities covered by the program would have to surrender enough permits for all of their emissions at the end of specified time periods. Depending on the program, these “covered entities” may include power plants, oil refineries, and other manufacturing facilities. Each permit—known as an “allowance”—would represent a set quantity of greenhouse gas emissions, such as one metric ton.² Allowances could be purchased and sold, creating a market in which the price of emissions fluctuates with supply and demand.

As we testified in August 2009, the government has two main options for distributing allowances, the value of which could total hundreds of billions

¹The six primary greenhouse gases include carbon dioxide, methane, and nitrous oxide, as well as three types of synthetic gases: hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

²Programs that cover emissions other than carbon dioxide may quantify these emissions in terms of carbon dioxide equivalent. Carbon dioxide equivalents provide a common standard for measuring the warming efficiency of different greenhouse gases and are calculated by multiplying the emissions of the non-carbon dioxide gas by its global warming potential, a factor that measures its heat-trapping ability relative to that of carbon dioxide.

of dollars annually by 2020.³ One option is to give allowances away for free, which would transfer their value to recipients and may compensate covered entities for costs incurred as a result of the program. Another option is to sell allowances, which would generate revenue that could be distributed in a number of ways—for example, tax cuts that improve economic efficiency or lump sum rebates to consumers. Selling allowances could also discourage efforts to gain free allowances through lobbying or other activities and help ensure that the price of emissions is the same for both new entrants and existing entities.⁴ As a result, many experts we interviewed for a previous report suggested that a cap-and-trade program should maximize the share of allowances sold.⁵ Existing cap-and-trade programs that regulate greenhouse gases have used two principal methods to sell allowances—sales on an exchange and auctions—and their experiences with these methods may offer valuable lessons as Congress considers establishing a cap-and-trade program.⁶

This report is one of four responding to your request for information on climate change policy options.⁷ Our objective was to describe the implications of different options for selling emissions allowances in a cap-and-trade program, given available information and the experiences of

³GAO, *Climate Change Policy: Preliminary Observations on Options for Distributing Emissions Allowances and Revenue under a Cap-and-Trade Program*, [GAO-09-950T](#) (Washington, D.C.: Aug. 4, 2009). See also: *Auctioning under Cap-and-Trade: Design, Participation, and Distribution of Revenues Before the Senate Comm. on Finance*, 111th Cong. (2009) (statement of Douglas Elmendorf, Director, Congressional Budget Office (CBO)). CBO notes that the actual value of allowances would depend on the design of the cap-and-trade program.

⁴For example, a firm may increase its emissions in pre-regulation years to drive up its emissions baselines and increase its allowance allocation.

⁵GAO, *International Climate Change Programs: Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism*, [GAO-09-151](#) (Washington, D.C.: Nov. 18, 2008).

⁶We do not assess nongovernmental sales as part of this report. Nongovernmental sales include the secondary market and sales or auctions by noncovered entities that receive allowances from the government entity administering the cap-and-trade program. For example, proposed legislation allocates some allowances to local distribution companies, state natural resource agencies, Indian tribes and other noncovered entities, and authorizes them to sell, auction, or retire the allowances.

⁷The three previous products are: GAO, *Climate Change Trade Measures: Considerations for U.S. Policy Makers*, [GAO-09-724R](#) (Washington, D.C.: July 8, 2009); GAO, *Climate Change Trade Measures: Estimating Industry Effects*, [GAO-09-875T](#) (Washington, D.C.: July 8, 2009); and [GAO-09-950T](#).

selected programs. To address this objective, we reviewed and analyzed academic and professional literature produced by research organizations, academic institutions, environmental groups, and industry associations, including international research. We also analyzed information on two cap-and-trade programs that have sold allowances—the European Union’s (EU) Emissions Trading Scheme (ETS) and the Regional Greenhouse Gas Initiative (RGGI), an initiative of 10 U.S. Northeast and Mid-Atlantic states. We collected information on these programs from EU member state officials, European Commission officials, RGGI program officials, academic literature, and research organizations. In addition to interviewing officials involved with RGGI auctions, we selected a nonprobability sample of five EU member states—Austria, Denmark, Germany, Ireland, and the United Kingdom—for in-depth study, based on a review of background literature and interviews with knowledgeable officials. This sample enabled us to assess allowance sales that exhibited variation in several key areas: the size of the allowance market, the share of allowances auctioned, the design of the sale, and the amount of revenue generated. While the sample allowed us to learn about many important aspects of, and variations in, the design of allowance sales, it was not intended to provide findings that would be generalizable to all allowance sales. We also met with ETS officials and other stakeholders to discuss allowance sales methods used in individual EU member states as well as preparations for future large-scale auctions.⁸ Appendix I provides a more detailed description of our scope and methodology.

We conducted our work from December 2008 to February 2010 in accordance with all sections of GAO’s Quality Assurance Framework that are relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings and conclusions in this product.

Background

Existing cap-and-trade programs that regulate greenhouse gases, such as the EU ETS, have experience in the sale of allowances. As we reported in November 2008, the ETS began the first of its trading periods, or “phases,”

⁸For information on future large-scale auctions, see:
http://ec.europa.eu/environment/climat/emission/auctioning_en.htm#3.

in 2005.⁹ In Phase I, which ran from 2005 to 2007, member states were allowed to auction up to 5 percent of their allowances, with the remainder distributed to covered entities free of charge. The auctioning limit increased to 10 percent in Phase II, which is to run from 2008 to 2012. The EU's decentralized approach gives member states the authority to design and execute their own sales. While some member states chose to sell or auction a portion of their allowances in Phases I and II, the quantity sold has been a relatively small percentage of the overall quantity of allowances distributed (see appendix III for more information).¹⁰ For Phase III, which begins in 2013, the EU decided to increase the amount of auctioning significantly, and as a result approximately half of all the allowances will be auctioned.¹¹ The EU is currently assessing various auction design options for Phase III and beyond—including holding centralized, EU-wide auctions—and plans to adopt an official auctioning regulation by June 2010.¹²

U.S. programs also offer experience in emissions allowance auctions. The federal government has auctioned allowances for the emission of sulfur dioxide under its Acid Rain Program since 1993, and the Commonwealth of Virginia auctioned allowances for nitrogen oxide emissions—a pollutant that contributes to the formation of smog—in 2004. More recently, in 2005, RGGI was created to regulate the carbon dioxide emissions of large fossil fuel-fired generators in participating states. RGGI has auctioned nearly 87 percent of emissions allowances issued under the program for 2009, and each of the six centralized auctions held since September 2008 has raised between \$38 million and \$117 million for programs to promote energy efficiency and renewable energy projects, among other uses. In addition to auctions for emissions allowances, the U.S. government has experience

⁹For more information on the EU ETS, see [GAO-09-151](#).

¹⁰At the time of this report, Germany had committed to sell 40 million allowances per year—or 8.8 percent of all the allowances it will issue in Phase II—the most of any EU ETS member state since the inception of the program. According to program officials, Germany will also sell 1 to 1.5 million allowances to cover administrative costs.

¹¹Electric power and certain industrial installations were originally covered under Phase I of the program. The scope of the ETS was expanded in 2009 to include other installations and certain flights of aircraft operators from or to EU airports. In 2012 and subsequent trading periods, 15 percent of the total allowances available for distribution to aircraft operators will be auctioned.

¹²Any auction, whether conducted by a member state or a centralized platform, must be open to covered entities throughout the EU because the ETS directive, or law, requires that all covered entities have fair, full, and equitable access to auctions in Phase III and beyond.

conducting other types of auctions, such as for government securities, surplus property, oil leases, timber harvests, and electromagnetic spectrum licenses. The Treasury Department's Bureau of Public Debt, for example, conducts more than 250 public auctions per year involving over \$5 trillion in marketable securities.

In a cap-and-trade program for greenhouse gas emissions, covered entities and other interested parties will be able to buy allowances not only from the government, but also from participants in the secondary trading market. In the ETS, for example, allowances can be purchased through over-the-counter markets or on exchanges such as the European Climate Exchange in London or BlueNext in Paris. Secondary market trading can involve a range of intermediaries—including banks and brokers—and several types of allowance transactions can occur. "Spot" sales involve the immediate payment and delivery of allowances between two parties. Market participants may also trade "forward" or "futures" contracts, both of which allow for delivery of allowances at a later date.¹³ Futures contracts may be attractive to covered entities that wish to secure an allowance price in advance and reduce uncertainty about future compliance costs. Because the value of futures contracts fluctuates based on the current market price of allowances, parties that do not have a compliance obligation under the program may also wish to purchase them as an investment.

The Method of Selling Allowances in a Cap-and-Trade Program Can Influence Program Outcomes

The literature and programs that we reviewed present many options for the design of a mechanism to sell allowances under a cap-and-trade program. We drew two major observations from the literature and the cap-and-trade programs we reviewed. First, because elements of the mechanism's design may affect outcomes—such as the price of allowances obtained at auctions and the cost of the program—it is important that design choices align with an emissions trading program's goals.¹⁴ Second, once a goal is chosen, policymakers have numerous choices regarding the sale of allowances, including whether to sell them on an exchange or use auctions. If policymakers choose auctions—as did the majority of countries participating in the ETS and the RGGI states—

¹³In forward contracts, the specific terms are negotiated between buyers, whereas futures contracts refer to standardized agreements available only through exchanges.

¹⁴The price of allowances is affected by a number of factors, including the stringency of the cap, energy prices, and weather conditions.

they must also make important design choices in the areas of format, participation requirements, frequency and timing, price controls, and rules for reporting and monitoring.

Establishing Clear Goals Is Critical

Program officials and economists suggested establishing clear goals to help guide the design and implementation of government allowance sales in a cap-and-trade program. Identifying priorities early is critical to developing an effective sales approach, as certain designs may better serve certain goals. Goals commonly cited by researchers and program officials include:

- *Simplicity and transparency.* Many economists and program officials recommended that allowance sales be simple and transparent for all participants. Sales should be guided by rules that are clear and understandable—both to participants and to the general public—to encourage participation, prevent discrimination, and ensure easy access to allowances. To that end, several economists and program officials recommended selecting an auction format that is easy to use and does not involve complicated bidding procedures. Reporting sales results in a public and timely manner can also help to create a transparent market.
- *Maximizing participation.* Ensuring sufficient levels of participation in allowance sales is critical, according to available information and program officials we interviewed. Participation fosters competition and limits opportunities for collusion. Economists and program officials also advised that sales should not discriminate against any one group of participants, whether by excluding them directly or indirectly, such as through high transaction costs. Participation can also be encouraged with a simple and transparent auction design.
- *Economic efficiency.* Economic literature suggests that efficiency is a key goal for allowance sales. In the case of allowance auctions, economic efficiency can be achieved if allowances are purchased by those who value them the most. A general measure of the efficiency of an auction, therefore, is its ability to generate bids that accurately reflect how much value a bidder places on the allowance. If efficiency is achieved, the resource—in this case, the right to emit greenhouse gases—is allocated to its highest-valued use. Efficiency may be affected by strategic bidding behavior or collusion if these activities artificially depress the price of allowances.
- *Facilitating price discovery.* Allowance sales may help facilitate price discovery—the process of determining a commodity’s price based on

supply and demand. Sales that successfully facilitate price discovery will generate an allowance price that accurately reflects the marginal cost of reducing emissions. That is, the price would reflect decisions by covered entities either to reduce their emissions or to purchase allowances to cover them, whichever is more cost-effective. Economists expect that this process of price discovery will prompt emissions reductions by those covered entities that can undertake them most cost-effectively. Without effective price discovery, the overall efficiency of the allowance market may be diminished, increasing the program's costs to the economy. According to several program officials involved in the ETS, the need for price discovery depends on the volume of allowances sold under the program. If only a small percentage is sold, and the rest freely allocated, price discovery will be accomplished in the secondary market.¹⁵

- *Avoiding market manipulation.* According to economic literature, allowance sales should limit opportunities for participants to collude or engage in other forms of market manipulation. Collusion to depress allowance prices, if successful, could distort price signals, reduce revenues collected by the government from the sale of allowances, and cause participants and observers to question the fairness and transparency of the program. In addition, if allowance ownership were to become concentrated among a small group of participants in the secondary market, these participants could then withhold allowances from the market, driving up prices and impeding efficiency. However, several program officials and economists said it would be difficult to pursue such a strategy in the presence of a liquid market, since participants would have to acquire large shares of allowances both at individual auctions and in the secondary market. In addition, literature and economists we interviewed suggest that a U.S. cap-and-trade program for carbon dioxide allowances would likely attract a large number of participants. According to them, broad participation would prevent any single participant from gaining undue influence within the market, limiting opportunities for collusion and market manipulation.
- *Revenue generation.* Available literature suggests that policymakers could also aim to maximize the level of revenues collected from the sale of allowances. For example, policymakers could design a sale so that it is more likely to achieve high allowance prices. However, while maximizing revenue is a common goal in other government auctions of public assets, high allowance prices could increase the burden of a cap-and-trade

¹⁵In the EU ETS, sellers that participate in the secondary market include banks, brokers, covered entities, and investors.

program on covered entities or consumers of their products, which could erode political support for the program. Furthermore, some program officials noted that it would be much easier to accomplish this goal by increasing the stringency of the emissions cap.

- *Minimizing administrative and transaction costs.* Several economists and program officials recommended minimizing the administrative and transaction costs associated with allowance sales. Administrative costs are the time and resources governments spend designing and implementing allowance sales; available information suggests that most of these costs are incurred in the design phase of the program. Transaction costs, on the other hand, refer to costs incurred by participants in obtaining allowances—for example, costs associated with registering for an auction, developing a bidding strategy, and any bidding fees. According to available information, high transaction costs could discourage participation, and smaller entities in particular may face disproportionately high costs relative to the value of allowances they purchase. According to economic literature, the design of an allowance sale can have a significant impact on both administrative and transaction costs. For instance, weekly auctions may result in higher administrative and transaction costs than those held less frequently, although using existing infrastructure may help to minimize these costs. While several economists noted that any costs incurred by governments and participants would likely be minor compared to the value of the allowances, program officials said that keeping these costs low would help ensure ongoing support for the program.

According to available literature and economists we interviewed, identifying the goals of the sale in advance can help policymakers evaluate the likely effects of a given sales method. This is especially important given that trade-offs may result from decisions regarding the various aspects of auction design. For example, a method that increases revenue collected from allowance sales may not be the most economically efficient approach. Some goals may also be interrelated—for example, a simple and transparent design may boost participation and reduce the risk of market manipulation.

Many Design Options Are Available to Meet Established Goals

The literature and programs that we reviewed present many options for the design of a mechanism to sell allowances in a cap-and-trade program. Each option has implications that will help determine the extent to which a program meets its goals. At a high level, policymakers face a choice about using auctions or other types of sales to distribute allowances. Auctions, if used, would entail additional design choices.

Sales or Auctions

According to available literature, selling emissions allowances through an exchange enables buyers to purchase allowances from an electronic platform as they would stocks or other commodities. While sales on an exchange are less widely used for emissions allowance distribution than auctions, two ETS member states have had experience with exchange-based sales: Germany (in ETS's Phase II) and Denmark (in ETS's Phase I).¹⁶ Germany's sales, directed by Germany's state-owned bank, took place through two major European exchanges—the European Climate Exchange and the European Energy Exchange.¹⁷ Allowances were sold daily, according to rules specified by the government. The bank used the same process as other members of the exchange wishing to trade allowances, such that buyers could not distinguish the government from other participants in the secondary market. Denmark's sales method differed from Germany's in that it paid a fee to two private firms to sell allowances on European exchanges. Rather than instructing the two firms to sell allowances daily, as Germany did, Denmark structured the fees paid to the firms such that they received an incentive to sell when they judged price conditions to be most favorable.

German and Danish officials we interviewed expressed general satisfaction with sales on exchanges and cited their potential strengths in meeting certain goals. For example, Germany's goal was to match the average secondary market price as closely as possible without disrupting the market, according to officials. Information provided by Germany's state-owned bank shows that the allowance price yielded through the exchanges did in fact mirror the market price of allowances sold during the same time period. Several officials praised the efficiency of such sales and reported general satisfaction among participants. Other potential advantages of sales over auctions include:

- *Lower administrative costs.* Germany and Denmark used existing exchanges, which made it unnecessary to design and administer auctions.
- *Ease of use.* Some member state officials we interviewed said that sales on exchanges are simpler than auctions on separate platforms because many

¹⁶In 2010, Germany began auctioning rather than selling allowances.

¹⁷The European Climate Exchange trades two types of carbon credits: EU ETS allowances and credits issued through the Clean Development Mechanism, a carbon offset program established under the Kyoto Protocol. The European Energy Exchange operates market platforms for both types of credits, as well for power, natural gas, and coal.

of the large companies affected by the ETS are already registered and active participants in the exchanges. According to German officials, this is one reason Germany continued using existing exchanges when it made the transition from sales to auctioning in 2010.

Despite these possible advantages, implementing such sales may prove challenging given the scale of a potential U.S. program. While Germany expects to sell or auction 40 million allowances annually in Phase II of the ETS—the highest volume among EU member states to date—legislation being considered by the U.S. Congress proposes initially auctioning over 1 billion allowances in 2012 alone.¹⁸ On such a large scale, auctions may be more feasible or desirable than sales, according to several economists and program officials. For example, European officials said that if large volumes of allowances are sold in this manner, it may be difficult to ensure that all participants, including smaller entities, are equally able to buy allowances at the market price. Some program officials also expressed reservations that if a high volume of allowances were sold through exchanges, the government would become the dominant seller in the secondary market and affect the price formation process. Moreover, one economist pointed out that no extensive studies had been undertaken on the performance of sales on exchanges, whereas auctions are well understood as a mechanism of distributing government assets.

Program officials reported that auctions, the more commonly used sales mechanism in the EU and RGGI, effectively distributed allowances to program participants, although several noted that allowance auctions have not yet been implemented on a large scale. According to economic literature and the economists and officials we interviewed, potential strengths of auctions include:

- *Price discovery.* As economists and officials have noted, the process of auctioning helps to establish the cost of emission reductions and maintain an allowance price that reflects that cost. Auctions enable a government to put allowances together in “batches” and sell them at predetermined times, and may help regulated entities make business decisions that incorporate the cost of compliance with emissions regulations. As one economist explained, auctions encourage covered entities to assess their marginal costs of emissions abatement, consider their allowance needs carefully, and bid accordingly. However, some economists and officials

¹⁸H.R. 2454, 111th Cong. (2009).

said that regardless of whether auctions or sales are used, price discovery will occur in the secondary market, once that market becomes established.

- *Simplicity.* Many of our interviewees cited auctions' simplicity as an advantage over sales because auctions are well-understood. RGGI officials reported that covered entities with a range of auction experience received training in the RGGI auction process and had no trouble familiarizing themselves with it.
- *Lower transaction costs.* Holding periodic auctions—weekly, monthly, or quarterly, for example—may decrease the per-transaction cost of buying and selling allowances, since buyers and sellers would not need to devote the time and resources necessary to participate in daily trading.
- *Transparency.* According to economists and officials, auctions take place under established rules and time frames, and thus convey clear information about when and how the government will sell allowances. According to European Commission officials, establishing a clear and predictable auction calendar can help inform market participants of the precise timing of volumes coming into the market, thereby avoiding unnecessary uncertainty and price volatility.¹⁹ Sales on exchanges may be less transparent, since it is difficult to monitor who is selling allowances and at what time.

Program officials noted that auctions can also be administered through exchanges. For example, Germany decided to conduct auctions using an existing European trading exchange beginning in 2010. According to a program official, this approach allows them to draw on preexisting auction infrastructure and administrative processes, as allowance bids are subject to the same rules as other exchange transactions. The European Commission's for the draft auctioning regulation governing ETS auctions in Phase III and beyond also proposes using an exchange or other trading platform to vet participants and administer auctions.

Allowance auctions could also be administered in other ways. For example, policymakers could use existing government auction mechanisms—such as those used by the U.S. Treasury to auction

¹⁹In some cases, price volatility may convey information about changes in market fundamentals. For example, the release of verified data in Phase I of the EU ETS indicated that the overall cap was likely to exceed total emissions. Prices fell in response, which established that the market was functional.

securities—to auction allowances. Alternatively, policymakers could choose to create a new auctioning platform or hire contractors to administer auction processes. For example, RGGI opted to use a proprietary auctioning platform, run by a contractor with experience in administering auctions for energy commodities.

If auctions are used, several other design determinations must be made, including: format, timing and size, participation requirements, price controls, and monitoring and reporting requirements.

Auction Format

The choice of auction format can affect how well the auction aligns with predetermined goals, such as maximizing simplicity, avoiding market manipulation, and aiding in price discovery. We focused our analysis on two classes of auctions most commonly discussed in the context of emissions allowance auctions—“uniform-price” and “discriminatory-price” auctions.

Choosing an appropriate auction format involves answering two key questions:

- *What price should winning bidders pay for allowances?*
 - In uniform-price auctions, all winning bidders pay the same price for the items purchased. In the hypothetical example illustrated in table 1, 5 companies bid for 10 allowances in a uniform-price auction. Even though they made different bids, each company that bids above a certain price receives allowances at the same price. This “clearing price” is the highest price point at which all of the 10 allowances available would be sold.²⁰ In this example, companies A, B, and C each receive allowances at the clearing price of \$3.50, although Company C receives only 2 of the 3 requested allowances because the number of bids at or above the clearing price exceeds the number of allowances available at this price. Companies D and E, which bid below the clearing price, receive no allowances.

²⁰Different ways may exist for determining the clearing price in a uniform-price auction. For example, the price may be the lowest bid price at which all available allowances received a bid, or the highest bid that is rejected.

Table 1: A Hypothetical Uniform-price Auction of 10 Allowances

Name of company	Number of allowances requested	Price per allowance requested (in dollars)
Company A	6	5.00
Company B	2	4.00
Company C	3	3.50
		-----Clearing price
Company D	4	2.75
Company E	4	2.50

Source: GAO.

Note: There were 10 allowances available. Companies A and B received the full allowance request, Company C received a partial allowance request, and Companies D and E received no allowances.

- In “discriminatory-price” auctions, winning bidders pay different prices for allowances purchased at auction. In some discriminatory-price auctions, winning bidders pay the amount of their bid. For example, in the hypothetical auction presented in table 1, Company A would get its full share of requested allowances at \$5 each, Company B would pay \$4 each, and Company C would receive part of its request at \$3.50 per allowance.
- *How many rounds of bidding should take place?*
 - In a typical single-round auction, participants place bids once during a predetermined time period. Because participants do not see other bids before the outcome is announced, no opportunity is provided to change a bid based on information about others’ bids. The single-round auction is thus sometimes referred to as a “sealed-bid” auction.²¹ Figure 1 presents a simplified version of the RGGI software interface that participants use for RGGI’s single-round auctions. As the figure shows, participants assemble a bid sheet, specifying the quantity of allowances requested at a stated bid price. Each participant may submit several bids at several different prices, if desired. According to a RGGI program official, when RGGI’s auction results are tabulated by the auction administrator’s automated system, the results appear in a format similar to that shown in table 1. Participants whose bids appear above the line receive allowances, those bidding at the clearing price

²¹While the terms “sealed-bid” and “single-round” are often used interchangeably, sealed-bid auction procedures may also be used in multiple-round formats. For example, in a sealed-bid, multiple-round auction, participants could submit a set of bids in advance of the auction and the bids would be revealed over time as the auction progresses.

receive a partial allocation, and those below the line do not receive allowances.

Figure 1: Participant's Bidding Screen, RGGI Uniform-Price, Single-Round Auction


RGGI CO₂ BUDGET TRADING PROGRAMS

[Help](#) | [My Profile](#) | [Logout](#)

Start

Markets

RFPs

[View RFP](#) | [Bid History](#) | [Awards](#)

RGGI, Inc.

Fixed-Training-CO2 Auction 1a

Place Bid

Auction Information

Auction Start Time:

11:00 a.m.

Auction End Time:

1:30 p.m.

Total Quantity:

3,000 allowances

Time Left:

0d 2h 25m 16s

Your Total Bids:

6

Reserve Price

\$1.86

Printable View

Bid Summary

Bid Value: \$408

Bid Quantity Total: 200 allowances

Bid History

Total Bids in View:6

Company Name	Bid Amount	Bid Quantity	Bid Value	Cumulative Quantity
Company E	\$5.00	5	\$25.00	5
Company E	\$3.50	10	\$35.00	15
Company E	\$2.00	15	\$30.00	30
Company E	\$1.90	20	\$38.00	50
Company E	\$1.88	50	\$94.00	100
Company E	\$1.86	100	\$186.00	200

Source: Adapted from World Energy Solutions, Inc., RGGI's auction administrator. The table in the original replicates the RGGI auction bidding screen.

- Auctions with multiple rounds of bidding occur in several formats, among them the “English” auction, in which the auction administrator raises the price of allowances round by round, and the “Dutch” auction, in which the auction administrator decreases the price round by round. Both the English and Dutch auctions are commonly referred to as

“clock auctions,” since the price is raised or lowered incrementally, like a clock’s hands. Participants in multiple-round auctions have the opportunity to change the quantity of allowances for which they bid—or drop out of the bidding—as information is revealed round by round. Importantly, economists note that to discourage participants from potentially distorting allowance prices by increasing the quantity for which they bid in later rounds—after competitors have revealed their strategies—a clock auction can include a rule against increasing the bid quantity after the first bidding round.

In designing an auction, policymakers may consider selecting a format that is sensitive to the context of the allowance market. Previous U.S. federal government experience with auctions has involved different formats in different markets. For example, in 1994 the Federal Communications Commission chose to auction spectrum licenses in a simultaneous multiple-round format. By contrast, Environmental Protection Agency auctions of allowances to emit sulfur dioxide involve a single round where successful bidders pay as they bid, and auctions of government securities held by the U.S. Department of the Treasury involve uniform pricing.

In interviews and in economic literature, officials and economists have emphasized the importance of tailoring an auction for carbon dioxide allowances to the characteristics of the market, which may be different from other markets where auctions have been used. An auction of carbon dioxide allowances would sell many identical items—permits to emit a specified quantity of carbon dioxide in a particular time period.²² Additionally, bidders in this market could include a large number of covered entities that emit carbon dioxide. These characteristics reveal both similarities and differences from some of the other markets listed above. For example, not all broadband spectrum licenses are alike, and their value to a buyer may further depend on the portfolio of licenses held. Furthermore, the number of potential buyers may be greater in the market for carbon dioxide emissions than sulfur dioxide emissions, in part because carbon dioxide is emitted in greater volume.

Existing cap-and-trade programs for carbon dioxide allowances—the EU ETS and RGGI—have employed the uniform-price, single-round format, in which winning bidders submit secret bids and pay the same price for allowances. Several program officials we spoke with expressed general

²²If greenhouse gases other than carbon dioxide are covered under the program, allowances would likely represent one unit of carbon dioxide equivalent.

satisfaction with this format, and the draft auctioning regulation governing ETS auctions in Phase III and beyond also proposes this approach. According to literature and economists we interviewed, advantages of this format include:

- *Simplicity.* For regulated entities that have participated in auctions, the simplicity and familiarity of the uniform-price, single-round format may prove valuable, according to several economists. This format has also proved easy to learn for those unfamiliar with auction processes, according to officials, as it involves relatively simple bidding procedures. One economist also reported that the uniform-price, single-round format is well-suited to automation compared to other auction formats, with much of the work handled by sophisticated but inexpensive computer programs. This economist pointed to RGGI, a small organization handling large pools of assets, as a case study in how simple the uniform-price, single-round auction can be to administer.
- *Avoidance of market manipulation.* Some economists said that other auction formats, such as clock auctions, may be more conducive to collusion than single-round auctions, because multiple bidding rounds give other bidders information and create opportunities for collusion.
- *Reduced risks for bidders.* Program officials and economists also said that the uniform-price, single-round format may alleviate concerns that could arise in discriminatory-price auctions. If a discriminatory-price auction requires participants to pay the value of their bids, for example, they run the risk of overbidding and paying more than other winning bidders for allowances. This may be of particular concern for small and inexperienced bidders, who may lack the information and resources to formulate a sophisticated bidding strategy. Uniform-price auctions reduce the possibility of making a costly bidding mistake, since all winning participants pay the same allowance price. For this reason, some economists believe that uniform-price auctions will generate greater participation than discriminatory-price auctions.

Despite the strengths of the uniform-price, single-round format, some economists suggested that policymakers undertake further study before selecting an auction format. One study suggests that laboratory experiments with auction format options may provide insights that theoretical studies cannot, given the context-specific nature of the

performance of various auction formats.²³ One economist also said that legislation need not specify a single auction format and could instead instruct government agencies responsible for the program to choose among various format options. Several RGGI states followed this path, by issuing regulations authorizing the auction administrator to use the uniform-price, single-round auction format or the ascending price, multiple-round format.²⁴ Policymakers could also leave room to revisit the auction format stipulated in cap-and-trade legislation, although introducing significant changes at later stages would require participants to relearn auctioning procedures.

Among auction format options other than the uniform-price, single-round format, the clock format may have comparative strengths in achieving certain goals, according to economists we interviewed. For example, economic literature suggests that clock auctions may lead to more reliable price discovery, since each participant may raise its bids in an attempt to win allowances, so that allowances go to those who are willing to pay the most.²⁵ However, economists who did experimental work on auction formats said that a clock auction fared no better in terms of price discovery than a uniform-price, single-round auction. Another argument for the clock format arises if multiple products are sold at an auction. For example, in addition to auctioning allowances for the current year, the government could decide to auction allowances of other future-year vintages—that is, allowances sold in advance of the compliance year(s) in which they may be remitted. A clock format would allow bidders to express preferences for different vintages, which may allow more readily for substitution of one vintage for another and prevent price irregularities.

The clock auction format may also present some disadvantages. An official involved with Ireland’s auctions said they chose a uniform-price, single-round format after determining that a clock auction would be comparatively expensive and difficult to implement. The format may also

²³Burtraw, Dallas, Jacob Goeree, Charles A. Holt, Erica Myers, Karen Palmer, and William Shobe, “Collusion in Auctions for Emissions Permits,” Resources for the Future Discussion Paper 08-36.

²⁴However, some state regulations required the uniform-price, single-round format for the first auction, but then authorized the auction administrator to choose among (1) the uniform-price, single-round format; (2) the ascending-price, multiple-round format; or (3) other formats for subsequent auctions.

²⁵Cramton, Peter and Suzi Kerr, “Tradeable Carbon Permit Auctions: How and Why to Auction not Grandfather,” *Energy Policy* (30) 2002, pp. 333-345.

complicate participation: one economist involved with Virginia's clock auctions of nitrogen oxide allowances received complaints about participants having to work at a computer terminal all day to compete in the auction. A single-round auction format, by contrast, would only require participants to submit a single bid sheet, similar to that shown in figure 1 above. The economist also pointed out that having thousands of participants monitoring a day of multiple-round auctioning in a large federal program would increase the cost of both participating in the program and administering it.

Other Auction Design Elements

Apart from format, policymakers would face a number of choices related to auction design, each of which has implications for program outcomes. Among other things, choices must be made regarding participation rules, the frequency and timing of auctions, the use of reserve prices or other price controls, and the monitoring and reporting of auction activities. We briefly describe each of these considerations below and provide additional detail in appendix II.

Participation. Maintaining high levels of auction participation can lead to greater competition which, in turn, can reduce the risk of collusion or other market manipulation. To maximize participation, economists and program officials recommended opening auctions up to as wide of a group of bidders as possible, including financial institutions and other entities that do not have compliance obligations under the program. According to them, limiting participation can increase the risk of market manipulation, making it difficult to ensure that all covered entities have access to allowances. In addition, program officials said that a well-designed vetting and registration system can reduce the risk that a participant will default on a bid.

Frequency and timing. According to economists, the frequency of auctions should be driven by the volume of allowances sold: higher volumes of allowances may require more frequent auctions. Available information suggests that holding frequent auctions, such as monthly or weekly, can help maintain market liquidity and provide flexibility to covered entities. On the other hand, some officials said frequent auctions may also complicate planning and increase administrative costs, depending on how the auctions are conducted. In terms of timing, many officials recommended auctioning future-year vintage allowances, which allow covered entities to secure allowances in advance and reduce the risks associated with fluctuating prices.

Price controls. Price controls could be implemented in a number of ways. A reserve price would set a price below which no allowances can be sold at an auction. Several program officials and economists suggested that setting a reserve price can be an effective way to guard against low auction clearing prices that may result from collusion or low participation. In addition, in some cases a reserve price may serve as a “price floor” throughout the secondary market. According to some economists and researchers, a price floor may help provide incentives for investment in low carbon technologies; however, some program officials cautioned that price floors could unduly interfere with the functioning of the allowance market. At the other end of the price spectrum, policymakers could also set upper limits on the price of allowances through price ceilings. While price ceilings could provide insurance against sustained high allowance prices, some program officials advised against the use of these measures, which they said could compromise emissions goals and impede international linkage of programs.

Monitoring and reporting. An effective system to report auction results and monitor activity can increase transparency and help oversight entities identify and correct instances of market abuse. Information on auction results can also provide information with which to evaluate and improve the program. As a result, several officials and economists recommended establishing a market monitor to track activity at auctions and in the secondary market. However, in reporting auction results, economists and officials cautioned against reporting certain information, such as bidders’ identities, which they said could inadvertently facilitate collusion.

We conducted our work from December 2008 to February 2010 in accordance with all sections of GAO’s Quality Assurance Framework that are relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings and conclusions in this product.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees and other interested parties. In addition, the report will be available at no charge on GAO’s Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Individuals making key contributions to this report are listed in appendix IV.

Sincerely yours,

A handwritten signature in black ink, reading "John B. Stephenson". The signature is fluid and cursive, with a long horizontal stroke at the end.

John B. Stephenson
Director, Natural Resources and Environment

Appendix I: Scope and Methodology

Our review assesses the implications of different options for selling allowances in cap-and-trade programs. To address this objective, we first identified cap-and-trade programs that regulate carbon dioxide emissions and have sold allowances through auctions or other means. Programs that met these criteria were the European Union's (EU) Emissions Trading Scheme (ETS) and the Regional Greenhouse Gas Initiative (RGGI). We then selected a nonprobability sample of 5 member states involved in the ETS—Austria, Denmark, Germany, Ireland, and the United Kingdom—in order to assess different methods that EU governments have used to sell allowances.¹ This sample enabled us to assess allowance sales that exhibited variation in several key areas: the size of the allowance market, the share of allowances auctioned, the design of the sale, and the amount of revenue generated. While the sample allowed us to learn about many important aspects of, and variations in, the design of allowance sales, it was not intended to provide findings that would be generalizable to all allowance sales.

To identify various options for selling allowances, we identified and reviewed over 40 works of academic and professional research produced by economists, industry associations, research organizations, academic institutions, and environmental groups, including international research. We identified these works through an internet and database search using relevant key words such as “allowance sales” and “auction design.” We also analyzed literature from government agencies, including the Congressional Budget Office (CBO) and the Congressional Research Service (CRS). Reviewing this research helped us to assess the different methods for designing an allowance sales mechanism and the potential implications of these methods. We did not independently assess the validity of data, assumptions, or methodologies underlying the economic studies we reviewed. We met with U.S. and international stakeholders including officials from RGGI and the European Commission as well as program officials in Austria, Denmark, Germany, Ireland, and the United Kingdom. We also conducted semistructured interviews with leading economists and researchers selected on the basis of their expertise in climate policy or auction design.

¹In the ETS, individual member states chose to hold national auctions in Phases I and II. Because all states participating in RGGI chose centralized auctions, we did not select a sample of RGGI states.

Appendix II: Other Elements of Auction Design

There are several key elements of auction design, in addition to format, that can affect whether an auction meets its established goals. This appendix provides more detail on the observations and recommendations of program officials, economists, and the economic literature regarding the following auction design elements: participation, frequency and timing, price controls, and reporting and monitoring.

Participation Requirements

Policymakers may shape participation in a cap-and-trade auction through various aspects of auction design. For example, auctions could be designed to restrict participation or to provide special assistance to smaller entities. Available information suggests that maintaining high rates of participation in allowance auctions can help promote liquidity and reduce the risk of collusion. We discuss three auction characteristics that help determine participation: participation limits, bid limits, and procedures for vetting and registration.

Participation limits. Available literature suggests that limiting or eliminating the ability of certain entities to participate in allowance auctions could reduce the amount of revenue generated through the auctions and hinder the efficient allocation of allowances. For example, excluding those entities that do not have a compliance obligation under the program would decrease overall auction participation, which, in turn, may increase the likelihood of collusive activities to depress allowance prices. In addition, if the auction clearing price falls below the price in secondary markets—whether due to collusion or other factors—auction participants may be able to buy allowances at auction and sell them on the secondary market for profit, thus capturing revenues that would have otherwise gone to the government. According to one study, the end result would be an implicit subsidy to the entities allowed to participate in the auction and a corresponding reduction in government revenue. Moreover, some program officials maintained that restricting certain groups from participating may present practical challenges given the interrelated nature of the marketplace—for example, while a buyer may not be a covered entity under the cap-and-trade program, it could be a parent company, supplier, or partner to a covered entity. According to researchers involved in the design of RGGI's auctions, attempting to assess and monitor these relationships could prove costly for an auction administrator.

Given these concerns, many economists and program officials favored maximizing the number of potential auction participants. Auctions held within the ETS and RGGI, for example, have allowed noncovered

entities—including banks, brokers, and other private firms—to purchase allowances at auctions. In fact, noncovered entities have purchased between 16 and 30 percent of allowances sold in RGGI auctions thus far, according to auction results data published on RGGI’s Web site. Economists and officials involved with these programs said that financial entities can play an important role in the market. For example, banks and brokers can foster liquidity and help provide regular price signals to covered entities. Smaller entities, in particular, may prefer purchasing allowances at financial institutions, as this relieves them of the need to learn the particulars of the auction process and develop an appropriate bidding strategy.

Bid limits. To prevent entities from hoarding allowances—which could allow these entities to gain a competitive advantage or raise the price of allowances, among other things—policymakers could set limits on the amount of allowances entities can purchase at auction. For example, in RGGI, associated entities can purchase no more than 25 percent of the allowances available in a given auction. However, such limits may be difficult to enforce, according to one program official, since one entity may be able to bid on behalf of another. Moreover, several economists and program officials we spoke with suggested that hoarding behavior would be highly unlikely in a future U.S. program, since an entity aiming to corner the market may have to buy the majority of allowances across several consecutive auctions, an unlikely possibility given the anticipated price and volume of allowances and the number of entities seeking them.

Vetting and registration. For an auction to be successful, participants must meet the financial commitments associated with their bids. Auctions may therefore include an application and screening process in which potential bidders demonstrate their eligibility to participate by providing information such as their credit and bankruptcy history.¹ The process could also include a declaration of “beneficial ownership,” which would require bidders to declare whether they would bid on their own account or on behalf of another entity. According to available information, identifying the beneficiaries of allowance transactions may help the entity responsible for monitoring the market spot evidence of potential market manipulation. Economists and program officials also recommended requiring participants to post some type of financial assurance, such as a bond,

¹According to some program officials, creditworthiness may be less of a concern if bidders are required to post collateral covering 100 percent of their bids.

deposit, or letter of credit demonstrating their ability to pay. Financial assurance requirements can serve as collateral in the event that participants are unwilling or unable to pay, and thus should be set at a level that ensures payment without discouraging participation. In Ireland's first auction, for instance, the nonrefundable deposit was set at about 3,000 Euro, or about \$3,778. According to program officials, this amount was later determined to be insufficient to compel payment—for example, if the prices in the secondary market fell below the clearing price after the auction, it may have been less expensive for the bidder to simply forfeit their deposit and nullify the sale. As a result, Irish officials raised the deposit amount to about 15,000 Euro, or about \$18,890, in the second auction.

While economists emphasize the importance of providing financial assurance, it is also important not to impose undue costs or paperwork requirements on participants. As a result, some economists recommended relying on established measures—such as credit scores—and simplifying the process as much as possible. An official involved with administering RGGI, for example, reported that RGGI made several improvements to its participant qualification procedures—including allowing electronic submissions and eliminating notarization requirements—after receiving feedback from participants. Program officials involved with the ETS also said that outsourcing vetting activities to an entity with experience in these activities, like an exchange, may help reduce the cost of these activities.

As existing programs have demonstrated, auction activities—including attracting and vetting potential auction participants and facilitating the bidding process—can be undertaken by either the government or a designated private entity. In RGGI, for example, a private consulting firm administers the auctions and conducts these activities. In contrast, Germany uses an existing emissions trading exchange to administer the auctions and conduct the required due diligence on potential auction participants. Another option to cut down on the government's administrative burden is to implement a “primary participant” model, an approach used in the United Kingdom to auction both government bonds and emissions allowances. In United Kingdom allowance auctions, all bidders must go through one of 11 registered primary participants—all large financial firms—to place their bids. The primary participants can

also bid on behalf of themselves.² A similar approach is used by the U.S. government to auction Treasury bills and bonds—most are purchased by banks and securities brokers (primary dealers) that trade directly with the Federal Reserve, although individuals and other entities can also participate in the auction. According to a program official involved with United Kingdom auctions, a major advantage of this model is that primary participants are responsible for developing and implementing vetting procedures and assume the financial risks associated with default. In addition, the banks that serve as primary participants already have experience performing background checks.

However, a primary participant model may also have some drawbacks, according to program officials. For example, United Kingdom primary participants were initially not compensated for their services, which may have dampened participation in the first auction and resulted in a lower clearing price. Primary participants are now compensated for each indirect bid they facilitate by paying a discounted clearing price.³ According to one official involved in United Kingdom auctions, this has improved auction participation and generated higher clearing prices. However, the official also acknowledged that some large bidders—such as electricity generators—oppose the primary participant model because it forces them to disclose their bidding strategy to another entity; they would rather participate in the auctions directly. As a result, the outline for the draft auctioning regulation for Phase III and beyond proposes allowing bidders to access auctions directly.

Provisions for smaller entities. Another option for encouraging participation is to enact special provisions for smaller entities, which may be discouraged from participating in auctions due to a lack of information or experience. For example, Austria and the United Kingdom have implemented “non-competitive” auctions, which allow some entities to bid for a limited amount of allowances prior to the actual (competitive) auction. By eliminating the need to compete with larger, better-informed entities, non-competitive auctions aim to provide assurance that smaller

²Under United Kingdom Treasury rules, primary participants must prevent the disclosure of confidential information they receive from indirect bidders to their employees responsible for preparing or submitting bids on the primary participant’s behalf.

³The United Kingdom allows primary participants to pay a discounted clearing price—5 Euro cents less per allowance—while charging its indirect bidders the actual clearing prices.

entities will be able to obtain needed allowances without running the risk of overbidding. However, thus far participation in non-competitive auctions has been low—of the 100,000 allowances set aside for Austria’s first non-competitive auction, only about 5,000 were actually sold. Further, in the European Commission’s 2009 consultation on the auction regulation, respondents showed little interest in incorporating non-competitive auctions or other special provisions for smaller entities. While a Commission official we spoke with acknowledged that few small entities contributed to the consultation, this official and others reported that smaller entities have generally preferred to purchase their allowances from banks and brokers rather than at auction.

Frequency and Timing

If auctions are used to sell allowances, policymakers must consider issues related to timing, including how frequently to hold auctions and whether to auction future years’ allowances in advance. According to available literature and economists we interviewed, the timing of auctions can have implications for market dynamics, prices, administrative costs, and participation. A variety of timing approaches are used in existing programs—for example, RGGI holds quarterly auctions, whereas Germany began holding two auctions twice weekly in 2010.

Program officials and economists we interviewed said that determining the appropriate auction frequency depends largely on the number of allowances auctioned during each year. Several noted that higher volumes of allowances may require more frequent auctions, so as to ensure a manageable and constant flow of allowances into the market. Because of uncertainty about the size of a future U.S. program, one program official was hesitant to recommend a specific frequency.

Nevertheless, available literature and our interviews point to several arguments in favor of holding auctions relatively frequently, such as weekly. First, economic literature indicates that frequent auctions can help maintain market liquidity and price stability. Because allowances would be sold in smaller batches, frequent auctions help encourage a constant flow of allowances into the market, reducing the impact of individual auctions on market prices. For this reason, the outline for the draft regulation governing Phase III of the ETS and beyond—when the level of auctioning is expected to increase significantly—proposes holding auctions at least weekly. Second, frequent auctions may help covered entities to meet their compliance obligations in a timely and flexible manner, rather than running the risk of submitting a losing bid and having to wait several months until the next auction. Third, frequent

auctions may alleviate the need for a covered entity to set aside large amounts of capital to compete for bigger, less frequently available blocks of allowances, which may be especially difficult for smaller entities. Frequent auctions also may facilitate efficient and flexible transactions through financial or other intermediaries, which can benefit both small and large covered entities. Finally, smaller, more frequent auctions may help mitigate the risk that participants could purchase a substantial fraction of allowances in an attempt to manipulate allowance prices.

However, holding frequent auctions may present trade-offs, according to available literature. Administrative and transaction costs could rise if auctions are held more frequently, and higher costs could reduce participation. In addition, officials involved in administering RGGI's quarterly auctions said it would be difficult to conduct necessary pre- and post-auction activities—including finalizing sales, returning auction collateral to bidders, and compiling reports—if auctions took place more frequently. Another potential disadvantage of frequently held auctions is the risk that participation will be low at some auctions.

Policymakers may choose to sell future-year vintage allowances in advance of the compliance year(s) in which they may be remitted. For example, in addition to offering allowances for the current 3-year compliance period, RGGI auctions also offer participants the ability to purchase allowances for the second compliance period, which is to start in 2012. In the ETS, allowances for Phase III of the program, which begins in 2013, may be auctioned as early as 2011 or 2012, according to the draft outline for the auctioning regulation.

Available literature and economists and officials we interviewed identified several potential benefits associated with auctioning allowances prior to the compliance period in which they may be remitted. Most importantly, it enables covered entities to hedge against the uncertainty of future allowance prices by purchasing them in advance. Auctions of future-year allowances may be particularly beneficial to electricity generators, which often establish contracts for fuel and electricity one to three years ahead of delivery. Entities could also potentially hedge price risk by establishing futures contracts with financial intermediaries; however, these intermediaries may charge risk premiums that may be passed on to customers.

Available information suggests that holding auctions even before the cap-and-trade program's first compliance period may help to jump-start the process of price discovery and improve liquidity. For example, RGGI held

its first auction in September 2008, approximately 3 months before the first compliance period began. A RGGI official said that this early auction provided price information that proved beneficial to financial institutions and covered entities alike.

However, holding advance auctions may also present risks. According to one program official, if actual emissions under the program are lower than expected, auctioning a greater number of allowances early on may depress prices in the short term.

Price Controls

In designing a cap-and-trade program, policymakers may decide to set limits around the price of emissions allowances sold at auctions or in the secondary market. For example, setting a reserve price would establish a minimum price below which no allowances could be sold at auction. The use of reserve prices is relatively common in greenhouse gas auctions—for example, RGGI and the EU member states we reviewed all used reserve prices.⁴ Policymakers could also decide to limit the extent to which allowance prices could rise and fall in the secondary market through price “floors” or “ceilings”.

Reserve prices and price floors. According to economic literature and program officials, a reserve price may have several benefits. For example, a reserve price could reduce incentives for collusion by limiting the profitability of collusive activities. A reserve price could also be used to safeguard against unusually low clearing prices at an auction due to low participation or other unforeseen events. According to one economist, an auction that produces allowance prices that are substantially lower than those in the secondary market may raise concerns about efficiency and equity. Protecting against such a scenario is the primary reason that the United Kingdom chose to institute reserve prices for its auctions, according to a program official. However, this official did not expect the reserve price ever to be triggered, since the likelihood of insufficient participation or collusion was extremely low.

Despite the fact that allowances are traded in secondary markets—where the government does not control prices—a reserve price may have effects that extend beyond the auction itself. In some cases, for example, the reserve price may effectively set a “price floor” for allowances throughout

⁴Ireland’s third and final auction did not have a reserve price.

the secondary market. According to economic literature, the extent to which a reserve price serves as a marketwide price floor depends on several factors, including the share of allowances to be auctioned and the ability to purchase offset permits or other imported allowances. For example, a CBO report said that a reserve price could create a price floor if the government chose to sell a significant fraction of emission allowances, as opposed to distributing them for free.⁵ A key benefit of a price floor, according to some economists and researchers, is that it provides more consistent financial incentives for investment in low-carbon and energy-efficient technologies that could potentially reduce compliance costs in the long run. By establishing a minimum price on emissions, a price floor could also result immediately in more intensive use of low-carbon energy sources or encourage consumers to choose goods and services that are less carbon-intensive.

While few economists and program officials disagreed with the use of auction reserve prices as a general protective measure, some expressed concern about using a reserve price to implement a marketwide price floor. For example, program officials involved in administering the ETS cautioned that price floors are unnecessary and can unduly interfere with the functioning of the allowance market. Accordingly, a European Commission official said that while an auction reserve price may be incorporated into the auction design, the primary law underpinning the ETS bars the use of price floors. Finally, some program officials warned that price floors could limit participation from certain entities—such as large banks—by reducing their opportunities for profit.

If a reserve price is used, policymakers would also need to consider what to do if it is triggered. Because no bids below the price would be accepted, some allowances at the auction would go unsold. One option for addressing unsold allowances is to retire them by removing them from the program entirely, an approach some researchers and program officials support as a way to help preserve the program's environmental integrity. Specifically, triggering the reserve price may indicate that the emissions cap is too generous; retiring allowances that remain unsold at the reserve price would effectively make the cap more stringent. Another option would be to “roll forward” any unsold allowances to the next auction, an approach used by the United Kingdom in allowance auctions. Economists describe this approach as administratively simple; however, when any

⁵CBO, *Policy Options for Reducing CO₂ Emissions* (February 2008).

unsold allowances are rolled over, as opposed to retired, future allowance prices could be lower, reducing incentives for emission reductions. A third option would entail placing the unsold allowances into a “contingency bank” and releasing them for sale at the next auction that closed at a price above a pre-identified trigger price. This approach removes unnecessary allowances from the program while demand is low but keeps allowance prices (and compliance costs) from rising as sharply as they otherwise would in subsequent periods when demand is high. However, one economist cautioned that managing the bank could introduce political risks. Importantly, each of these three options applies to a scenario in which a reserve price is applied at auction. If policymakers decided to implement a firm price floor that applied throughout the secondary market, the government would have to guarantee a minimum price to sellers in that market. In this case, triggering the floor price would indicate that the quantity of allowances offered for sale at the floor price exceeded the quantity demanded by market participants. To guarantee the minimum price, the government could buy back the excess quantity. However, this could create budgetary and other complications, as the government would not be able to anticipate market outcomes.

Price ceilings and strategic reserves. To protect against unexpectedly high compliance costs, some cap-and-trade proposals also involve setting an upper limit on the price of allowances, either through a price ceiling—often known as a “safety valve”—or by establishing a “strategic reserve” of allowances. A safety valve would give covered entities the opportunity to purchase an unlimited amount of additional allowances from the government at a predetermined price. In the event the allowance price rose higher than the safety valve price, covered entities could buy allowances from the government at the lower price rather than purchasing them on the market. If the safety valve was triggered and additional allowances released, however, emissions could rise beyond the level set by the initial cap and compromise the program’s emissions goals. As an alternative option, policymakers could set a strategic reserve of allowances to be released only if the price threshold is reached. The key distinction from a safety valve approach is that the allowances in the reserve would eventually be paid back in some way, thus maintaining the integrity of the cap over time. If the allowances in the reserve were used, for example, the corresponding increase in emissions could be offset, such as by tightening emissions caps in future years.

Some economists and program officials have cited several possible advantages associated with price ceilings. Setting a maximum price for allowances would provide insurance against unexpected price spikes in

allowances—or a sustained period of high prices—either of which could cause the price of consumer goods and services to rise. If allowance prices are higher than expected, for example, a price ceiling could limit the costs to businesses and consumers while new technologies are developed that may achieve reductions at less cost. Because it provides some parameters around the cost of the cap-and-trade program, a price ceiling could also reduce the risk that firms that are both energy-intensive and trade-intensive will face competitive pressures from industries in countries without comparable limits on greenhouse gas emissions. Finally, establishing price ceilings in advance may increase the likelihood that the program will endure through severe economic fluctuations, thus providing certainty to investors.

Several of the potential disadvantages cited for price floors also apply to price ceilings—namely, that they may interfere with market functioning and discourage participation by financial entities. In addition to these disadvantages, a safety valve could have negative environmental implications if emissions rise considerably higher than the established caps. Available information suggests that establishing a safety valve in a U.S. program could impede linkages with other cap-and-trade programs, which would allow participants under a U.S. program to trade allowances with other programs, such as the ETS. In theory, linking can enhance the cost-effectiveness of the participating programs by enabling covered entities to take advantage of differences in the cost of abatement options. However, establishing a safety valve in one program would have implications for other linked programs—for example, linked countries may not be able to ensure that their emissions would be below a required level in a given year. Additionally, a price ceiling could discourage investment in research and development to create new energy-efficient technologies by limiting future profits from their sale. Moreover, some officials reported that price floors and ceilings are unnecessary if the initial cap is set correctly, using accurate, current emissions data, which they considered to be a better strategy for regulating prices than using price controls to artificially manipulate the market.

Reporting and Monitoring

According to available literature and program officials, establishing a system to report and monitor auction activities is an important aspect of auction design. Effective reporting can increase the program's transparency and help participants make informed bidding decisions. In addition, monitoring auction results can help government agencies or designated private entities identify instances of market abuse and evaluate whether auctions have met established goals.

Reporting of auction results. If auctions are used, policymakers would need to consider how and when to report data on auction results. Several program officials recommended making auction results available immediately after the auction. According to one official, providing timely and accurate data on auction results can provide covered entities with information on costs to use as part of their strategic planning efforts. In determining which data to report, program officials recommended that the government disclose aggregated data such as the quantity of allowances sold, the number of participants (and the fraction that won allowances), and the clearing price. RGGI makes auction results data available through an online program called CO2 Allowance Tracking System, which allows the public to download emissions data and relevant auction results.

While providing timely aggregated data can serve a useful purpose, economic literature suggests that revealing too much information about auction results could inadvertently facilitate collusion or limit auction participation. For example, publicizing the names of auction winners and their respective purchases may enable entities to determine whether collusive agreements established prior to the auction were honored. In addition, program officials said that reporting the identity of bidders allows market participants to discern the patterns and strategies of others. According to a European Commission official, entities may choose not to participate at auctions if they fear that commercially sensitive information will be revealed through their bidding. Some program officials noted that while restricting access to such data may run counter to traditional ideas about transparency, it may serve the public's best interest to establish clear limits around the amount and type of auction data released.

Monitoring and oversight. An auction monitoring system can help identify cases of market abuse, ensure that auctions comply with established rules, and provide information useful in evaluating and improving auction design. Several program officials recommended designating a market monitor to observe and assess activities at auctions and in the secondary market. The auction monitor could either be a private or public authority—for example, the RGGI program uses a private consulting firm to perform a number of market monitoring activities. According to a RGGI official, these activities include: ensuring auction rules are consistently applied in each auction, analyzing participant behavior and identifying any irregularities, and modeling the impact of potential design modifications to the program. The RGGI market monitor also analyzes secondary market activity, although the Commodity Futures Trading Commission (CFTC) is responsible for protecting market participants against fraud, manipulation, and abusive trading practices.

In Phase I and Phase II of the ETS, individual member states have used different methods to monitor auction results. For example, the United Kingdom government manages auctions but has appointed an independent observer to ensure auctions are conducted in accordance with the law. In Austria, an energy exchange handles vetting procedures and auction administration while the government handles oversight. For Phase III of the ETS and beyond, the EU Directive requires member states to report to the European Commission on various aspects of auction outcomes, including issues related to access, price formation, and technical issues. In addition, the outline for the draft auctioning regulation from Phase III and beyond foresees the appointment of a single auction monitor. Respondents to the EU's consultation on Phase III auctioning generally favored this proposal, although some respondents noted efforts to curb market abuse at auctions would be ineffective if these efforts are not accompanied by similar efforts in the secondary market.

Appendix III: Allowance Sales Conducted in the EU ETS and RGGI

Table 2: Allowance Sales in the EU Emissions Trading Scheme as of 12/31/09

Member state	Method of sale	Year of sale	Amount sold		Clearing price	Amount of revenue generated
			Percentage of each member state's cap sold (or expected to be sold)	Number of allowances sold (in millions) as of 12/31/09		
Ireland	Auctions (3 total) Sale (1 total)	2006 and 2008 (auctions) 2009 (sale)	2.3 (Phase I) 0.5 (Phase II)	1.7	Auction 1: \$33.12 Auction 2: 8.65 Auction 3: 0.01 Sale: \$17.94	\$19.9 million
Hungary	Auctions (2 total)	2006 – 2007	2.5 (Phase I)	2.4	Auction 1: 9.34 Auction 2: 1.09	12.5 million
Denmark	Sales on an exchange	2006 - 2007	5.0 (Phase I)	5.1	Weighted average price: 2006-2007: \$7.62	38.3 million
Lithuania	Auction (1 total)	2007	1.5 (Phase I)	0.6	Auction 1: \$.07	40,915
United Kingdom	Auctions (7 total)	2008 - 2009	7.0 (Phase II)	29.0	Auctions 1 to 7: Between \$12.87 and \$19.36	472.7 million
Austria	Auctions (2 total)	2009	1.3 (Phase II)	.5	Auction 1: \$13.66 Auction 2: \$16.68	6.1 million
Germany	Sales on an exchange	2008 - 2009	8.8 (Phase II)	80.0	Weighted average price: 2008 sales: \$27.97 2009 sales: \$15.49	1.7 billion

Source: GAO analysis of ETS data, obtained through interviews with program officials and documents from the European Commission, member state governments, and ETS auction administrators.

Notes: Data as of December 31, 2009. For auctions held in Phase I, this figure represents the percentage of actual allowances sold; for auctions held in Phase II, it represents the projected amount of allowances to be auctioned, based on National Allocation Plans (NAP) submitted by each member state. The Phase II NAPs for the United Kingdom and Austria also indicate that unused allowances from the New Entrant Reserve will be auctioned; we did not include these allowances in our calculations. Purchasing power parities (PPP) published by the Organization for Economic Co-operation and Development (Main Economic Indicators, February 2010) were used to convert sales prices and revenues from euros to dollars. The gross domestic product index was used to adjust the resulting figures for inflation.

**Appendix III: Allowance Sales Conducted in
the EU ETS and RGGI**

Table 3: Auctions Held in the Regional Greenhouse Gas Initiative (RGGI)

Monetary amounts in dollars

Date of auction	Vintage sold	Number of allowances auctioned (rounded)	Number of entities submitting bids	Clearing price	Amount of revenue raised (rounded)
9/25/08	2009	12.6 million	59	3.07	\$38.6 million
12/17/08	2009	31.5 million	69	3.38	106.5 million
3/18/09	2009	31.5 million	50	3.51	117.2 million
	2012	2.2 million	20	3.05	
6/17/09	2009	30.9 million	54	3.23	104.2 million
	2012	2.2 million	13	2.06	
9/9/09	2009	28.4 million	46	2.19	66.3 million
	2012	2.2 million	12	1.87	
12/2/09	2009	28.6 million	62	2.05	61.6 million
	2012	1.6 million	8	1.86	

Source: GAO analysis of RGGI auction reports issued by Potomac Economics, RGGI's independent market monitor.

Appendix IV: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

In addition to the contact named above, Michael Hix (Assistant Director), Cindy Gilbert, Robert Grace, Richard Johnson, Jessica Lemke, Micah McMillan, Benjamin Shouse, Jeanette Soares, Ardith A. Spence, and Kiki Theodoropolous made key contributions to this report.

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