
RGGI Inc.



**ANNUAL REPORT ON THE MARKET
FOR RGGI CO₂ ALLOWANCES: 2016**

Prepared for:

RGGI, Inc., on behalf of the RGGI Participating States

Prepared By:

**POTOMAC
ECONOMICS**

May 2017

This report was prepared by Potomac Economics (the contractor) in the course of performing work contracted for and sponsored by RGGI, Inc. on behalf of the RGGI Participating States (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont). The opinions expressed in this report do not necessarily reflect those of RGGI, Inc. or any of the Participating States, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, RGGI, Inc., the Participating States, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. RGGI, Inc., the Participating States, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort of Northeast and Mid-Atlantic states to reduce emissions of carbon dioxide (CO₂) from the power sector.

RGGI, Inc. is a non-profit corporation created to provide technical and administrative services to the states participating in the Regional Greenhouse Gas Initiative.

Table of Contents

I. Executive Summary	5
II. Background on the CO₂ Allowance Market	10
A. Regional CO ₂ Emissions Cap	10
B. Compliance Obligations	12
C. CO ₂ Allowance Tracking System (“COATS”)	13
D. Primary Market for RGGI CO ₂ Allowances.....	14
E. Secondary Market for RGGI CO ₂ Allowances	14
III. CO₂ Allowance Prices	17
A. Prices in the Auctions and the Secondary Market	17
B. Volatility of CO ₂ Allowance Prices	19
IV. Trading and Acquisition of CO₂ Allowances	22
A. Distribution of Auction Awards	23
B. CO ₂ Allowance Trading Volumes	24
C. Acquisition of CO ₂ Allowances in the Secondary Market	25
D. Patterns of CO ₂ Allowance Holdings.....	27
V. Participation in the CO₂ Allowance Market	31
A. Demand for CO ₂ Allowances	32
B. Participation in RGGI Auctions	33
C. Acquisition of CO ₂ Allowances by Individual Firms	34
D. Participation in the CO ₂ Allowance Futures Market	37
VI. Discussion of Market Monitoring	39

Table of Figures

Figure 1: CO₂ Allowance Prices in the Auctions and Secondary Market..... 18

Figure 2: Option-Implied Volatility of CO₂ Allowance Futures Prices..... 21

Figure 3: Distribution of Auction Awards 23

Figure 4: Volume of Trading of CO₂ Allowances and Allowance Futures 25

Figure 5: Net Changes in Futures Open Interest and Net Transfers of CO₂ Allowances 26

Figure 6: Sources of CO₂ Allowances Held in COATS Accounts..... 29

Figure 7: Estimated Demand for CO₂ Allowances 32

Figure 8: Number of Bidders According to the Quantity of Bids Submitted 33

Figure 9: Distribution of Auction Awards 35

Figure 10: Distribution of CO₂ Allowance Holdings 36

Figure 11: Concentration of Open Interest in CCFE Futures and Options 38

I. EXECUTIVE SUMMARY

The Regional Greenhouse Gas Initiative (“RGGI”) became the first mandatory cap-and-trade program to limit CO₂ emissions in the United States in 2009. Electric power generators located in the states participating in RGGI are required to obtain a number of CO₂ allowances equal to the number of tons of CO₂ they emit. RGGI distributes CO₂ emissions allowances to the market primarily through auctions, making it distinctive among existing cap-and-trade programs. Ninety-four percent of the CO₂ allowances that have entered into circulation initially entered the market through one of the auctions. Through the end of 2016, RGGI has conducted 34 successful auctions, selling a total of 860 million CO₂ allowances for \$2.6 billion.

The RGGI CO₂ emissions cap was 86.5 million tons in 2016, and it will be reduced by 2.5 percent per year until it reaches 78.2 million tons in 2020. However, RGGI is currently using an adjusted cap that is 21.9 million tons lower than the emissions cap in each year through 2020 (to account for the surplus of CO₂ allowances that accumulated from 2009 to 2013).¹

This report evaluates activity in the market for RGGI CO₂ allowances in 2016, focusing on the following areas: allowance prices, trading and acquisition of allowances in the auctions and the secondary market, participation in the market by individual firms, and market monitoring. For reporting purposes, firms are often broken up into the following categories:

- *Compliance-Oriented Entities* – Compliance entities that appear to acquire and hold allowances primarily to satisfy their own compliance obligations.
- *Investors with Compliance Obligations* – Firms that have compliance obligations but which hold a number of allowances that exceeds their estimated compliance obligations by a margin suggesting they also buy for re-sale or some other investment purpose. These firms often transfer significant quantities of allowances to unaffiliated firms.²

¹ These program details are described further in Section II.A.

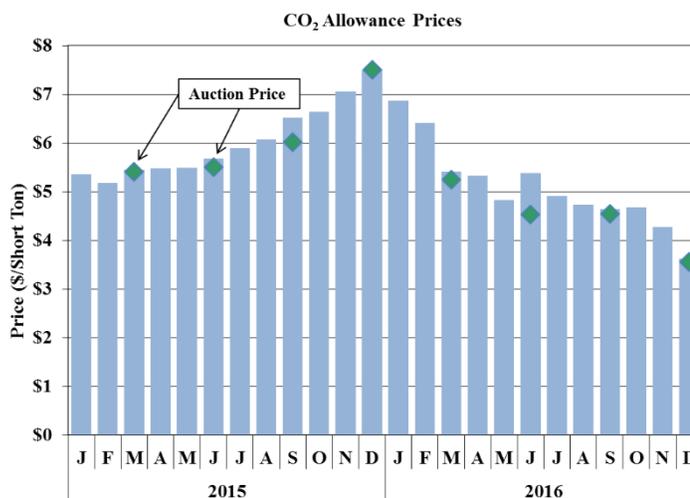
² The assessment of whether a compliance entity holds a number of allowances that exceeds its compliance obligations by a margin that suggests they are also buying for re-sale or some other investment purpose is based on: (a) the entity’s forecasted share of the total compliance obligations for the entire RGGI footprint through 2020, (b) the total number of allowances in circulation, and (c) consideration of the pattern of the entity’s allowance transfers to unaffiliated firms versus affiliated firms. Since the designation of a compliance entity as

- *Investors without Compliance Obligations* – Firms without any compliance obligations.

In this report, the “Investors with Compliance Obligations” category is sometimes combined with one of the other two categories when discussing market trends and participation. In all such cases, the text of this report clearly defines the grouping as either: “compliance entities” combining the first and second categories or “investors” combining the second and third categories.

CO₂ Allowance Prices

The average auction clearing price decreased 27 percent from \$6.10 in 2015 to \$4.47 in 2016, and secondary market prices were generally consistent with auction clearing prices throughout the year. After three straight years of increasing prices, allowance prices fell during most of 2016 with the largest reductions occurring in February and in November.³ Downward shifts in allowance



prices in February and November 2016 were due in part to changes in expectations about the likelihood of the Clean Power Plan being implemented and the implications for RGGI allowance demand.

Acquisition and Holdings of CO₂ Allowances

Firms initially acquire CO₂ allowances in the primary market, mainly by purchasing them in the quarterly auctions. Firms can also buy and sell CO₂ allowances in the secondary market.

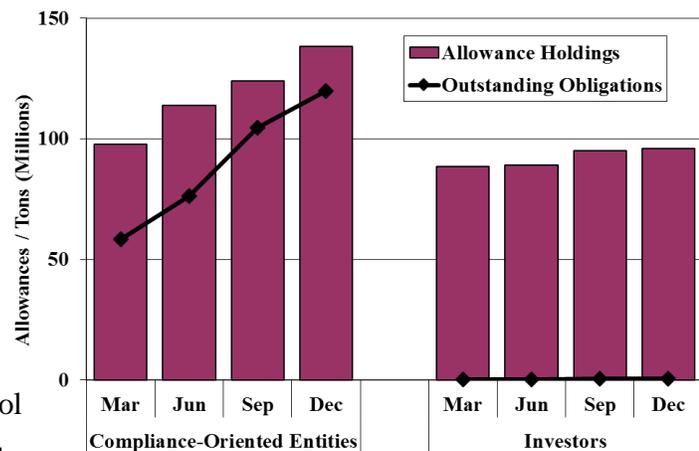
an investor is based on a review of its transactions and holdings, the designation of a particular firm may change over time as more information becomes available. Therefore, some of the quantities in this report may not match previous reports because of changes in the classification of particular firms.

³ Allowance prices are summarized in more detail in Section III.A.

Secondary market activity consists mainly of trading of futures and options contracts on the public exchange and transfers of ownership recorded in COATS (“CO₂ Allowance Tracking System”).

The large private bank of surplus CO₂ allowances (which accumulated primarily before 2013) declined significantly in 2016 from 130 million at the beginning of the year to 114 million at the end of the year.⁴ Surplus allowances fell because the number of allowances sold in the auctions in 2016 was significantly reduced by the interim adjustments in the cap (i.e., FCPIA and SCPIA).⁵ Because of these interim adjustments to the cap, the current surplus of allowances is expected to wind-down over the remainder of the decade.

The figure to the right summarizes the holdings of CO₂ allowances at the end of each quarter in 2016 for two categories of firms.⁶ It shows that, as a group, compliance-oriented entities held substantially more CO₂ allowances than needed to satisfy their outstanding compliance obligations for the third control period. These entities held 138 of the 234 million allowances in circulation at the end of 2016, and they accounted for 120 million of the outstanding compliance obligations.



Compliance-oriented entities accumulated a substantial quantity of CO₂ allowances through the secondary market during 2016, and many investors were also active in the secondary market.

⁴ We define the “private bank of allowances” as the number of allowances in circulation (i.e., in Compliance Accounts or in General Accounts). We define the “private bank of *surplus* allowances” as the number of allowances in circulation minus the compliance obligations for which allowances have not been surrendered.

⁵ The First Control Period Interim Adjustment (“FCPIA”) and the Second Control Period Interim Adjustment (“SCPIA”) are described in Section II.A.

⁶ Monthly totals are provided with additional detail in Section IV.D.

The volume of futures trading continued to increase, rising 22 percent from 206 million CO₂ allowances in 2015 to 251 million in 2016. Trading activity was highest in the first quarter, which accounted for 41 percent of the annual volume.⁷ Overall, the secondary market performed competitively in 2016.

Although the auctions are still the primary means by which firms acquire CO₂ allowances, many individual compliance-oriented entities relied primarily or exclusively on the secondary market in 2016. Sixty-five percent of the CO₂ allowances in circulation at the end of 2016 were held by firms that had held them since the beginning of the year, 18 percent were held by firms that acquired them through auctions or state allocations during 2016, and 16 percent were held by firms that purchased them in the secondary market during 2016. A robust secondary market is beneficial because it provides compliance entities with more flexibility related to when they can purchase CO₂ allowances.

Participation in the Market by Individual Firms

Participation by many firms promotes competition and helps ensure that CO₂ allowance prices are determined efficiently. Over time, firms that need CO₂ allowances for compliance should be able to acquire them through the auctions and/or the secondary market, and the holdings of individual firms should be relatively consistent with their potential uses for allowances.⁸

In 2016, we found broad participation in the RGGI market. The demand for CO₂ allowances is dispersed relatively widely across firms as the three largest compliance-oriented entities accounted for just 41 percent of the total projected demand, a small increase from 2015. The average number of auction participants decreased from 50 in 2015 to 41 in 2016 reflecting less participation by compliance-oriented entities and a slight uptick in participation by investors. Allowance holdings were generally distributed across compliance-oriented entities consistent with their compliance obligations, although the surplus of allowances in circulation led many

⁷ Trading volumes and open interest are summarized in Sections IV.B and IV.C.

⁸ Participation in the auctions and the secondary market by individual firms is evaluated in Section V.

individual firms to hold large surpluses. The top ten compliance-oriented entities accounted for 42 percent of total holdings and smaller compliance-oriented entities accounted for 16 percent. The top ten investors (ranked by surplus holdings) accounted for 41 percent. These levels are consistent with competitive expectations given that the current private bank of allowances far exceeds the outstanding compliance obligations of firms in the third control period.

Market Monitoring

As the RGGI Market Monitor, we evaluate the conduct of market participants in the auctions and in the secondary market to identify potential anti-competitive conduct. We also assess whether the auctions were administered properly by EnerNOC.

In our reviews of the four auctions in 2016, we found no material concerns regarding the auction process, barriers to participation in the auctions, or the competitiveness of the results. Large numbers of firms participated in the offerings of CO₂ allowances. Further, we found that the auctions were administered in accordance with the noticed rules and bids received.

We find no evidence of anti-competitive conduct in the secondary market for CO₂ allowances, and we find that firms have generally purchased quantities of allowances that are consistent with their expected needs.

II. BACKGROUND ON THE CO₂ ALLOWANCE MARKET

RGGI began full operation in 2009, becoming the first mandatory market-based program to limit CO₂ emissions in the United States. Market-based cap-and-trade programs work by setting an aggregate emissions limit for a particular class of emitters, and requiring them to acquire a number of allowances sufficient to cover their emissions. Firms that own allowances can decide whether it is more profitable to use them to cover their emissions or to sell them to an emitter that can use them more efficiently. In this manner, the goal of market-based programs is to use market forces to reduce overall emissions in the most cost-effective ways.

RGGI is a collaborative effort of Northeast and Mid-Atlantic states to reduce overall CO₂ emissions.⁹ Electricity generating plants with more than 25 MW of capacity (“CO₂ budget sources”) must acquire a number of CO₂ allowances sufficient to cover their CO₂ emissions by the end of each control period. Firms that own budget sources (“compliance entities”) can acquire CO₂ allowances through a variety of means, including by purchasing them in the quarterly RGGI auctions or in the secondary market for allowances.

The market for RGGI CO₂ allowances has several key elements, which are discussed in this section: compliance obligations, the CO₂ Allowance Tracking System (“COATS”), the primary market for allowances, and the secondary market for allowances.

A. Regional CO₂ Emissions Cap

Following a 2012 Program Review, each of the Participating States announced changes to the RGGI program, including a reduced RGGI CO₂ cap for the period from 2014 to 2020.¹⁰ The

⁹ The full set of rules for the RGGI program (known as the “Model Rule”) may be found at http://www.rggi.org/docs/ProgramReview/FinalProgramReviewMaterials/Model_Rule_FINAL.pdf.

¹⁰ The current emissions cap and other changes to the Model Rule were announced on February 7, 2013. See http://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf. Subsequently, each of the Participating States revised its CO₂ Budget Trading Program to be consistent with the updated Model Rule. See http://www.rggi.org/docs/PressReleases/PR011314_AuctionNotice23.pdf. See also www.rggi.org/design/overview/cap.

new CO₂ cap was set at 91.0 million tons for 2014 and is being reduced by 2.5 percent per year until it reaches approximately 78.2 million tons for 2020. So, the cap was 86.5 million tons for 2016.

Interim Adjustments to Account for Banked Allowances

Further adjustments were made to the cap to account for the surplus of allowances that was banked from allocation years 2009 to 2013.¹¹ Although many of the CO₂ allowances from allocation years 2009 to 2013 were not distributed, 690 million allowances were put in circulation compared to total compliance obligations of 550 million tons for the period from 2009 to 2013.¹² Unused CO₂ allowances can be banked by the holder, so the private bank of allowances exceeded the total expected compliance obligations by 140 million tons at the beginning of 2014. Consequently, two interim adjustments were used to adjust the RGGI CO₂ cap to account for the private bank of allowances that had accumulated by the first quarter of 2014.

First Control Period Interim Adjustment for Banked Allowances (“FCPIABA”) – This is a reduction in the number of CO₂ allowances that is being sold over the seven-year period from 2014 to 2020. The amount of the reduction is equal to the private bank of first control period CO₂ allowances (i.e., allocation years 2009, 2010, and 2011) that were in circulation after compliance was completed for the first control period. The FCPIABA is approximately 8.2 million CO₂ allowances per year from 2014 to 2020.¹³

Second Control Period Interim Adjustment for Banked Allowances (“SCPIABA”) – This is a reduction in the number of CO₂ allowances that is being sold over the six-year period from 2015 to 2020. The amount of the reduction is equal to the private bank of 2012 and 2013 allocation

¹¹ The emissions cap was reduced from 188 million tons to 165 million tons in 2012 to account for the departure of New Jersey at the end of the first control period.

¹² This includes 53 million tons of compliance obligations for New Jersey from 2009 to 2011.

¹³ See www.rggi.org/design/overview/cap.

year allowances that are in excess of 2012 and 2013 emissions. The SCPIABA is approximately 13.7 million CO₂ allowances per year from 2015 to 2020.¹⁴

Given the new CO₂ cap and the interim control period adjustments for banked allowances, the adjusted CO₂ cap fell from approximately 82.8 million in 2014 to 64.6 million in 2016 and will eventually fall to 56.3 million in 2020. Overall, the number of CO₂ allowances distributed for the adjusted CO₂ cap for the period from 2014 to 2020 will be approximately 449 million. These will be in addition to the 140 million surplus allowances that were already in circulation at the end of 2013 for a total supply of 589 million from 2014 to 2020.

Cost Containment Reserve

As part of the 2012 Program Review, RGGI implemented a provision known as the Cost Containment Reserve (“CCR”) in 2014.¹⁵ The CCR allows for the sale of a fixed number of allowances in addition to the cap when the clearing price in the quarterly auction reaches the CCR Trigger Price. The CCR is replenished at the start of each calendar year. In 2014, the CCR had a withdrawal limit of five million allowances, and the CCR Trigger Price was \$4.00. In 2015 and 2016, the CCR had a withdrawal limit of ten million allowances, and the CCR Trigger Prices were \$6.00 and \$8.00, respectively. From 2017 to 2020, the annual withdrawal limit will be ten million allowances, and the CCR Trigger Prices will rise to \$10.00 in 2017 and 2.5 percent in each year thereafter. All 15 million allowances were sold from the CCR for 2014 and 2015, but the CCR was not triggered in 2016. These are in addition to the 589 million allowances already planned to be available for the period from 2014 to 2020, raising the total supply to 604 million allowances.

B. Compliance Obligations

CO₂ budget sources are fossil fuel-fired electricity generating plants with greater than 25 MW of capacity. Shortly after the end of each control period, compliance entities must submit a

¹⁴ *ibid.*

¹⁵ See http://www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_Summary.pdf.

sufficient number of CO₂ allowances to cover their CO₂ emissions during the control period. The first control period ran from January 1, 2009 to December 31, 2011, the second control period ran from January 1, 2012 to December 31, 2014, and the third control period will run from January 1, 2015 to December 31, 2017.

In 2015, RGGI completed the compliance process for the second control period. By January 30, compliance entities were required to submit all CO₂ emissions data for CO₂ budget sources for the second control period to the Environmental Protection Agency's ("EPA's") Clean Air Markets Division ("CAMD") Business System. By March 2, the Compliance Account for each CO₂ budget source was required to hold first or second control period CO₂ allowances sufficient to satisfy its compliance obligation. Each CO₂ budget source was also required to submit a Compliance Certification Report certifying that it was in compliance with its state's CO₂ Budget Trading Program.¹⁶

In early 2016, RGGI completed the new interim compliance process for 2015. Interim compliance differs from the triennial compliance process because compliance entities are only required to surrender CO₂ allowances for 50 percent of their compliance obligations. Approximately 41 million CO₂ allowances were surrendered in March 2016 for interim compliance.

C. CO₂ Allowance Tracking System ("COATS")

COATS is the registry for RGGI CO₂ allowances. Each CO₂ allowance has a unique serial number and can be used to satisfy one short ton of compliance obligations. When firms trade CO₂ allowances in the secondary market, the seller must record the transfer of ownership in COATS before the buyer is recognized as the owner.¹⁷

¹⁶ The Compliance Summary for the first and second control periods may be found at https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=reportsv2.final_compliance_summary_rpt&clearfuseattrs=true

¹⁷ Public information related to the COATS registry may be found at http://www.rrgi.org/market/tracking/public_reporting.

D. Primary Market for RGGI CO₂ Allowances

The participating states have taken the approach of using auctions rather than free allocations as the primary means for distributing RGGI CO₂ allowances to the market. Accordingly, the primary market for CO₂ allowances consists mainly of the quarterly auctions.

Auctions – Through the end of 2016, 94 percent of the CO₂ allowances that have been put into circulation initially entered the market through one of the 34 auctions that have taken place on a quarterly basis since September 2008.

Offset Projects – Additional CO₂ allowances can also be awarded for approved CO₂ emissions offset projects (project-based greenhouse gas emissions reductions or carbon sequestration that occurs outside the capped electricity generation sector), although no such allowances have been awarded thus far.

Early Reduction Allowances – In 2009, there was a one-time award by certain participating states of 2.4 million early reduction allowances (ERAs), which were awarded for qualifying CO₂ emissions reductions achieved at CO₂ budget sources during 2006 through 2008, prior to the start of the first control period.

Allocations & Sales by States – Approximately 29.7 million CO₂ allowances for the first control period were allocated by individual states through either fixed-price sales or free allocations. Approximately 16.0 million CO₂ allowances for the second control period were allocated by individual states. Approximately 4.8 million CO₂ allowances for the third control period were allocated by individual states.

Regardless of how CO₂ allowances initially enter the market, they can be traded to other firms in the secondary market.

E. Secondary Market for RGGI CO₂ Allowances

The secondary market is important for several reasons. First, it gives a firm the ability to obtain CO₂ allowances at any time during the three months between the RGGI auctions. Second, it provides a way for a firm to protect itself against the potential volatility of future auction clearing

prices. Third, it provides price signals that can assist a firm in making investment decisions in markets affected by the cost of RGGI compliance.

The secondary market for RGGI CO₂ allowances comprises the trading of physical allowances and financial derivatives, such as futures, forwards, and options contracts. A physical CO₂ allowance trade occurs when the parties to the transaction register the transfer of ownership in COATS. Financial derivatives include any contracts whereby parties agree to exchange funds and/or allowances at some future date, depending in many cases on factors such as the price of allowances at some future date. Many financial derivatives eventually result in the transfer of physical CO₂ allowances (i.e., the transfer is registered in COATS), but this may occur months or years after the parties enter into a financial transaction. These include the following types of transactions:

- *Futures* – Under these contracts, two parties agree to exchange a fixed number of CO₂ allowances of a certain vintage year at a particular price at a specific point in the future (called the “delivery month”). At the end of the delivery month, the contracted number of CO₂ allowances must be physically transferred to the buyer’s account in the COATS registry and funds must be transferred to the seller. The vintage year refers to the allocation year of the CO₂ allowance that is to be transferred. One standard futures contract equals 1,000 RGGI CO₂ allowances.
- *Forwards* – These are like futures contracts, but a forward contract typically requires that all financial settlement occur at expiration.
- *Call Options* – Call options give the purchaser the option to buy a fixed number of CO₂ allowances of a certain vintage year at a particular strike price at any time prior to the expiration date. For example, suppose a firm holds a call option with a \$4 strike price and a December 2016 expiration date. If the price of the corresponding forward contract rose to \$5, the firm could exercise the option to buy CO₂ allowances at \$4 and immediately sell them at \$5. Alternatively, if the price of the forward contract stayed below \$4, the firm would let the option expire without exercising it. One standard options contract can be exercised for 1,000 RGGI allowances.
- *Put Options* – Put options are similar to call options but they give the purchaser the option to *sell* a certain number of CO₂ allowances of a particular vintage year at a specified strike price any time prior to the expiration date.

Futures, forwards, and options contracts allow firms to manage risks associated with unforeseen swings in commodity prices. Futures and forwards allow firms to lock-in the prices of future purchases or sales. Options allow firms to limit their exposure to price volatility. Call options

protect the purchaser if the price of the commodity increases, while put options protect the purchaser if the price of the commodity decreases. Although options provide less certainty than futures and forward contracts, they usually require less financial security, which could make them more attractive to some firms.

The terms of futures, forward, and option contracts vary in the degree to which they are standardized. “Exchange-traded” contracts typically have the most standardized provisions, while the term “over-the-counter” (“OTC”) is applied to contracts with less standardized provisions. However, OTC contracts, once entered into, are often settled through a clearinghouse in order to protect the parties from the risk that the counterparty defaults.

The amount of *open interest* is the net amount of futures, forwards, or options contracts that have been traded for a contract with a particular set of specifications (i.e., vintage year, delivery month, etc.), but have not reached the time of delivery, expired, or been exercised. For example, if Firm A sells 100 contracts of a particular type to Firm B, Firm A will have a short position of 100 contracts, Firm B will have a long position of 100 contracts, and the total open interest for the particular type of contract will be 100 contracts. Hence, the total open interest can be determined by summing across all of the long positions of market participants or by summing across all of the short positions.

III. CO₂ ALLOWANCE PRICES

The market for RGGI CO₂ allowances consists primarily of purchases in the quarterly auctions and trading of allowances and allowance futures and options contracts in the secondary market. The clearing prices from quarterly auctions provide public information about the market value of CO₂ allowances four times per year, while the prices of futures and forwards trades on public exchanges and transaction prices recorded in COATS provide price information more frequently. This section of the report evaluates prices in the markets for RGGI CO₂ allowances in 2016.

Key observations regarding RGGI CO₂ allowance prices:

- *Price Trends* – Prices in the secondary market opened the year at around \$8.00, fell rapidly in early-February before stabilizing around \$5.50, and then decreased gradually to around \$4.50 in early-June. After a brief period of elevated prices from mid-June to mid-July, prices remained near \$4.50 until November and closed the year at \$3.62. Downward shifts in CO₂ allowance prices in February and November 2016 reflected changes in expectations about the likelihood of the Clean Power Plan being implemented and the implications for RGGI allowance demand.
- *Auction Clearing Prices* – The volume-weighted average auction clearing price decreased 27 percent from \$6.10 in 2015 to \$4.47 in 2016. Auction prices decreased during 2016 concluding with Auction 34, which cleared at \$3.55 on December 7.
- *Option-Implied Price Volatility* – Volatility in the RGGI CO₂ allowance market increased sharply in February 2016. Volatility remained elevated through the year and peaked from July to September following a brief period of increased CO₂ allowance prices.

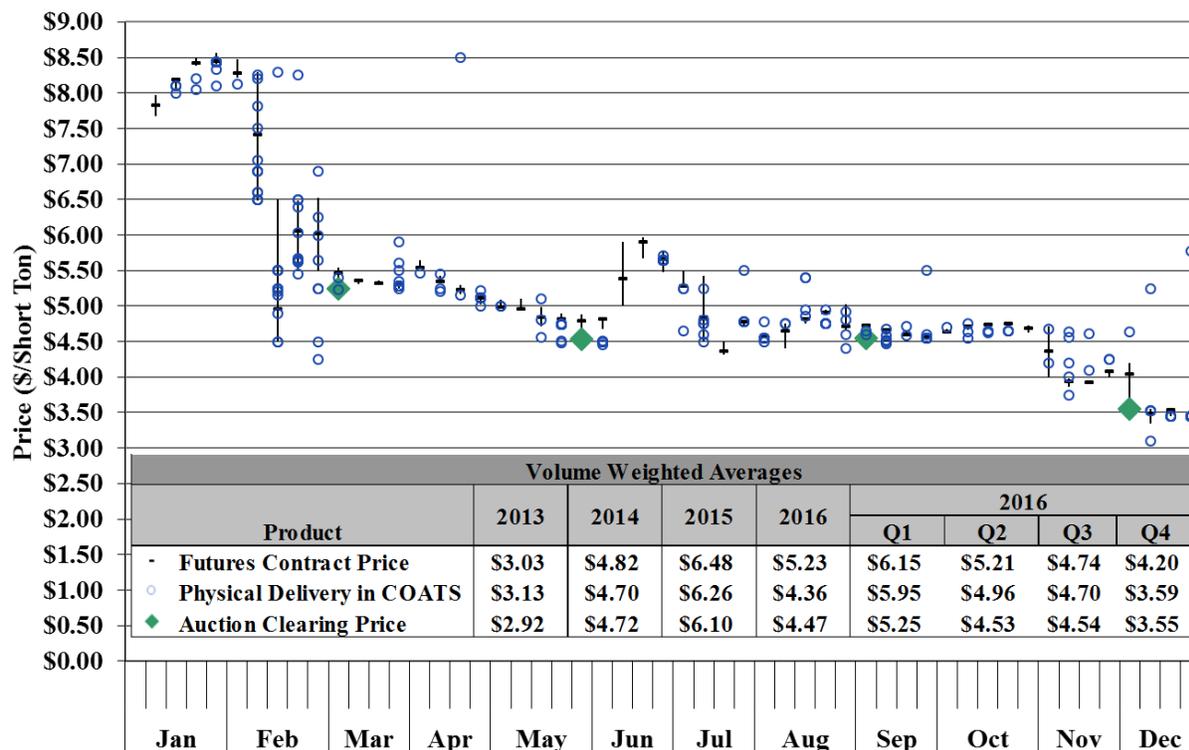
A. Prices in the Auctions and the Secondary Market

Figure 1 summarizes prices in the auctions and the secondary market on a weekly basis in 2016. Futures contract prices are summarized for each week by a black vertical line from the minimum transaction price to the maximum transaction price in the week and by a black horizontal tick mark at the volume-weighted average price for each week. The volume-weighted average price of physical deliveries of CO₂ allowances recorded in COATS are shown by blue circles for each day when a transaction took place at a price that was recorded by the transacting parties.¹⁸ The

¹⁸ Parties must report the transaction price if there is an underlying financial transaction related to the transfer.

figure also shows the auction clearing prices of CO₂ allowances in the four quarterly auctions held during 2016, which are represented by the green diamonds.

Figure 1: CO₂ Allowance Prices in the Auctions and Secondary Market 2016



Observations regarding prices in auctions and the secondary market:

- General Price Levels** – The prices of CO₂ allowances began the year near \$8.00 and briefly rose, but dropped sharply in February. Despite some outliers, secondary market prices were generally consistent with auction clearing prices. Prices ranged in a band between \$4.50 and \$5.50 from March through October with a brief increase to nearly \$6.00 in late June and early July. Prices dipped again in November and closed the year around \$3.50.
- Futures Contract Prices** – These were generally consistent with the prices of physical deliveries in COATS throughout the year. However, while futures followed a similar trend of decreasing prices, the volume-weighted average futures price for all vintages and control periods remained above the average price for physical delivery of allowances. The average futures price was higher than the average physical delivery price because more futures volumes occurred early in the year when price levels were higher, while most of the physical deliveries occurred in December. For the calendar year 2016, the average futures price was \$5.23, 19 percent less than in 2015, but still above 2014 prices.

- *Physical Deliveries in COATS* – The volume-weighted average transaction price of CO₂ allowances decreased 30 percent from \$6.26 in 2015 to \$4.36 in 2016. The pricing of transactions was generally consistent with futures trades and auction clearing prices throughout the year. However, several transactions were recorded at levels substantially above or below the prevailing price levels indicated by futures prices and most other COATS transactions. In particular, several large transactions recorded in COATS during the last several weeks of the year settled at high prices because they resulted from deals that were made in 2015.
- *Auction Clearing Prices* – The volume-weighted average auction clearing price decreased 27 percent from \$6.10 in 2015 to \$4.47 in 2016. Auction prices decreased throughout the year concluding with Auction 34, which cleared at \$3.55 on December 7.

B. Volatility of CO₂ Allowance Prices

Cap-and-trade markets are designed to give firms efficient incentives to reduce or offset emissions. In the short-term, high-emitting generators operate less frequently in favor of low-emitting generators. In the long-term, the market will affect the decisions of firms to develop offset projects, to retire old inefficient generation, to retain existing zero-emissions generation, and to perform maintenance that increases fuel efficiency and lowers carbon-intensity. Predictable CO₂ allowance prices decrease the risks associated with making long-term investments in reducing CO₂ emissions. Since CO₂ allowance prices can be volatile, the availability of futures and options contracts allows firms to protect themselves from the risks of such investments. This subsection evaluates two measures of price volatility in the market for RGGI CO₂ allowances.

One measure of volatility is known as *historic volatility*,¹⁹ which is a measure of volatility based on day-to-day price variations over a recent period (e.g., several months or one year). This is a useful measure when factors influencing the volatility of prices in the recent period are likely to be the same as the factors influencing the volatility of prices in the future.

Observations regarding historic volatility of CO₂ allowance prices:

¹⁹ Historic volatility is a measure of the standard deviation of the day-over-day percentage change in price. Volatility is normally expressed as an estimated standard deviation for a one year period, even if it is calculated from a shorter period of time.

- *Historic Volatility in 2016* – The historic volatility of futures prices jumped to 108 percent in the first quarter of 2016 — the highest level observed since RGGI’s inception. Volatility sharply decreased in the second quarter and then remained between 36 and 38 percent throughout the rest of the year.
- *Historic Volatility Long-Term Trend* – From 2010 to 2012, there was a substantial surplus of CO₂ allowances and prices remained very close to the auction reserve price, leading to low price volatility. Allowances are never sold for less than the auction reserve price, so it acts as a price floor. Volatility increased from 5 percent in 2012 to 35 percent in 2013 after the announcement of planned changes following the 2012 Program Review. As prices began to level-off in the second half of 2014, the volatility of allowance prices also decreased considerably. Those conditions generally remained through 2015. In early 2016, prices sharply dropped and volatility rose commensurately.

Another measure of the volatility of CO₂ allowance prices is known as *option-implied volatility*,²⁰ which measures the volatility that is implied by the trading of option contracts for CO₂ allowances. If a firm perceives that CO₂ allowance prices are volatile, the firm may be willing to pay a high price for an option contract that protects it from unforeseen allowance price fluctuations. Likewise, if a firm perceives that CO₂ allowance prices are relatively stable, the firm will be willing to pay relatively little for the same option contract.²¹

The following scatter plot reports the option-implied (i.e., expected) volatility of RGGI CO₂ allowance futures contracts, which can be inferred from the trading of options contracts in 2016.²² The vertical axis shows the option-implied (expected) volatility of CO₂ allowance futures prices, and the horizontal axis shows the trade date. The figure excludes contracts if the trade date is fewer than 90 days from the contract expiration date. This is because historical

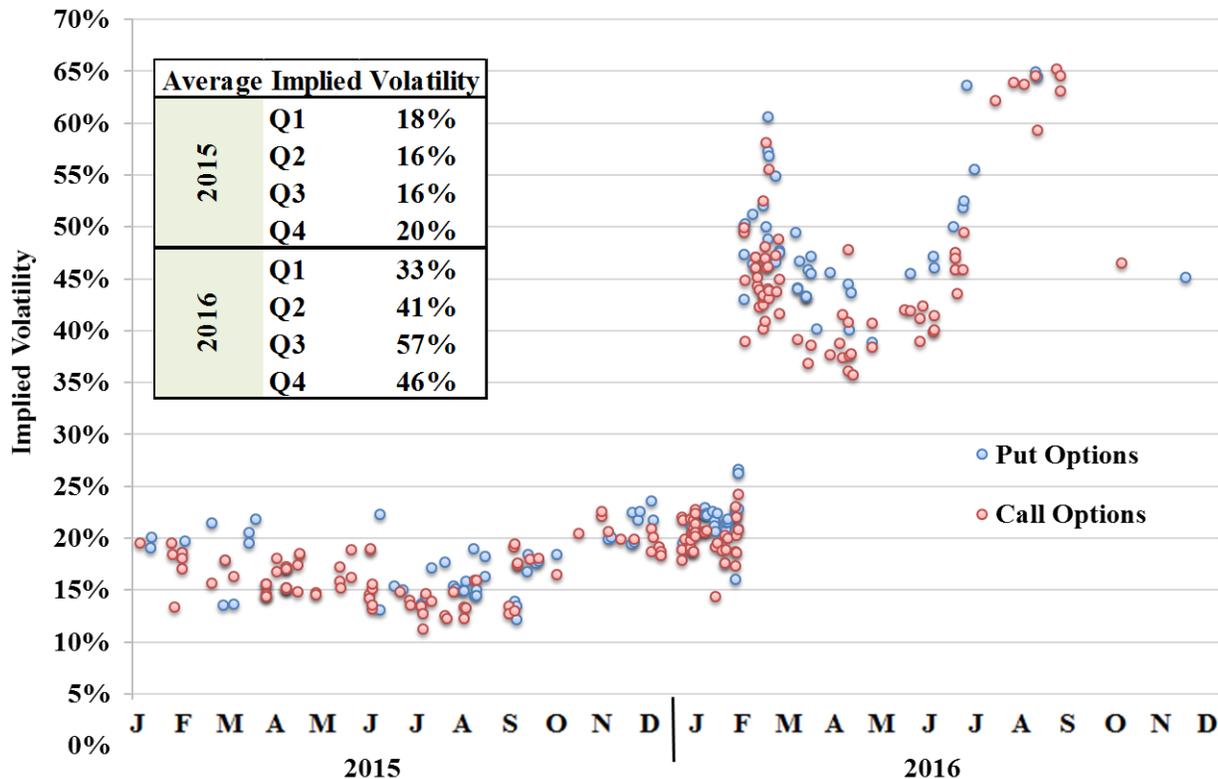
²⁰ The option-implied volatility of a CO₂ allowance refers to the expected standard deviation of the distribution of allowance prices one year in the future. For example, if the expected value of the price one year in the future is \$1 and the option-implied volatility is 25 percent, this implies that the probability that the price will be within 25 percent of \$1 (i.e., between \$0.75 and \$1.25) is 68.2 percent assuming that the price is distributed log-normally.

²¹ The price of an option contract depends primarily on two factors: (i) the expected value of a CO₂ allowance relative to the strike price of the option, and (ii) the expected volatility of an allowance over the period until the expiration date. When call option prices and put option prices move in opposite directions, it signals a change in the expected price of allowances. Conversely, when call option prices and put option prices move in the same direction, it signals a change in the expected volatility of allowance prices.

²² Black’s model for valuing futures options is used to estimate the option-implied volatilities of RGGI allowance futures prices.

pricing patterns suggest that CO₂ allowance prices become more volatile around the time of each quarterly auction. Therefore, excluding contracts with short times to maturity reduces variations in implied volatility that are driven by the timing of the trades within a particular quarter.

**Figure 2: Option-Implied Volatility of CO₂ Allowance Futures Prices
2015 & 2016**



Observations regarding the option-implied volatility of CO₂ allowance prices:

- *General Patterns of Volatility* – Option-implied volatility varied considerably during 2015 and 2016, but was broadly consistent with the pattern of historic price volatility. Both volatility metrics reflect that uncertainty regarding allowance prices increased considerably throughout 2016. In contrast to the gradually increasing prices and lower volatility of 2015, 2016 experienced large price variations. These factors contributed to both elevated volatility and large swings in volatility metrics.
- *Cost Containment Reserve* – Since the program changes announced in February 2013, the CCR has been a significant factor in reducing the volatility of allowance prices. The CCR reduces volatility directly by making additional supply available if allowance prices rise to the prescribed levels, but the CCR also has a significant indirect effect on expectations. For example, as CO₂ allowances prices rose in 2015, option-implied volatility levels were moderate in large part because the size and placement of the CCR from 2017 to 2020 would limit the potential for price increases above \$10.

IV. TRADING AND ACQUISITION OF CO₂ ALLOWANCES

This section evaluates the trading and acquisition of CO₂ allowances in the primary and secondary allowance markets. Firms initially acquire CO₂ allowances in the primary market, mainly by purchasing them in the quarterly auctions. Firms then buy and sell CO₂ allowances in the secondary market. Secondary market activity can be observed from information about the trading of futures and options contracts on public exchanges and in the OTC market as well as from the transfers of ownership recorded in COATS. This section analyzes the movement of CO₂ allowances from their initial introduction to the market and in the secondary market.

This section evaluates the activity of firms in the CO₂ allowance market in 2016, including the acquisition of allowances in the quarterly auctions and trading in the secondary market.

Key observations regarding trading and acquisition of CO₂ allowances:

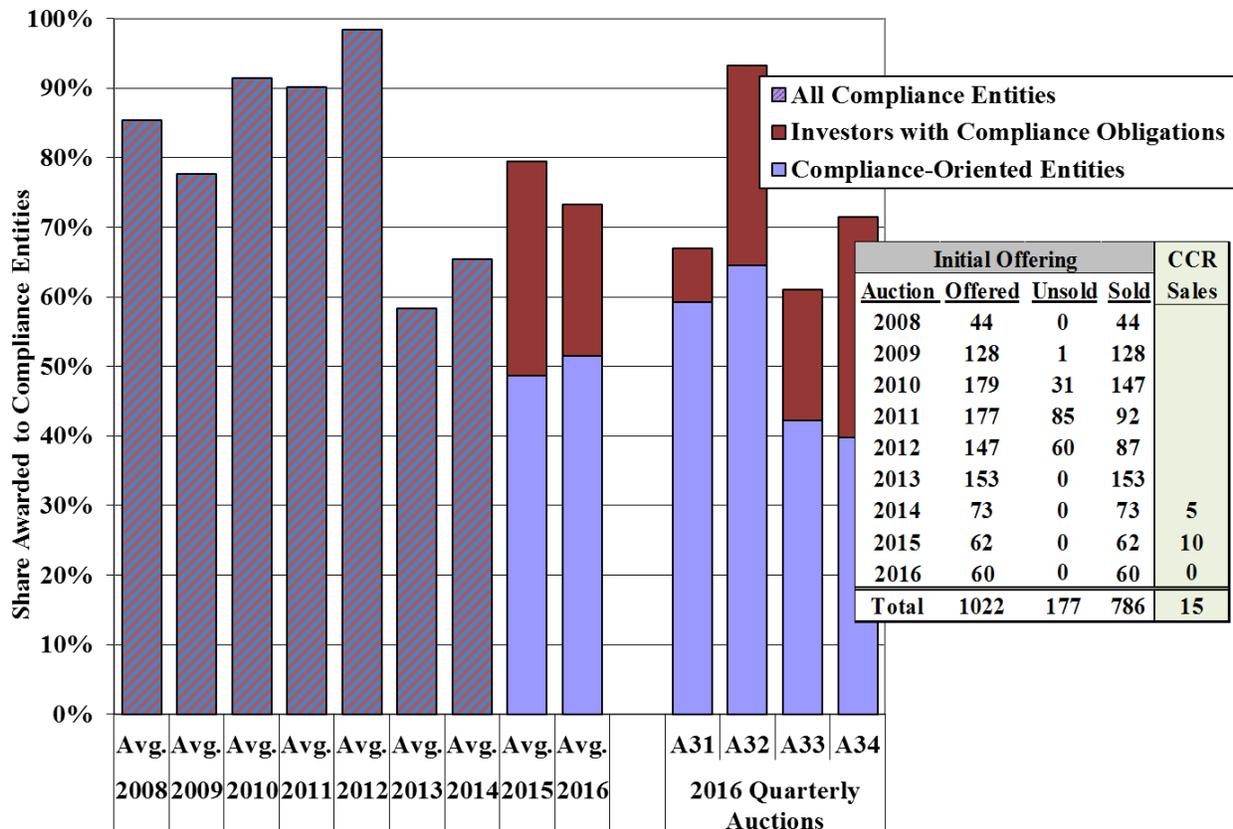
- *CO₂ Allowances in Circulation* – The overall number of CO₂ allowances in circulation increased from 213 million at the end of 2015 to 234 million at the end of 2016. Over the same period, 79 million tons of additional compliance obligations were incurred and nearly 42 million allowances were surrendered for 2015 Interim Compliance. Thus, the amount of surplus holdings (in excess of outstanding compliance obligations) fell from 130 million at the end of 2015 to 114 million at the end of 2016. The private bank of surplus allowances is expected to fall each year until 2020 because of annual reductions in the emissions cap and because of the interim adjustments for banked CO₂ allowances.
- *Participation by Compliance-Oriented Entities* – Of the CO₂ allowances in circulation at the end of 2016, 138 million (59 percent) were held by compliance-oriented entities. The number of allowances held by this group exceeded their outstanding compliance obligations (120 million tons) at the end of 2016 by a substantial margin.
- *Participation by Investors* – Of the CO₂ allowances in circulation at the end of 2016, 96 million (41 percent) were held by investors. A small number of investors with compliance obligations surrendered less than 1 million allowances for 2015 Interim Compliance in the third control period. A high level of participation by investors is expected given the large current surplus of CO₂ allowances, and investor participation will reduce overall volatility as the CO₂ emissions cap tightens over the remainder of the decade.
- *Trading Activity in the Secondary Market* – The volume of futures trading increased by 22 percent, rising from 206 million CO₂ allowances in 2015 to 251 million in 2016. The volume of allowance transfers between unaffiliated firms in COATS decreased, dropping 29 percent from approximately 139 million CO₂ allowances in 2015 to 98 million in 2016. Overall, the secondary market was relatively liquid and competitive in 2016.

- *Patterns of CO₂ Allowance Acquisition* – Of the CO₂ allowances in circulation at the end of 2016, 65 percent were held by firms since the beginning of the year, 18 percent were held by firms that acquired them through auctions or state allocations in 2016, and 16 percent were held by firms that purchased them in the secondary market in 2016.

A. Distribution of Auction Awards

Figure 3 reports the quantity of CO₂ allowances that were offered and sold in each auction held in 2016 (i.e., Auctions 31 through 34) and in each year from 2008 to 2016. The height of each bar represents the percentage of CO₂ allowances (as a share of allowances sold) that was purchased by compliance entities, while the remaining share was purchased by investors without compliance obligations. Before 2015, all compliance entities are shown together. Beginning in 2015, compliance entities are divided into two categories: blue bars showing the percentage of allowances purchased by compliance-oriented entities, and red bars showing the percentage of allowances purchased by investors with compliance obligations. The table in the figure shows the numbers of offered, unsold, and sold allowances in each calendar year since 2008.

**Figure 3: Distribution of Auction Awards
Auctions 31 to 34**



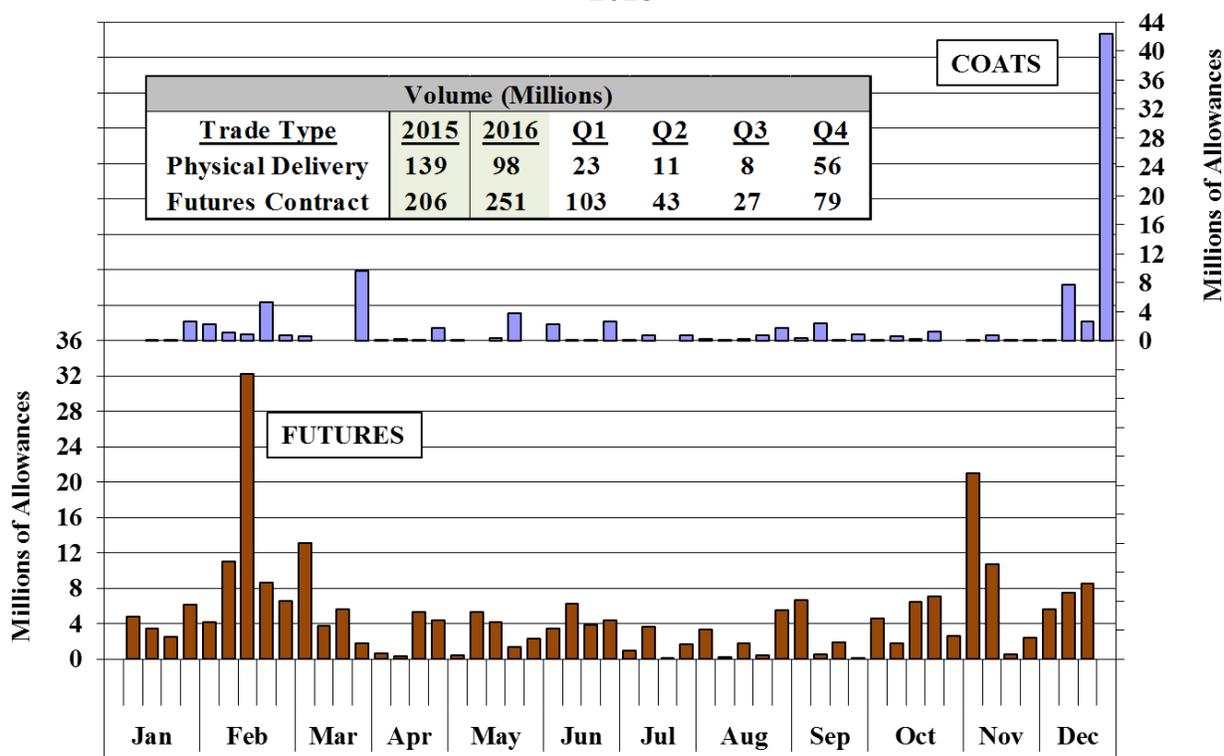
Observations regarding distribution of auction awards:

- *Compliance Entities* – The share of CO₂ allowances purchased in the auctions by all compliance entities decreased from 79 percent in 2015 to 73 percent in 2016 while the share purchased by just compliance-oriented entities increased from 49 percent in 2015 to 51 percent in 2016.
- *Investors* – The share of CO₂ allowances purchased in the auctions by investors with compliance obligations averaged 22 percent in 2015 and reached a high of 32 percent of the allowances sold in Auction 34. The share of allowances purchased by investors without compliance obligations averaged 27 percent in 2016.
- *Unsold CO₂ Allowances* – For the fourth year in a row, 100 percent of the allowances in the initial offerings of the auctions were sold.

B. CO₂ Allowance Trading Volumes

The following figure summarizes the volume of trading of futures and forward contracts on the Intercontinental Exchange (“ICE”) as well as transfers of CO₂ allowances between unaffiliated parties that were recorded in COATS on a weekly basis in 2016. The bottom portion of the figure is plotted against the left vertical axis, and shows the weekly volume of futures trading of CO₂ allowance contracts. The top portion of the figure is plotted against the right vertical axis, and shows the weekly volume of CO₂ allowance transfers between unaffiliated firms that are reported in COATS. The table shows quarterly volumes in 2016 as well a year-over-year comparison of the total volume of futures trading and CO₂ allowance transfers in COATS.

**Figure 4: Volume of Trading of CO₂ Allowances and Allowance Futures
2016**



Observations regarding CO₂ allowance trading volumes:

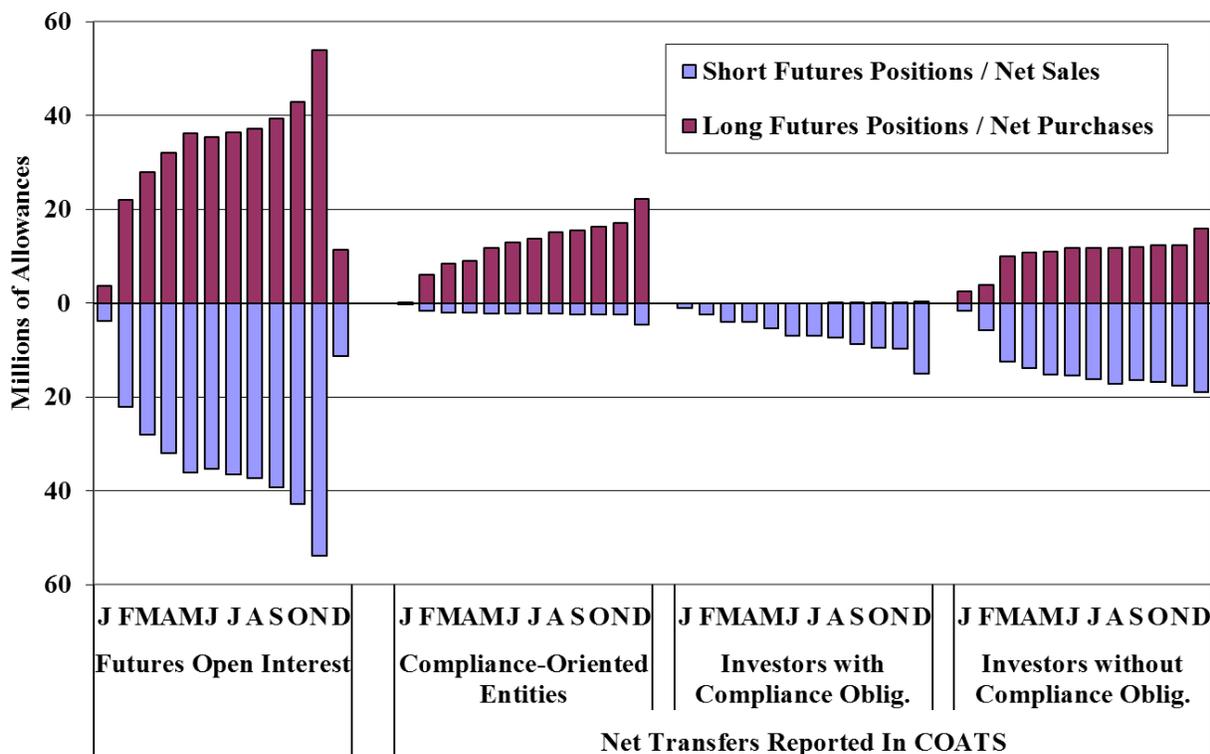
- *Volume of Futures Trading* – The volume of futures trading totaled approximately 251 million CO₂ allowances in 2016, up 22 percent from 206 million in 2015. Forty-one percent of the yearly volume occurred in the first quarter of 2016, when 103 million were traded. The highest volumes occurred in February and November when there were large price movements.
- *CO₂ Allowance Transfers* – The volume of CO₂ allowance transfers between unaffiliated firms totaled approximately 98 million in 2016, down 29 percent from 139 million in 2015. Allowance transfers rose significantly in the last week of December as a result of the settlement of the benchmark futures contract and OTC contract.

C. Acquisition of CO₂ Allowances in the Secondary Market

This section evaluates how the ownership of CO₂ allowances is affected by trading in the secondary market. Net changes in the ownership of CO₂ allowances are quantified in Figure 5 for 2016 using two measures: the open interest in RGGI futures contracts and the net purchases

and sales of CO₂ allowances by individual firms.²³ Futures open interest is based on futures positions at the end of the last business day of each month, while net purchases and sales are based on registered holdings in COATS at the end of the last business day of each month.

Figure 5: Net Changes in Futures Open Interest and Net Transfers of CO₂ Allowances²⁴ 2016



Observations regarding the acquisition of CO₂ allowances in the secondary market:

- *Open Interest in Futures* – Open interest increased throughout the year, particularly in the first quarter of 2016. The net change in open interest of futures contracts from the beginning of 2016 peaked at nearly 92 million allowances on December 23 before falling to 48 million after the settlement of the benchmark contract.

²³ Open interest is defined in Section II.E. Net purchases/sales of CO₂ allowances by a particular firm include the net change in the amount of CO₂ allowances in a firm’s COATS account that has resulted from trading (rather than the auctions or allocations). For example, if a firm purchases 100,000 CO₂ allowances from another firm, and then sells 30,000 allowances, the firm’s net purchase of allowances would be 70,000.

²⁴ The figure reports the net change in futures open interest that has occurred since January 1, 2016. The total open interest in RGGI futures products is 37 million greater than the net change reported in Figure 5. Net transfers of CO₂ allowances include transfers that occurred since January 1, 2016.

- *Net Transfers Reported by Compliance-Oriented Entities* – Overall, compliance-oriented firms used the secondary market to increase their holdings by 18 million allowances in 2016, with 26 percent of the net purchase occurring in February.
- *Net Transfers Reported by Investors with Compliance Obligations* – Investors with compliance obligations are reported separately from compliance-oriented entities because they exhibited different transaction patterns in 2016. Overall, investors with compliance obligations used the secondary market to reduce their holdings by 15 million CO₂ allowances during 2016.
- *Net Transfers Reported by Investors without Compliance Obligations* – Purely investment-focused entities without compliance obligations continued to be active in the secondary market in 2016. Some of these firms increased their CO₂ allowance holdings during 2016, while others reduced their holdings. Collectively, these entities sold a net of 3 million CO₂ allowances over the year.
- *Total Net Acquisition Reported in COATS* – The total net purchase of CO₂ allowances in 2016 (39 million) is less than half of the gross volume of transactions between unaffiliated firms (98 million as shown in Figure 4). This is because some firms have both purchased and sold CO₂ allowances in the secondary market such that the net change in their position is smaller than the total volume of their transactions. Although the total net purchase of CO₂ allowances was substantial, it was still smaller than the 60 million CO₂ allowances that were acquired in the auctions in 2016. Thus, the auctions were the principal means by which some compliance entities acquired CO₂ allowances in 2016, while others relied primarily or exclusively on the secondary market.

D. Patterns of CO₂ Allowance Holdings

The following figure combines information on the acquisition of CO₂ allowances from the auctions and state allocations with information on the purchase and sale of allowances in the secondary market and the initial holdings of allowances on January 1, 2016. Together, this information provides a summary of the holdings of CO₂ allowances in COATS accounts according to whether the allowances were acquired: (i) prior to 2016, (ii) through the primary market, or (iii) through the secondary market. Figure 6 reports several categories of CO₂ allowances that are described below.

Net Purchases in the Secondary Market includes CO₂ allowances that were held in the COATS account of a firm that purchased them in the secondary market after January 1, 2016.

Awards and Allocations – Retained in COATS Account includes CO₂ allowances that were still held in the COATS account of the firm that purchased them in an auction or acquired them

through an allocation in 2016. If a firm was a net seller of CO₂ allowances at any point in 2016, then the CO₂ allowances were first deducted from this category.

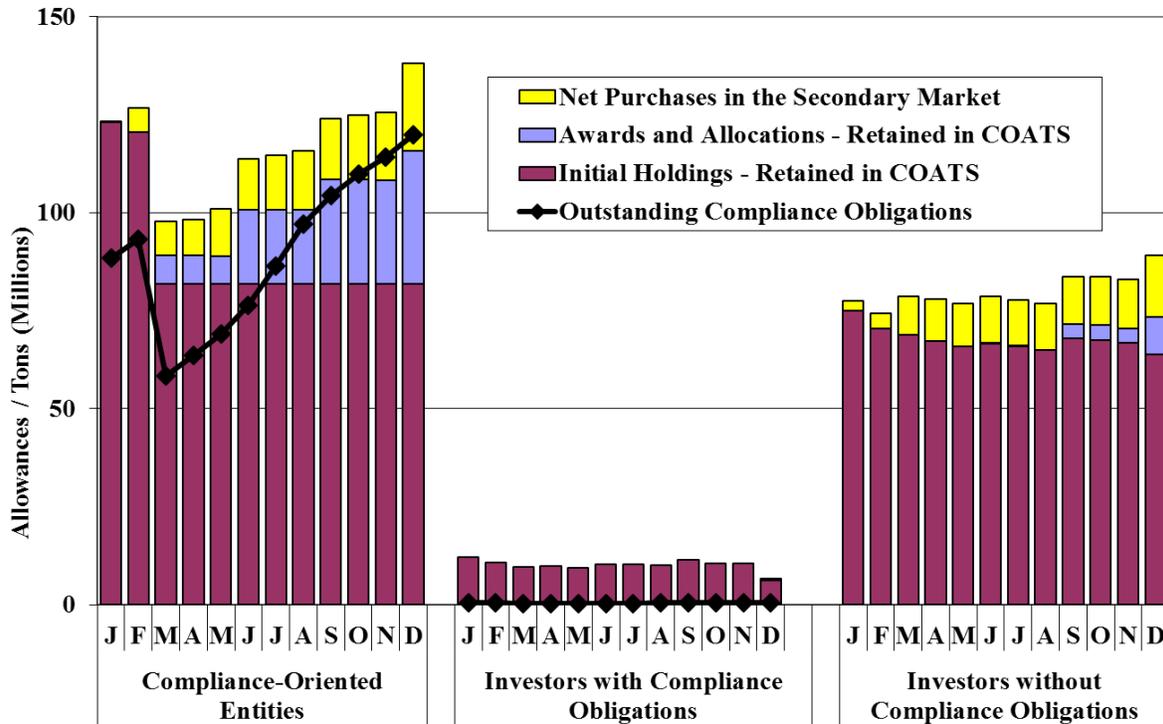
Initial Holdings – Retained in COATS Account includes CO₂ allowances that were held in the COATS account of the firm from the beginning of 2016. If a firm sold CO₂ allowances in 2016, those allowances were deducted from this category after any awards and allocations were exhausted.

For each firm, its holdings of CO₂ allowances in COATS are equal to the sum of three categories: *Initial Holdings – Retained in COATS Account*, *Awards and Allocations – Retained in COATS Account*, and its *Net Purchases in Secondary Market*.²⁵ Figure 6 shows the three categories of CO₂ allowances at the end of each month in 2016. The figure also shows the cumulative compliance obligations for compliance entities in the third control period. The information is aggregated separately for compliance-oriented entities, investors with compliance obligations, and investors without compliance obligations.

²⁵ If a firm held 15,000 allowances at the beginning 2016, purchased 50,000 allowances in an auction, purchased 100,000 allowances in the secondary market, and then sold 130,000 allowances in the secondary market, the firm would contribute:

- 0 allowances to *Net Purchases in Secondary Market*.
- 20,000 allowances to *Awards and Allocation – Retained in COATS Account*.
- 15,000 allowances to *Initial Holdings – Retained in COATS Account*.

**Figure 6: Sources of CO₂ Allowances Held in COATS Accounts
2016**



Observations regarding registered CO₂ allowance holdings:

- Holdings by Compliance-Oriented Entities* – Two hundred and thirteen million CO₂ allowances were in circulation at the beginning of January 2016. Of these, 123 million (58 percent) were held by compliance-oriented entities. These firms remained active in purchasing allowances throughout the year, and they also surrendered 41 million for 2015 Interim Compliance in March 2016. At the end of 2016, the number of allowances held by compliance-oriented entities had increased to 138 million.
- Holdings by Investors with Compliance Obligations* – Approximately 13 million of the CO₂ allowances in circulation at the beginning of 2016 were held by investors with compliance obligations. These firms surrendered less than 1 million allowances to satisfy their interim compliance obligations and were generally net sellers in the secondary market. These entities held 7 million of the allowances in circulation at the end of 2016 (3 percent).
- Outstanding Compliance Obligations in the Third Control Period* – Compliance obligations for the third control period stood at 83 million at the end of 2015. Another 79 million tons of obligations were incurred in 2016 for a total of nearly 162 million tons. Because nearly 42 million allowances were surrendered in the Interim Compliance for 2015, the total amount of outstanding compliance obligations was 120 million tons at the end of 2016.

- *Holdings by Investors without Compliance Obligations* – The share of allowances held by these entities increased from 36 percent at the beginning of 2016 to 38 percent at the end of the year, reflecting that these entities mostly held steady with an overall slight increase in holdings. At the end of 2016, entities without compliance obligations held 89 million of the allowances in circulation.

V. PARTICIPATION IN THE CO₂ ALLOWANCE MARKET

This section evaluates participation by individual firms in the CO₂ allowance market.

Participation by many firms promotes competition and helps ensure that CO₂ allowance prices are determined efficiently. Over time, firms that need CO₂ allowances for compliance should be able to acquire them through the auctions and/or the secondary market, and the holdings of individual firms should be relatively consistent with their potential uses for allowances.

This section evaluates the level of participation by individual firms in four ways: (i) the demand for allowances by individual firms, (ii) the breadth of participation in the quarterly auctions, (iii) the holdings of individual firms relative to their demand for allowances, and (iv) the breadth of participation in the trading of allowance futures contracts.

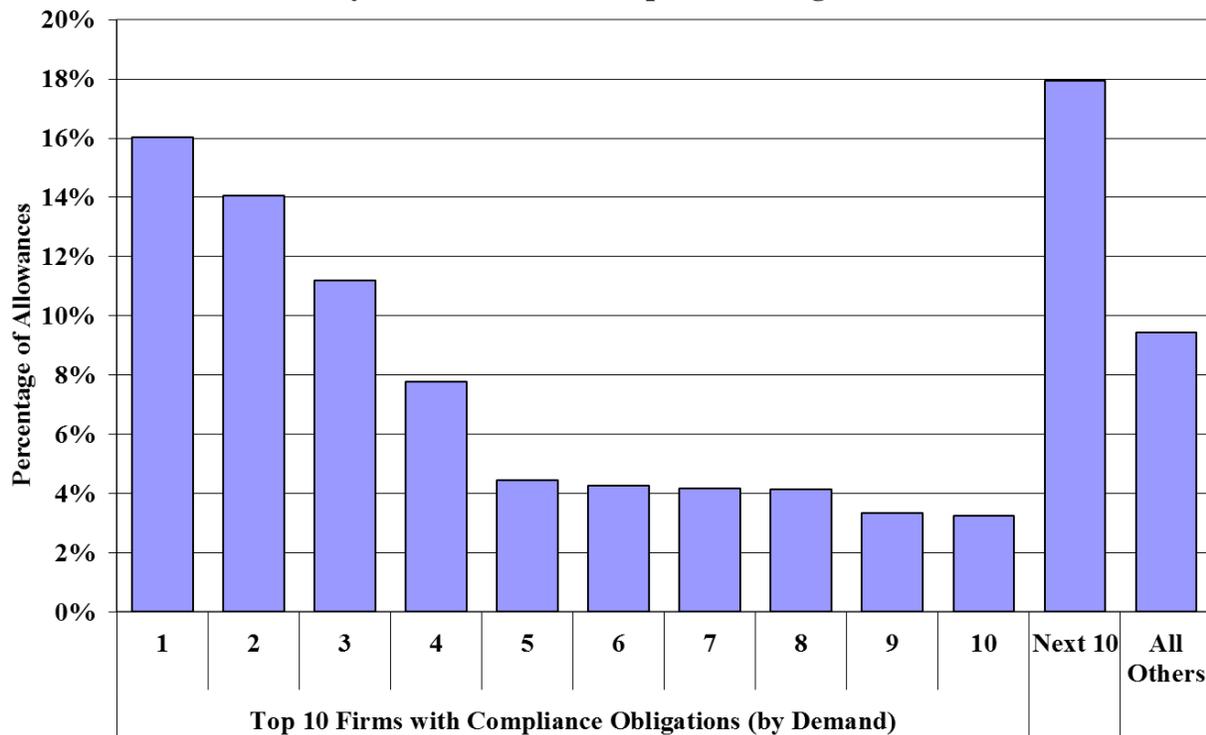
Key observations regarding participation in the CO₂ allowance market:

- *Demand for CO₂ Allowances* – The demand for CO₂ allowances is dispersed widely across firms, resulting in participation in the auctions by large number of firms. The three largest firms with compliance obligations accounted for 41 percent of the total projected demand and the top ten accounted for 73 percent.
- *Participation in the Auctions* – Large numbers of bidders participated in the quarterly auctions. The number of compliance-oriented entities submitting bids fell to an average of 28, while the number of participating investors increased from 13 in 2015 to an average of 14 in 2016.
- *Distribution of CO₂ Allowances Awarded* – Auction awards were widely distributed across different types of firms as the top ten compliance-oriented entities received 51 percent, while the top ten investors received 40 percent.
- *Distribution of CO₂ Allowance Holdings* – Holdings are distributed widely across firms. The top ten compliance-oriented entities accounted for 42 percent of the total holdings and smaller compliance-oriented entities accounted for 16 percent of holdings at the end of 2016. The share of allowances held by the top ten investors decreased from 48 percent at the end of 2015 to 41 percent at the end of 2016.
- *Concentration of Futures Holdings* – Many firms have open interest in RGGI CO₂ allowance futures and options, but a relatively small number of firms account for large shares of the net long and short positions futures contracts. The net long positions of the top four firms accounted for an average of 41 percent of the total long positions for the weeks that were published, while the net short positions of the top four firms accounted for an average of 51 percent of the total short positions.

A. Demand for CO₂ Allowances

The following figure summarizes the projected demand for CO₂ allowances of individual compliance entities at the end of 2016. We project the demand of each compliance entity for CO₂ allowances based on historical CO₂ emissions patterns and expected changes in future market conditions. The projected demand is shown for each of the top ten compliance entities (i.e. the ten firms with the highest projected demand), the second ten compliance entities as a group, and all other compliance entities as a group. The projected demand is reported in Figure 7 as a percentage of the total projected market demand.

**Figure 7: Estimated Demand for CO₂ Allowances
By All Firms with Compliance Obligations**



Observations regarding demand for CO₂ allowances:

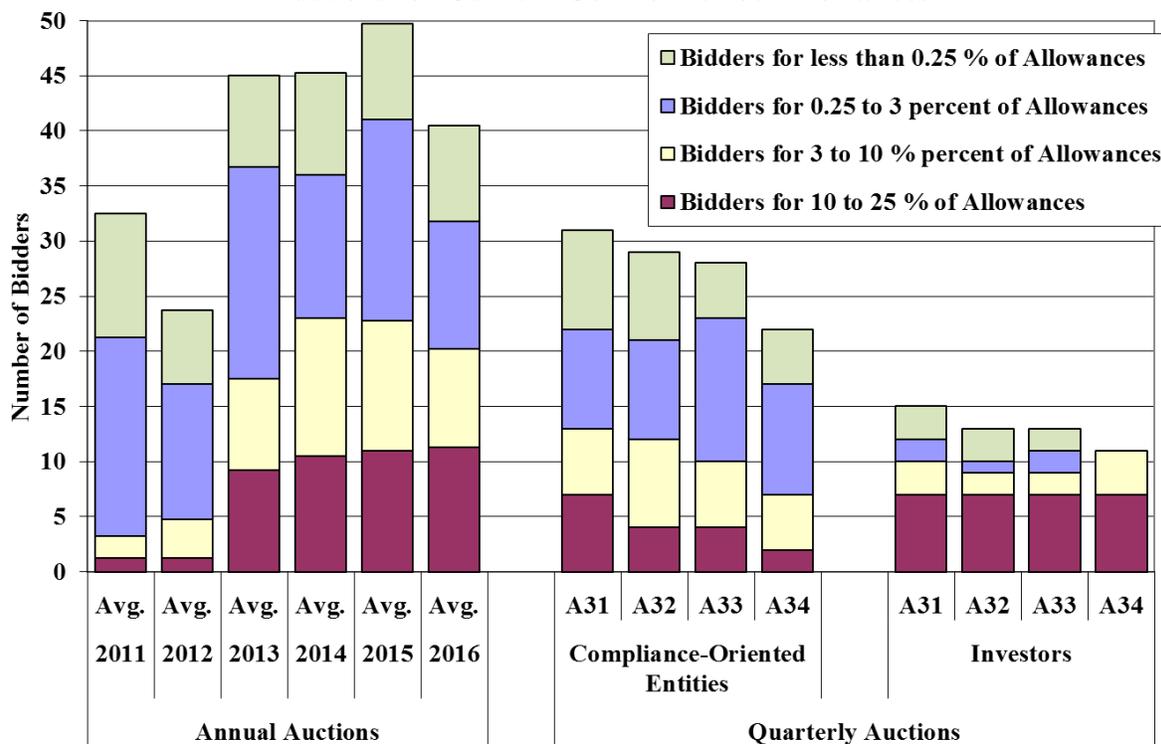
- *Demand for CO₂ Allowances* – The demand for CO₂ allowances is dispersed relatively widely across firms. The three largest compliance entities account for 41 percent of the total projected demand. The top ten compliance entities account for 73 percent of the total projected market demand, while the next ten compliance entities account for 18 percent, and compliance entities that are not among the top 20 account for 9 percent.

- *Concentration of Demand* – The concentration of demand by compliance entities increased slightly from 2015. As a share of total demand, the top compliance entity increased by 1 percent and the top five increased by 3 percent.

B. Participation in RGGI Auctions

The following figure summarizes the breadth of participation in the four auctions during 2016. The figure reports the number of firms that submitted bids in each auction. For 2016, the number of bidders is shown separately based on whether the bidder is a compliance-oriented entity or an investor in the RGGI marketplace. The figure shows these quantities averaged across the auctions in each year from 2011 to 2016.²⁶

**Figure 8: Number of Bidders According to the Quantity of Bids Submitted
Auctions for Current Control Period Allowances**



Observations regarding participation in the RGGI auctions:

²⁶ For example, in Auction 31, approximately 14.8 million CO₂ allowances were offered. So, a firm that submitted bids for 200,000 allowances would be counted in the “0.25 to 3 percent” category, since $200,000 \div 14.8 \text{ million} = 1.3 \text{ percent}$.

- *Participation* – In the 2016 auctions, the number of bidders ranged from 33 to 46 and averaged 41, a decrease of 20 percent from an average of 50 bidders in the 2015 auctions. The number of compliance-oriented entities submitting bids decreased from an average of 37 in 2015 to 28 in 2016, while the number of participating investors increased from 13 in 2015 to an average of 14 in 2016.
- *Large and Small Bidders* – The number of large bidders (i.e., firms submitting bids for more than three percent of the allowances in a current control period offering) averaged 20 in 2016, down from 23 in 2015. The average number of small bidders (i.e., firms submitting bids for up to three percent of allowances offered for sale) decreased from 27 in 2015 to 20 in 2016.
- *Competition* – Participation by a large number of firms promotes competition and helps ensure that the auction clearing price reflects the market value of CO₂ allowances. Despite reduced participation from 2015, the levels of participation in 2016 were healthy, and we found no material evidence of anti-competitive conduct or significant barriers to participation in our reviews of the bids and the qualification process of each auction.

C. Acquisition of CO₂ Allowances by Individual Firms

In a well-functioning market, we expect each firm to purchase a number of CO₂ allowances that is generally consistent with its demand. Individual firms may purchase a larger or smaller share according to how the current price of CO₂ allowances compares to their expectations of allowance prices in the future. Firms that believe CO₂ allowances are currently undervalued can be expected to purchase a larger share, while firms that believe allowances are overvalued can be expected to purchase a smaller share. Thus, competition by many firms helps ensure that the current price of CO₂ allowances in the auctions and in the secondary market reflects reasonable expectations.

The following two figures examine the distribution of CO₂ allowances across individual firms following the seventh full year of the RGGI market's operation. Figure 9 illustrates how broadly CO₂ allowances were distributed in the auctions, while Figure 10 illustrates how the holdings of allowances in COATS accounts were distributed after the close of 2016. The figures show that CO₂ allowances have generally been acquired by firms in quantities that are consistent with their demand, which is a positive indicator regarding the competitiveness of the market.

Figure 9 reports the average quantities of CO₂ allowances that were awarded to firms in the auctions in 2015 and 2016. The awards are shown for each of the top ten compliance-oriented

entities (i.e. the ten firms with the highest projected demand) and for each of the top ten investors (i.e., the ten firms with the largest total awards). Compliance-oriented entities are ranked in descending order based on total awards rather than demand. The table also shows the level of awards given to remaining (not included in the top 10) firms in each category as a group.

**Figure 9: Distribution of Auction Awards
2015 – 2016**

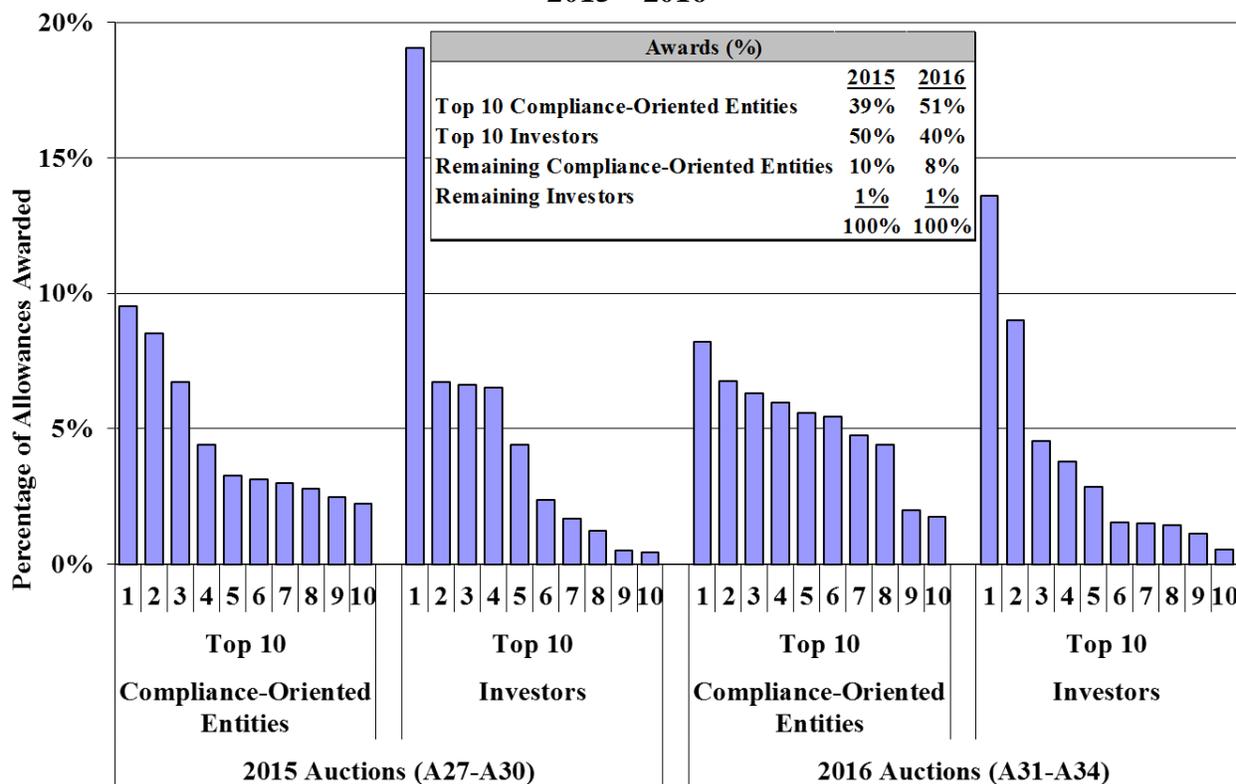
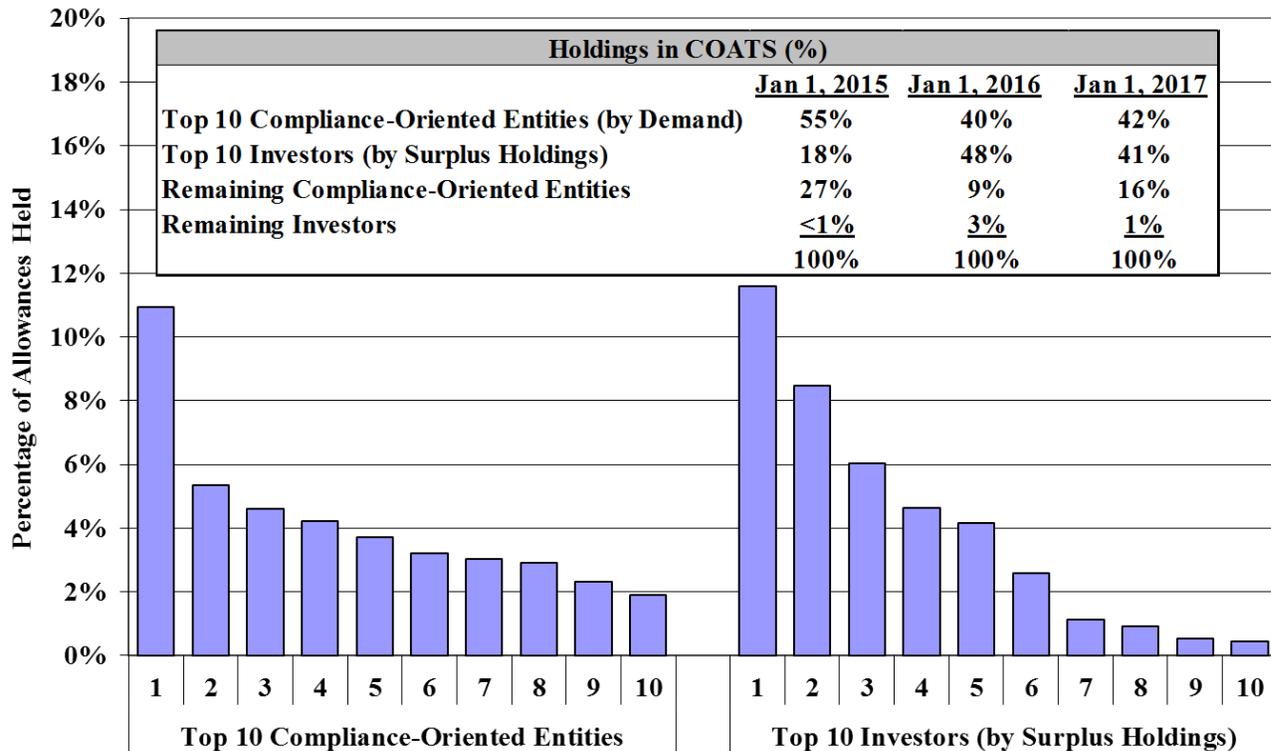


Figure 10 reports the quantities of CO₂ allowances that were held in the COATS accounts of individual firms at the beginning of January 2017, following the delivery of contracts dated for December 2016 delivery. The holdings are shown for each of the top compliance-oriented entities (i.e. the ten firms with the highest projected demand) and for the top ten investors. The top ten investors are ranked in descending order based on total holdings rather than demand. The table also shows the level of holdings of the remaining (not included in the top ten) compliance-oriented entities as a group and investors as a group.

**Figure 10: Distribution of CO₂ Allowance Holdings
January 1, 2017**



Observations regarding the distribution of CO₂ allowances:

- *Distribution of CO₂ Allowances Awarded* – The share of awards allocated to the top ten compliance-oriented entities increased from 39 percent in 2015 to 51 percent in 2016, while the share of awards allocated to the top ten investors decreased from 50 percent in 2015 to 40 percent in 2016.
- *Distribution of CO₂ Allowance Holdings* – The holdings of CO₂ allowances were distributed across compliance-oriented entities at the close of 2016 at levels that were generally consistent with their demand, and a small number of these entities owned a moderate surplus. The share of holdings of the top ten compliance-oriented entities was 42 percent at the end of 2016, while the share of holdings of smaller compliance-oriented entities was 16 percent. The share of holdings by the top ten investors was 41 percent at the end of 2016. The distribution of allowance holdings is consistent with competitive expectations given that the private bank of allowances far exceeds the compliance obligations of firms thus far in the third control period. The large surplus makes it more difficult for one firm or a small number of firms to hoard allowances.

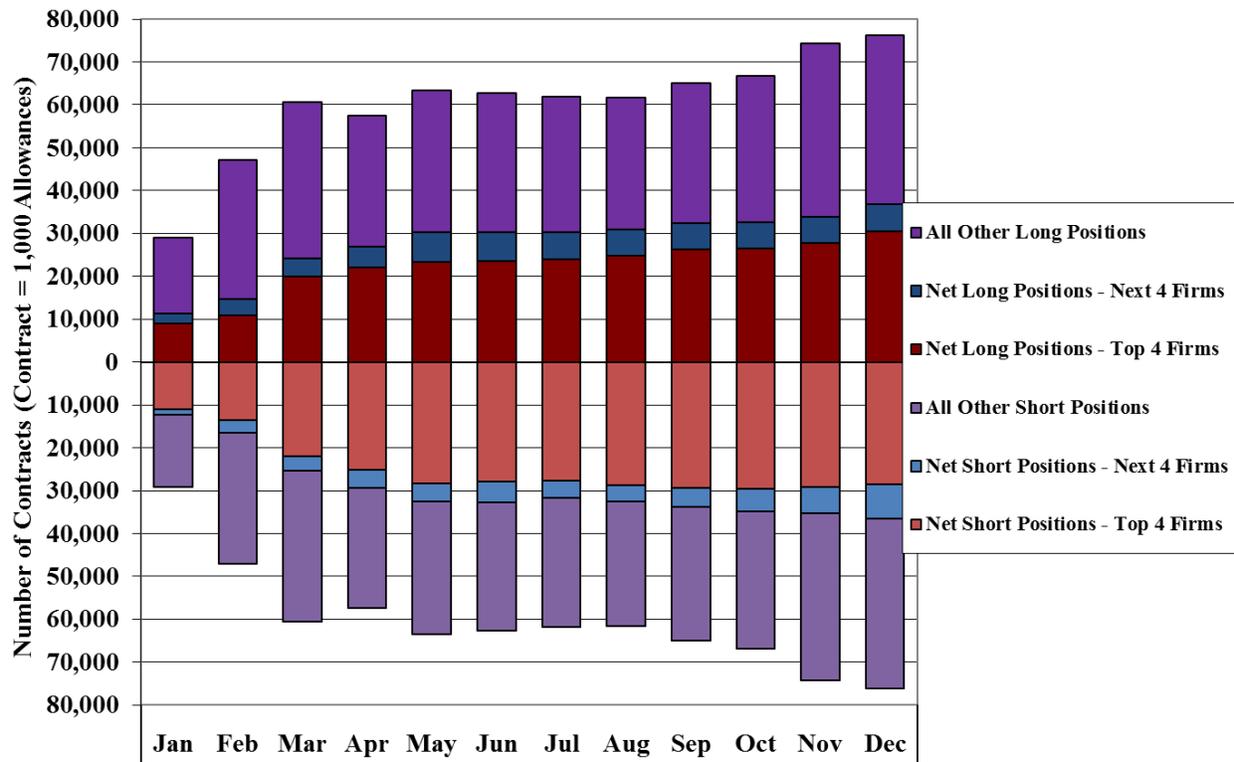
D. Participation in the CO₂ Allowance Futures Market

Additional information about the trading of futures, forwards, and options is available in the weekly Commitments of Traders (“COT”) reports, which are published by the Commodity Futures Trading Commission (“CFTC”) ²⁷ for each week when greater than 20 firms have reportable positions in a particular product.

Figure 11 summarizes the concentration of open interest in Vintage 2016 ICE futures and options contracts when information was available from the CFTC. The figure reports the average monthly net long positions in three categories: (i) the four firms with the largest long positions, (ii) the four firms with the largest long positions not including the Top 4 (see “Next 4 Firms”), and (iii) all other long positions. The figure also reports the average monthly net short positions for three categories.

²⁷ Each day, firms with an open interest of 25 contracts or more are required to report their positions to the CFTC. Each Tuesday, the CFTC publishes the COT report, which summarizes the positions of market participants.

Figure 11: Concentration of Open Interest in CCFE Futures and Options



Observations regarding the concentration of open interest in futures and options contracts by individual firms:

- *Number of Participants* – The number of participants in the market for RGGI CO₂ allowance derivatives increased in 2016, and the COT report was published 52 weeks of the year as compared to 47 weeks in 2015 and just 34 weeks in 2014. For the weeks that were reported, up to 35 firms had significant positions in RGGI Vintage 2016 futures contracts.²⁸
- *Concentration of Ownership* – Many firms have open interest in RGGI CO₂ allowance futures and options, although a small number of firms account for large shares of the net long and short positions in Vintage 2016 contracts. The net long positions of the top four firms accounted for an average of 41 percent of the total long positions for the weeks that were published, while the net short positions of the top four firms accounted for an average of 51 percent of the total short positions.

²⁸ The COT report was not published near the end of December 2016 because fewer than 20 firms held reportable positions in RGGI futures.

VI. DISCUSSION OF MARKET MONITORING

As the RGGI Market Monitor, we evaluate the conduct of market participants in the auctions and in the secondary market to identify potential anti-competitive conduct. We also assess whether the auctions were administered properly by the auction administrator.

Participation in the auctions by a large number of firms promotes competition and helps ensure that the auction clearing price reflects the market value of allowances. Hence, the participation by a substantial number of firms as observed in Figure 8 is a positive indicator regarding the competitiveness of the first 34 auctions. We have found no material evidence of anti-competitive conduct or significant barriers to participation in our reviews of the bids and the qualification process for each product in each auction. We also found that the auctions were conducted in accordance with the noticed rules and bids received.

In our monitoring of the secondary market, we evaluate whether firms could potentially hoard a substantial share of the supply of allowances to influence prices or to prevent a competitor from obtaining allowances. Based on our review of the holdings of individual firms, we find no evidence that hoarding is a significant concern, and that the holdings of individual firms are generally consistent with their expected need for allowances over the current control period. Figure 6 shows that compliance-oriented entities as a group hold a comfortable surplus of allowances, while Figure 10 demonstrates that the allowances are adequately distributed across the COATS accounts of individual compliance-oriented entities.

Another potential concern is that a firm expecting to purchase CO₂ allowances in the auction might sell a large number of futures contracts in an effort to push prices in the secondary market below the competitive level. Such a firm might profit from buying a large number of CO₂ allowances in the auction at a discount if the bidding in the auction were influenced by the depressed futures price. For this to be a profitable strategy, the firm would need to be able to substantially depress the futures price with a relatively small amount of sales—an amount smaller than the amount of CO₂ allowances it planned to buy in the auction. The best protection against this strategy is a market where other firms respond by making additional purchases. Firms that are looking for an opportunity to reduce their short positions or to purchase CO₂

allowances for their future compliance needs help limit the effectiveness of a strategy to depress prices below the competitive level. Such firms have a strong incentive to make additional purchases if a firm deliberately attempts to depress the futures price.

We have found no material evidence of anti-competitive conduct or significant barriers to participation in the auctions and in the secondary market, and we have found that price variations are generally driven by reasonable expectations related to the long-term supply and demand for allowances.