
RGGI Inc.



**REPORT ON THE SECONDARY MARKET
FOR RGGI CO₂ ALLOWANCES: FIRST QUARTER 2017**

Prepared for:

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

Prepared By:

**POTOMAC
ECONOMICS**

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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.

A. INTRODUCTION AND SUMMARY

The primary market for RGGI CO₂ allowances consists mainly of the auctions where allowances are initially sold. Once a CO₂ allowance is purchased in the primary market, it can then be resold in the secondary market. The secondary market for RGGI CO₂ allowances comprises the trading of physical allowances and financial derivatives, such as futures and options contracts.

The secondary market is important for several reasons. First, it gives firms an ability to obtain CO₂ allowances at any time during the three months between the RGGI auctions. Second, it provides firms a way to protect themselves against the potential volatility of future auction clearing prices. Third, it provides price signals that assist firms in making investment decisions in markets affected by the cost of RGGI compliance.

This report provides a summary of activity in the secondary market in the first quarter of 2017 and discusses the results of our market power screens. Several patterns have emerged in this period in the secondary market:

- CO₂ Allowance Prices – CO₂ allowance futures prices averaged \$3.43, down 17 percent from the previous quarter and 43 percent from the first quarter of 2016.
 - ✓ Prices initially rose from around \$3.50 to nearly \$4.00 in early February before falling to around \$3.30 at the end of February. After Auction 35 cleared at \$3.00 in early March, prices in the secondary market generally ranged between \$3.05 and \$3.30 over the remainder of the quarter.
- Secondary Market Activity – Futures trading volumes and the volume of allowance transfers sharply decreased from the fourth quarter.
 - ✓ The volume of trading of RGGI futures was 18.8 million CO₂ allowances in the first quarter of 2017, which was down 82 percent from the first quarter of 2016 when trading volumes were elevated during a period of falling prices.
 - ✓ The total volume of CO₂ allowance transfers between unaffiliated firms was 12.8 million, which was down 77 percent from the previous quarter. This pattern is typical because a large number of allowances are transferred at the end of December every year as a result of the closing of futures contracts.
- CO₂ Allowance Holdings – At the end of the first quarter of 2017:
 - ✓ There were 209 million CO₂ allowances in circulation.
 - ✓ Compliance-oriented entities held approximately 112 million of the allowances in circulation (54 percent).

- ✓ Approximately 114 million of the allowances in circulation (55 percent) are believed to be held for compliance purposes.

We evaluate information on the holdings of CO₂ allowances and allowance derivatives as well as the demand for allowances to identify firms that may have acquired a position that raises competitive concerns. In the current study period, we find no evidence of anticompetitive conduct.

B. BACKGROUND

The secondary market for RGGI CO₂ allowances comprises the trading of physical allowances and financial derivatives, such as futures, forward, and option contracts. A physical allowance trade occurs when the parties to the transaction register the transfer of ownership in RGGI's CO₂ Allowance Tracking System ("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 compliance year of the CO₂ allowance that is to be transferred. One standard futures contract equals 1,000 RGGI allowances.¹
- *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 \$5 strike price, and December 2015 expiration date. If the price of the corresponding forward contract rose to \$5.75, the firm could exercise the option to buy CO₂ allowances at \$5 and immediately sell them at \$5.75. Alternatively, if the price of the forward contract stayed below \$5, the firm

¹ More precisely, a futures contract requires parties with an open interest to post financial assurance in an account with the exchange until the contract reaches expiration. The exchange continually withdraws and deposits funds according to changes in the prices of the contracts in which the party has interest. For example, if a firm buys a contract for 1,000 allowances at \$3.50/allowance, the purchasing firm (firm with a long position) must put \$3,500 in an account (or whatever share of the entire liability the exchange requires). If the futures price declines to \$3/allowance, the exchange transfers \$500 from the account of a firm with a long position to the account of a firm with a short position (firm that sold a contract), and the firm with a long position is only required to keep \$3,000 in the account. At the end of the delivery month, allowances are exchanged for funds according to the closing price on the last day of the month.

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, forward, and option 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 forwards, they usually require less financial security, making 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 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.

The 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. Option-implied volatility refers to volatility estimates that are derived by analyzing the price and other terms of an option contract compared with the price of CO₂ allowances.

Compliance entities and their affiliates includes firms that are believed to: (i) have a parent-subsidiary relationship with a compliance entity, (ii) be subsidiaries of a parent company that has a large interest in a compliance entity, (iii) have substantial control over the operation of a budget source and/or responsibility for acquiring RGGI allowances to satisfy its compliance obligations.

Compliance-oriented entities include compliance entities that appear to acquire and hold allowances primarily to satisfy their compliance obligations. 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 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.

The number of allowances that are believed to be *held for compliance purposes* includes 100 percent of the allowances held by compliance-oriented entities and a portion of allowances held by other compliance entities (i.e., entities with compliance obligations that are not included in the compliance-oriented category).

C. SUMMARY OF PRICES

This section summarizes prices in the secondary market for RGGI CO₂ allowances in the first quarter of 2017. Figure 1 summarizes transaction prices in the secondary market for CO₂ allowances, including the prices of allowance transfers registered in COATS² and the prices of futures contract trades on the Intercontinental Exchange (“ICE”). Figure 2 summarizes the option-implied (i.e., expected) volatility of RGGI CO₂ allowance prices based on an analysis of the trading of options contracts.³ Key observations regarding RGGI CO₂ allowance prices:

- Futures prices averaged \$3.43, down 17 percent from the previous quarter. Prices initially rose from around \$3.50 to nearly \$4.00 in early February before falling to slightly above \$3.00 by the end of the quarter.
- Although the prices of ICE futures were generally consistent with COATS transfer prices, the average COATS transfer price was nearly \$1 higher than the average futures price because of several high-priced COATS transactions that resulted from the closing of contracts whose pricing terms were set in 2015, when prices were higher.
- The clearing price in Auction 35, held on March 8, was \$3.00. This was down from Auction 34 in December 2016, which cleared at \$3.55.
- Option trading was up slightly from the previous quarter, but still down compared with recent years. Eight option trades were recorded on ICE in the first quarter, up from five in the fourth quarter.

Prices of CO₂ Allowances and Allowance Derivatives

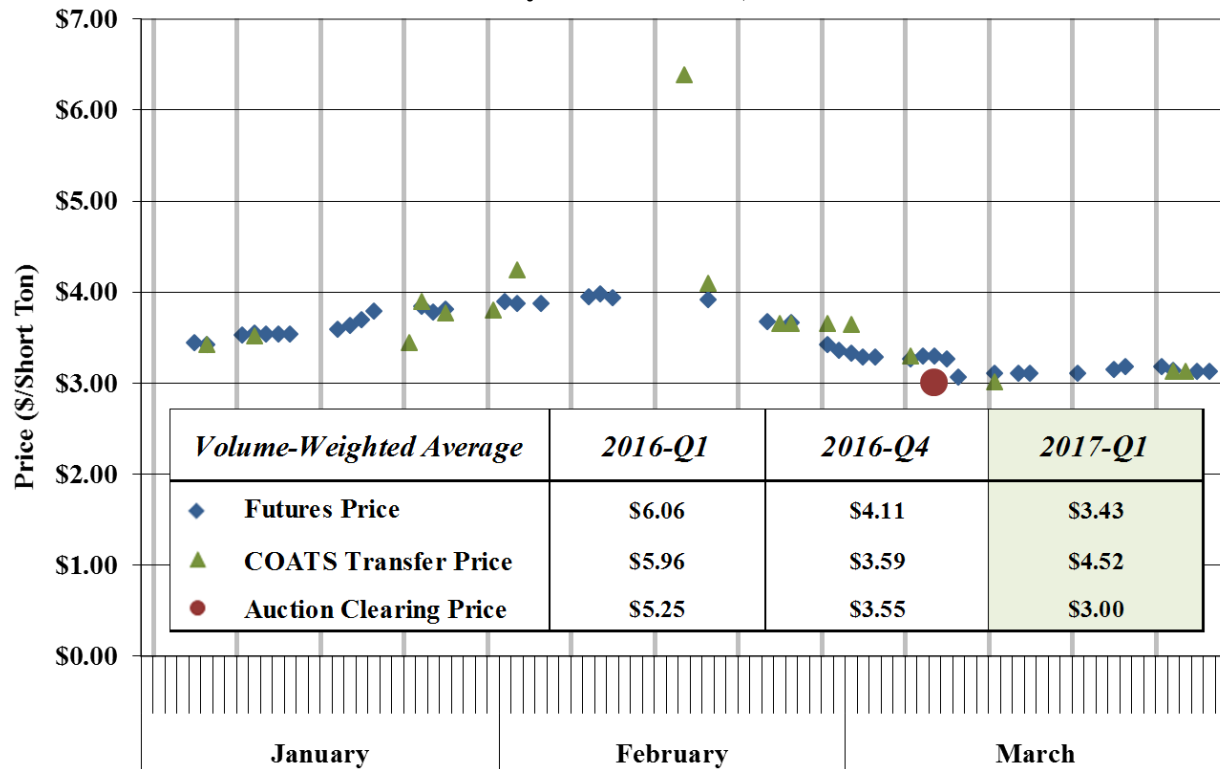
Figure 1 summarizes prices in the secondary market during the period. The blue diamonds show the price of ICE futures on days with trading volume. The green triangles show the volume-weighted average prices of physical deliveries registered in COATS on days with transactions when the price was recorded (“COATS transactions”). The red circle shows the clearing price of the CO₂ allowances that were sold in RGGI Auction 35, which was held on March 8. Figure 1 also shows volume-weighted average prices for each category in the first quarter of 2017

² Parties are required to report the transaction price if there is an underlying financial transaction related to the transfer of allowances between accounts.

³ 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.

compared to the previous quarter and the first quarter of the previous year. Volume-weighted average prices for the first, second, and third control period CO₂ allowances are shown together.

**Figure 1: Prices in the Secondary Market for RGGI CO₂ Allowances⁴
January 1 to March 31, 2017**



Key observations regarding CO₂ allowance prices:

- The average price of CO₂ allowance transfers in COATS during the first quarter of 2017 was \$4.52, approximately 26 percent higher than in the previous quarter and 24 percent lower than the first quarter of 2016.
- The prices of ICE futures trades were generally consistent with COATS transfer prices throughout the first quarter. However, the average COATS transfer price was nearly \$1 higher than the average futures price because of several high-priced COATS transactions that resulted from the closing of contracts whose pricing terms were set in 2015, when prices

⁴ Sources: Auction clearing prices are available at www.rggi.org/market/co2_auctions/results, ICE futures prices are available at www.theice.com, and the prices of physical deliveries are based on information in COATS. Futures prices are shown for the prompt month contract settlement price even if the volume traded was for another contract.

were higher. The average futures price of \$3.43 was 43 percent lower than in the first quarter of 2016.

- The clearing price in Auction 35 was \$3.00, which was slightly lower than secondary market prices leading up to, and after, the auction. The auction clearing price dropped \$0.55 from Auction 34 (which was held in December 2016).

Prices of Options for CO₂ Allowances

The clearing prices of option contracts provide insight about how the market expects the price of the underlying commodity to move in the future. The price of an option depends on two factors: (i) the expected value of the underlying commodity relative to the strike price of the option, and (ii) the expected volatility of the underlying commodity over the period before the expiration date. When call option price decreases coincide with put option price increases, it signals a decrease in the expected price of the underlying commodity. Conversely, when call option prices and put option prices move in the same direction, it signals a change in the expected volatility of the underlying commodity price.

Key observations regarding the pricing of options for CO₂ allowances in the first quarter of 2017:

- Eight option trades were recorded on ICE in the first quarter, up from five in the fourth quarter.
- The strike prices of the put options ranged from \$3.00 to \$3.75, while the call options were sold with strike prices of \$4.25 and \$5.00. These strike prices provide some indication of the market's expectations for the potential range of variation in allowance prices.

Volatility of CO₂ Allowance Prices

Market-based emissions reduction programs such as RGGI are designed to give firms efficient incentives to reduce or offset emissions. In the short-term, high-emitting generators will 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, retire older inefficient generation, and 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.

Expected price volatility is affected by elements of the RGGI program that promote allowance price stability. Potential upward price movements are limited by the Cost Containment Reserve (“CCR”), which allows for the sale of a fixed number of allowances in addition to the cap if the auction clearing price reaches the CCR Trigger Price.⁵ Potential downward price movements are limited by the Reserve Price, which currently prevents allowances from being sold in the auction at a price below \$2.15 (and is indexed to inflation).

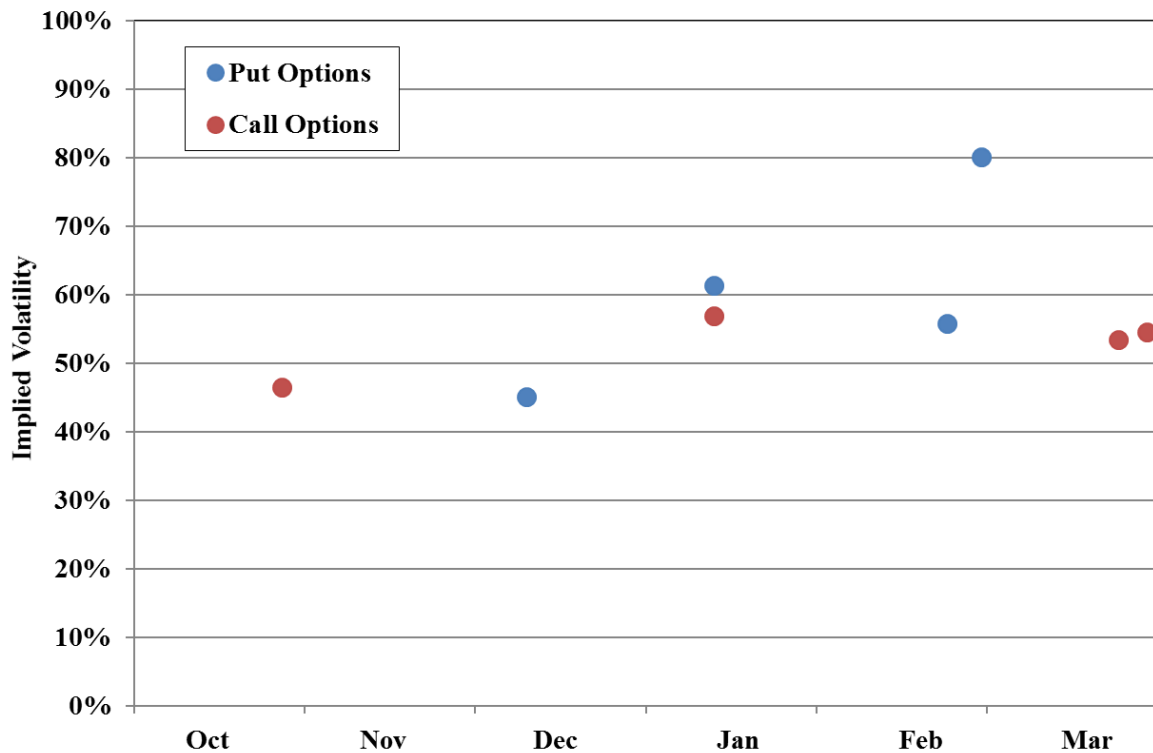
One measure of the volatility of CO₂ allowance prices is known as option-implied volatility, which measures the volatility that is implied by the trading of option contracts for CO₂ allowances. If a firm perceives that CO₂ allowance prices are volatile, the firm may be willing to pay a high price for 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.

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 over the last six months.⁶ 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 less than 90 days prior to the expiration date. Excluding these contracts reduces variations in implied volatility that are driven by short-term issues such as the timing of the trades within a particular quarter (i.e. around the time of each quarterly auction).

⁵ From 2015 to 2020, the annual withdrawal limit is ten million allowances. Ten million CCR allowances were released in Auction 29, which was held in September 2015. The CCR Trigger price for 2015 was \$6.00, it rose to \$8.00 in 2016 and \$10.00 in 2017, and it will rise 2.5 percent in each year through 2020.

⁶ Black’s model for valuing futures options is used to estimate the option-implied volatilities of RGGI allowance futures prices.

**Figure 2: Option-Implied Volatility of CO₂ Allowance Futures Prices
October 1, 2016 to March 31, 2017**



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

- In the fourth quarter of 2016, implied volatility ranged between 45 and 47 percent.
- In the first quarter of 2017, implied volatility ranged between 53 and 80 percent, although the number of trades was much lower in the fourth quarter.
- Overall, option-implied volatility levels averaged 60.4 percent in the first quarter of 2017.

D. VOLUMES AND OPEN INTEREST

This section evaluates the volume of COATS transactions (i.e., transfers of CO₂ allowances between unaffiliated parties as recorded in COATS) as well as the volume of trading and the level of open interest in exchange-traded futures and options. Figure 3 examines the volumes of transactions recorded in COATS and of futures trading. Figure 4 summarizes the level of open interest in exchange-traded RGGI futures and option contracts. Figure 5 evaluates the concentration of firms with open interest in exchange-traded RGGI futures and option contracts.

Key observations regarding trading volumes and open interest in the first quarter of 2017:

- Secondary market activity was typical for the first quarter of the calendar year when a large share of the open futures and options contracts are settled.
 - ✓ The volume of CO₂ allowance transfers between unaffiliated firms was 12.8 million, down nearly 77 percent from the previous quarter and 45 percent from the first quarter of 2016.
 - ✓ Open interest in RGGI futures rose steadily from 48.0 million allowances at the end of the fourth quarter of 2016 to 53.5 million allowances at the end of the first quarter.
- RGGI futures trading volume was 18.8 million CO₂ allowances in the first quarter of 2017, which down 76 percent from the previous quarter and 82 percent from the first quarter of 2016, indicating a significant reduction in secondary market activity from recent quarters.
- There were 209 million CO₂ allowances in circulation.
 - ✓ Compliance-oriented entities held approximately 112 million of the allowances in circulation (54 percent).
 - ✓ Approximately 114 million of the allowances in circulation (55 percent) are believed to be held for compliance purposes.

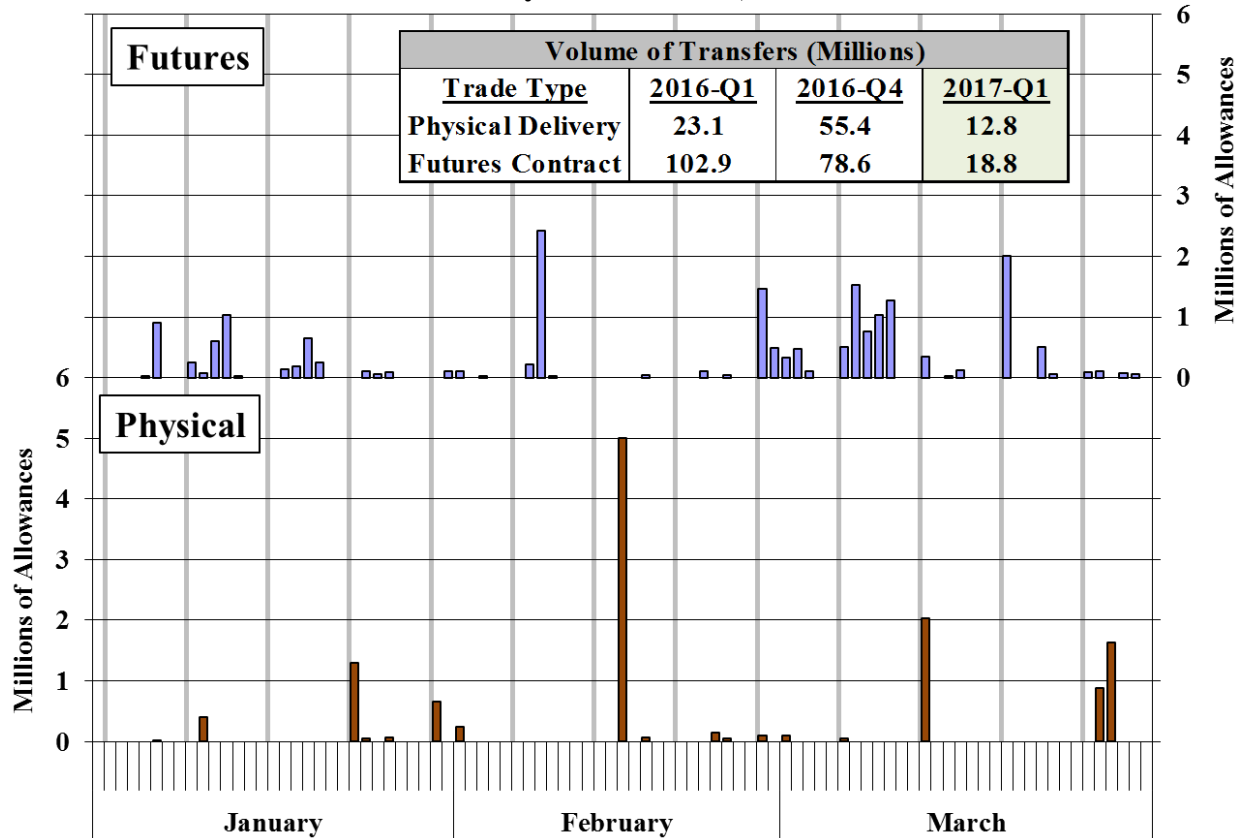
Volume of CO₂ Allowance Transfers, Futures, and Options

Figure 3 summarizes the volume of transfers of CO₂ allowances between the COATS accounts of unaffiliated firms and the volume of trading of RGGI futures listed on ICE. The figure also shows the volume of transfers in the first quarter of 2017 compared to the previous quarter and to the first quarter of 2016.⁷ The volume of futures trading and transfers of CO₂ allowances for

⁷ Firms are categorized as affiliated based on available information. As a result, calculations provided in previous reports may be inconsistent with results in this report when new information becomes available.

each control period are shown together because all CO₂ allowances are essentially interchangeable for compliance purposes.

**Figure 3: Volume of CO₂ Allowance Transfers Between Unaffiliated Parties⁸
January 1 to March 31, 2017**



Key observations regarding the volume of transfers of CO₂ allowances in COATS between unaffiliated firms:

- The total volume of CO₂ allowance transfers between unaffiliated firms was 12.8 million, down nearly 77 percent from the previous quarter and almost half of the transfer volume from the first quarter of 2016.

Key observations regarding the volume of trading of RGGI futures and options contracts:

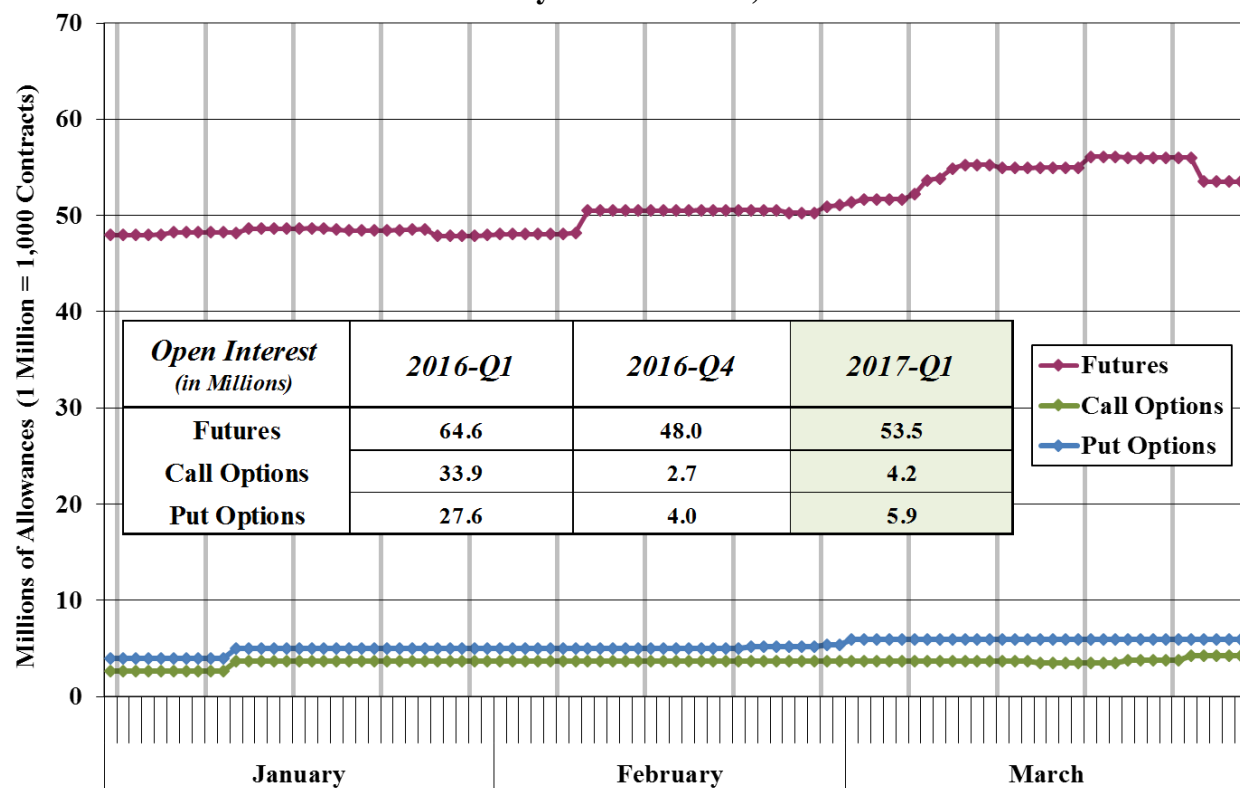
⁸ Source: CO₂ allowance transfers are based on information in COATS.

- The total volume of trading of RGGI futures listed on ICE was 18.8 million CO₂ allowances in the first quarter of 2017, down 76 percent from the previous quarter and a decrease of 82 percent from the first quarter of 2016.
- Approximately 22 percent of the futures trading volume listed on ICE during the first quarter of 2017 was for contracts that settled during the quarter. An additional 70 percent of the volume of trading was for contracts that will settle in December 2017.
- The total volume of options traded in the first quarter of 2017 was nearly 10 million CO₂ allowances, an increase of several million allowances over the previous quarter.

Open Interest in Exchange-Traded RGGI Futures and Options

Figure 4 summarizes the level of open interest in exchange-traded futures and options listed on the ICE during the first quarter of 2017. The red line shows the level of open interest in futures contracts. The green line shows the level of open interest in call options. The blue line shows the level of open interest in put options.

**Figure 4: Open Interest in RGGI Futures and Options
January 1 to March 31, 2017**



Key observations regarding the level of open interest in RGGI futures and options:

- The total open interest in RGGI futures rose steadily from nearly 48 million allowances at the end of the fourth quarter of 2016 to nearly 54 million allowances by the close of the first quarter of 2017.
- The open interest in RGGI call options increased 58 percent from 2.7 million at the end of the fourth quarter of 2016 to 4.2 million at the end of March.
- The open interest in RGGI put options increased similarly to the call options, rising by 48 percent from the beginning to the end the first quarter of 2017.
- The level of open interest across RGGI options products increased from the end of 2016.

Concentration of Open Interest

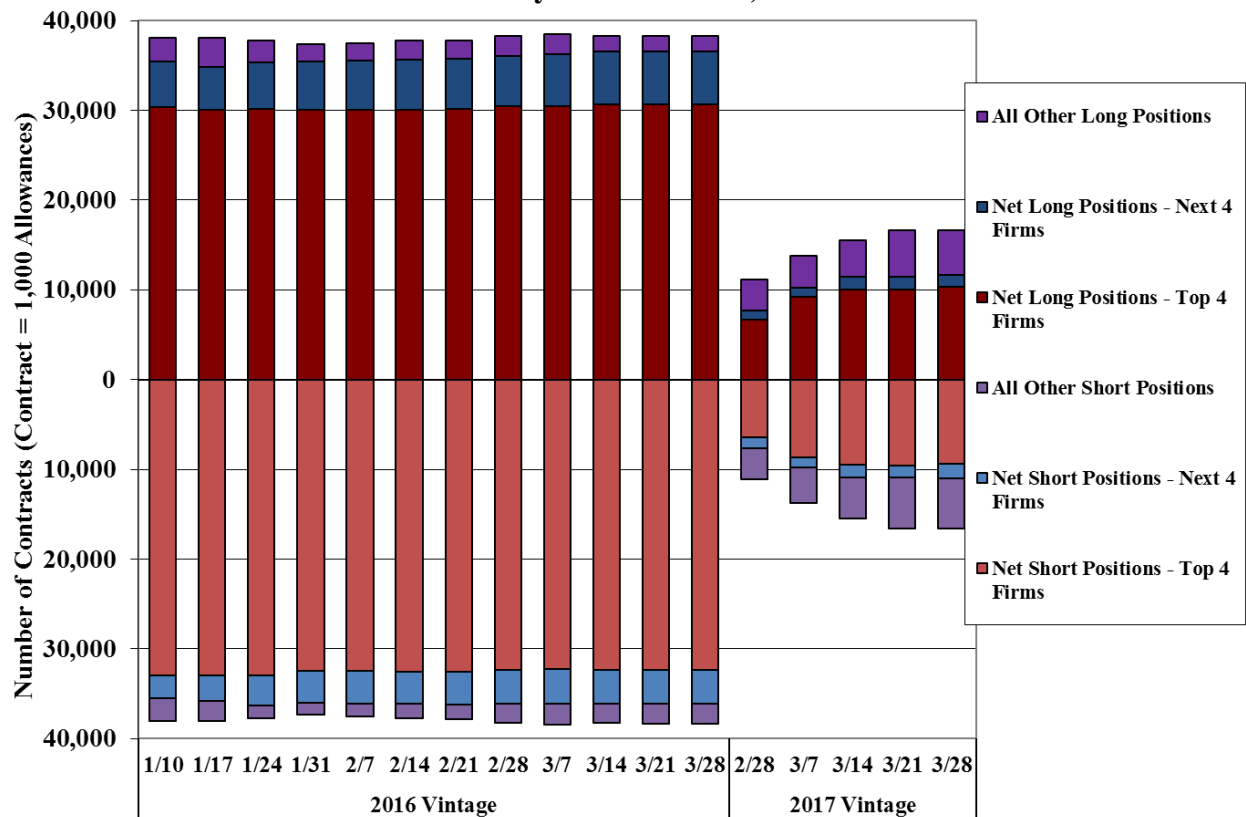
Additional information about the trading of futures, forwards, and options is available in the weekly Commitments of Traders (“COT”) reports, which are published by the Commodity Futures Trading Commission (“CFTC”)^{9,10} for each week when greater than 20 firms have reportable positions in a particular product.

Figure 5 summarizes the concentration of open interest in 2016 and 2017 vintage ICE futures and options contracts. The figure reports the net long positions in three categories: (i) the four firms with the largest long positions (see “Top 4 Firms”), (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 net short positions in three categories: (i) the four firms with the largest short positions (see “Top 4 Firms”), (ii) the four firms with the largest short positions not including the Top 4 (see “Next 4 Firms”), and (iii) all other short positions.

⁹ Each day, firms with an open interest of 25 contracts or more are required to report their positions to the CFTC. The CFTC categorizes each firm as Commercial if it engages in trading primarily to supply its own need for allowances or Non-Commercial if it trades for another purpose. Hence, compliance entities are generally designated as Commercial and other entities are frequently designated as Non-Commercial. Each Tuesday, the CFTC issues the COT report, which is a summary of the long and short positions of participants in the market.

¹⁰ The CFTC does not publish information from the COT reports for weeks when fewer than 20 firms have reportable positions for a given product, which is why no information is shown for any vintage contract other than 2016 until February 28th (each vintage is reported separately).

Figure 5: Concentration of Open Interest in CCFE Futures and Options¹¹
January 1 to March 31, 2017



Observations regarding the concentration of open interest:

- 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 2016 vintage contracts. 2017 vintage contracts were not reported by the CFTC until February 28th.
 - ✓ The “Top Four” Firms accounted for an average of 70 percent of the total net long positions in 2017 vintage contracts for the weeks shown during the quarter, while 81 percent of the total net long positions were held by eight firms.
 - ✓ The “Top Four” Firms accounted for an average of 70 percent of the total net short positions in vintage 2017 contracts for the weeks shown during the quarter, while 79 percent of the total net short positions were held by eight firms.
 - ✓ These results suggest that many firms have significant spreading positions (i.e., combinations of long and short positions of equal magnitude with different expiration dates).

¹¹ Source: The CFTC’s Commitment of Traders reports which are available at “www.cftc.gov/MarketReports/CommitmentsofTraders/HistoricalCompressed/index.htm”.

- The CFTC does not publish firm-level information on open interest, although the information they publish provides an indication of the upper limits of the net long and net short positions of individual firms. Combined with firm-specific information about CO₂ allowance holdings from COATS, the information on open interest that is published by the CFTC is useful for evaluating the potential for a firm to hoard RGGI CO₂ allowances, which is discussed further in Section E.

E. DISCUSSION OF MARKET MONITORING

As the RGGI Market Monitor, we monitor trading in the secondary CO₂ allowance market in order to identify anticompetitive conduct. Additionally, the Commodity Futures Trading Commission (“CFTC”) evaluates trading in the secondary CO₂ allowance market consistent with its role as the regulator of derivative markets in the U.S. This section discusses two types of anti-competitive conduct for which we monitor. As in previous reports on the secondary market, we find no evidence of anti-competitive conduct.

In any commodity market, one potential concern is that a firm could hoard a substantial share of the supply of a commodity to influence prices or to prevent a competitor from obtaining CO₂ allowances. Hence, we screen information on the holdings of CO₂ allowances and allowance-derivatives and the demand for allowances to identify firms that might acquire a position that raises competitive concerns. The ability of an individual firm to hoard is limited by the substantial private bank of CO₂ allowances that has been accumulated and also by the market rules, particularly the auction rules that limit the amount of allowances that can be purchased by a single party or group of affiliated parties in a single offering to 25 percent.

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 the price of the contracts 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. Nevertheless, the CFTC has access to confidential transaction data, which allows it to monitor for evidence of manipulative conduct.