RGGI Inc.

REPORT ON THE SECONDARY MARKET FOR RGGI CO_2 ALLOWANCES: THIRD QUARTER 2018

Prepared for:

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

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POTOMAC ECONOMICS

November 2018

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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 (CO_2) 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 CO_2 allowances consists mainly of the auctions where allowances are initially sold. Once a CO_2 allowance is purchased in the primary market, it can then be resold in the secondary market. The secondary market for RGGI CO_2 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 CO_2 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 third quarter of 2018 and discusses the results of our market power screens.

- *CO_2 Allowance Prices* – CO_2 allowance futures prices averaged $4.69, significantly higher than both the previous quarter and the third quarter of 2017.
  - ✓ Futures prices opened the quarter near $4.40 and remained between $4.25 and $4.50 until September. Following Auction 41 in early September prices began to rise, reaching a high of $5.08 at the end of the quarter.
  - ✓ Auction 41 cleared at $4.50, consistent with secondary market prices in early September.
- *Secondary Market Activity* – Futures trading volumes increased in the third quarter, while allowance transfers in COATS decreased relative to the previous quarter.
  - ✓ The volume of trading of RGGI futures was 63.5 million CO_2 allowances in the third quarter of 2018, up 55 percent from the previous quarter and 36 percent from the third quarter of 2017.
  - ✓ The total volume of CO_2 allowance transfers between unaffiliated firms was 8.7 million. This volume was down 19 percent from the second quarter of 2018.
- *CO_2 Allowance Holdings* – At the end of the third quarter of 2018:
  - ✓ There were 155 million CO_2 allowances in circulation.
  - ✓ Compliance-oriented entities held approximately 61 million of the allowances in circulation (39 percent).
  - ✓ Approximately 72 million of the allowances in circulation (46 percent) are believed to be held for compliance purposes.

We evaluate information on the holdings of CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 allowances must be physically transferred to the buyer's account in the COATS registry and funds must be transferred to the seller. Allowances transferred must be usable for compliance in the vintage year of the futures contract. One standard futures contract equals 1,000 RGGI allowances.[1] These contracts are listed by an exchange with simple standardized terms to promote liquidity.
- *Forwards* – These are like futures contracts, but a forward contract typically requires that all financial settlement occur at expiration. These contracts can be made off an exchange between two parties, allowing the parties to agree to less standardized terms.
- *Call Options* – Call options give the purchaser the option to buy a fixed number of CO_2 allowances of a certain vintage year at a particular strike price at the expiration date. For example, suppose a firm holds a call option with $5 strike price, and December 2018 expiration date. If the price of the corresponding forward contract rose to $5.75, the firm could exercise the option to buy CO_2 allowances at $5 and immediately sell them at $5.75. Alternatively, if the price of the forward contract stayed below $5, the firm would let the

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[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.

option expire without exercising it. One standard options contract can be exercised for 1,000 RGGI allowances. Currently, call option contracts listed on ICE are European style, meaning that they cannot be exercised before the expiration date.

- *Put Options* – Put options are similar to call options but they give the purchaser the option to *sell* a certain number of CO_2 allowances of a particular vintage year at a specified strike price any time prior to the expiration date. Currently, put option contracts listed on ICE are European style, meaning that they cannot be exercised before 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 forward contracts, they generally require less financial security since they do not obligate the holder to exercise the contract if its value declines, 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 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.

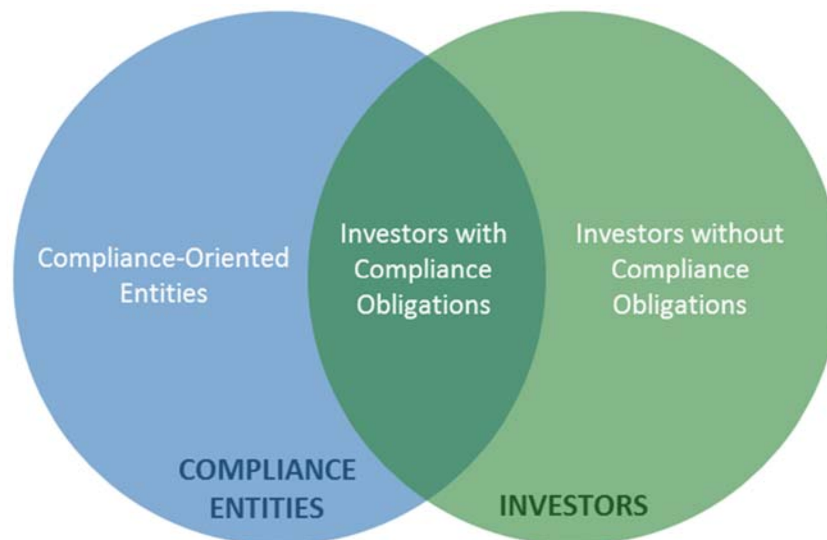
The volatility of a CO_2 allowance refers to the expected standard deviation of the distribution of allowance prices one year in the future. For example, if the expected value of the price one year

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 CO_2 allowances.

Categories of Firms Participating in the RGGI Market

Participation in the RGGI market involves many different firms with various interests in RGGI allowances. Some participate in order to satisfy compliance obligations, others have investment interests, and still others participate for both purposes. To more effectively track the activity of different participants, we use several classifications for participant firms. Figure 1 summarizes the relationship between these classifications.

Figure 1: Classifications of Participant Firms in the RGGI Marketplace



- *Compliance-oriented entities* are compliance entities that appear to acquire and hold allowances primarily to satisfy their compliance obligations.
- *Investors with Compliance Obligations* are 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.

- *Investors without Compliance Obligations* are firms without any compliance obligations.

These three categories form the basis for two overlapping groups.

- *Compliance Entities* –All firms with compliance obligations, and their affiliates.[2] Combines the first and second of the above categories.
- *Investors* – All firms which are assessed to be purchasing primarily for investment rather than compliance purposes. Combines the second and third of the above categories.

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).

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[2] Affiliates are firms that: (i) have a parent-subsidiary relationship with a compliance entity, (ii) are 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.

C. SUMMARY OF PRICES

This section summarizes prices in the secondary market for RGGI CO_2 allowances in the third quarter of 2018. Figure 2 summarizes transaction prices in the secondary market for CO_2 allowances, including the prices of allowance transfers registered in COATS[3] and the prices of futures contract trades on the Intercontinental Exchange ("ICE").

Key observations regarding RGGI CO_2 allowance prices:

- Prices opened the quarter near $4.40 and remained between $4.25 and $4.50 until September. Following Auction 41 in early September prices began to rise, reaching a high of $5.08.
- Futures prices averaged $4.69 and COATS transfer prices averaged $4.60, which were both up from the second quarter. Futures prices rose 14 percent from the third quarter of 2017.
- The clearing price in Auction 41, which was held on September 5, was $4.50, consistent with futures prices at the time.
- Options trading increased from the previous quarter but remained sparse relative to pre-2017 activity in RGGI options.

Prices of CO_2 Allowances and Allowance Derivatives

Figure 2 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 CO_2 allowances that were sold in RGGI Auction 41, which was held on September 5. Figure 2 also shows volume-weighted average prices for each category in the third quarter of 2018 compared to the previous quarter and the third quarter of the previous year. Volume-weighted average prices for the first, second, third, and fourth control period CO_2 allowances are shown together.

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

Figure 2: Prices in the Secondary Market for RGGI CO_2 Allowances[4]
July 1 to September 30, 2018

Key observations regarding CO_2 allowance prices:

- Futures contracts opened the quarter near $4.40 and remained between $4.25 and $4.50 until September. Following Auction 41 in early September prices began to rise, reaching a high of $5.08.
- COATS transfer prices were broadly consistent with futures prices, albeit with a small number of minor outliers. This reflects that some of the COATS transfers settled at prices that were determined at an earlier date or resulted from a contract with less standard provisions.

[4] Sources: Auction clearing prices are available at https://www.rggi.org/auctions/auction-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. Average COATS Transfer Prices for previous quarters have been updated to reflect transactions reported after the compilation of data for previous quarterly reports.

- The clearing price in Auction 41 was $4.50, which was in line with the secondary market price trend leading up to the auction. The auction clearing price increased $0.48 from Auction 40 (which was held in June 2018).

Prices of Options for CO_2 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 CO_2 allowances in the third quarter of 2018:

- Eight options trades were recorded on ICE in the third quarter, up from a single trade in the previous quarter.
- All eight trades were calls recorded in September, with strike prices ranging from $4.50 for December 2018 options to $6.00 for December 2019 options.

Volatility of CO_2 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 CO_2 allowance prices decrease the risks associated with making long-term investments in reducing CO_2 emissions. Since CO_2 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 $2.20 (and is indexed to inflation), and the Emissions Containment Reserve ("ECR"), which will withhold allowances from circulation if prices fall below established trigger prices starting in 2021.[6]

One measure of the volatility of CO_2 allowance prices is known as option-implied volatility, which measures the volatility that is implied by the trading of option contracts for CO_2 allowances. If a firm perceives that CO_2 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 CO_2 allowance prices are relatively stable, the firm will be willing to pay relatively little for the same option contract.

Only nine option trades in total have been recorded over the past two quarters, therefore the options-implied volatility figure has been omitted from this report. For analysis of historical options trading refer to the Secondary Market reports from previous quarters.

5 From 2015 to 2020, the annual withdrawal limit is ten million allowances. The CCR trigger price was $10.00 in 2017, rose to $10.25 in 2018, and it will rise 2.5 percent in each year through 2020. After 2020, the size of the CCR and the CCR trigger price will be set in accordance with the 2017 Model Rule. Details are provided at http://www.rggi.org/program-overview-and-design/elements.

6 Beginning in 2021, the size of the ECR will be equal to 10 percent of the budgets of states implementing the ECR. The ECR trigger price for 2021 will be $6.00 and will rise 7 percent each year thereafter. Details are provided at http://www.rggi.org/program-overview-and-design/elements.

D. VOLUMES AND OPEN INTEREST

This section evaluates the volume of COATS transactions (i.e., transfers of CO_2 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 third quarter of 2018:

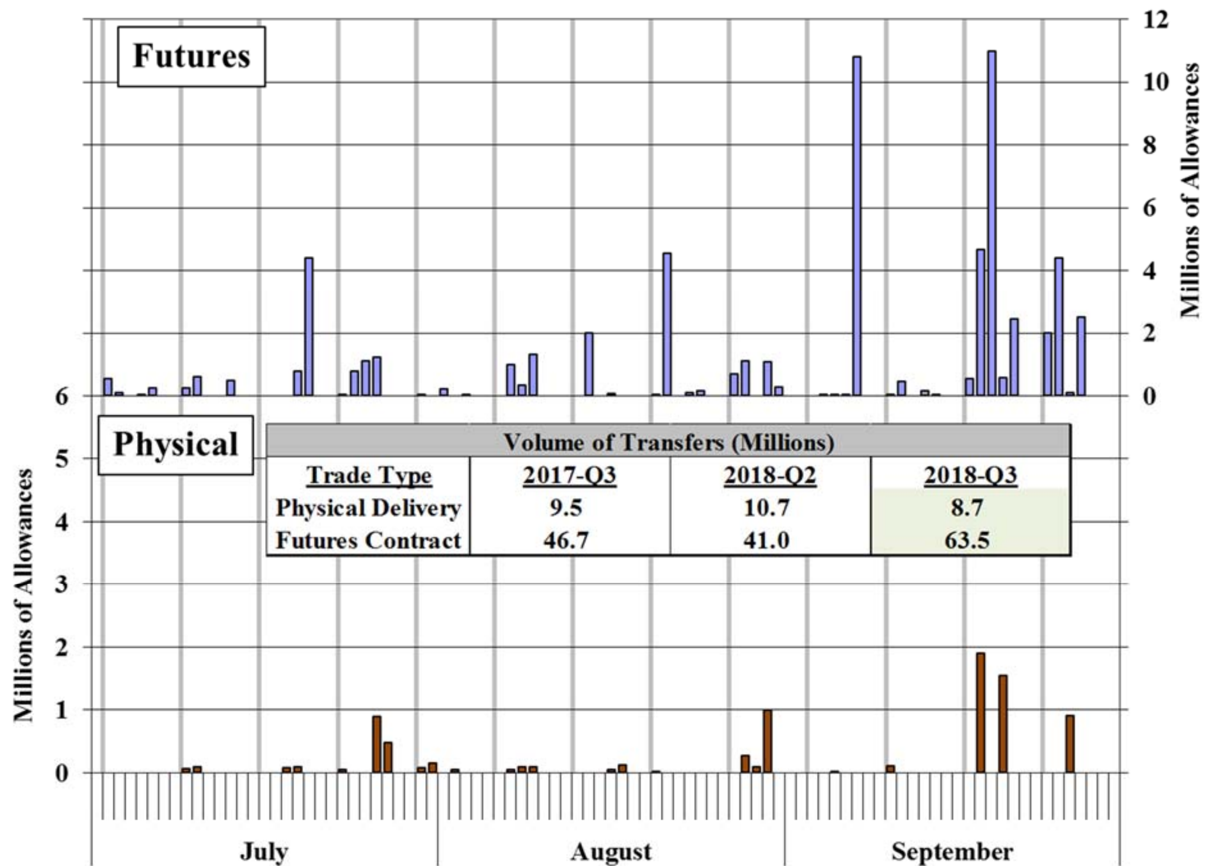
- RGGI futures trading volume was 63.5 million CO_2 allowances in the third quarter of 2018, up 55 percent from the previous quarter and 36 percent from the third quarter of 2017.
- Physical allowance transfers between unaffiliated firms were down 19 percent from the second quarter.
- There were 155 million CO_2 allowances in circulation at the end of the quarter.
    - ✓ Compliance-oriented entities held approximately 61 million of the allowances in circulation (39 percent).
    - ✓ Approximately 72 million of the allowances in circulation (46 percent) are believed to be held for compliance purposes.

Volume of CO_2 Allowance Transfers, Futures, and Options

Figure 3 summarizes the volume of transfers of CO_2 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 third quarter of 2018 compared to the previous quarter and to the third quarter of 2017.[7] The volume of futures trading and transfers of CO_2 allowances for each control period are shown together because all CO_2 allowances are essentially interchangeable for compliance purposes.

[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.

Figure 3: Volume of CO_2 Allowance Transfers Between Unaffiliated Parties[8]
July 1 to September 30, 2018



Key observations regarding physical CO_2 allowance transfers between unaffiliated firms:

- The total volume of CO_2 allowance transfers between unaffiliated firms was 8.7 million, down 19 percent from the second quarter, and down from the third quarter of 2017.[9]

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

- The total volume of trading of RGGI futures was 63.5 million CO_2 allowances in the third quarter of 2018, an increase of 55 percent from the previous quarter, and 36 percent from the third quarter of 2017.

8 Source: CO_2 allowance transfers are based on information in COATS.

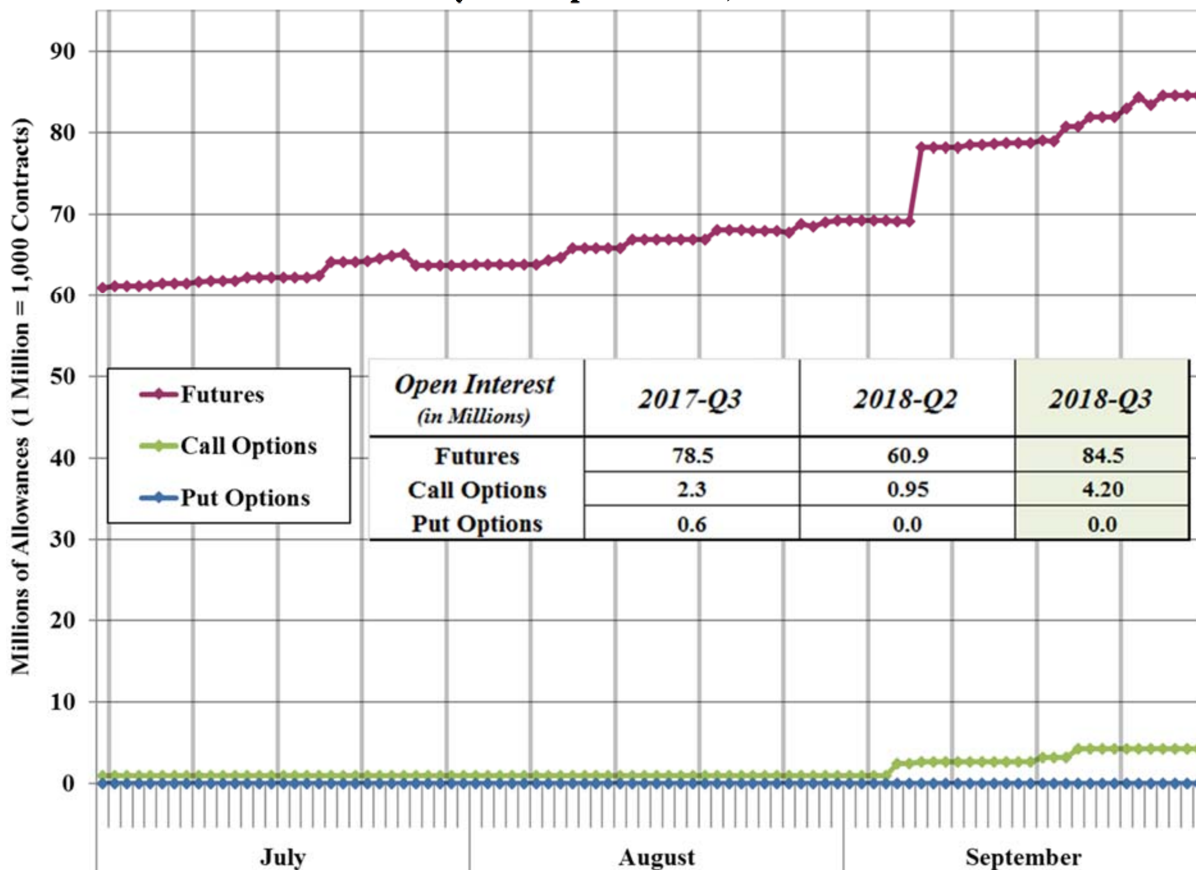
9 The physical delivery volumes for previous quarters are higher than recorded in previous reports due to several transactions that were not reported in COATS until after data was compiled for the previous report, as well as the addition of transactions that were reported without prices, but appear to be priced on an external exchange.

- Approximately 4 percent of the trading volume of futures contracts listed on ICE during the third quarter of 2018 was for contracts that settled during the quarter. Futures trading accounted for a relatively small portion of CO_2 allowance transfers. Additionally, 49 percent of the total volume of trading was for contracts that settle in December 2018.

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 third quarter of 2018. 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
July 1 to September 30, 2018



Open Interest (in Millions)	2017-Q3	2018-Q2	2018-Q3
Futures	78.5	60.9	84.5
Call Options	2.3	0.95	4.20
Put Options	0.6	0.0	0.0

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

- The total open interest in RGGI futures increased from 60.9 million allowances at the end of the second quarter of 2018 to 84.5 million allowances by the close of the third quarter of 2018.
- The open interest in RGGI call options increased to 4.2 million by the end of the third quarter.
- There was no open interest in put options in the third quarter of 2018.
- Overall, the level of open interest across RGGI options and futures products increased by 43 percent at the close of the third quarter.

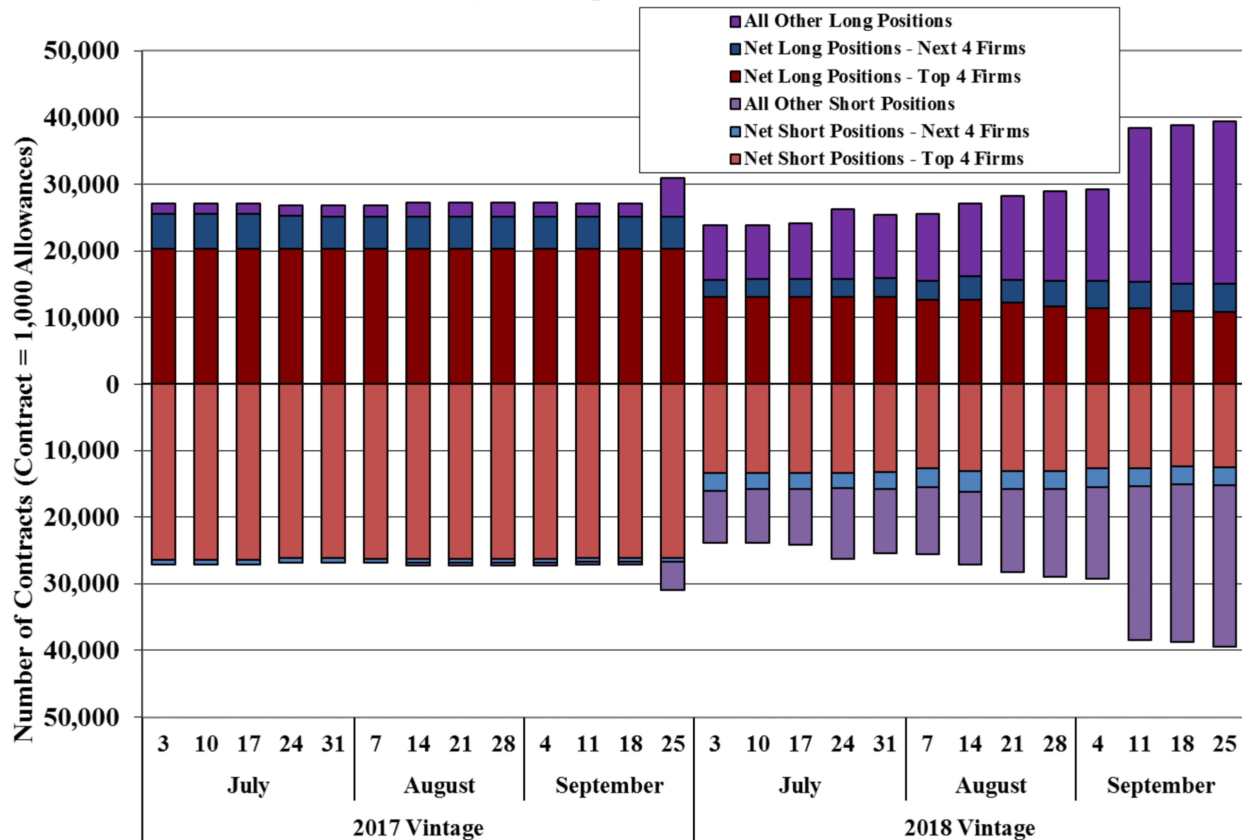
Concentration of Open Interest

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")[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 2017 and 2018 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, (ii) the four firms with the largest long positions not including the Top 4, 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, (ii) the four firms with the largest short positions not including the Top 4, and (iii) all other short positions.

[10] 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.

Figure 5: Concentration of Open Interest in ICE Futures and Options
July 1 to September 30, 2018



Key observations regarding the concentration of open interest:

- After open interest in 2018 Vintage contracts jumped dramatically by 20,000 contracts (short and long positions combined) in the last week of the second quarter, it then fell in the first week of the third quarter by 10,000 contracts. As a result, 2018 Vintage contracts did not exceed 2017 Vintage open interest again until the third week of August.
- Although many firms have open interest in RGGI CO_2 allowance futures and options, a small number of firms account for large shares of the net long and short positions in 2017 and 2018 Vintage contracts.
- For 2018 Vintage contracts, concentration decreased steadily with each week of the third quarter as the bulk of new open interest came from firms with smaller positions.
    - ✓ The "Top Four" Firms' concentration steadily fell from 56 percent to 32 percent for net short positions and from 55 percent to 28 percent for net long positions for the 2018 Vintage contracts over the course of the quarter.
    - ✓ Vintage 2018 contracts' "Top Four" Firms account for a smaller portion of open interest compared to Vintage 2017 contracts in the third quarter of 2017 even though the trend of declining concentration was also present. At this time last year, the "Top

Four" Firms' concentration for Vintage 2017 fell to 50 percent by the end of the quarter for net short positions and 52 percent for net long positions.

- ✓ On a weekly basis, the "Top Four" Firms accounted for an average of 44 percent (not weighted by volume) of the total net long positions in 2018 Vintage contracts during the quarter, while 55 percent of the total net long positions were held by eight firms.
- ✓ On a weekly basis, the "Top Four" Firms accounted for an average of 46 percent (not weighted by volume) of the total net short positions in Vintage 2018 contracts during the quarter, while 56 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).
- ✓ The total open interest in 2017 Vintage contracts decreased slightly during the quarter until the final week, when it increased by more than the cumulative decrease during the rest of the quarter.
- ✓ Concentration of both long and short positions for the "Top Four" firms holding 2017 Vintage contracts averaged 74 percent and 96 percent, respectively, significantly higher that the corresponding averages for 2018 Vintage contracts.

- 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 CO_2 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 CO_2 allowances, which is discussed further in Section E.

E. Discussion of Market Monitoring

As the RGGI Market Monitor, we monitor trading in the secondary CO_2 allowance market in order to identify anticompetitive conduct. Additionally, the Commodity Futures Trading Commission ("CFTC") evaluates trading in the secondary CO_2 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 CO_2 allowances. Hence, we screen information on the holdings of CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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.