The Regional Greenhouse Gas Initiative
an initiative of Eastern States of the US

CO_2 Emissions from Electricity Generation and Imports in the Regional Greenhouse Gas Initiative: 2021 Monitoring Report

December 19, 2024

The 2021 Monitoring Report on CO_2 Emissions from Electricity Generation and Imports in the Regional Greenhouse Gas Initiative (2021 Electricity Monitoring Report) was prepared on behalf of the states participating in the Regional Greenhouse Gas Initiative (RGGI): Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.[1] The opinions expressed in this report do not necessarily reflect those of any of the states participating in RGGI, 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., and the states participating in RGGI 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. and the states participating in RGGI 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 Eastern states to reduce emissions of carbon dioxide (CO_2), a greenhouse gas that causes global warming.

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

[1] This report summarizes data for the eleven states participating in RGGI in 2021: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia. New Jersey resumed participation in RGGI in 2020, Virginia participated from 2021 to 2023, and Pennsylvania began participation in 2022 which was followed by a court ordered stay. Therefore, Pennsylvania is not included in this report.

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Executive Summary

The 2021 Electricity Monitoring Report, the thirteenth report in a series of annual monitoring reports, summarizing the data for the period from 2006 through 2021, for electricity generation, net electricity imports, and related carbon dioxide (CO_2) emissions for the states participating in the Regional Greenhouse Gas Initiative (RGGI) in 2021. The "nine-state RGGI region" (RGGI-9) consists of Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey resumed participation in RGGI in 2020 and Virginia became a participating state in 2021, establishing an "eleven-state RGGI region" (RGGI-11).

These monitoring reports were called for in the 2005 RGGI Memorandum of Understanding (MOU) in response to expressed concerns about the potential for the RGGI CO_2 Budget Trading Program to cause CO_2 emissions from generation serving load in the RGGI region to shift towards sources that are not subject to RGGI.[2] If this potential shift results in an overall net increase in emissions, it is referred to as "emissions leakage."

In the New England and Mid-Atlantic states, CO_2 emissions from the regional electric power sector are a function of highly dynamic wholesale electricity markets. The cost of compliance with the RGGI CO_2 Budget Trading Program is only one of multiple factors that influence the dispatch of electric generation, and resulting CO_2 emissions, through the operation of these markets. As a result, this report presents data without assigning causality to any one of the factors influencing observed trends.

A key metric presented in this report that may provide a preliminary or potential indication of emissions leakage, or a lack thereof, is electric generation and related CO_2 emissions from all non-RGGI electric generation serving electricity load in the eleven-state RGGI region. Because this report does not establish the causes of observed trends, it should be emphasized that this report does not provide indicators of CO_2 emissions leakage.

The 2021 Electricity Monitoring Report tracks electricity generation, net electricity imports, and related CO_2 emissions for the nine-state RGGI region during the three-year current period of 2019 to 2021 relative to 2006 to 2008, a three-year base period prior to the start of the first RGGI control period. The report also tracks the same categories for the 2021 annual averages in the eleven-state RGGI region and compares these to the 2006 to 2008 base period.

The observed trends in electricity demand, electricity generation, and net electricity imports show there has been a small decrease in CO_2 emissions from total non-RGGI electric generation serving load in the nine-state RGGI region during the period of 2019 to 2021 when compared to the base period, as well as in the eleven-state RGGI region during the 2021 calendar year when compared to the base period.

[2] The Memorandum of Understanding called for monitoring electricity imports into the RGGI participating states commencing from the start of the RGGI CO_2 Budget Trading Program and reporting the results of such monitoring on an annual basis beginning in 2010.

Summary of Results

Change in Annual Average Electric Load (Demand for Electricity) and Annual Average Generation

Nine-State RGGI Region

- The annual average **electric load** in the nine-state RGGI region from 2019 to 2021 decreased by 42.8 million MWh, or 11.1 percent, compared to the average for 2006 to 2008. (See Figures 1 and 3.)

- The annual average **electric generation** from all sources in the nine-state RGGI region from 2019 to 2021 decreased by 53.2 million MWh, or 16.1 percent, compared to the average for 2006 to 2008. (See Figures 1 and 3.)

- Annual average **net imports** into the nine-state RGGI region from 2019 to 2021 increased by 19.6 million MWh, or 35.0 percent, compared to the average for 2006 to 2008. (See Figures 1 and 3.)

Eleven-State RGGI Region

- The annual average **electric load** in the eleven-state RGGI region for 2021 decreased by 38.8 million MWh, or 6.7 percent, compared to the baseline average for 2006 to 2008. (See Figures 2, 4, and 5.)

- The annual average **electric generation** from all sources in the eleven-state RGGI region in 2021 decreased by 36.9 million MWh, or 8.0 percent, compared to the baseline. (See Figures 2, 4, and 5.)

- The annual average **net imports** into the eleven-state RGGI region in 2021 increased by 7.5 million MWh, or 6.4 percent, compared to the baseline. (See Figures 2, 4, and 5.)

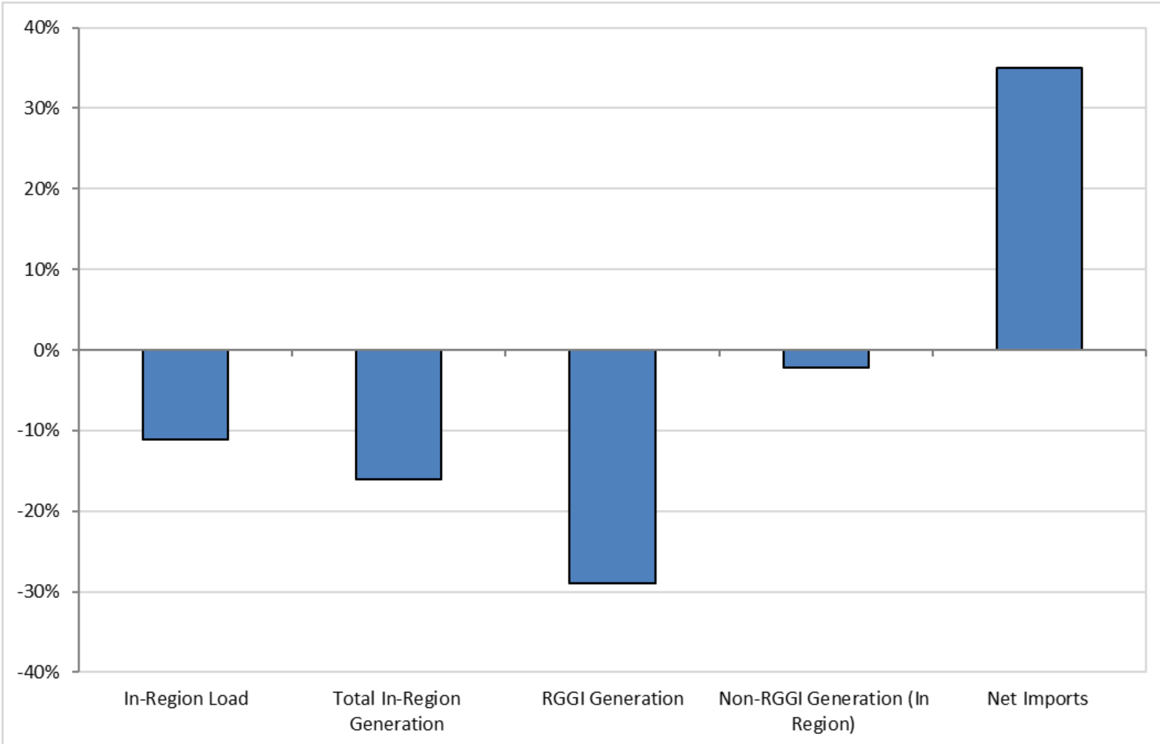

Figure 1. Percentage change in annual average electricity load and generation serving the nine-state RGGI region for 2019 to 2021, relative to the base period of 2006 to 2008.

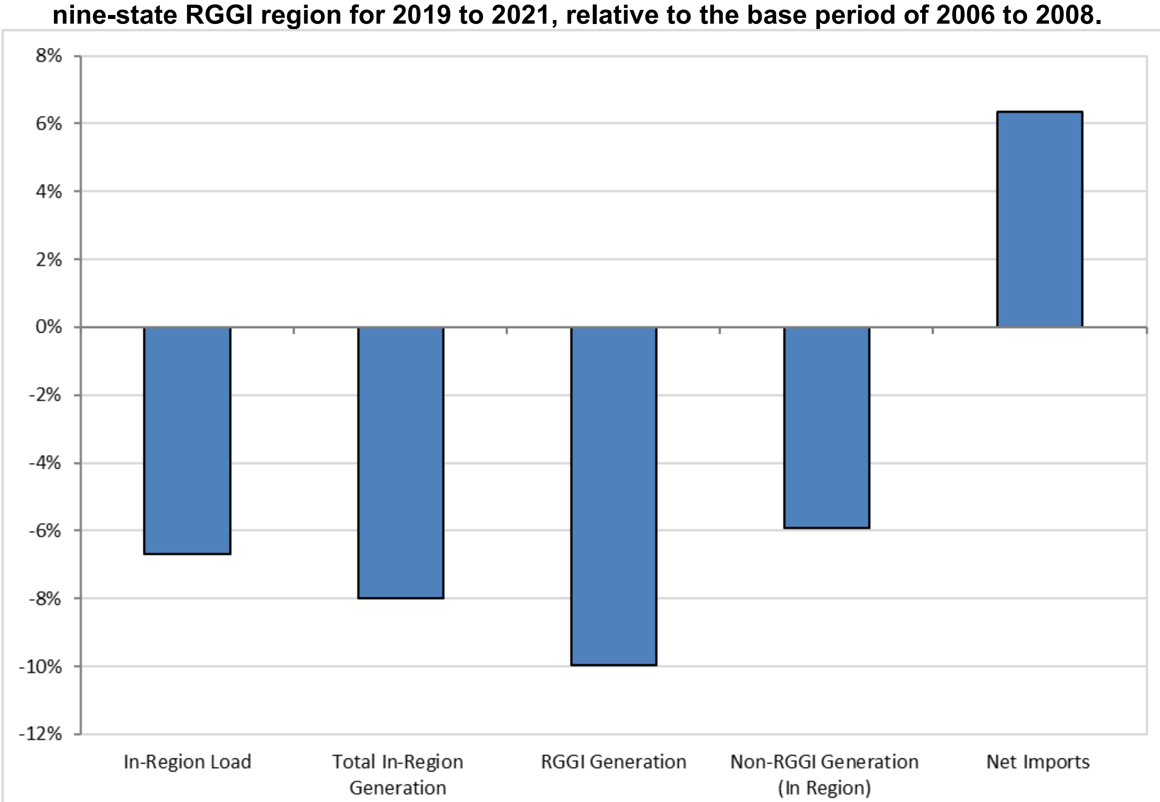

Figure 2. Percentage change in annual average electricity load and generation serving the eleven-state RGGI region for 2021, relative to the base period of 2006 to 2008.

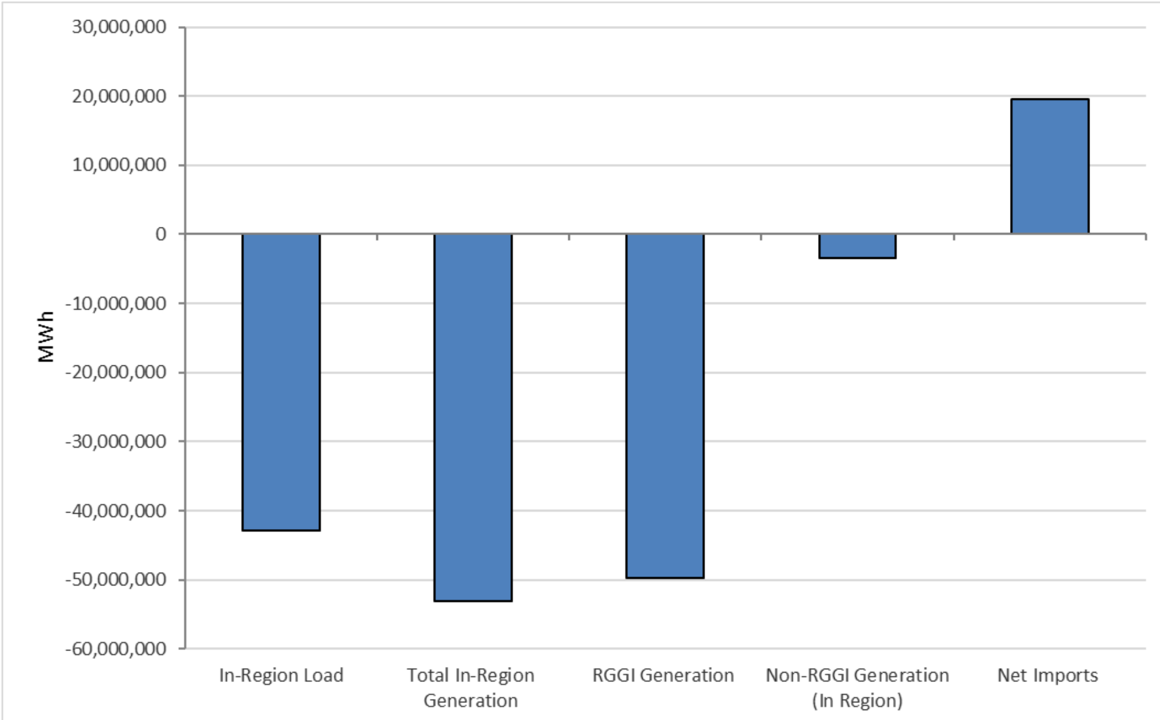

Figure 3. Change in MWhs of annual average electricity load and generation serving the nine-state RGGI Region for 2019 to 2021, relative to the base period of 2006 to 2008.

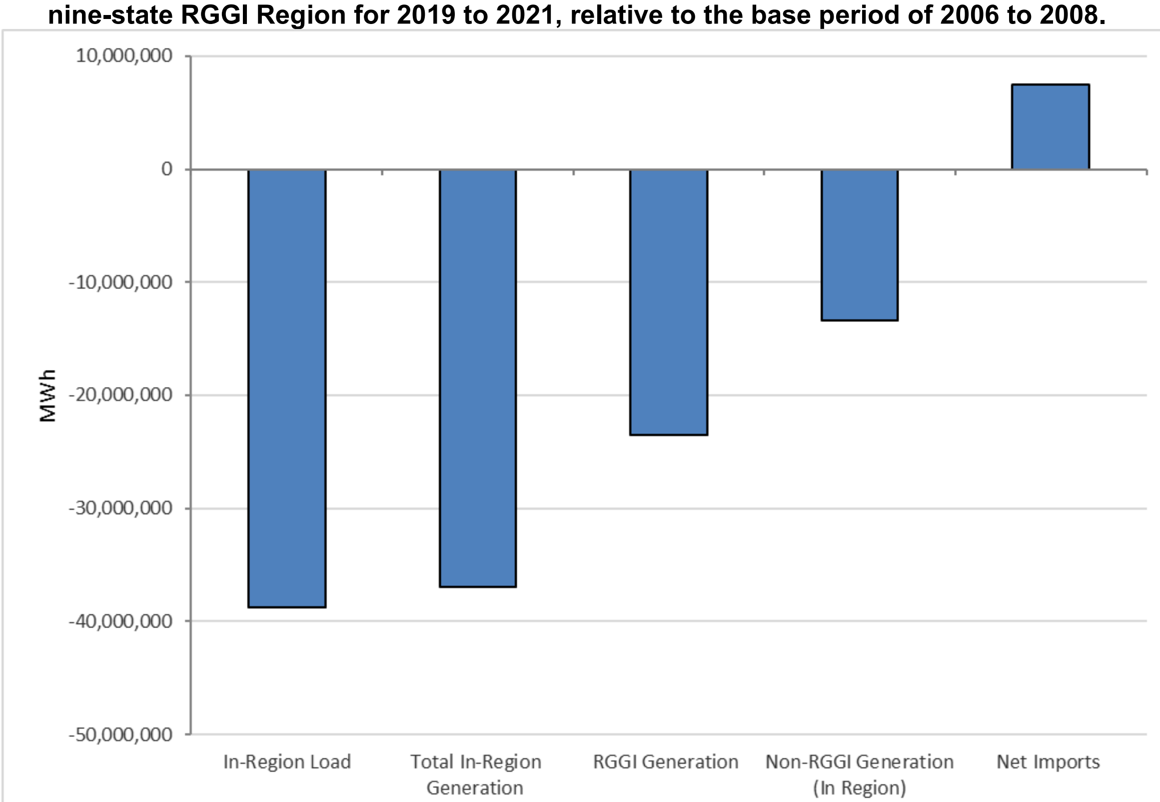

Figure 4. Change in MWhs of annual average electricity load and generation serving the eleven-state RGGI Region for 2021, relative to the base period of 2006 to 2008.

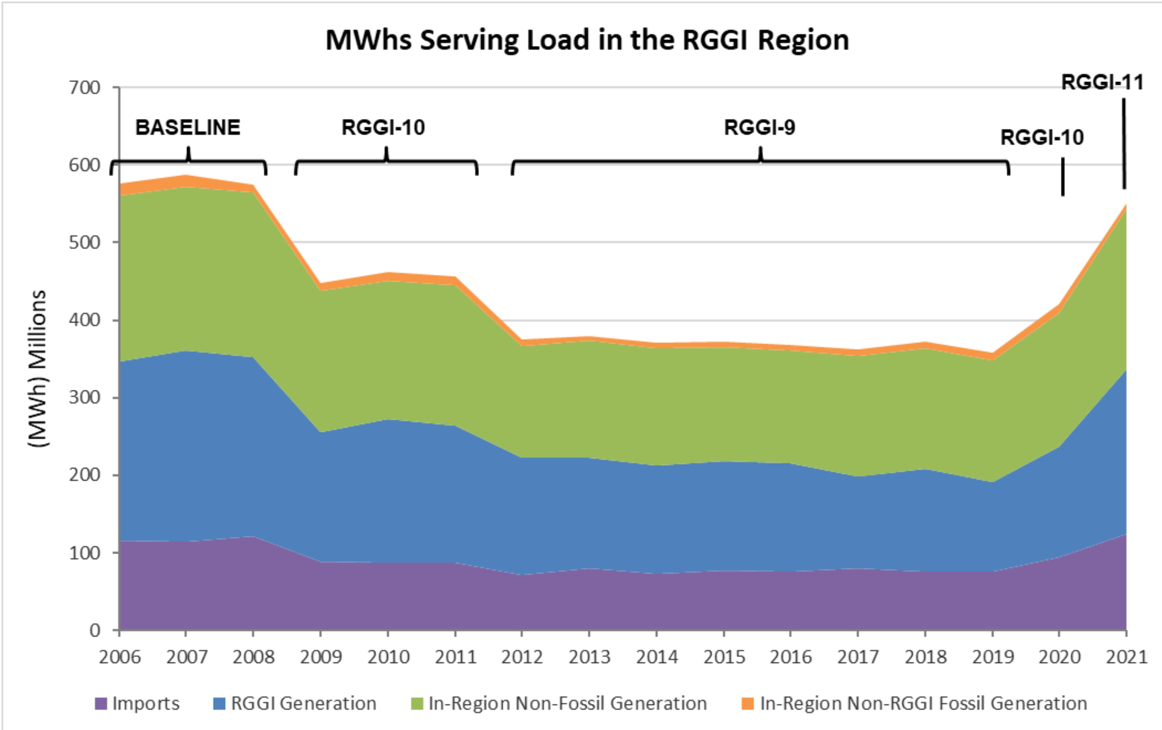

Figure 5. MWhs of generation serving load in the RGGI region from 2006-2021. Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

Change in Annual Average Non-RGGI Emissions, Non-RGGI Emissions Rate, and Non-RGGI Generation

Nine-State RGGI Region

- The monitoring results indicate there was a decrease of 6.0 million short tons of CO_2, or 13.1 percent, in **CO_2 emissions** from all non-RGGI electric generation serving load in the nine-state RGGI region for 2019 to 2021 relative to the base period of 2006 to 2008.

- The annual average **CO_2 emissions rate** from all non-RGGI electric generation sources serving load in the nine-state RGGI region for 2019 to 2021 decreased by 81 lb CO_2/MWh to 342 lb CO_2/MWh, or 19.2 percent, compared to the base period rate of 424 lb CO_2/MWh.

- The annual average **electric generation** from all non-RGGI electric generation sources serving load in the nine-state RGGI region for 2019 to 2021 increased by 16.2 million MWh, or 7.6 percent, compared to the base period of 2006 to 2008.

Eleven-State RGGI Region

- For the eleven-state RGGI region, the **CO_2 emissions** from all non-RGGI electric generation serving load for the 2021 calendar year relative to the base period decreased by 25.0 million short tons, or 27.0 percent.

- The **CO_2 emissions rate** from this category in the eleven-state RGGI region decreased by 139 lb CO_2/MWh from 539 lb CO_2/MWh to 400 lb CO_2/MWh, or 24.7 percent, in 2021 compared to the base period of 2006 to 2008.

- The **electric generation** from this category in the eleven-state RGGI region decreased by 6.0 million MWh, or 1.7 percent, in 2021 compared to the base period of 2006 to 2008.

Change in Annual Average RGGI Emissions, RGGI Emissions Rate, and RGGI Generation

Nine-State RGGI Region

- The annual average **CO_2 emissions** from RGGI electric generation sources from 2019 to 2021 for the nine-state RGGI region decreased by 76.2 million short tons of CO_2, or 55.0 percent, compared to the base period of 2006 to 2008. (See Figures 6 and 8.)

- The annual average **CO_2 emissions rate** from RGGI electric generation sources from 2019 to 2021 for the nine-state RGGI region decreased by 590 lb CO_2/MWh to 1,016 lb CO_2/MWh, or 36.7 percent, compared to the base period rate of 1,606 lb CO_2/MWh.

- The annual average **electric generation** from RGGI electric generation sources from 2019 to 2021 for the nine-state RGGI region decreased by 49.8 million MWh, or 28.9 percent, compared to the base period of 2006 to 2008. (See Figures 1 and 3.)

Eleven-State RGGI Region

- For the eleven-state RGGI region, **CO_2 emissions** from RGGI electric generation sources in 2021 decreased by 87.7 million short tons of CO_2, or 45.7 percent, compared to the base period. (See Figures 7 and 9.)

- For the eleven-state RGGI region, **CO_2 emissions rate** from RGGI electric generation sources in 2021 decreased by 645.4 lb CO_2/MWh from 1,628 lb CO_2/MWh to 983 lb CO_2/MWh, or 39.6 percent, compared to the base period.

- For the eleven-state RGGI region, **electric generation** from RGGI electric generation sources in 2021 decreased by 23.5 million MWh, or 10.0 percent, compared to the base period. (See Figures 2 and 4.)

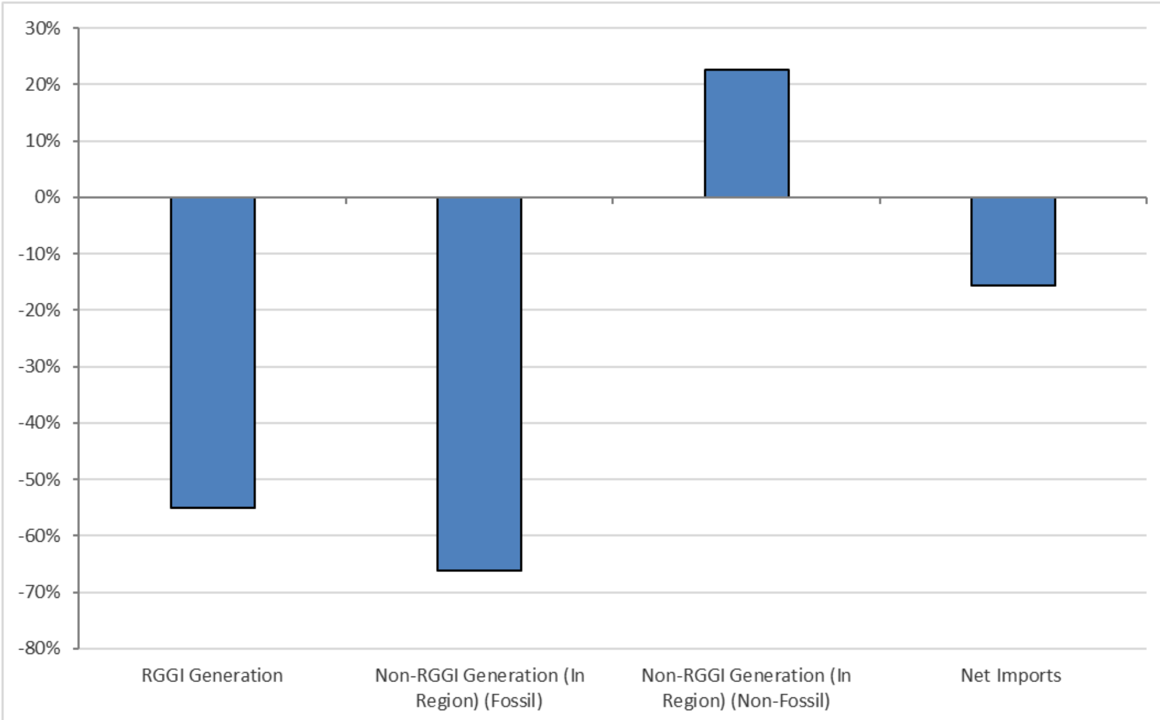

Figure 6. Percent change in annual average CO_2 emissions from generation serving load in the nine-state RGGI region for 2019 to 2021, relative to the base period of 2006 to 2008.

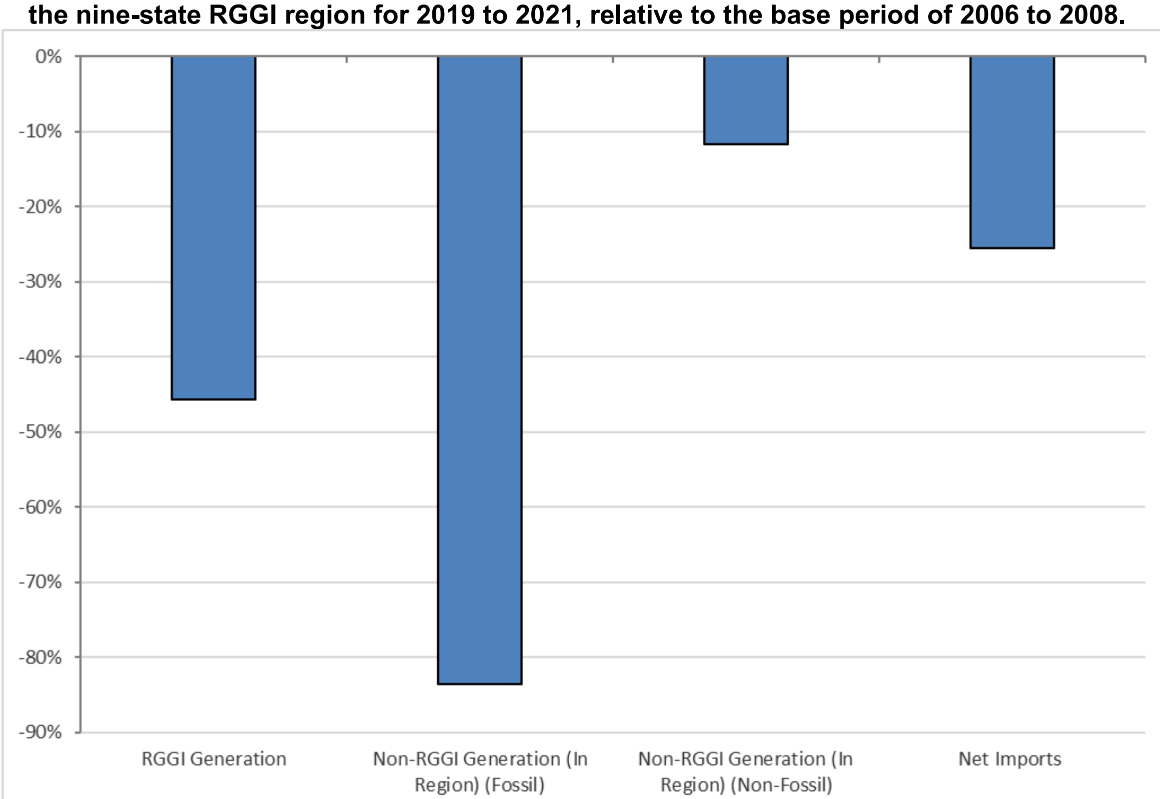

Figure 7. Percent change in annual average CO_2 emissions from generation serving load in the eleven-state RGGI region for 2021, relative to the base period of 2006 to 2008.

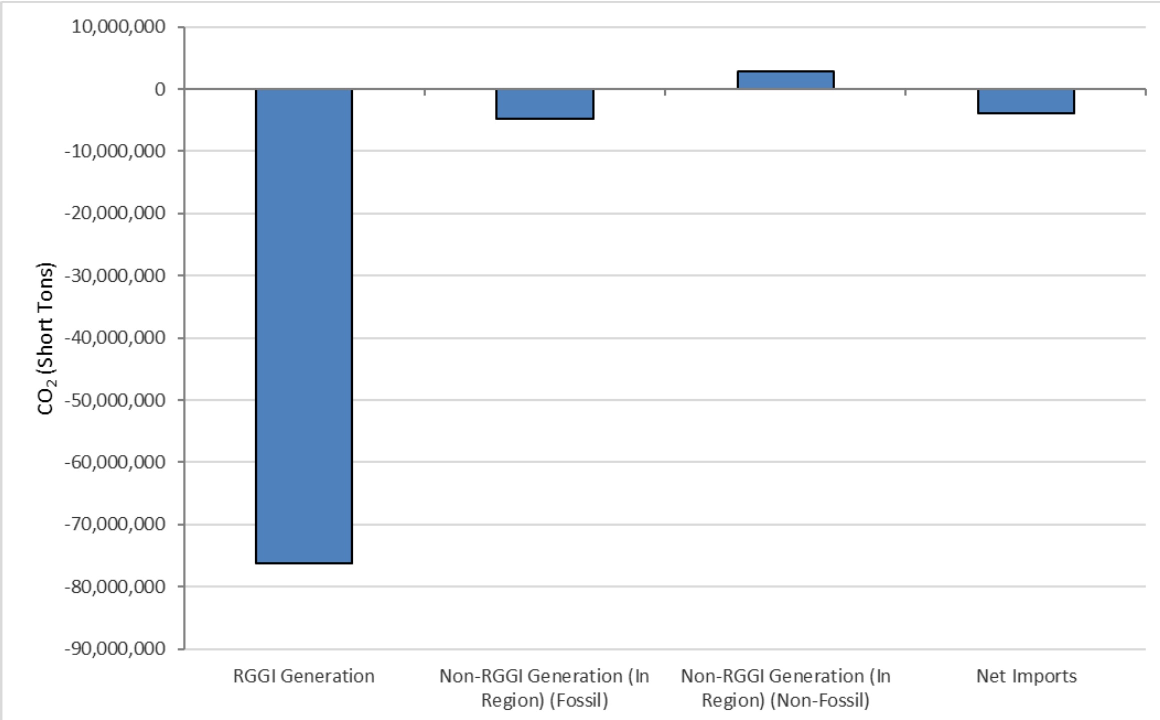

Figure 8. Change in annual average CO_2 emissions from generation serving load in the nine-state RGGI region for 2019 to 2021, relative to the base period of 2006 to 2008.

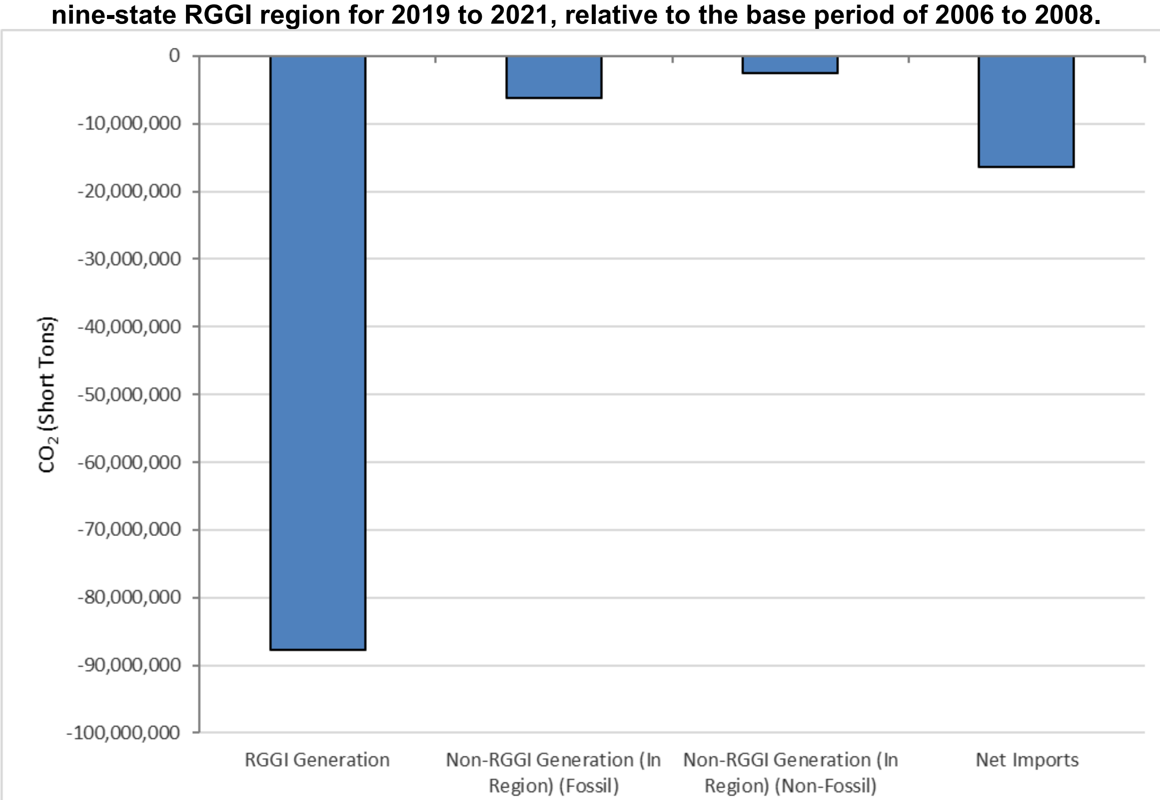

Figure 9. Change in annual average CO_2 emissions from generation serving load in the eleven-state RGGI region for 2021, relative to the base period of 2006 to 2008.

Conclusions

It should be emphasized that this report does not provide indicators of CO_2 emissions leakage, but rather tracks electricity generation and imports, and related CO_2 emissions, in the RGGI region. A key metric presented in this report that may provide a preliminary or potential indication of emissions leakage, or a lack thereof, is electric generation and related CO_2 emissions from all non-RGGI electric generation serving electric load in the region.

Monitoring results show that there has been an increase in the amount of non-RGGI electric generation serving load in the RGGI region as well as a decrease in the CO_2 emissions rate of this generation, which largely offsets the increase in generation. Specifically, there has been a 13.1 percent decrease in average annual CO_2 emissions from non-RGGI electric generation serving load in the nine-state RGGI region during the period of 2019 to 2021 when compared to the base period of 2006 to 2008, and a 27.0 percent decrease for the eleven-state RGGI region in the calendar year 2021 when compared to the base period.

I. Background

The 2021 Electricity Monitoring Report summarizes monitoring data and tracks trends for electricity demand, net electricity imports, electricity generation from multiple categories of generation sources (including net electricity imports), and the CO_2 emissions related to these categories of electric generation in the RGGI region, for the period from 2006 through 2021.[3] This monitoring was called for in the 2005 RGGI MOU in response to expressed concerns about the potential for the RGGI CO_2 Budget Trading Programs[4] to result in "emissions leakage".[5] The monitoring approach that was used to compile the data summarized in this report was specified in a March 2007 report from the RGGI Staff Working Group, *Potential Emissions Leakage and the Regional Greenhouse Gas Initiative (RGGI): Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Mechanisms*.[6]

The report should not be used to draw definitive conclusions about whether CO_2 emissions leakage has occurred, as it does not address the causes of observed trends among different categories of electric generation serving load in the eleven-state RGGI region. This report is an analysis of CO_2 emissions only and does not speak to other greenhouse gases.

II. Monitoring Approach

The data summarized in this report track electricity generation and electricity use in each of the three independent system operator (ISO) regions fully or partially subject to the RGGI CO_2 Budget Trading Program: ISO-New England (ISO-NE), New York ISO (NYISO), and PJM. The data track total MWh of electricity used to serve electric load in each ISO (or portion of an ISO subject to RGGI, in the case of PJM), the actual or estimated short tons of CO_2 emissions related to the generation of this electricity, and the associated lb CO_2/MWh emission rate.

Throughout this report, references to "electric generation" and "electric load" include only that portion of electric generation or electric load dispatched or served through the regional transmission system administered by ISOs and tracked by individual ISOs. This excludes most electric generation output and electric load typically known as "behind-the-meter," which refers to electric generation that is not dispatched by ISOs, and electric load met through on-site electric generation facilities (e.g., industrial cogeneration and other smaller distributed generation resources, such as combined heat and power and solar photovoltaics). The electric generation MWh output that is used on-site is not included in the monitoring results.[7]

[3] This 2021 report is the first report to include Virginia.

[4] RGGI is comprised of state CO_2 Budget Trading Programs. Under each of these state programs, a regulated power plant must hold CO_2 allowances equal to its emissions to demonstrate compliance at the end of a three-year control period. Beginning in 2015, a regulated power plant must hold CO_2 allowances equal to 50% of its emissions to demonstrate compliance during each of the first two years of a three-year control period. CO_2 allowances are issued by participating states in a finite amount, or "budget", resulting in a regional cap on CO_2 emissions from the electric generation sector in the RGGI region. Regulated power plants are fossil fuel-fired electric generating units with an electric generation capacity of 25 megawatts (MWe) or greater.

[5] Specifically, the MOU called for monitoring electricity imports into the RGGI participating states from the start of the RGGI CO_2 Budget Trading Program and reporting the results of such monitoring on an annual basis beginning in 2010.

[6] The report also specified requested changes that were made to generator attribute tracking systems for ISO-NE and PJM to facilitate RGGI monitoring. The report is available at https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf.

[7] Behind-the-meter electric generators eligible for credit under state renewable portfolio standards typically voluntarily report electric generation to the ISO-NE Generation Information System (GIS), NY Generation Attribute Tracking System

For each year 2006 through 2021, the following categories of data are presented for the RGGI region as well as for each ISO:

- RGGI Generation: Electric generation (MWh), CO_2 emissions (short tons), and emission rate (lb CO_2/MWh) for electric generating units subject to a CO_2 allowance compliance obligation under state CO_2 Budget Trading Program regulations.[8]

- Non-RGGI Generation: Electricity generation (MWh), CO_2 emissions (short tons), and emission rate (lb CO_2/MWh) for all non-RGGI electric generation serving electric load in the eleven-state RGGI region. This includes both in-region electric generation and net electricity imports. In addition to total non-RGGI generation, data for the following subcategories of non-RGGI generation are also presented:

  - Non-RGGI In-Region Generation: Electric generation from electric generation units located in the eleven-state RGGI region that are not subject to a CO_2 allowance compliance obligation (e.g., generators under 25 megawatts electrical (MWe) capacity and non-fossil fuel-fired electric generators)[9].

  - Net Imports: Electric generation from net electricity imports (MWh) from adjacent control areas, or portion of a control area, outside the RGGI region (can be fossil or non-fossil generation).[10]

III. Evaluation of Monitoring Data

This section addresses issues considered in evaluation of the monitoring data, including the selection of base periods for comparison of data and general monitoring limitations.

Base Period

This report compares monitoring data for the period from 2019 to 2021 to a base period of 2006 to 2008 for the nine-state RGGI region. The report also tracks the same categories for the 2021 annual averages in the eleven-state RGGI region and compares these to the base period. The period of 2006 to 2008 represents the three years immediately prior to the start of the first RGGI control period. It was selected as the base period to provide a point of comparison to the three-year control periods of RGGI.

(NYGATS), and PJM Generation Attribute Tracking System (GATS), which are discussed in Section IV. Methodology. These behind-the-meter electric generators that report to ISO-NE GIS, NYGATS, and PJM GATS are included in the monitoring results. CO_2 emissions data for behind-the-meter electric generation that is RGGI-affected are also included in this report. In addition, only electricity output from cogeneration facilities is reported by ISOs, meaning that the average lb CO_2/MWh emission rate for all reporting years in this report is for electricity generation dispatched to the ISO grid only and does not account for behind-the-meter MWh output or useful steam output from cogeneration facilities.

[8] For the purposes of this report, this category does not include electric generators that may be subject to a state CO_2 Budget Trading Program regulation, or portion of such regulation, but that are not subject to a CO_2 allowance compliance obligation that requires the generator to submit CO_2 allowances equivalent to its CO_2 emissions. For example, under Maryland's CO_2 Budget Trading Program regulations, certain industrial cogenerators may be subject to alternative CO_2 compliance obligations under certain conditions in lieu of submission of CO_2 allowances.

[9] In New York, generators including and over 15 MWe capacity are subject to CO_2 allowance compliance obligation.

[10] For individual ISOs, net imports represent actual annual net electricity flows between ISOs, as reported by the ISOs. For PJM, net electricity imports represent inferred transfers of electricity from the non-RGGI geographic portion of PJM into the RGGI geographic portion of PJM.

In monitoring reports from 2009, 2010, 2011, and 2020 data comparisons were made to the base period for the ten-state region (RGGI-10). For 2012 through 2019, data comparisons were made to the base period for the nine-state region, reflecting the states participating in RGGI during that time.[11] The monitoring report for 2021 introduces Virginia and compares data for the eleven-state region, in addition to continuing to report data comparisons for the nine-state region.

Key Metrics

A key metric presented in this report that may provide a preliminary or potential indication of emissions leakage, or a lack thereof, is electric generation and related CO_2 emissions from all non-RGGI electric generation serving electric load in the RGGI region. This includes electric generation in the RGGI region from electric generating units that are not subject to a CO_2 allowance compliance obligation under a state CO_2 Budget Trading Program (e.g., small fossil units not subject to RGGI or non-fossil units not subject to RGGI), as well as net imports of electricity into the RGGI region. If CO_2 emissions leakage were to occur, it would manifest as an increase in CO_2 emissions from this category of non-RGGI electric generation, assuming all other factors that impact electricity system dispatch and CO_2 emissions (such as electricity demand, relative fossil fuel prices, and wholesale electricity prices) did not change. As a result, an increase in CO_2 emissions from this category of electric generation in a year subsequent to implementation of RGGI, relative to a baseline prior to the implementation of RGGI, could be an indicator of *potential* CO_2 emissions leakage.

General Limitations

It should be emphasized that this report does not provide indicators of CO_2 emissions leakage, but rather tracks electricity generation and net electricity imports and related CO_2 emissions in the RGGI region for 2019 to 2021, relative to baseline years prior to implementation of RGGI. Determining whether CO_2 emissions leakage has occurred requires the evaluation of a hypothetical counterfactual – the amount of CO_2 emissions from non-RGGI electric generation that would occur, assuming there is no shift in electric generation to CO_2-emitting non-RGGI electric generators as a result of the implementation of the RGGI CO_2 Budget Trading Program. In theory, an increase in CO_2 emissions or CO_2 emission rate from non-RGGI electric generation as compared to a historical baseline year could occur in a scenario in which CO_2 emissions leakage does not occur. Conversely, leakage could theoretically occur in a scenario in which CO_2 emissions and CO_2 emission rate for non-RGGI electric generation *decreased* as compared to a historical baseline year, as such emissions could have decreased further under a hypothetical counterfactual in which no CO_2 emissions leakage occurs.

Changes in these data over time may point to *potential* CO_2 emissions leakage as a result of states implementing the CO_2 Budget Trading Program, or a lack thereof, but may also be the result of wholesale electricity market and fuel market dynamics unrelated to the implementation of the CO_2 Budget Trading Program, or a combination of these factors.

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[11] ISO-NE data for years 2006-2015 was adjusted and corrected by the ISO-NE states in the 2016 Electricity Monitoring Report to account for misclassifications of certain generators. New York Control Area (NYCA) data for years 2006-2009 was adjusted and corrected by New York State Department of Public Service (NYSDPS) in the 2011 Electricity Monitoring Report to account for misclassifications of certain generators. The impacts on RGGI and non-RGGI generation and emissions were not significant. All reports available at https://www.rggi.org/allowance-tracking/emissions.

The analysis of lifecycle CO_2 emissions or reductions from fuels used in non-RGGI non-fossil-fuel units is also not within the scope of this report. For example, the direct emissions of CO_2 and the lb CO_2/MWh emission rates from non-RGGI non-fossil fuel units in this report do not reflect the biomass lifecycle carbon reduction of atmospheric CO_2 levels resulting from uptake of CO_2 from the atmosphere as a result of forest and biomass growth. Likewise, for municipal solid waste combustors, direct emissions of CO_2 are presented with no analysis of the lifecycle of the waste components.

IV. Methodology

Data Sources

For ISO-NE and PJM, the data presented are primarily from the NEPOOL Generation Information System (GIS) and PJM Generation Attribute Tracking System (GATS),[12] supplemented by ISO electricity import/export data, and CO_2 emissions data for RGGI electric generation from the RGGI CO_2 Allowance Tracking System (RGGI COATS) and emissions statement data reported to state environmental agencies in the RGGI participating states. For non-RGGI electric generation, CO_2 emissions are based on CO_2 emissions for individual electric generation facilities in the NEPOOL GIS and PJM GATS tracking systems. A summary of data sources for ISO-NE and PJM is provided in Appendix A.

For NYISO, MWh data for 2006 to 2015 were compiled by the NYS DPS from NYISO data (MWh generation data) and, beginning in 2016, MWh data were compiled by the NYS DPS from NYISO data (MWh generation data) fed into the New York Generation Attribute Tracking System (NYGATS), which began operation for the 2016 calendar year. NYGATS also captures PJM, NEPOOL, and Hydro Quebec and Ontario data (MWh electricity net import data). This MWh data was supplemented by CO_2 emissions data compiled by the New York State Department of Environmental Conservation (NYSDEC), the EPA, and validated self-reporting in NYGATS. CO_2 emissions data for RGGI electric generation units were compiled from RGGI COATS and from NYSDEC emissions statement program data. CO_2 emissions data for fossil fuel-fired electric generation units that are non-RGGI were taken or extrapolated from reports compiled by NYSDEC, the EPA, and validated self-reporting in NYGATS. A summary of data sources for NYISO is provided in Appendix A.

For each ISO, CO_2 emissions related to net electricity imports from each adjacent control area[13] are the product of a lb CO_2/MWh emission rate and the reported MWh of net imports. The CO_2 emission rate for electricity imports is based on the system average CO_2 emission rate for the respective exporting adjacent control area.[14] For ISO-NE and NYISO, net electricity imports are based on actual flow data for electricity transfers

[12] These ISO tracking systems track every MWh of electric generation for each electric generator that participates in the ISO wholesale market. Modifications were made to both systems at the request of the RGGI Staff Working Group to facilitate the tracking presented in this report. (See Staff Working Group, *Potential Emissions Leakage and the Regional Greenhouse Gas Initiative (RGGI): Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Mechanisms,* pp. 18-26; available at https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf.) These systems do not fully capture the portion of electric generation that is "behind the meter" and used to serve on-site electric load (e.g., MWh supplied from industrial cogeneration to meet on-site industrial electricity load).
[13] For PJM, this represents inferred imports from the non-RGGI geographic portion of PJM.
[14] This assumes that power transferred originates in the adjacent control area and is delivered for use in the receiving control area. This assumption does not account for the wheeling of power through control areas.

between adjacent control areas.[15] For PJM, net electricity imports are inferred and represent “transfers” of electricity from the non-RGGI geographic portion of PJM into the RGGI geographic portion of PJM (Delaware, Maryland, New Jersey, and Virginia). This data is compiled from PJM GATS, which reports data for both the non-RGGI and RGGI geographic portions of PJM. Inferred net imports are based on total MWh load in the RGGI geographic portion of PJM minus total electric generation in the RGGI geographic portion of PJM. Any shortfall in generation relative to load is assumed to be met through an inferred “import” of electricity from the non-RGGI geographic portion of PJM into the RGGI geographic portion of PJM.[16]

When aggregating individual ISO net import data, the reported regional net imports of electricity and related CO_2 emissions from net imports presented in this report represent net imports from adjacent regions not subject to the RGGI CO_2 Budget Trading Program. Some of the individual ISO net import subtotals represent net imports from another ISO or portion of an ISO that is also subject to the RGGI CO_2 Budget Trading Program (e.g., from ISO-NE into NYISO and vice versa). To avoid inappropriate double counting of MWh and related CO_2 emissions, the net import subtotals from adjacent ISOs or portion of an ISO subject to the RGGI CO_2 Budget Trading Program were not included when rolling up the individual ISO data into regional summary totals, as the electricity and CO_2 emissions represented by these net imports are included in the electric generation subtotals for each ISO. In rolling up total regional net imports, NYISO net imports from PJM represent a prorated portion of total net imports from PJM that are assumed to originate from the non-RGGI geographic portion of PJM. For each year, this proration is based on the percentage of total PJM MWh generation that occurred in the non-RGGI geographic portion of PJM.

Monitoring Limitations

The monitoring approach used in this report is subject to certain inherent limitations. These limitations primarily involve tracking for the PJM ISO, as well as how net exports from PJM to NYISO are addressed when rolling up ISO-specific data into regional totals.

For ISO-NE and NYISO, net electricity import data is based on the tracking of actual electricity flows between adjacent control areas.[17] This type of tracking is not possible for the RGGI portion of PJM, as PJM is dispatched as a single control area and electricity flows between geographic subsets of PJM on a state-by-state basis are not available. As a result, “electricity imports” into the four-state RGGI portion of PJM (Delaware, Maryland, New Jersey, and Virginia) from the rest of PJM must be inferred.

This also means that net electricity exports from the non-RGGI portion of PJM into NYISO cannot be determined based on actual electricity flows, as the actual monitored flows of electricity between PJM and NYISO do not allow for a differentiation between these two geographic subsets of PJM. As a result, certain assumptions must be made to prorate the portion of net exports from the non-RGGI portion of PJM into NYISO. For this report, this proration is based on the annual percentage of electric generation in the non-

[15] The exception is net import data from Hydro Quebec into NYISO, which represents net scheduled electricity imports. Scheduled flows are those flows that are scheduled at an ISO interface for a defined period, while actual flows are the metered flows at an ISO interface for a defined period. Differences between the two can arise from transactions scheduled on contract paths that do not fully correspond to the physical paths on which the electricity related to the transaction actually flows.
[16] This category of data does not technically represent an import of electricity, as PJM is dispatched as a single control area.
[17] The exception is net import data from Hydro Quebec into NYISO, which represents net scheduled electricity imports.

RGGI portion of PJM for a respective reporting year as a percentage of total PJM generation for that year. The actual monitored net electricity flows from PJM into NYISO are multiplied by this percentage to derive an estimate of net electricity exports from non-RGGI PJM into NYISO. These assumed flows may not be fully representative of the actual electric generation source of net exports from non-RGGI PJM into NYISO.

A more modest monitoring limitation involves the electric generation data tracked by the three ISOs. ISO tracking does not include electric generation that is not dispatched into the ISO. This typically involves the portion of industrial cogeneration of electricity used on-site at industrial facilities as well as smaller distributed combined heat and power and renewable energy generation, which is sometimes referred to as “behind-the-meter” generation.[18]

V. Monitoring Results

Monitoring results are provided in this section for the full ten-state RGGI region. These results provide a compilation of data from each ISO fully or partially subject to the RGGI CO_2 Budget Trading Program: ISO-NE, NYISO, and PJM. ISO-NE and NYISO are fully subject to RGGI. For PJM, monitoring data is compiled for the four-state portion of PJM subject to RGGI (Delaware, Maryland, New Jersey, and Virginia). Monitoring data for each ISO is presented in Appendix B.

Monitoring results for the RGGI region for 2006 through 2021 are summarized in Table 1.[19]

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[18] See footnote 7.

[19] Note that reported regional net electricity imports represent net imports from adjacent control areas or a portion of a control area not subject to the RGGI CO_2 Budget Trading Program. As a result, the net electricity imports and related CO_2 emissions as reported in tabular summaries for each ISO provided in Appendix B may not add up to the reported total regional net imports and related CO_2 emissions. This is because some of the individual ISO net import subtotals represent net imports from another ISO that is also subject to the RGGI CO_2 Budget Trading Program. In order to avoid inappropriate double counting of MWh and related CO_2 emissions, these net import subtotals were not included when rolling up the individual ISO data into regional summary totals, as the electricity and CO_2 emissions represented by these net imports are included in the electric generation subtotals for each ISO.

Table 1. 2006 – 2021 Monitoring Summary for the RGGI Region

Annual averages for 2006 to 2008 (baseline) and 2021 represent the eleven-state RGGI region, 2009 to 2011 and 2020 represent the ten-state region, and 2012 to 2019 represent the nine-state region.

MWh	Electricity Serving In-Region Demand (MWh)							In-Region Electricity Generation (MWh)					*Summary Data*
	Total in RGGI	Net Imports - from Ontario to NYISO	Net Imports - from Quebec to NY & NE	Net Imports - from New Brunswick to NE	Net Imports - from non-RGGI PJM to NY	Net Imports - from non-RGGI PJM to RGGI PJM	Total Net Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Fossil Fuel-Fired Units	Non-Fossil Fuel-Fired Units	All Non-RGGI Units	All Units[20]	Non-RGGI Generation (Non-RGGI Generation within RGGI + Net Imports)
2006	575,341,395	3,672,282	8,982,749	1,047,000	7,127,777	94,471,071	115,300,879	230,651,243	15,675,477	213,949,842	229,625,319	460,040,516	344,926,198
2007	587,583,886	2,637,442	11,912,292	896,000	7,583,487	91,096,901	114,126,122	246,997,218	15,461,718	211,215,555	226,677,273	473,457,764	340,803,395
2008	575,302,585	6,162,902	15,141,014	1,285,000	7,998,554	91,516,082	122,103,552	229,909,179	10,218,607	212,922,487	223,141,094	453,199,033	345,244,646
2009	448,024,418	6,463,657	17,065,805	1,569,000	7,073,143	56,299,698	88,471,303	166,726,324	10,345,654	182,940,955	193,286,609	359,553,115	281,757,912
2010	461,285,678	3,872,635	13,549,209	737,000	10,460,586	58,001,518	86,620,948	185,391,332	11,905,069	178,157,745	190,062,814	374,663,730	276,683,762
2011	455,494,331	3,318,681	18,681,204	846,000	9,566,928	55,406,781	87,819,594	175,677,461	11,366,482	182,172,364	193,538,846	367,674,737	281,358,440
2012	372,082,306	5,749,461	22,312,689	643,000	7,926,652	34,442,085	71,073,887	151,793,798	8,241,438	143,617,952	151,859,390	301,007,419	222,933,277
2013	374,872,244	7,593,954	24,566,017	3,711,000	8,700,473	35,843,247	80,414,691	142,194,444	5,682,543	150,478,150	156,160,693	294,458,553	236,575,384
2014	364,133,729	7,180,281	22,052,178	3,527,050	8,239,526	32,656,507	73,655,542	138,677,245	6,423,947	151,930,514	158,354,461	292,306,718	232,010,003
2015	365,508,854	8,302,624	22,375,396	4,108,000	7,144,877	35,680,933	77,611,830	140,574,471	6,427,097	147,569,738	153,996,835	289,855,382	231,608,665
2016	363,036,567	7,668,000	21,843,000	4,842,000	7,936,937	33,910,113	76,200,050	139,176,565	6,965,600	146,001,202	152,966,802	286,897,517	229,166,852
2017	352,974,095	7,720,948	25,290,091	4,305,000	7,551,092	35,770,266	80,637,398	117,676,806	7,497,659	156,000,097	163,497,757	273,959,695	244,135,154
2018	362,498,067	6,586,515	24,803,861	4,044,000	10,145,908	30,085,536	75,665,820	132,757,016	7,644,625	155,822,346	163,466,971	288,396,056	239,132,791
2019	349,348,654	6,504,484	23,188,032	3,233,000	10,623,631	32,136,849	75,685,996	116,153,644	10,309,214	155,896,924	166,206,138	273,980,264	241,892,134
2020	411,031,375	7,472,000	23,953,000	2,585,000	8,510,135	51,196,818	93,716,953	143,530,528	11,457,265	172,244,676	183,701,940	319,008,422	277,418,894
2021	540,603,673	5,666,080	24,427,857	2,598,000	10,161,996	81,775,715	124,629,648	212,343,014	7,374,086	205,699,251	213,073,336	417,665,029	337,702,984

CO_2	Tons of CO_2 from Electricity Serving In-Region Demand							Tons of CO_2 from in-Region Electricity Generation					*Summary Data*
	Total in RGGI	Net Imports - from Ontario to NYISO	Net Imports - from Quebec to NY & NE	Net Imports - from New Brunswick to NE	Net Imports - from non-RGGI PJM to NY	Net Imports - from non-RGGI PJM to RGGI PJM	Total Net Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Fossil Fuel-Fired Units	Non-Fossil Fuel-Fired Units	All Non-RGGI Units	All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	288,202,644	769,120	39,607	547,053	4,520,246	59,911,033	65,787,059	191,241,698	8,905,149	22,268,738	31,173,887	222,415,585	96,960,946
2007	294,306,225	604,715	157,573	408,896	4,767,491	57,269,645	63,208,319	203,791,464	8,696,376	18,610,066	27,306,443	231,097,906	90,514,761
2008	271,611,447	1,154,884	41,725	736,564	4,979,177	56,969,639	63,881,990	181,115,565	4,682,470	21,931,423	26,613,893	207,729,458	90,495,883
2009	177,625,189	712,496	67,723	968,535	4,213,398	33,537,149	39,499,301	120,481,579	4,817,978	12,826,331	17,644,309	138,125,888	57,143,609
2010	196,597,792	554,950	37,339	406,202	6,339,400	35,150,499	42,488,390	133,921,703	5,421,415	14,766,284	20,187,699	154,109,402	62,676,089

[20] See Appendix A, Table 2, Table Note 1.

2011	176,616,407	336,556	47,363	410,324	5,706,392	33,048,520	39,549,155	117,165,688	5,160,339	14,741,225	19,901,564	137,067,252	59,450,720
2012	135,245,657	602,081	66,408	297,690	4,287,069	18,627,737	23,880,985	92,734,116	4,037,376	14,593,226	18,630,601	111,364,717	42,511,586
2013	132,502,742	795,236	54,159	1,186,296	4,822,624	19,867,713	26,726,027	86,618,562	2,191,307	16,967,034	19,158,342	105,776,903	45,884,369
2014	130,934,052	603,144	34,032	1,088,614	4,534,250	17,971,031	24,231,071	86,530,517	2,613,572	17,560,032	20,173,603	106,703,922	44,404,674
2015	126,801,452	697,420	27,131	1,313,206	3,602,223	17,989,208	23,629,188	82,987,695	3,415,102	16,555,084	19,970,186	102,957,881	43,599,373
2016	122,211,267	337,392	28,893	1,761,339	3,908,557	16,699,087	22,735,269	79,054,009	3,511,705	16,736,138	20,247,842	99,301,852	42,983,111
2017	107,727,436	298,260	33,453	1,471,090	3,599,881	17,052,989	22,455,673	64,491,131	3,601,719	17,178,913	20,780,632	85,271,763	43,236,305
2018	112,570,412	45,447	35,544	1,248,169	4,692,013	13,913,167	19,934,339	71,057,227	3,573,618	18,005,228	21,578,846	92,636,073	41,513,186
2019	101,072,961	44,881	30,673	926,581	4,995,026	15,110,127	21,107,288	59,648,430	3,281,030	17,036,213	20,317,243	79,965,673	41,424,531
2020	118,703,387	63,811	39,605	826,348	3,880,520	23,345,135	28,155,419	71,424,751	3,039,528	16,083,690	19,123,218	90,547,969	47,278,637
2021	171,931,774	48,388	35,005	830,503	5,193,704	41,794,827	47,902,428	104,322,755	1,213,919	18,492,672	19,706,591	124,029,346	67,609,019

	Emissions Rate for Electricity Serving In-Region Demand							**Emissions Rate for In-Region Electricity Generation**					***Summary Data***
lb CO_2/ MWh	**Total in RGGI**	**Net Imports - from Ontario to NYISO**	**Net Imports - from Quebec to NY & NE**	**Net Imports - from New Brunswick to NE**	**Net Imports - from non-RGGI PJM to NY**	**Net Imports - from non-RGGI PJM to RGGI PJM**	**Total Net Imports - from All Adjoining ISOs**	**RGGI-Affected Units**	**Non-RGGI Fossil Fuel-Fired Units**	**Non-Fossil Fuel-Fired Units**	**All Non-RGGI Units**	**All Units**	**Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)**
2006	1,002	419	9	1,045	1,268	1,268	1,141	1,658	1,136	208	272	967	562
2007	1,002	459	26	913	1,257	1,257	1,108	1,650	1,125	176	241	976	531
2008	944	375	6	1,146	1,245	1,245	1,046	1,576	916	206	239	917	524
2009	793	220	8	1,235	1,191	1,191	893	1,445	931	140	183	768	406
2010	852	287	6	1,102	1,212	1,212	981	1,445	911	166	212	823	453
2011	775	203	5	970	1,193	1,193	901	1,334	908	162	206	746	423
2012	727	209	6	926	1,082	1,082	672	1,222	980	203	245	740	381
2013	707	209	4	639	1,109	1,109	665	1,218	771	226	245	718	381
2014	719	168	3	617	1,101	1,101	658	1,248	814	231	255	730	383
2015	694	168	2	639	1,008	1,008	609	1,181	1,063	224	259	710	376
2016	673	88	3	728	985	985	597	1,136	1,008	229	265	692	375
2017	610	77	3	683	953	953	557	1,096	961	220	254	623	354
2018	621	14	3	617	925	925	527	1,070	935	231	264	642	347
2019	579	14	3	573	940	940	558	1,027	637	219	244	584	343
2020	578	17	3	639	912	912	601	995	531	187	208	568	341
2021	636	17	3	639	1,022	1,022	769	983	329	180	185	594	400

Nine-State RGGI Region 2019 to 2021 Annual Average Compared to Baseline

The monitoring results indicate that the 2019 to 2021 annual average electricity load in the nine-state RGGI region decreased by 42.8 million MWh, or 11.1 percent, compared to the 2006 to 2008 base period. Annual average electric generation from all sources in the nine-state RGGI region decreased by 53.2 million MWh, or 16.1 percent, compared to the base period.

Annual average electric generation from RGGI generation in 2019 to 2021 decreased by 49.8 million MWh, or 28.9 percent, compared to the three-year base period, and annual average CO_2 emissions from RGGI generation decreased by 76.2 million short tons, or 55.0 percent. The annual average CO_2 emission rate of RGGI generation decreased by 589.5 lb CO_2/MWh from 1,606 to 1,016 lb CO_2/MWh, a decrease of 36.7 percent. Annual average electric generation from non-RGGI generation sources located in the nine-state RGGI region decreased by 3.4 million MWh, or 2.1 percent, during this period, and annual average CO_2 emissions from this category decreased by 2.0 million short tons, or 9.9 percent. The annual average CO_2 emission rate of non-RGGI electric generation located in the nine-state RGGI region decreased by 20.4 lb CO_2/MWh, or 8.0 percent.

For 2019 to 2021, annual average electric generation from all non-RGGI electric generation serving load in the nine-state RGGI region increased by 16.2 million MWh, an increase of 7.6 percent, compared to the annual average generation for the base period. (See Figure 6). The CO_2 emissions from this category decreased by 6.0 million short tons, a reduction of 13.1 percent, and the CO_2 emission rate decreased by 81.4 lb CO_2/MWh from 424 to 342 lb CO_2/MWh, a reduction of 19.2 percent. (See Figures 10, 11, and 12).

Annual average net electricity imports into the nine-state RGGI region increased by 19.6 million MWh, or 35.0 percent, in 2019 to 2021 compared to the 2006 to 2008 base period. (See Figure 13). CO_2 emissions related to these net electricity imports during this period decreased by 4.0 million short tons, or 15.7 percent, and the average CO_2 emission rate of the electric generation supplying these imports decreased by 342.6 lb CO_2/MWh from 905 to 563 lb CO_2/MWh, a reduction of 37.8 percent. (See Figure 14).

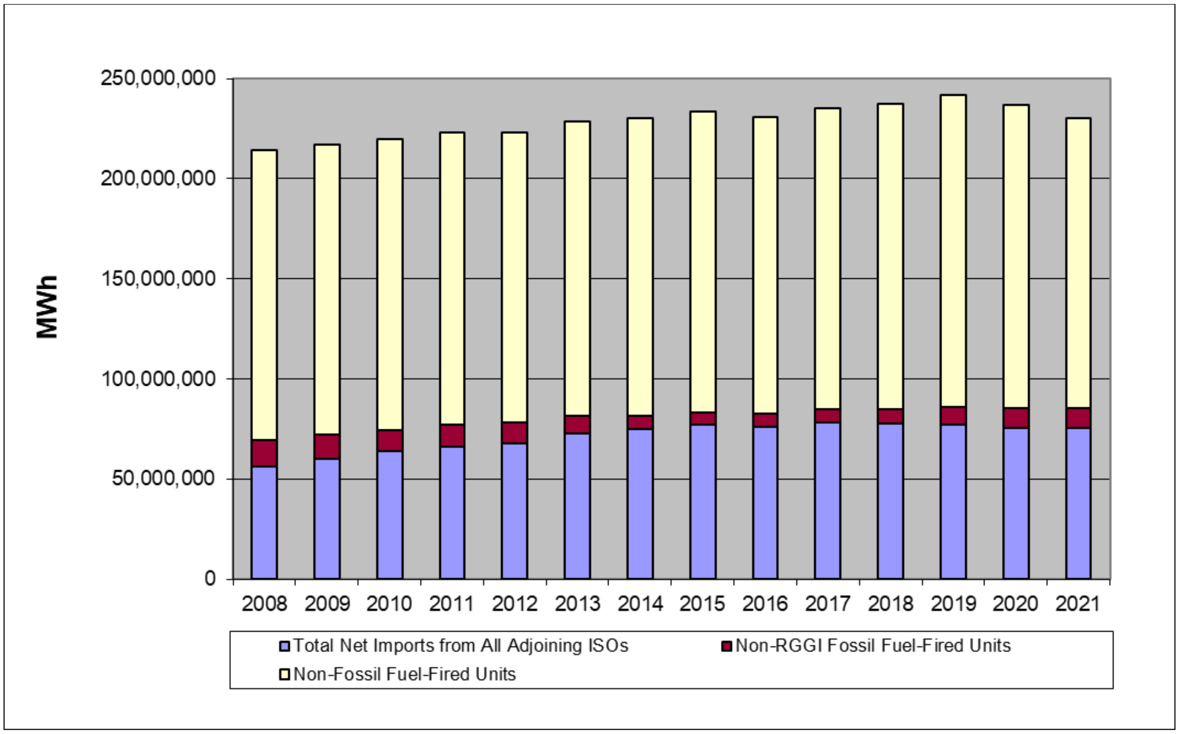

Figure 10. Non-RGGI Generation Serving Load in Nine-State RGGI Region (MWh) (Three Year Trailing Average)

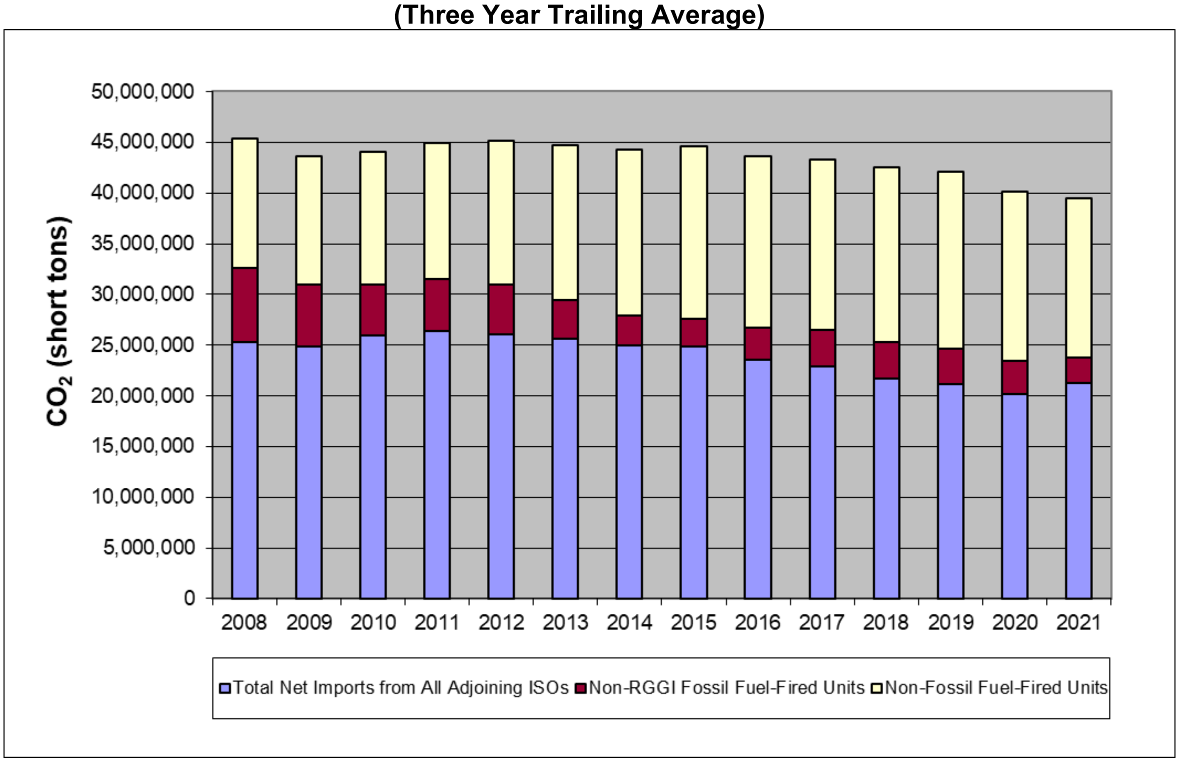

Figure 11. CO_2 Emissions from Non-RGGI Generation Serving Load in Nine-State RGGI Region (short tons CO_2) (Three Year Trailing Average)

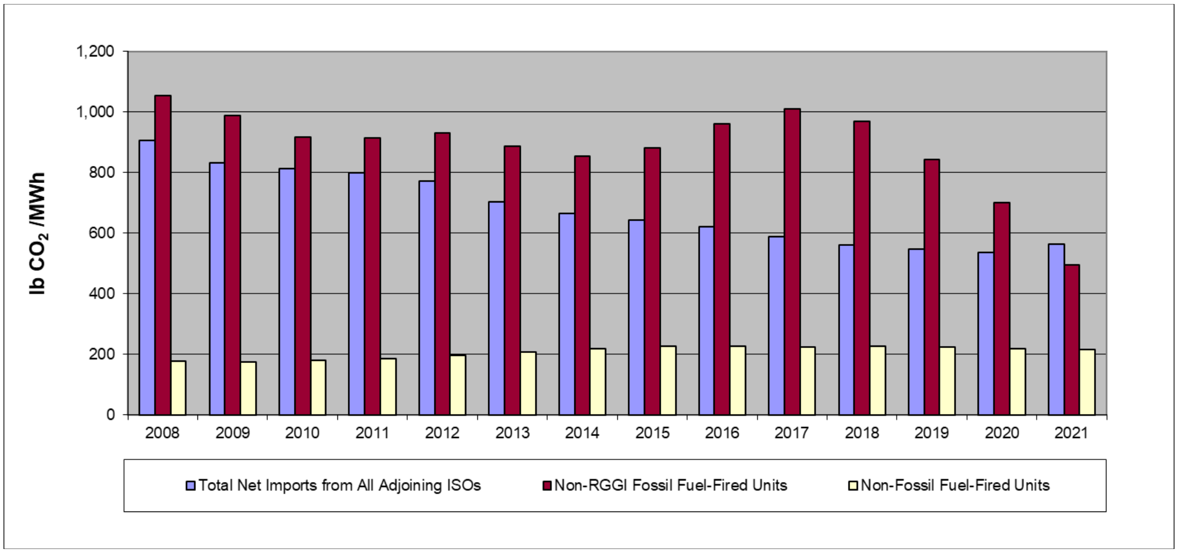

Figure 12. CO_2 Emission Rate for Non-RGGI Generation Serving Load in Nine-State RGGI Region (lb CO_2/MWh) (Three Year Trailing Average)

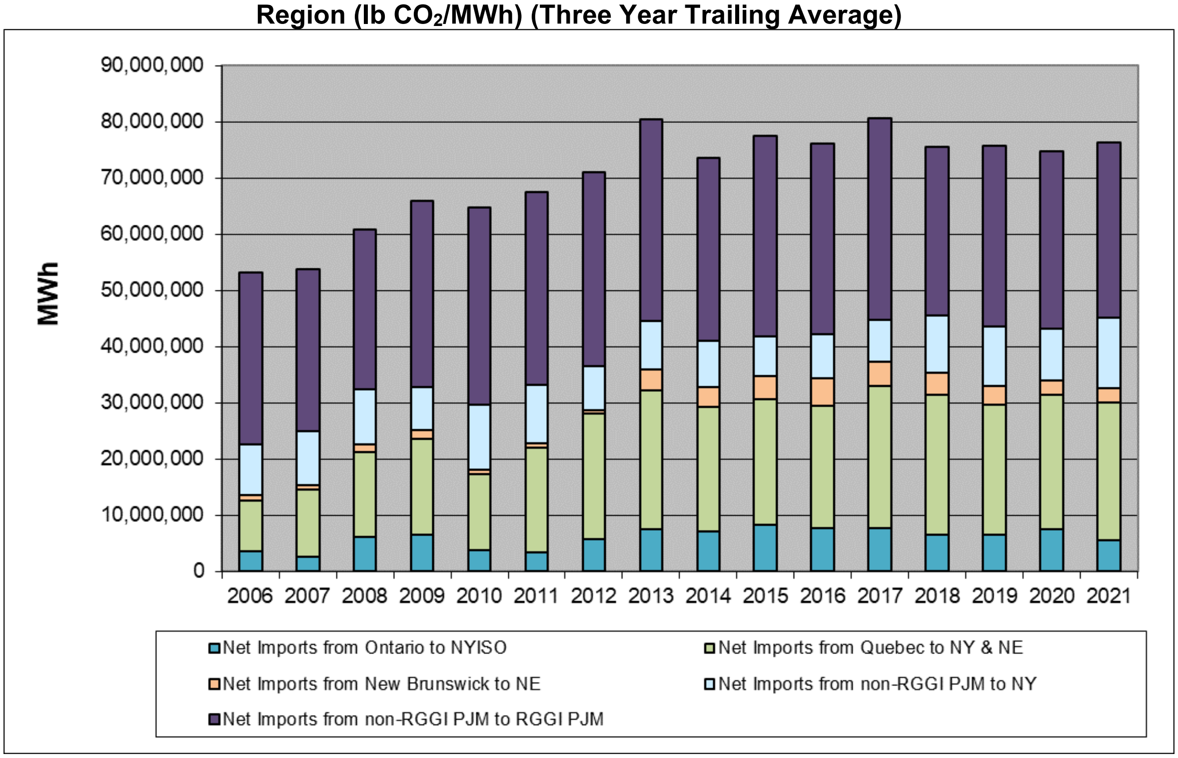

Figure 13. Net Electricity Imports to Nine-State RGGI Region (MWh) (Three Year Trailing Average)

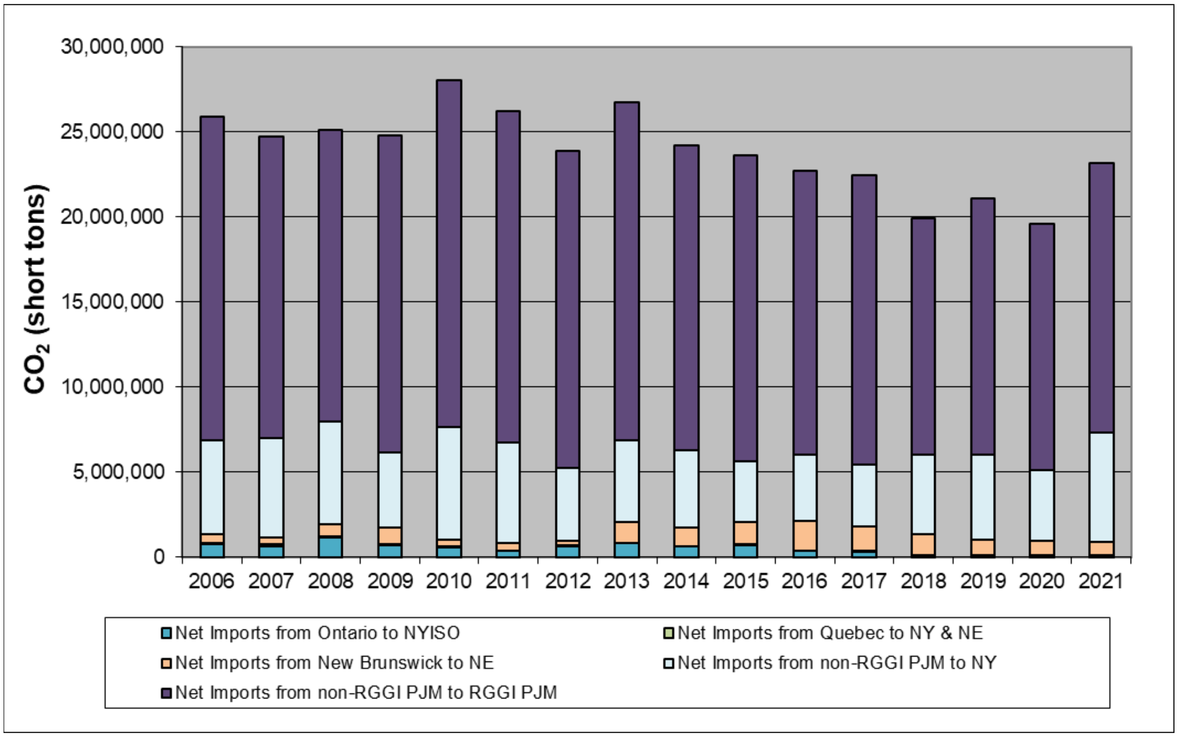

Figure 14. CO_2 Emissions Related to Net Electricity Imports to Nine-State RGGI Region (short tons CO_2) (Three Year Trailing Average)

Eleven-State RGGI Region 2021 Annual Average Compared to Baseline

The monitoring results indicate the 2021 annual average electricity load in the eleven-state RGGI region decreased by 38.8 million MWh, or 6.7 percent, compared to the 2006 to 2008 base period. The annual average 2021 electric generation from all sources in the eleven-state RGGI region decreased by 36.9 million MWh, or 8.0 percent, compared to the base period.

Compared to the annual average during the 2006 to 2008 base period, 2021 RGGI generation decreased by 23.5 million MWh, or 10.0 percent, and CO_2 emissions from RGGI generation decreased by 87.7 million short tons of CO_2, or 45.7 percent. Compared to the base period, the CO_2 emission rate of RGGI electric generation in 2021 decreased by 645 lb CO_2/MWh from 1,628 to 983 lb CO_2/MWh, a reduction of 39.6 percent.

Compared to the annual average during the 2006 to 2008 base period, 2021 electric generation from non-RGGI generation sources located in the eleven-state RGGI region decreased by 13.4 million MWh, or 5.9 percent. CO_2 emissions from this category decreased by 8.7 million short tons, or 30.5 percent, and the CO_2 emission rate decreased by 65.4 lb CO_2/MWh from 250 to 185 lb CO_2/MWh, or 26.1 percent.

For 2021, annual average electric generation from all non-RGGI electric generation serving load in the eleven-state RGGI region decreased by 6.0 million MWh, a decrease of 1.7 percent, compared to the annual average generation for the base period. The CO_2 emissions from this category decreased by 25.0 million short tons, or 27.0 percent. (See Figures 15, 16, and 17.)

Compared to the annual average during the 2006 to 2008 base period, 2021 net electricity imports into the eleven-state RGGI region increased by 7.5 million MWh, or 6.4 percent. (See Figure 18). CO_2 emissions related to these net electricity imports decreased by 16.4 million short tons of CO_2, or 25.5 percent, during this period (See Figure 19). The average CO_2 emission rate of the electric generation supplying these imports decreased by 329.7 lb CO_2/MWh from 1,098 to 769 lb CO_2/MWh, a reduction of 30.0 percent.

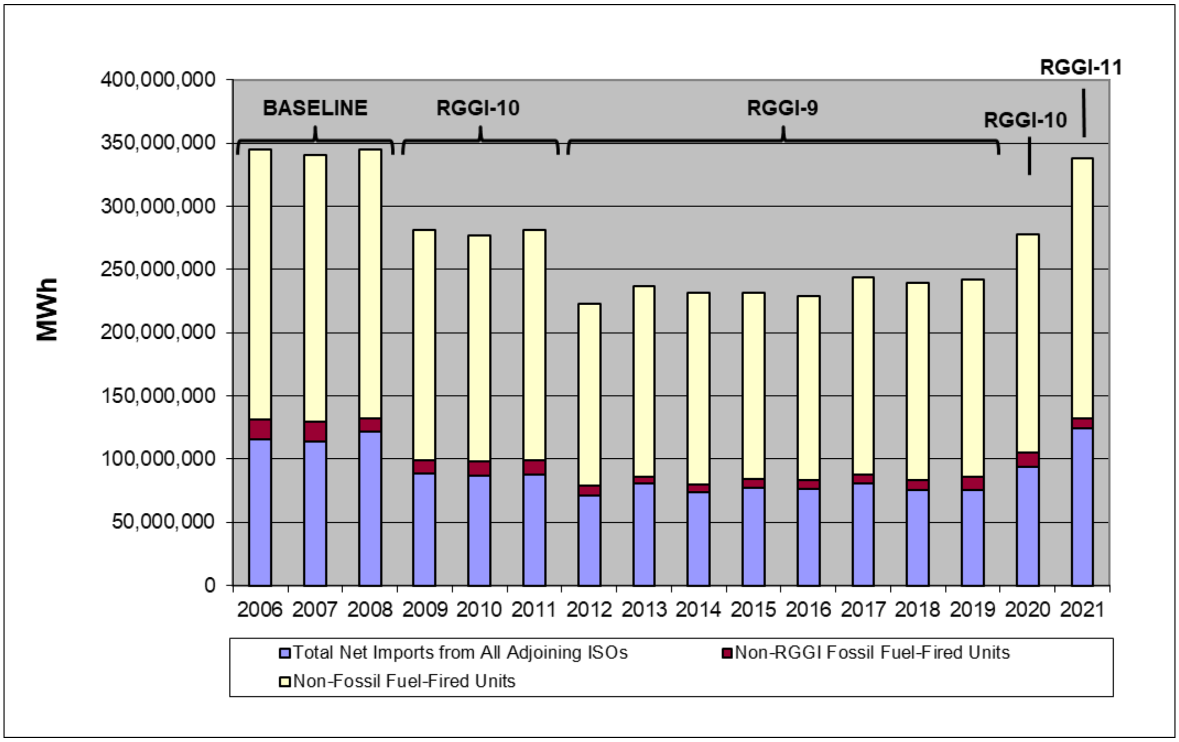

Figure 15. Non-RGGI Generation Serving Load in RGGI Region (MWh). Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

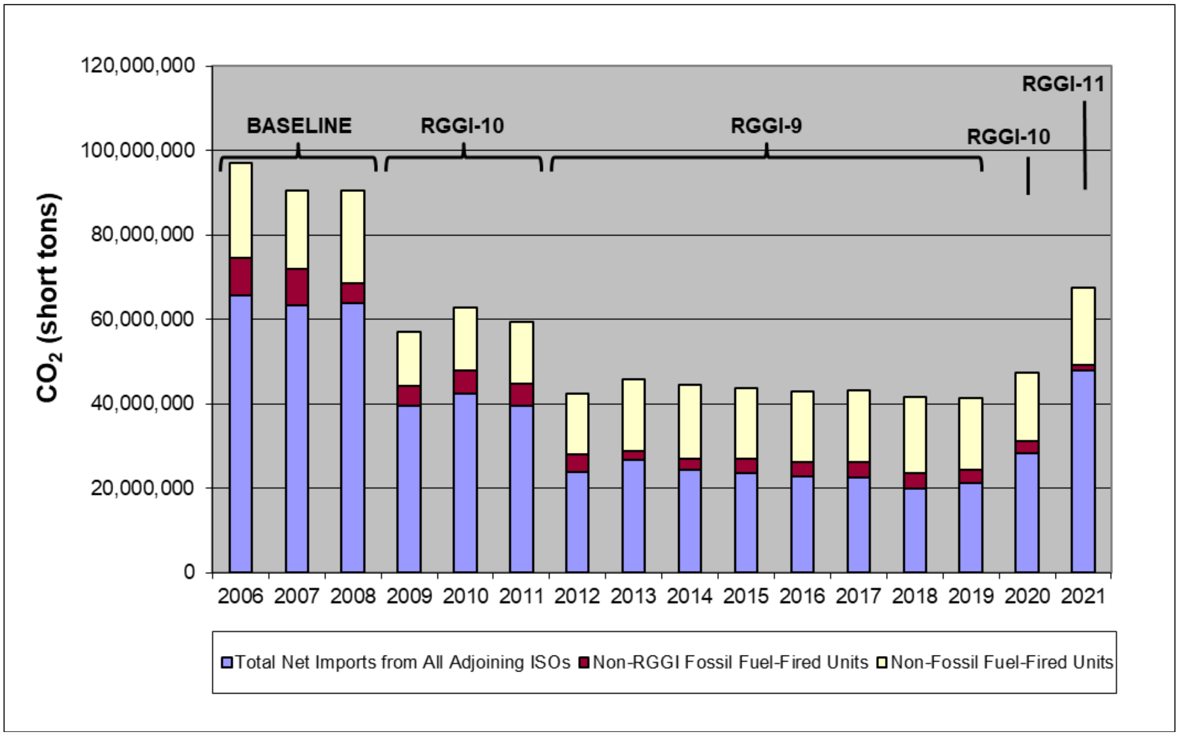

Figure 16. CO_2 Emissions from Non-RGGI Generation Serving Load in the RGGI Region (short tons CO_2). Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

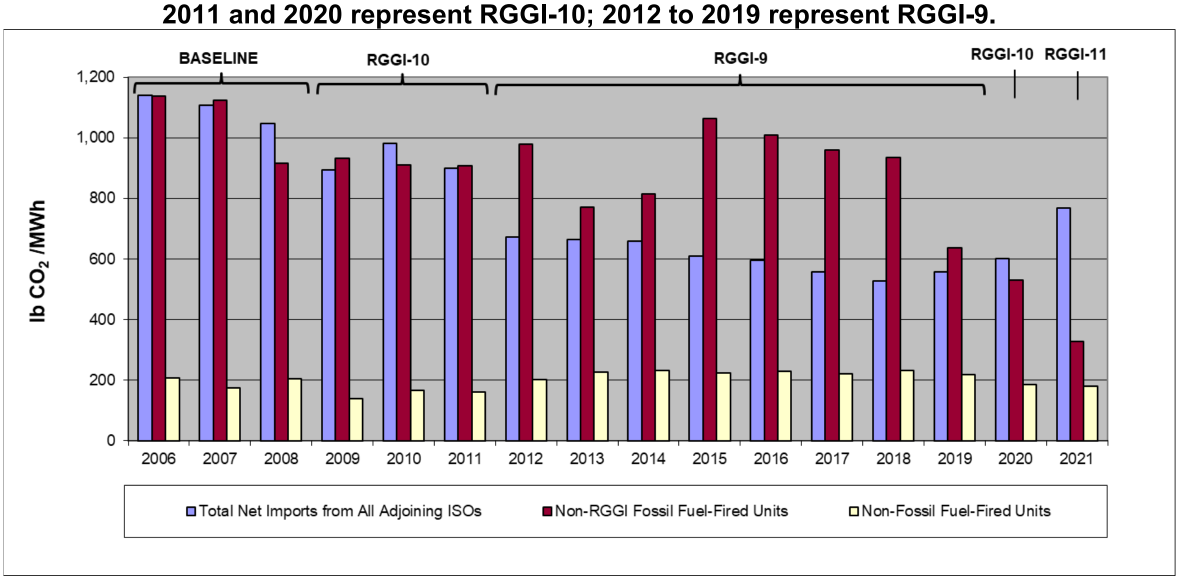

Figure 17. CO_2 Emission Rate for Non-RGGI Generation Serving Load in the RGGI Region (lb CO_2/MWh). Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

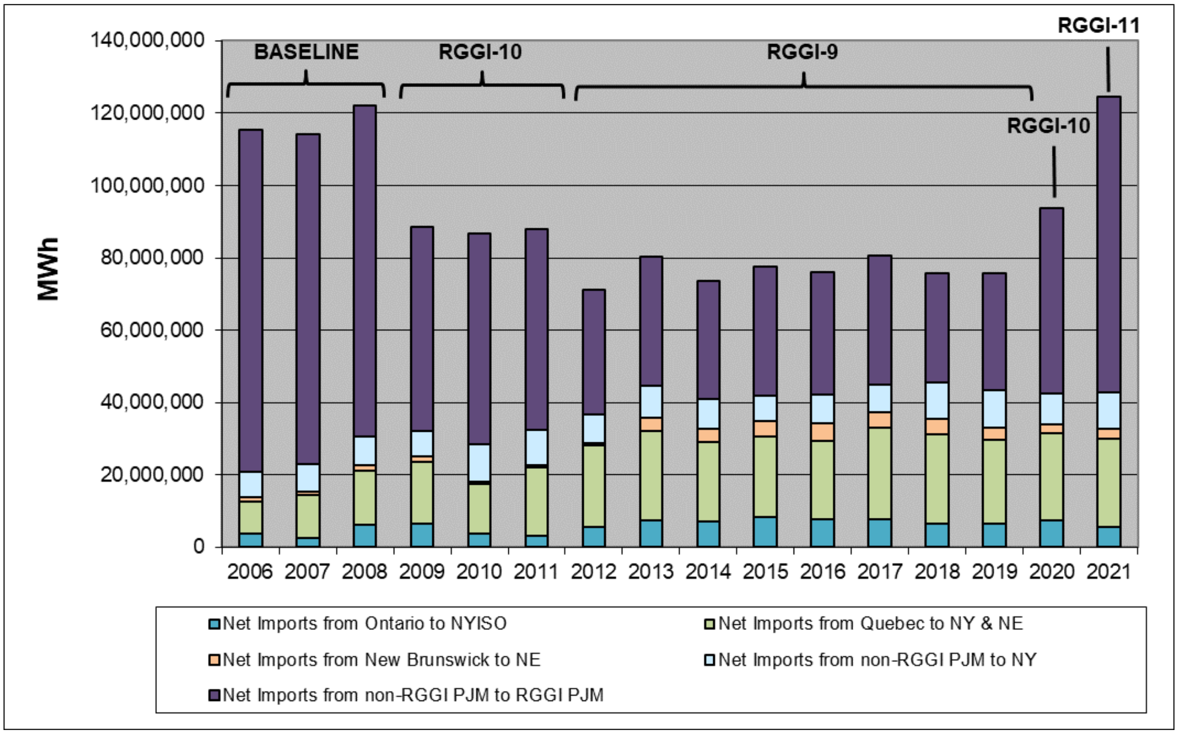

Figure 18. Net Electricity Imports to the RGGI Region (MWh). Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

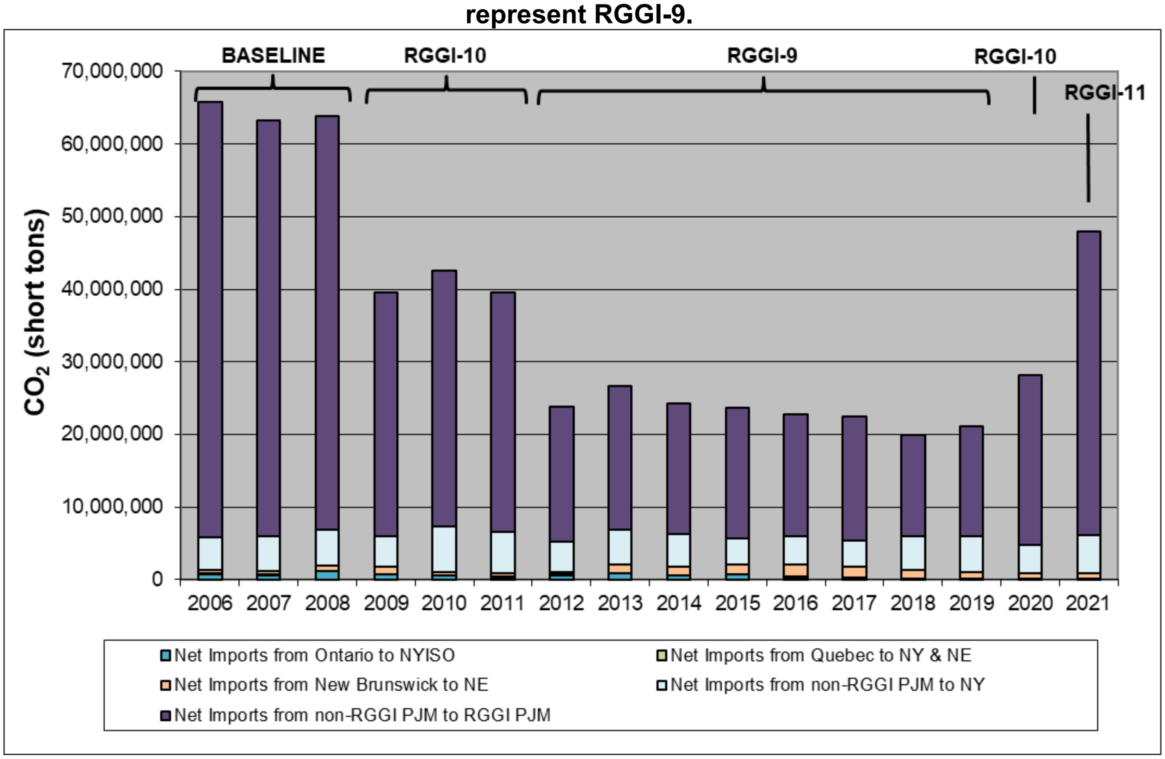

Figure 19. CO_2 Emissions related to Net Electricity Imports to the RGGI Region (short tons CO_2). Annual averages for baseline years and 2021 represent RGGI-11; 2009 to 2011 and 2020 represent RGGI-10; 2012 to 2019 represent RGGI-9.

VI. Discussion

As mentioned earlier in this report, multiple market factors interact to influence the dispatch of electric generation. CO_2 allowance costs have been relatively modest compared to other factors that impact wholesale electricity prices.

The wholesale electricity price is paid by market participants such as utilities, who then supply power to end-use retail consumers at retail rates. Retail rates are influenced by the wholesale price, but also include other costs such as delivery charges, administrative costs, and premiums for shielding retail rates from wholesale price volatility. Retail rates vary by state and are approved by state public utility commissions. Finally, consumer energy bills depend not just on the retail rate, but on the amount of power used by the end-use consumer. Improved energy efficiency can cause consumer bills to decline even as wholesale and/or retail rates increase. Without taking any of RGGI's benefits into account, CO_2 allowance costs accounted for 6.4 percent of the average all-in wholesale electricity price for ISO-NE, 11.2 percent of the average all-in wholesale electricity price for the New York Control Area (NYCA)[21], and 2.7 percent of the average all-in locational marginal price on a per MWh basis for PJM in 2021.[22] However, the wholesale price is only one of many factors which determine the amount that consumers pay.

When RGGI's benefits are taken into account, independent reports indicate that RGGI is generating net bill savings for consumers. Independent reports from the Analysis Group studied RGGI's first, second, third, and fourth three-year control periods, finding that RGGI is reducing consumer energy bills and generating net economic benefits on the order of $5 billion.[23] In particular, the reports found that energy efficiency programs funded by RGGI investments reduce demand for electricity, resulting not only in direct savings for those consumers making the efficiency investments, but also in downward pressure on wholesale prices that reduce costs for all electricity ratepayers. The Analysis Group reports also do not include additional potential economic gains from co-benefits such as public health improvements and avoided climate change impacts.

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[21] NYISO refers to the New York Independent System Operator, which is the organization responsible for managing New York's electricity grid. The New York Control Area (NYCA) refers to the physical area that falls under NYISO's jurisdiction. Throughout the report the terms are used interchangeably.

[22] For 2021, the average all-in wholesale electricity price was $54.05/MWh for ISO-NE and $47.59/MWh for the NYCA, and the load-weighted average locational marginal price was $39.78/MWh for PJM (energy only) (see *ISO-NE Monthly Wholesale Load Cost Report; NYISO Power Trends 2022; 2021 State of the Market Report for PJM)*. The CO_2 allowance component is based on a 2021 average CO_2 allowance spot price of $9.61 per CO_2 allowance (See Potomac Economics, *Annual Report on the Market for RGGI CO_2 Allowances: 2021*). For PJM, the CO_2 allowance component of the Locational Marginal Price (LMP) for 2021 was $1.08 per MWh (See *2021 State of the Market Report for PJM*). ISO-NE and the NYCA do not report the CO_2 allowance component of wholesale electricity prices. The New England and New York analyses used a 2021 average CO_2 allowance spot price of $9.61 as a starting point for deriving a CO_2 allowance wholesale price component. For both ISO-NE and the NYCA, the CO_2 emission rate of the assumed marginal unit was used to translate the annual average spot price for CO_2 allowances into a dollar per MWh value. For ISO-NE, this resulted in an average CO_2 allowance wholesale price component of approximately $3.45 per MWh. For the NYCA, this resulted in an average CO_2 allowance wholesale price component of $5.31 per MWh.

[23] "The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States." Analysis Group. May 2023.
"The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeastern and Mid-Atlantic States." Analysis Group. April 2018.
"The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeastern and Mid-Atlantic States." Analysis Group. July 2015.
"The Economic Impact of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States." Analysis Group. November 2011.

Wholesale prices fell from 2008 to 2010. In 2010, higher fuel prices, increased economic activity, and hot weather led to an increase in wholesale prices in 2010 relative to 2009. Average electricity prices decreased in 2011 relative to 2010, primarily due to a decrease in natural gas prices and mild winter temperatures in late 2011.[24] This decline in electricity prices continued through 2012 as the price of natural gas continued to fall and temperatures remained mild through the winter. Higher natural gas prices, especially during winter months, resulted in higher electricity prices in 2013.[25] The first quarter of 2014 saw cold weather, with milder weather experienced in the following three quarters, and the net effect was an overall increase in prices in 2014[26]. Wholesale prices fell in 2015 and then reached a low in 2016 due to a warm winter that resulted in less demand for natural gas.[27] 2017 saw a slight increase in wholesale prices across the three ISOs. Cold temperatures in early 2018 raised natural gas prices, which further increased average electricity prices in 2018.[28] In 2019, wholesale prices decreased in all ISOs, with prices dropping to a record low in the NYCA's market.[29] This was due to a mild summer, resulting in lower demand, and reductions in natural gas prices, which decreased by 20 to 40 percent from 2018 to 2019 depending on the region.[30]

Annual averages and wholesale prices for calendar year 2020 were greatly affected by COVID-19, making 2020 a unique year. Starting in the spring there were work-from-home and social-distancing measures, travel restrictions, and the closing of businesses, which affected energy supply and demand. After accounting for weather, cumulative load in PJM was 3.4 percent lower when compared to 2019.[31] The NYCA also noted a significant decrease, falling as low as 10 percent lower than expected levels, then increasing in late summer and fall but still lower than forecasted levels.[32] While there was a significant decrease in demand from commercial customers, there was a rise in in residential use, affecting daily load patterns – the NYCA saw an increase in demand in residential areas, such as Long Island.

Although wholesale electricity prices hit record lows in 2020, market prices rebounded in 2021 due to an increase of natural gas prices, higher demand for electricity, and extreme weather. In the NYCA, electricity demand increased by almost 1.5% from 2020 to 2021[33], while average natural gas prices more than doubled due to liquified natural gas exports growing faster than domestic production[34]. Additionally, transmission congestion and fluctuations in capacity requirements, driven by generator retirements in New York, further contributed to price increases.[35] Of PJM's increase in average LMP, 72.7 percent was driven by increased fuel and emissions costs, primarily due to higher natural gas prices.[36] ISO-NE, where natural gas has been the primary fuel type of the past five years[37], experienced a 38% increase in cooling degree days and a 10% increase in

[24] See, for example, Monitoring Analytics, *2011 State of the Market Report for PJM*, Section 1, Introduction.
[25] See, for example, *NYISO 2013 Annual Report*, p. 13.
[26] See, for example *NYISO 2014 Annual Report,* p. ii.
[27] See, for example, *ISO-NE 2018 Annual Markets Report*, p. 4.
[28] See, for example, *NYISO Power Trends 2019,* p. 30.
[29] See, for example, *NYISO Power Trends, 2020*, p. 7
[30] Potomac Economics, *2019 State of the Market Report for the New York ISO Markets*, p. 4.
[31] Monitoring Analytics, *2020 State of the Market for PJM*; Volume 2, Energy Market, p. 2.
[32] Potomac Economics, *2020 State of the Market Report for the New York ISO Markets*, p. 11.
[33] *NYISO Power Trends, 2022,* p. 27
[34] Potomac Economics, *2021 State of the Market Report for New York ISO Markets,* p. i.
[35] Potomac Economics, *2021 State of the Market Report for New York ISO Markets,* p. 4.
[36] Monitoring Analytics, *2021 State of the Market for PJM*; Volume 2, Energy Market, p. 1.
[37] *ISO-NE 2021 Air Emissions Report,* p. 20.

heating degree days, which affected net energy load and generation.[38] Furthermore, Texas' winter storm in February 2021 caused rippled effects across the country, spiking energy prices as supply shortages impacted multiple regions.[39]

A number of market drivers have changed dramatically during the 2006 through 2021 monitoring timeframe. These changes are due to several factors, including additional investments in energy efficiency and renewable energy (funded in part by RGGI auction proceeds); complementary state clean energy programs and policies; lower natural gas prices (changes in relative fuel prices); changes in the generation mix, including additional renewable generation; and weather trends. An analysis of these changes, and their estimated impact on CO_2 emissions in the ten-state RGGI region from 2006 to 2009, was completed by the New York State Energy Research and Development Authority (NYSERDA).[40] A 2015 peer-reviewed study in the journal *Energy Economics* examined a similar set of factors and found that RGGI played a significant role in the observed emissions decline in the region.[41] A 2019 research report by the Congressional Research Service cited both studies towards a conclusion that the RGGI cap, the market signal sent by the allowance price, and the reinvestment of proceeds have worked together to help support a shift towards cleaner generation and regional emissions reductions.[42]

A key factor impacting the potential for emissions leakage is the relative cost of electric generation inside and outside the RGGI region (both with and without the incorporation of CO_2 allowance costs), and the relationship of this cost differential with physical transmission capability, the all-in market costs of inter-region power transmission, and the market impacts of transferring significant incremental amounts of power into the RGGI region. The dynamic and highly specific nature of market factors and physical constraints that may cause or mitigate emissions leakage make both a retrospective analysis and future projections of emissions leakage difficult. The factors that may result in emissions leakage are likely to be both temporally and geographically specific.

The dynamics of a competitive wholesale electricity market could drive emissions leakage if there is a sufficient net financial incentive to shift electric generation to units not subject to CO_2 regulation. The extent of this impact is likely to depend, at least in part, on the market value of CO_2 allowances (and the related $/MWh CO_2 costs incorporated into bids by generators subject to the RGGI CO_2 Budget Trading Program) in relation to other economic factors associated with the generation and delivery of electricity. If the cost of RGGI CO_2 compliance on a per MWh basis is lower than the aggregate per MWh price signal of mitigating market factors, which are discussed below, no net market dynamic driving emissions leakage would be expected to occur. Market factors that may impact the economics of importing incremental power in response to a CO_2 allowance price signal[43] include:

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[38] *ISO-NE 2021 Air Emissions Report,* p. 2.

[39] Monitoring Analytics, *2021 State of the Market for PJM*; Volume 2, Energy Market, p. 440.

[40] New York State Energy Research and Development Authority (NYSERDA), *Relative Effects of Various Factors on RGGI Electricity Sector CO_2 Emissions: 2009 Compared to 2005*, November 2010; available at Retrospective_Analysis_Draft_White_Paper.pdf.

[41] Murray, Brian C. and Peter T. Maniloff. "Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors." *Energy Economics*. August 2015.

[42] Congressional Research Service. *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress,* July 2019, available at https://fas.org/sgp/crs/misc/R41836.pdf.

[43] Some of these factors may also impact the economics of shifting dispatch to smaller in-region fossil fuel-fired electric generation in the RGGI region that is not subject to regulation of CO_2.

- ***Existing Generator Economics**:* Including a CO_2 compliance cost into the generation costs of an individual electric generator may make that generator uneconomic relative to a competitor. Whether this occurs depends on the operating costs of each electric generator, both with and without CO_2 compliance costs. Key factors that influence electric generator operating costs include fuel prices, generator heat rate (Btu of fuel input per kWh of electric generation output), and costs for air pollutant emissions such as nitrogen oxides (NO_X), sulfur dioxide (SO_2), and CO_2. As a result, inclusion of a CO_2 allowance cost must be sufficient to supplant any preexisting generator cost differentials in order to shift generation from a RGGI source to a non-RGGI source.

- ***Existing Locational Generation Price Differentials***: Locational Marginal Pricing (LMP) can be expected to affect the market response to the imposition of a CO_2 allowance cost adder to generation in the RGGI region. LMP is the cost of supplying the last MWh of generation dispatched at a specific location, which reflects transmission constraints and the marginal cost of generation units. LMP is based on the principle that the generation of power has different values at different points in the electric power network. Transmission resources are finite, and transmission "congestion" occurs when available, low-cost electric generation supply cannot be delivered to the demand location due to transmission network limitations. When electricity from the least-cost electric generation source in a region cannot be delivered to electricity load in a transmission-constrained area, higher cost units in this constrained area are dispatched to meet that load. The result is that the wholesale price of electricity in the constrained area is higher than in the unconstrained area.

  Differential LMPs between regions represent the presence of transmission constraints and line losses that require the dispatch of higher priced electric generation in a certain region. Electricity demand can have a large impact on LMPs in a specific region.

- ***Congestion Charges***: Congestion charges and the standard cost of transmitting electricity may make significant incremental imports into the RGGI region uneconomic as a response to a modest generation price differential resulting from RGGI CO_2 allowance costs. As an example, in PJM, power transmission is subject to congestion charges, which are based on the difference between LMPs at the source (generator location, or "generator bus") and LMPs at the sink (electric distribution utility location, or "load serving entity (LSE) bus"). Thus, in addition to standard transmission charges, entities importing power into the RGGI region would need to pay congestion charges based on the differential between LMPs in the uncapped non-RGGI region where the generator is located and LMPs in the capped RGGI region where the electricity is delivered.[44]

- ***Line loss charges***: The greater the distance that electricity is transmitted, and the more power transmitted through a power line, the greater the loss of the power initially put into the line, based on the physics of the electricity

[44] For example, the congestion component of the 2021 average day-ahead, load weighted LMP in the Delmarva Power & Light zone (Delaware and Maryland) of PJM was -$0.87 per MWh. For the Baltimore Gas & Electric zone (Maryland), the congestion component was $5.00 per MWh. Source: Monitoring Analytics, *2021 State of the Market for PJM*; Section 11, Table 11-7, p. 571.

transmission network. As a result, the costs of transmission line-losses impact the economics of importing power. In PJM, line losses are accounted for in the calculation of LMP through the application of a line loss “penalty factor.” If the dispatch of an electric generator would result in an increase in system line losses in a certain location, a positive penalty factor is applied to the generator’s bid into the wholesale market, making the unit look less economically attractive to dispatch.[45]

- ***Long-Term Contracts***: Existing long-term power purchase agreements can be expected to mitigate emissions leakage. These agreements mandate the purchase of power from particular sources for pre-set time periods, delaying the response to changes in market conditions.

- ***Reliability Constraints***: Reliability constraints also play a role in determining the dispatch of electric generation units, to the extent that units supply needed generation capacity and ancillary services in a specified region or location on the electricity grid.

- ***Other Factors***: Other relevant factors may include standard transmission pricing, relative fuel prices, natural gas supply and costs that can be influenced by pipeline constraints, and relative heat rates of generation units.[46]

VII. Conclusions

This report presents data and trends for electricity generation, net electricity imports, and related CO_2 emissions of electric generation serving load in the RGGI region without assigning causality to any one of the factors influencing observed trends. Monitoring results show that there has been an increase in the amount of non-RGGI electric generation serving load in the RGGI region, combined with a decrease in the CO_2 emissions rate of this generation. These two trends largely offset one another. Overall, the monitoring results show that there has been a 13.1 percent decrease in average annual CO_2 emissions from non-RGGI electric generation serving load in the nine-state RGGI region during the period of 2019 to 2021 when compared to the annual average annual CO_2 emissions during the base period of 2006 to 2008, and a 27.0 percent decrease for the eleven-state RGGI region in the calendar year 2021 when compared to the base period.

Emissions leakage may manifest through an increase in CO_2 emissions from this aggregate category of non-RGGI electric generation, all other factors being equal. However, given that the monitoring results presented in this report do not address causality, the results should be evaluated in context with market dynamics. Changes in factors such as electricity demand, relative fossil fuel prices, and wholesale electricity prices, can also play a role in changing emissions and generation trends.

When taking only costs into account and not including RGGI’s economic benefits, the average CO_2 allowance price in 2021 represented approximately 11.2 percent or less of

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[45] For example, the line loss component of the 2021 average day-ahead, load weighted LMP in the Delmarva Power & Light zone (Delaware and Maryland) of PJM was $0.67 per MWh. Similarly, for the Baltimore Gas & Electric zone (Maryland), the line loss component of LMP was $1.05 per MWh. Source: Monitoring Analytics, *2021 State of the Market for PJM*; Section 11, Table 11-7, p. 571.

[46] Heat rate is a measure of electric generator energy efficiency, represented as Btu of fuel input per kWh of electricity output.

the average wholesale electricity price and/or average all-in locational marginal price in the three ISOs fully or partially subject to RGGI. The monitoring results are consistent with market dynamics given the CO_2 allowance prices that result in CO_2 compliance costs on a per MWh basis. The price signal from RGGI allowances prices is likely lower than the aggregate per MWh price signal of mitigating market factors discussed in this report that would counter emissions leakage.

This report is the thirteenth in a series of annual monitoring reports, as called for in the 2005 RGGI MOU. Ongoing monitoring will further evaluate changes in market and non-market drivers that impact CO_2 emissions related to electricity generation and imports in the RGGI region.

Appendix A. Eleven-State ISO Monitoring Sources

Table 2. Summary of Data Sources for ISO-NE

	Electricity Demand (Annual)					*Electricity Generation (Annual)*				
Code	**A-1**	**A-2**	**A-2**	**A-2**	**A-3**	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**
Monitoring Category	Total Electricity Use in ISO-NE	Net Electricity Imports - from New York	Net Electricity Imports - from Quebec	Net Electricity Imports - from New Brunswick	Total Net Electricity Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Units (Fossil Fuel-Fired)	Non-RGGI Units (Non-Fossil Fuel-Fired)	All Non-RGGI Units (Fossil and Non-Fossil)	All Units
MWh	ISO-NE[1]	NYS PSC Calculation (2014-2018) ISO-NE[1] (2019-2021)	ISO-NE[1]	ISO-NE[1]	Sum of A2s	NEPOOL-GIS[2]	NEPOOL-GIS[2]	NEPOOL-GIS[2]	Sum of B-2 and B-3	ISO-NE[1]
CO_2 Tons	Sum of A-3 and B-5	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	Sum of A-2s	State reported data for 2006-2008; RGGI COATS for 2009 to 2016.[4] Includes only sources subject to a state CO_2 Budget Trading Program CO_2 allowance compliance obligation. Does not include biomass-derived CO_2 emissions.	NEPOOL-GIS[2]	NEPOOL-GIS[2]	Sum of B-2 and B-3	Sum of B-1 and B-4
CO_2 lb/MWh	CO_2 tons divided by MWh	NYISO A-2 in Table 3 below	Environment and Climate Change Canada[3]	Environment and Climate Change Canada[3]	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh

Table Notes:
1. ISO-NE, Historical Data Reports, “Net Energy and Peak Load by Source” (Annual Summary). Available at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/net-ener-peak-load. Note that B-5 MWh calculated as the sum of the above NEPOOL GIS-based B-1 to B-4 will differ from B-5 MWh from the ISO-NE website, as the website is updated if errors found, while NEPOOL GIS data is frozen at time of certificate creation.
2. NEPOOL Generation Information System. Available at https://www.nepoolgis.com/.
3. *National Inventory Report 1990–2022: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada, 2024. In Part 3. Available at https://unfccc.int/sites/default/files/resource/2024NIR%20-%20Part%203.pdf . Note that New Brunswick and Quebec emission factors are updated for every year, as compared to the previous year’s report.
4. Historical 2006 – 2008 CO_2 emissions data reported by RGGI participating states compiled from CO_2 emissions data reported to U.S. EPA pursuant 40 CFR Part 75 and from CO_2 emissions and fuel use data reported to state emissions statement programs. 2009 through 2021 CO_2 emissions data is from data reported to the RGGI CO_2 Allowance Tracking System (RGGI COATS), available at rggi-coats.org.

Table 3. Summary of Data Sources for NYISO

	Electricity Demand (Annual)						*Electricity Generation (Annual)*				
Code	**A-1**	**A-2**	**A-2**	**A-2**	**A-2**	**A-3**	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**
Monitoring Category	Total Electricity Use in NYISO	Net Electricity Imports - from Hydro Quebec	Net Electricity Imports - from ISO-NE	Net Electricity Imports - from Ontario	Net Electricity Imports - from PJM	Total Net Electricity Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Units (Fossil Fuel-Fired)	Non-RGGI Units (Non-Fossil Fuel-Fired)	All Non-RGGI Units (Fossil and Non-Fossil)	All Units
MWh	NYS PSC Calculation (2006-2015); NYGATS from NYISO data feeds (2016-2021)	Hydro Quebec[1] (2006-2015); NYGATS from NYISO data feeds (2016-2021)	ISO-NE[2] (2006-2015); NYGATS from NYISO/NEPOOL GIS data feeds (2016-2021)	Ontario Independent Electricity System Operator[3]	PJM Annual State of the Market Report[4]	Sum of A-2s	NYS PSC Calculation[5] (2006-2015); NYGATS from NYISO data feeds (2016-2021)	NYS PSC Calculation [5,8] (2006-2015); NYGATS from NYISO data feeds (2016-2021)	NYS PSC Calculation[5] (2006-2015); NYGATS from NYISO data feeds (2016-2021)	Sum of B-2 and B-3	Sum of B-1 and B-4
CO_2 Tons	Sum of A-3 and B-5	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	Sum of A-2s	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	MWh multiplied by CO_2/MWh	Sum of B-2 and B-3	Sum of B-1 and B-4
CO_2 lb/MWh	CO_2 tons divided by MWh	Environment and Climate Change Canada[6]	ISO-NE system average (2006-2015); NYS PSC Calculation (2016-2021)	Environment and Climate Change Canada[6]	PJM GATS[7]	CO_2 tons divided by MWh	NYS PSC Calculation	NYS PSC Calculation	NYS PSC Calculation	CO_2 tons divided by MWh	CO_2 tons divided by MWh

Table Notes:
1. Hydro Quebec response to information request.

2. ISO-NE, Historical Data Reports, "Net Energy and Peak Load by Source" (Annual Summary). Available at https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/net-ener-peak-load.
3. Ontario IESO response to information request.
4. Monitoring Analytics, *State of the Market for PJM* (2006 through 2021 reports).
5. NYS PSC calculation based on MWh for each generator reported by NYISO and assignment of each generator to appropriate monitoring classification.
6. *National Inventory Report 1990–2022: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada, 2024. In Part 3. Available at https://unfccc.int/sites/default/files/resource/2024NIR%20-%20Part%203.pdf. Note that New Brunswick and Quebec emission factors are updated for every year, as compared to the previous year's report.
7. PJM Generation Attribute Tracking System, accessible at https://www.pjm-eis.com/.
8. MWh and CO_2 emissions data include Linden Cogeneration, units 005001 – 009001, and Bayonne Energy Center, units CTG1 – CTG8, as these units are physically located in New Jersey, but dispatch electricity into NYISO.

Table 4. Summary of Data Sources for RGGI PJM

	Electricity Demand (Annual)				*Electricity Generation (Annual)*				
Code	**A-1**	**A-2**	**A-2**	**A-3**	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**
Monitoring Category	Total Electricity Use in RGGI PJM	Net Electricity Imports - from Non-RGGI PJM	Net Electricity Imports - from NYISO	Total Net Electricity Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Units (Fossil Fuel-Fired)	Non-RGGI Units (Non-Fossil Fuel-Fired)	All Non-RGGI Units (Fossil and Non-Fossil)	All Units
MWh	Sum of A-3 and B-5	PJM GATS[1]	PJM GATS[1]	Sum of A-2s	PJM GATS[1]	PJM GATS[1]	PJM GATS[1]	Sum of B-2 and B-3	Sum of B-1 and B-4
CO_2 Tons	Sum of A-3 and B-5	PJM GATS[1]	MWh multiplied by CO_2/MWh	Sum of A-2s	State reported data for 2006-2008; RGGI COATS for 2009 through 2021. Includes only sources subject to a state CO_2 Budget Trading Program CO_2 allowance compliance obligation; does not include Maryland LIESA sources; does not include Linden Cogeneration units 005001-009001.[2,3]	PJM GATS[1]	PJM GATS[1]	Sum of B-2 and B-3	Sum of B-1 and B-4
CO_2 lb/MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	B-5	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh	CO_2 tons divided by MWh

Table Notes:
1. PJM Generation Attribute Tracking System, accessible at https://www.pjm-eis.com/.
2. Historical 2006 – 2008 CO_2 emissions data reported by RGGI participating states compiled from CO_2 emissions data reported to U.S. EPA pursuant 40 CFR Part 75 and from CO_2 emissions and fuel use data reported to state emissions statement programs. 2009 through 2021 CO_2 emissions data is from data reported to the RGGI CO_2 Allowance Tracking System (RGGI COATS), available at rggi-coats.org.
3. MWh and CO_2 emissions data do not include Maryland Limited Industrial Exemption Set-aside (LIESA) sources. LIESA sources for 2009-2021 include Severstal Sparrows Point LLC, Luke Paper Company, and Cove Point LNG Terminal. LIESA sources refer to certain industrial cogenerators under Maryland's CO_2 Budget Trading Program regulations that are subject to alternative CO_2 compliance obligations under certain conditions in lieu of submission of CO_2 allowances.

Appendix B. ISO-Specific Monitoring Results

Detailed monitoring results for ISO-NE, NYISO, and the RGGI portion of PJM are presented below.[47]

ISO-NE

Monitoring results for ISO-NE for 2006 through 2021 are summarized below in Table 5 and Figures 20 through 29. Annual averages for calendar years 2006 to 2008 represent the baseline.

Table 5. 2006 – 2021 Monitoring Summary for ISO-NE

MWh	Electricity Demand					Electricity Generation					*Summary Data*
	Total in ISO	Net Imports - from NYISO	Net Imports - from Quebec	Net Imports - from New Brunswick	Total Net Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Fossil Fuel-Fired Units	Non-Fossil Fuel-Fired Units	All Non-RGGI Units	All Units[48]	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	134,243,000	-877,000	6,023,000	1,047,000	6,193,000	66,235,352	7,994,499	54,056,195	62,050,694	128,050,000	68,243,694
2007	136,869,000	-2,477,000	7,727,000	896,000	6,146,000	69,488,412	8,430,445	53,020,870	61,451,315	130,723,000	67,597,315
2008	134,000,000	-1,529,000	9,495,000	1,285,000	9,251,000	66,518,558	5,416,213	52,665,469	58,081,682	124,749,000	67,332,682
2009	128,801,000	-3,031,000	10,826,000	1,569,000	9,363,000	60,473,925	6,443,028	52,979,865	59,422,893	119,437,000	68,785,893
2010	131,956,000	-4,412,000	9,214,000	737,000	5,539,000	65,238,708	8,074,341	53,893,367	61,967,708	126,416,000	67,506,708
2011	130,752,000	-2,262,000	11,558,000	846,000	10,142,000	62,957,969	7,886,924	51,306,677	59,193,601	120,610,000	69,335,601
2012	129,590,000	-1,073,000	13,077,000	643,000	12,648,000	62,129,238	4,314,475	53,144,056	57,458,531	116,942,000	70,106,531
2013	131,001,000	1,322,000	13,928,000	3,711,000	18,961,000	57,766,430	1,637,377	56,533,777	58,171,154	112,041,000	77,132,154
2014	127,176,000	3,908,078	13,212,403	3,527,050	20,647,531	53,539,784	1,739,519	57,802,685	59,542,204	108,357,000	80,189,735
2015	126,955,000	3,911,358	12,978,000	4,108,000	20,997,358	58,406,246	1,742,545	52,483,133	54,225,678	107,916,000	75,223,036
2016	124,416,000	1,335,255	12,285,000	4,842,000	18,462,255	55,090,362	2,024,903	53,702,585	55,727,488	105,572,000	74,189,743
2017	121,220,000	1,478,998	14,495,000	4,305,000	20,278,998	49,456,967	2,335,299	57,986,601	60,321,901	102,564,000	80,600,898
2018	123,472,000	3,285,809	13,966,000	4,044,000	21,295,809	52,512,178	2,505,743	56,550,010	59,055,753	103,740,000	80,351,562

[47] Short tons of CO_2 emitted and the lb CO_2/MWh emission rates in this report do not represent total lifecycle reductions or contributions of greenhouse gases. Such analysis is outside the scope of this report.
[48] See Appendix A, Table 2, Table Note 1.

2019	119,237,000	5,739,000	14,091,000	3,233,000	23,063,000[49]	45,498,548	5,093,268	55,677,702	60,770,970	97,890,000	83,833,970
2020	116,875,000	7,070,000	13,969,000	2,585,000	23,624,000	45,866,660	6,827,056	50,475,331	57,302,386	94,945,000	80,832,386
2021	118,789,000	2,490,004	13,700,000	2,598,000	18,788,004	50,561,269	6,833,812	52,048,241	58,882,053	101,692,000	77,670,056

CO_2	Electricity Demand					Electricity Generation					*Summary Data*
	Total in ISO	**Net Imports - from NYISO**	**Net Imports - from Quebec**	**Net Imports - from New Brunswick**	**Total Net Imports - from All Adjoining ISOs**	**RGGI-Affected Units**	**Non-RGGI Fossil Fuel-Fired Units**	**Non-Fossil Fuel-Fired Units**	**All Non-RGGI Units**	**All Units**	**Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)**
2006	42,202,458	-404,953	26,557	547,053	168,657	47,783,423	2,294,218	9,049,196	11,343,414	59,126,837	11,512,070
2007	50,079,316	-1,155,569	25,468	455,316	-674,785	49,434,978	2,963,453	8,586,395	11,549,849	60,984,826	10,875,064
2008	54,286,213	-671,104	26,166	736,564	91,627	44,508,400	1,820,953	8,425,083	10,246,036	54,754,436	10,337,663
2009	44,334,489	-1,287,840	42,961	968,535	-276,344	38,815,561	2,733,899	9,198,068	11,931,967	50,747,528	11,655,623
2010	49,139,981	-1,932,583	25,392	406,202	-1,500,990	41,682,538	3,331,687	10,359,631	13,691,318	55,373,857	12,190,329
2011	43,513,964	-933,856	29,303	410,324	-494,228	35,599,032	3,294,100	11,029,838	14,323,938	49,793,256	13,829,710
2012	38,748,137	-410,272	38,920	297,690	-73,661	31,657,173	1,815,918	11,240,839	13,056,757	44,713,885	12,983,095
2013	45,985,934	522,082	30,706	1,186,296	1,739,082	30,173,526	604,510	13,469,005	14,073,514	44,247,040	15,812,597
2014	45,016,852	1,054,224	20,390	1,088,614	2,163,233	27,665,118	584,114	14,605,525	15,189,639	42,854,758	17,352,872
2015	45,213,688	1,011,086	15,736	1,313,206	2,340,028	28,867,519	609,582	13,155,735	13,765,317	42,632,836	16,105,345
2016	42,138,496	414,597	16,250	1,761,339	2,192,186	26,013,525	635,083	13,123,557	13,758,641	39,772,166	15,950,827
2017	40,398,875	421,514	19,174	1,471,090	1,911,777	23,990,894	677,682	13,818,521	14,496,203	38,487,097	16,407,980
2018	40,274,183	966,028	20,013	1,248,169	2,234,210	23,873,039	650,362	13,516,572	14,166,934	38,039,973	16,401,145
2019	37,257,184	1,683,331	18,639	926,581	2,628,551	20,465,688	719,228	13,443,717	14,162,945	34,628,633	16,791,496
2020	37,721,586	2,111,456	23,097	826,348	2,960,901	21,713,725	920,191	12,156,818	13,077,009	34,790,734	16,037,910
2021	38,111,360	847,846	19,632	830,503	1,697,982	23,969,439	842,796	11,601,144	12,443,940	36,413,379	14,141,922

[49] The total for 2019 includes 1,349,000 MWhs wheeled through from Canada via New York.

lb CO_2/ MWh	Electricity Demand					Electricity Generation					*Summary Data*
	Total in ISO	Net Imports - from NYISO	Net Imports - from Quebec	Net Imports - from New Brunswick	Total Net Imports - from All Adjoining ISOs	RGGI-Affected Units	Non-RGGI Fossil Fuel-Fired Units	Non-Fossil Fuel-Fired Units	All Non-RGGI Units	All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	629	923	9	1,045	54	1,443	574	335	366	923	337
2007	732	933	7	1,016	-220	1,423	703	324	376	933	322
2008	810	878	6	1,146	20	1,338	672	320	353	878	307
2009	688	850	8	1,235	-59	1,284	849	347	402	850	339
2010	666	876	6	1,102	-542	1,278	825	384	442	876	361
2011	666	826	5	970	-97	1,131	835	430	484	826	399
2012	598	765	6	926	-12	1,019	842	423	454	765	370
2013	702	790	4	639	183	1,045	738	476	484	790	410
2014	708	540	3	617	210	1,033	672	505	510	791	433
2015	712	517	2	639	223	989	700	501	508	790	428
2016	677	621	3	728	237	944	627	489	494	753	430
2017	667	570	3	683	189	970	580	477	481	750	407
2018	652	588	3	617	210	909	519	478	480	733	408
2019	625	587	3	573	228	900	282	483	466	708	401
2020	646	597	3	639	251	947	270	482	456	733	396
2021	642	681	3	639	181	948	247	446	423	716	364

The monitoring results indicate that the annual average electricity load in ISO-NE for 2019 to 2021 decreased by 16.7 million MWh, or 12.4 percent, compared to the annual average for the baseline period of 2006 to 2008. Electric generation from all sources in ISO-NE decreased by 21.6 million MWh, or 16.9 percent, compared to the base period.

For ISO-NE, annual average electric generation from RGGI generation in 2019 to 2021 decreased by 20.1 million MWh during this period, or 29.8 percent, and annual average CO_2 emissions from RGGI electric generation in ISO-NE decreased by 25.2 million short tons of CO_2, or 53.3 percent. The CO_2 emission rate of RGGI electric generation decreased by 469.8 lb CO_2/MWh, or 33.5 percent. Annual average electric generation from non-RGGI electric generation sources located for ISO-NE in 2019 to 2021 decreased by 1.5 million MWh, or 2.5 percent, during this period, and CO_2 emissions from this category of electric generation increased by 2.2 million short tons of CO_2, an increase of 19.7 percent. The annual average CO_2 emission rate of non-RGGI electric generation located in ISO-NE increased by 83.6 lb CO_2/MWh, an increase of 22.9 percent.

When the 2019 to 2021 annual average is compared to the 2006 to 2008 base period annual average, electric generation from all non-RGGI electric generation serving load in ISO-NE increased by 13.1 million MWh, or 19.3 percent. The CO_2 emissions from this category of electric generation increased by 4.5 million short tons of CO_2, or 43.5 percent, and the CO_2 emission rate increased by 65.0 lb CO_2/MWh, or 20.2 percent. (See Figures 20, 21, and 22.)

Annual average net electricity imports into ISO-NE for 2019 to 2021 increased by 14.6 million MWh compared to the base period annual average for 2006 to 2008. (See Figure 23). Annual average CO_2 emissions related to these net electricity imports increased by 2.6 million short tons of CO_2 during this period.[50] The annual average CO_2 emission rate of the electric generation supplying these imports increased by 260.9 lb CO_2/MWh. (See Figure 24).

[50] ISO-NE net exports to NYISO doubled from 2008 to 2009 and increased again in 2010. Negative values for MWh and CO_2 tons indicate that more MWh were exported (from New England to New York) than imported. As a result, the increase in net exports to NYISO in 2009 and 2010 increased the amount of CO_2 emissions debited from the ISO-NE net import total, resulting in a negative CO_2 emissions value for total CO_2 emissions related to total net electricity imports in 2009, 2010, 2011, and 2012 for ISO-NE. In 2013, the trend was reversed as NE imported more than was exported to NY.

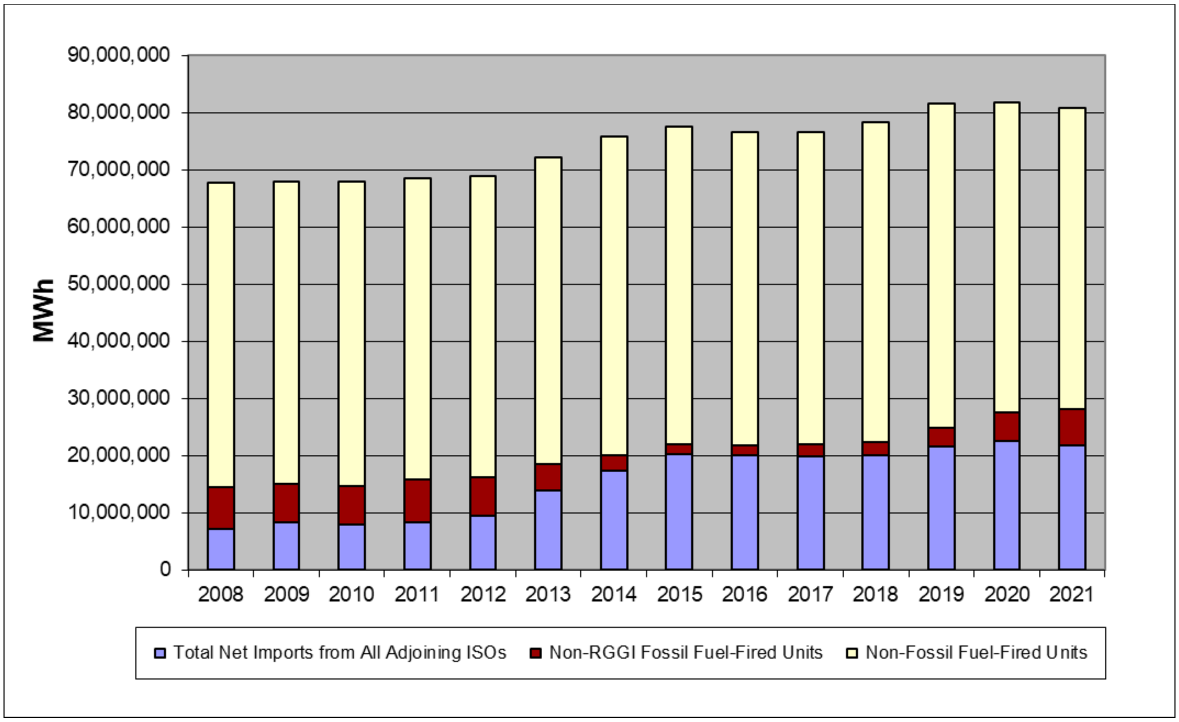

Figure 20. Non-RGGI Generation Serving Load in ISO-NE (MWh) (Three Year Trailing Average)

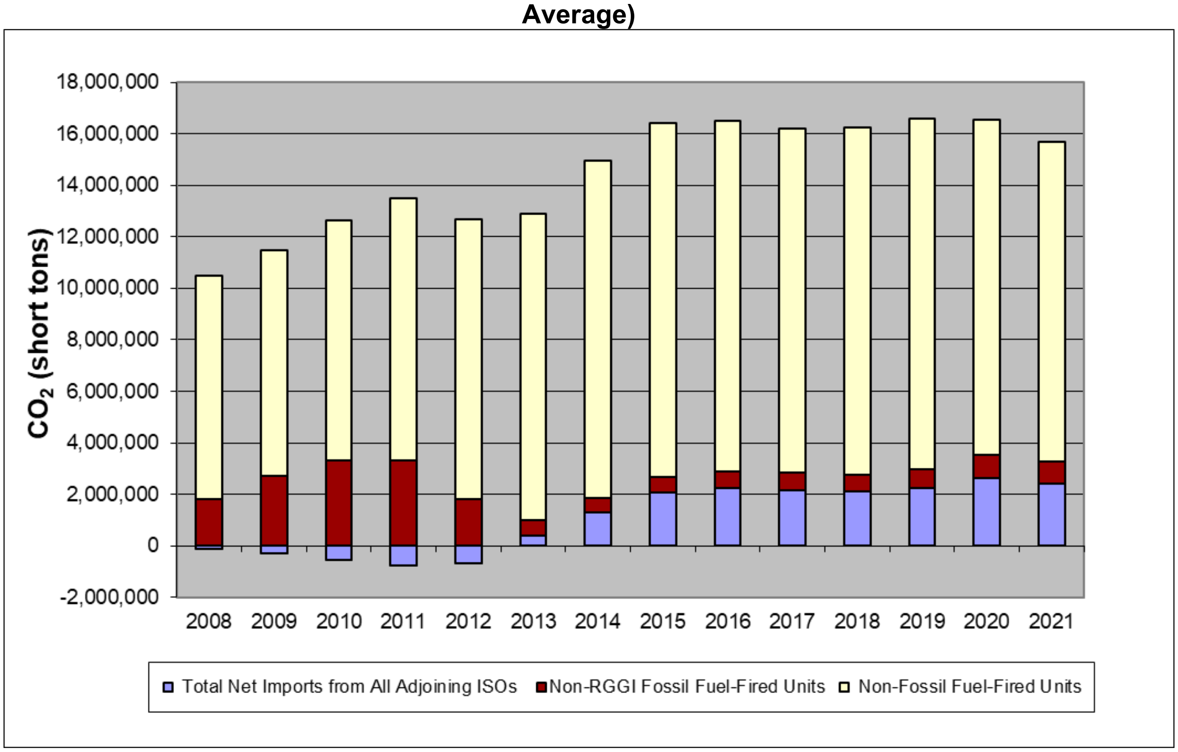

Figure 21. CO_2 Emissions from Non-RGGI Generation Serving Load in ISO-NE (short tons CO_2) (Three Year Trailing Average)

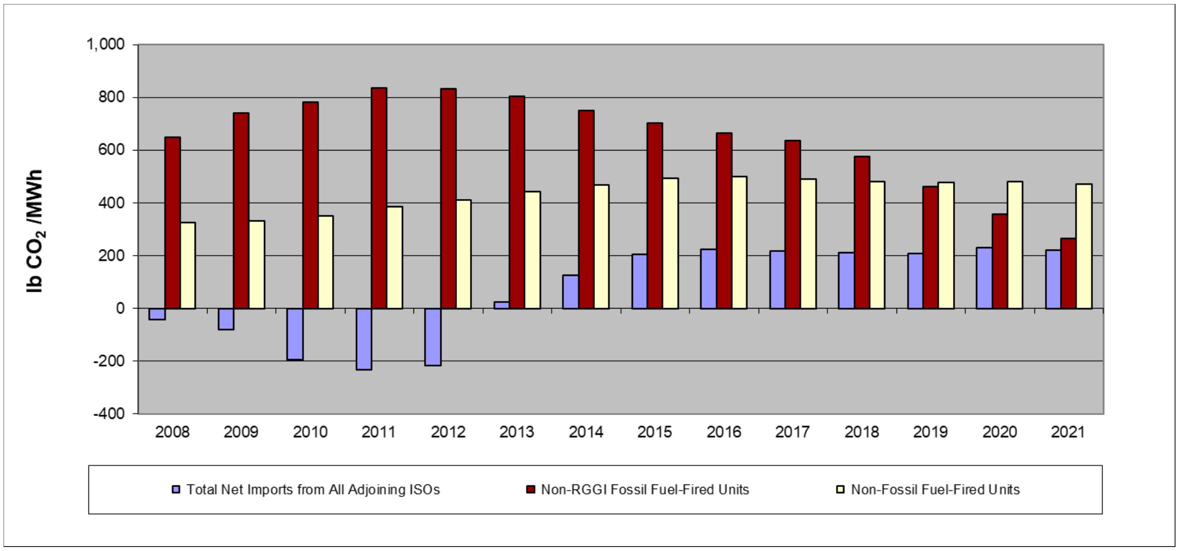

Figure 22. CO_2 Emission Rate for Non-RGGI Generation Serving Load in ISO-NE (lb CO_2/MWh) (Three Year Trailing Average)

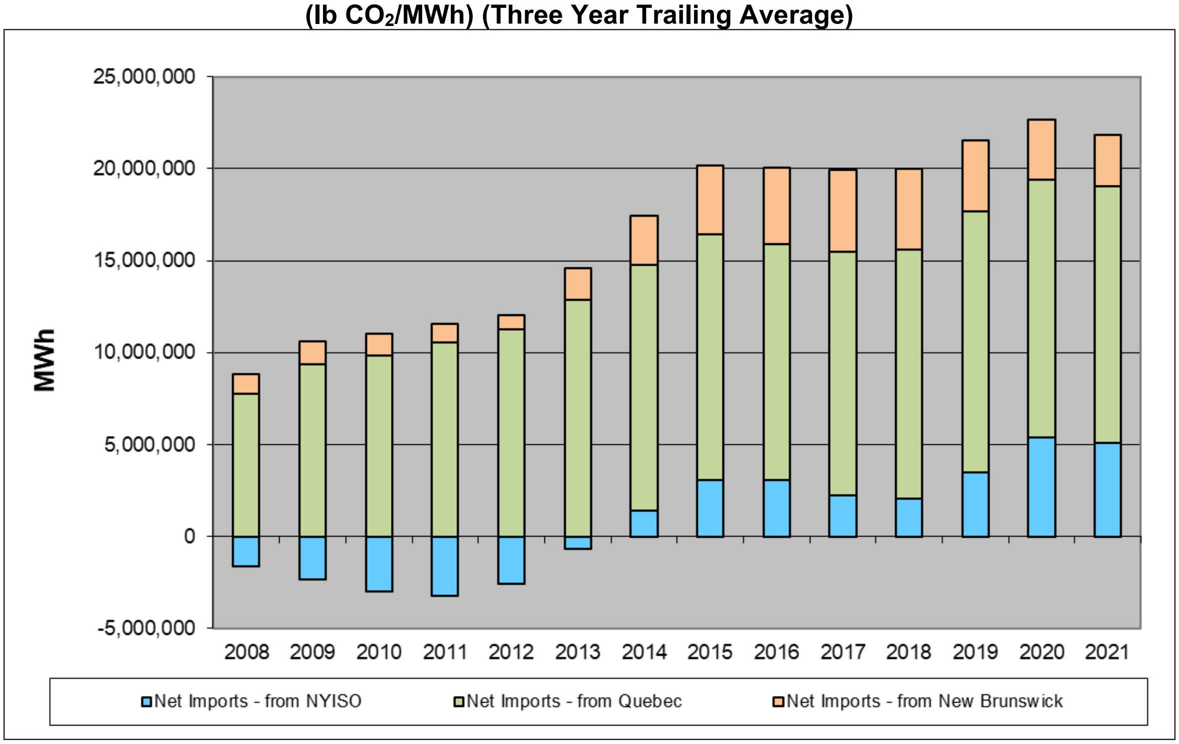

Figure 23. Net Electricity Imports to ISO-NE (MWh) (Three Year Lagging)

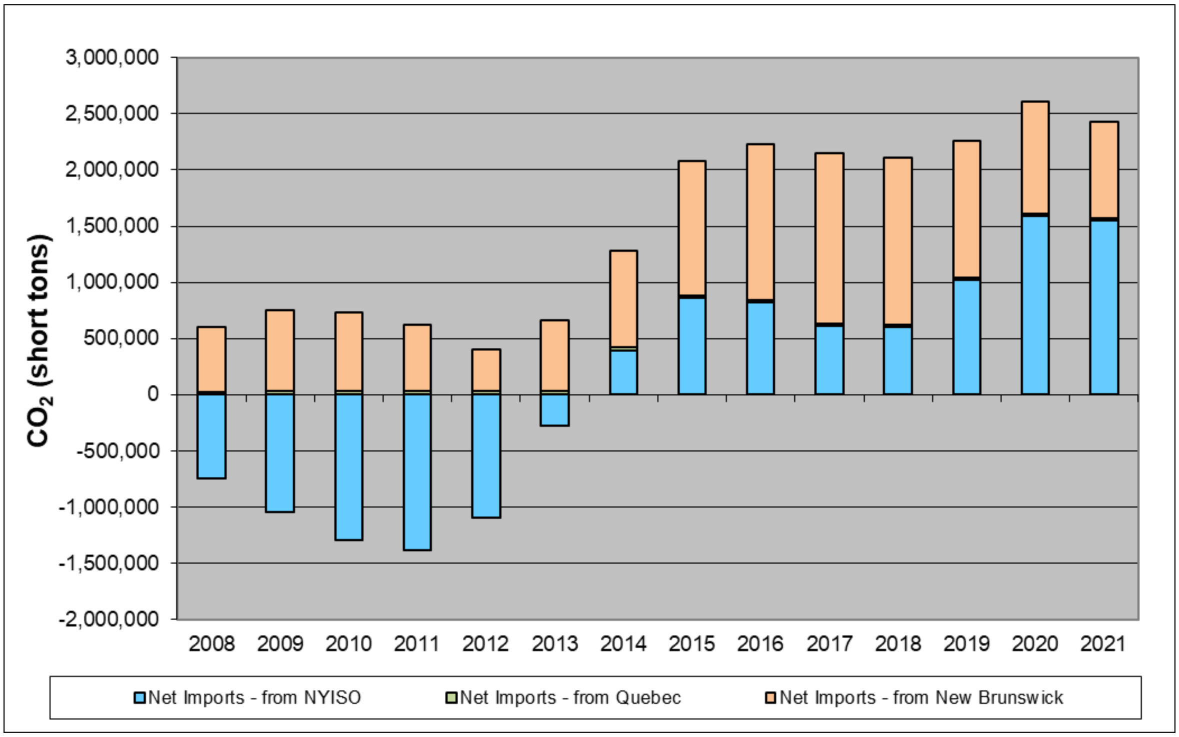

Figure 24. CO_2 Emissions Related to Net Electricity Imports to ISO-NE (short tons CO_2) (Three Year Lagging)

The monitoring results indicate the 2021 annual average electricity load in ISO-NE decreased by 16.2 million MWh, or 12.0 percent, compared to the 2006 to 2008 base period. The annual average 2021 electric generation from all sources in ISO-NE decreased by 18.5 million MWh, or 14.5 percent, compared to the base period.

Compared to the annual average during the 2006 to 2008 base period, 2021 RGGI electric generation in ISO-NE decreased by 16.9 million MWh, or 25.0 percent, and CO_2 emissions from RGGI generation in ISO-NE decreased by 23.3 million short tons of CO_2, or 49.3 percent. The CO_2 emission rate of RGGI electric generation decreased by 453.2 lb CO_2/MWh, a reduction of 32.3 percent. Compared to the 2006 to 2008 annual average, 2021 electric generation from non-RGGI generation located in ISO-NE decreased by 1.6 million MWh, or 2.7 percent, and CO_2 emissions from this category increased by 1.4 million short tons of CO_2, an increase of 12.7 percent. The CO_2 emission rate of non-RGGI electric generation located in ISO-NE increased by 57.9 lb CO_2/MWh, an increase of 15.9 percent.

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2021 from all non-RGGI electric generation sources serving load in ISO-NE increased by 9.9 million MWh, an increase of 14.7 percent. Compared to the 2006 to 2008 annual average, 2021 CO_2 emissions from this category of electric generation increased by 3.2 million short tons of CO_2, an increase of 29.6 percent, and the CO_2 emission rate increased by 42.1 lb CO_2/MWh, an increase of 13.1 percent.

Compared to the annual average during the 2006 to 2008 base period, 2021 net electricity imports into ISO-NE increased by 11.6 million MWh. CO_2 emissions related to these net electricity imports increased by 1.8 million short tons of CO_2 during this period.

The CO_2 emission rate of the electric generation supplying these imports increased by 221.9 lb CO_2/MWh.

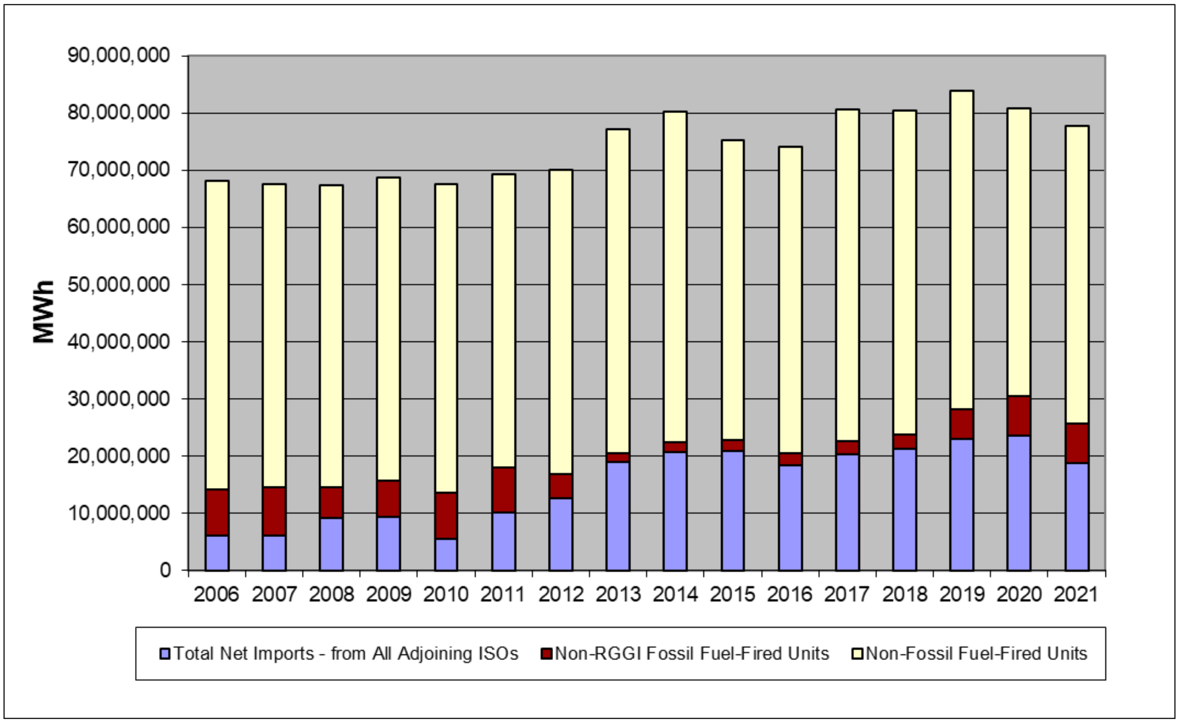

Figure 25. Non-RGGI Generation Serving Load in ISO-NE (MWh)

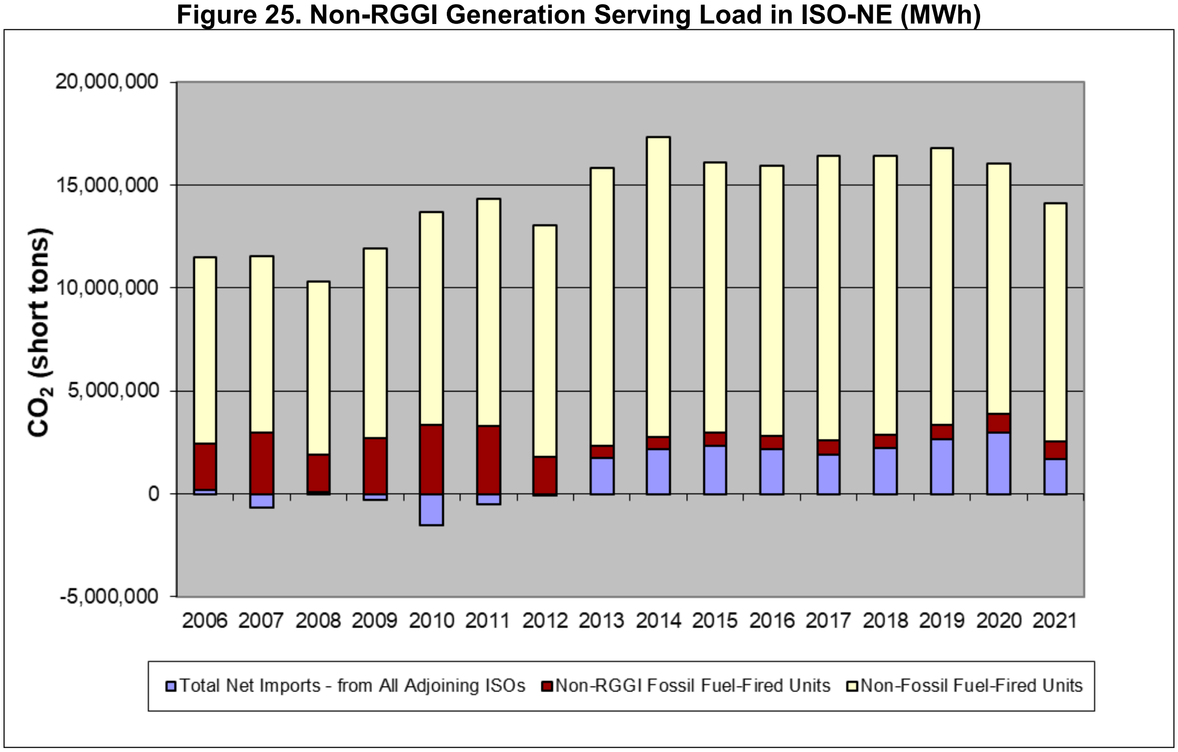

Figure 26. CO_2 Emissions from Non-RGGI Generation Serving Load in ISO-NE (short tons CO_2)

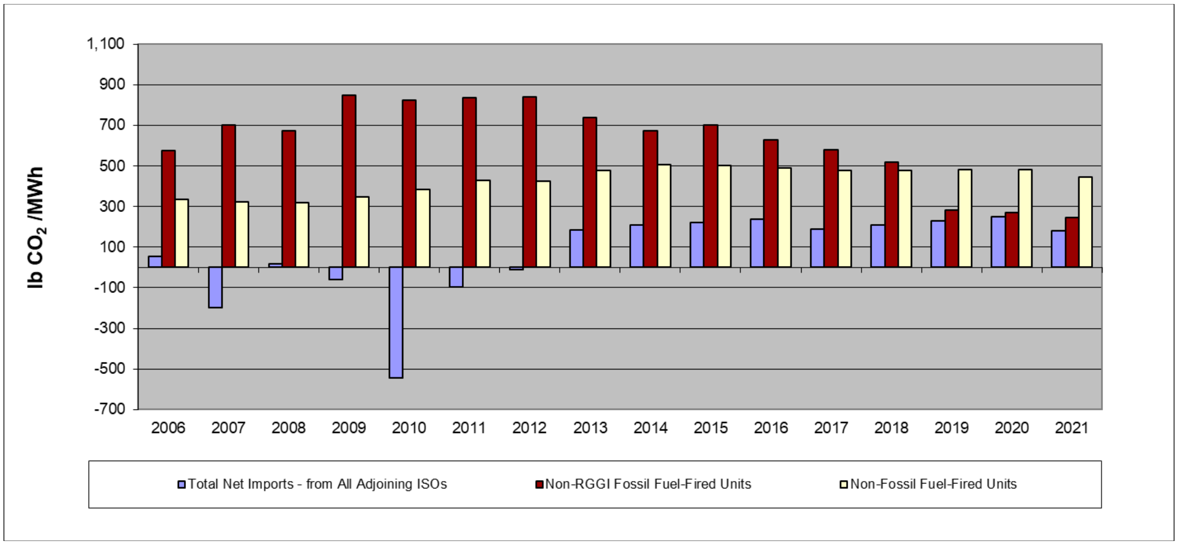

Figure 27. CO_2 Emission Rate for Non-RGGI Generation Serving Load in ISO-NE (lb CO_2/MWh)

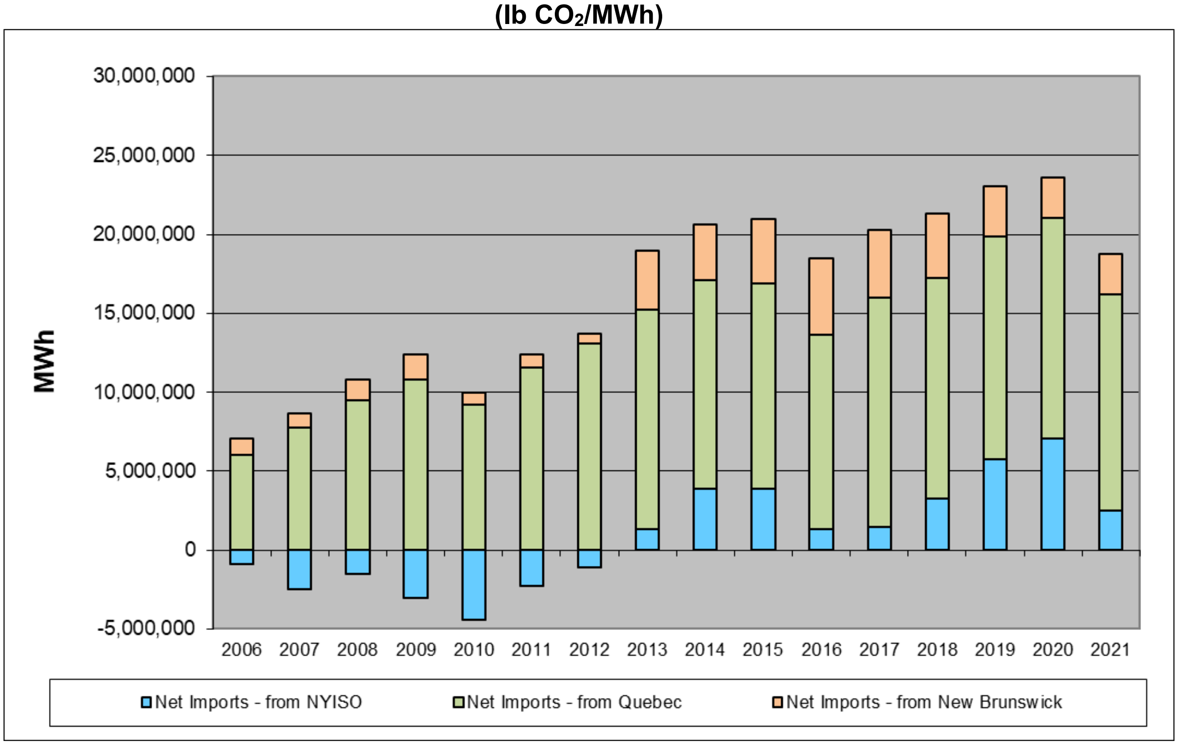

Figure 28. Net Electricity Imports to ISO-NE (MWh)

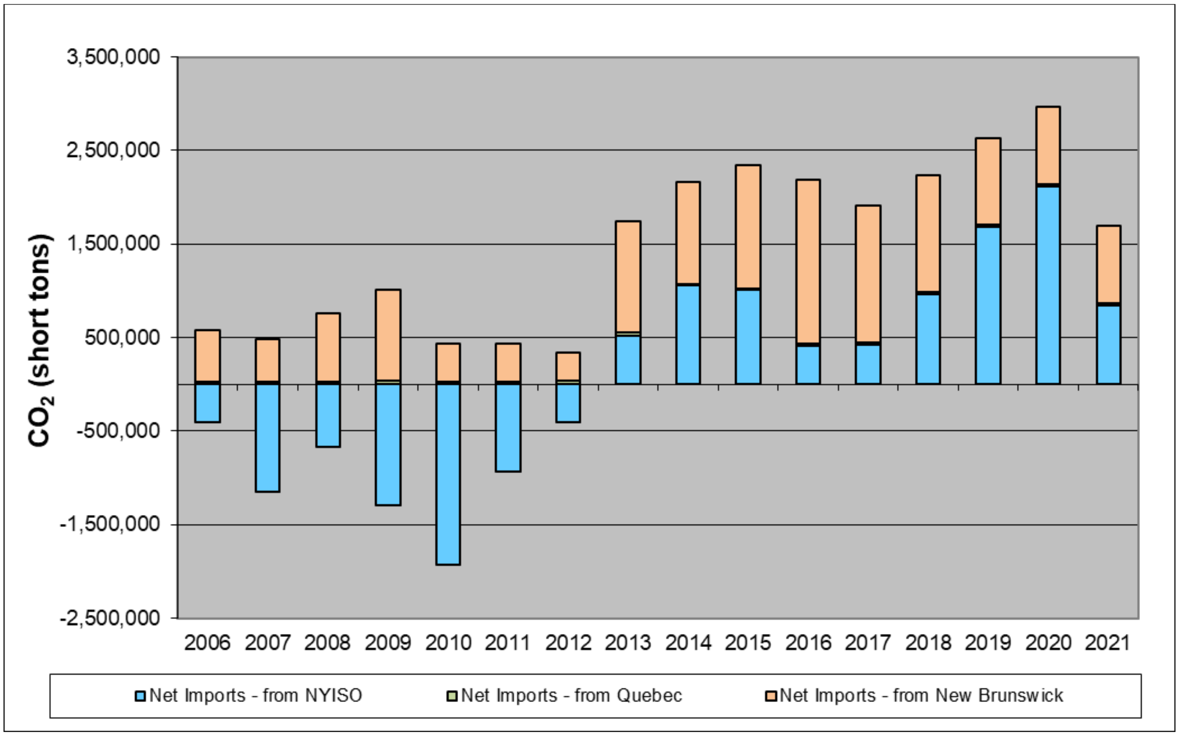

Figure 29. CO_2 Emissions Related to Net Electricity Imports to ISO-NE (short tons CO_2)

NYISO

Monitoring results for NYISO for 2006 through 2021 are summarized below in Table 6 and Figures 30 through 39. Annual averages for calendar years 2006 to 2008 represent the baseline.

Table 6. 2006 – 2021 Monitoring Summary for the NYCA

MWh	Electricity Demand						Electricity Generation					*Summary Data*
	Total Annual Electricity Load in NYISO	Net Imports - from Quebec	Net Imports - from ISO-NE	Net Imports - from Ontario	Net Imports - from PJM	Total Net Electricity Imports	Annual Electric Generation - RGGI-Affected Units	Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units	Annual Electric Generation - Non-Fossil Fuel-Fired Units	Annual Electric Generation - All Non-RGGI Units	Total Annual Electric Generation - All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	166,654,413	2,959,749	877,000	3,672,282	9,559,000	17,068,031	66,864,341	7,322,844	75,399,197	82,722,041	149,586,382	99,790,072
2007	169,932,177	4,185,292	2,477,000	2,637,442	10,225,000	19,524,734	71,336,352	6,648,463	72,422,628	79,071,091	150,407,443	98,595,825
2008	168,646,767	5,646,014	1,529,000	6,162,902	10,690,000	24,027,916	64,620,511	4,618,782	75,379,558	79,998,340	144,618,851	104,026,256
2009	160,565,962	6,239,805	3,031,000	6,463,657	8,331,000	24,065,462	56,246,945	3,750,738	76,502,817	80,253,555	136,500,500	104,319,017
2010	164,282,144	4,335,209	4,412,000	3,872,635	12,305,000	24,924,844	62,527,452	3,686,768	73,143,080	76,829,848	139,357,300	101,754,692
2011	163,818,485	7,123,204	2,262,000	3,318,681	11,150,000	23,853,885	59,098,130	3,252,477	77,613,993	80,866,470	139,964,600	104,720,355
2012	163,689,994	9,235,689	1,073,000	5,749,461	8,408,800	24,466,950	61,313,672	3,736,023	74,173,349	77,909,372	139,223,044	102,376,322
2013	166,412,302	10,638,017	-1,322,000	7,593,954	9,190,966	26,100,937	59,652,799	3,963,738	76,694,828	80,658,566	140,311,365	106,759,503
2014	160,598,000	8,839,775	-3,908,078	7,180,281	8,721,704	20,833,682	58,403,922	4,612,684	76,747,712	81,360,396	139,764,318	102,194,078
2015	160,650,689	9,397,396	-3,911,358	8,302,624	7,558,163	21,346,825	57,328,298	4,627,476	77,348,090	81,975,566	139,303,864	103,322,391
2016	160,798,000	9,558,000	-1,335,255	7,668,000	8,399,813	24,290,558	57,581,414	4,889,216	74,479,557	79,368,773	136,950,187	103,659,331
2017	156,370,000	10,795,091	-1,478,998	7,720,948	7,948,559	24,985,600	47,011,708	5,134,132	79,238,560	84,372,692	131,384,400	109,358,292
2018	161,114,000	10,837,861	-3,285,809	6,586,515	10,776,410	24,914,977	51,472,100	5,083,318	79,643,605	84,726,923	136,199,023	109,641,900
2019	155,832,000	9,097,032	-4,345,905	6,504,484	11,206,632	22,462,243	46,900,119	5,161,207	81,303,132	86,464,339	133,364,458	108,926,582
2020	150,198,000	9,984,000	-7,070,000	7,472,000	9,639,000	20,025,000	51,458,959	4,577,254	74,136,787	78,714,041	130,173,000	98,739,041
2021	152,145,806	10,727,857	-2,490,004	5,666,080	13,231,822	27,135,755	59,226,886	463,199	65,319,966	65,783,165	125,010,051	92,918,919

CO_2	Electricity Demand						Electricity Generation					Summary Data
	Total Annual Electricity Load in NYISO	Net Imports - from Quebec	Net Imports - from ISO-NE	Net Imports - from Ontario	Net Imports - from PJM	Total Net Electricity Imports	Annual Electric Generation - RGGI-Affected Units	Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units	Annual Electric Generation - Non-Fossil Fuel-Fired Units	Annual Electric Generation - All Non-RGGI Units	Total Annual Electric Generation - All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	69,807,908	13,050	404,953	769,120	5,983,934	7,171,057	53,638,129	6,319,357	2,679,365	8,998,722	62,636,851	16,169,779
2007	71,578,150	13,794	1,155,569	604,715	6,349,725	8,123,803	55,717,151	5,430,598	2,306,598	7,737,196	63,454,347	15,860,999
2008	63,062,489	15,559	671,104	1,154,884	6,520,900	8,362,447	48,348,177	2,676,684	3,675,181	6,351,865	54,700,042	14,714,312
2009	48,529,762	24,762	1,287,840	712,496	4,736,174	6,761,271	37,861,408	1,931,753	1,975,329	3,907,082	41,768,490	10,668,354
2010	55,583,232	11,947	1,932,583	554,950	7,179,968	9,679,448	42,113,171	1,944,024	1,846,589	3,790,613	45,903,784	13,470,061
2011	48,275,690	18,060	936,289	336,556	6,389,108	7,677,579	37,148,379	1,683,269	1,764,030	3,447,299	40,595,678	11,127,311
2012	44,898,580	27,488	410,272	602,081	4,212,809	5,252,649	35,640,442	2,008,494	1,996,995	4,005,489	39,645,930	9,258,138
2013	42,408,932	23,453	-522,082	795,236	4,871,212	5,167,821	33,476,561	1,485,213	2,279,339	3,764,552	37,241,113	8,932,371
2014	42,040,391	13,642	-1,105,986	603,144	4,827,463	4,338,263	34,028,752	1,946,553	1,726,824	3,673,376	37,702,326	8,011,639
2015	40,890,195	11,395	-1,011,086	697,420	3,831,989	3,529,718	32,550,962	2,745,481	2,064,034	4,809,515	37,334,037	8,339,233
2016	39,501,402	12,643	-414,597	337,392	4,162,107	4,097,546	30,666,015	2,823,920	1,913,921	4,737,841	35,403,858	8,835,387
2017	33,305,807	14,279	-421,514	298,260	3,918,639	3,809,665	24,577,905	2,897,654	2,020,583	4,918,237	29,496,143	8,727,902
2018	37,526,044	13,602	-966,028	45,477	5,188,841	4,281,862	27,215,742	2,870,820	3,157,620	6,028,440	33,244,182	10,310,302
2019	32,979,231	11,417	-1,274,716	44,881	5,090,963	3,872,545	24,218,861	2,513,146	2,374,679	4,887,825	29,106,686	8,760,370
2020	32,088,052	12,530	-2,111,456	63,811	4,170,169	2,135,054	26,217,597	2,087,785	1,647,616	3,735,401	29,952,998	5,870,455
2021	35,789,616	13,463	-847,846	48,388	6,099,870	5,313,875	27,897,486	324,293	2,253,961	2,578,254	30,475,740	7,892,130

lb CO_2/ MWh	Electricity Demand						Electricity Generation					*Summary Data*
	Total Annual Electricity Load in NYISO	Net Imports - from Quebec	Net Imports - from ISO-NE	Net Imports - from Ontario	Net Imports - from PJM	Total Net Electricity Imports	Annual Electric Generation - RGGI-Affected Units	Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units	Annual Electric Generation - Non-Fossil Fuel-Fired Units	Annual Electric Generation - All Non-RGGI Units	Total Annual Electric Generation - All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	838	9	923	419	1,252	840	1,604	1,726	71	218	837	324
2007	842	7	933	459	1,242	832	1,562	1,634	64	196	844	322
2008	748	6	878	375	1,220	696	1,496	1,159	98	159	756	283
2009	604	8	850	220	1,137	562	1,346	1,030	52	97	612	205
2010	677	6	876	287	1,167	777	1,347	1,055	50	99	659	265
2011	589	5	826	203	1,146	644	1,257	1,035	45	85	580	213
2012	549	6	765	209	1,002	429	1,163	1,075	54	103	570	181
2013	510	4	790	209	1,060	396	1,122	749	59	93	531	167
2014	524	3	566	168	1,107	416	1,165	844	45	90	540	157
2015	509	2	517	168	1,014	331	1,191	1,187	53	117	536	161
2016	491	3	621	88	991	337	1,108	1,155	51	119	517	170
2017	426	3	570	77	986	305	1,112	1,129	51	117	449	160
2018	466	3	588	14	963	344	1,057	1,130	79	142	488	188
2019	423	3	587	14	909	345	1,033	974	58	113	436	161
2020	427	3	597	17	865	213	1,019	912	44	95	456	119
2021	470	3	681	17	922	392	1,082	1,400	69	78	488	170

The monitoring results indicate that the 2019 to 2021 annual average electricity load in NYISO decreased by 15.7 million MWh, or 9.3 percent, compared to the annual average for the baseline period of 2006 to 2008. The 2019 to 2021 annual average electric generation from all sources in NYISO decreased by 18.7 million MWh, or 12.6 percent, compared to the base period.

In NYISO, annual average electric generation from RGGI generation for 2019 to 2021 decreased by 15.1 million MWh during this period, or 22.3 percent, and annual average CO_2 emissions from RGGI electric generation in NYISO decreased by 26.5 million short tons of CO_2, or 50.3 percent. The annual average CO_2 emission rate of RGGI electric generation decreased by 509.7 lb CO_2/MWh, a reduction of 32.8 percent. Annual average electric generation from non-RGGI sources located in 2019 to 2021 for NYISO decreased by 3.6 million MWh, or 4.5 percent, during this period, and average annual CO_2 emissions from this category decreased by 4.0 million short tons of CO_2, a decrease of 51.5 percent. The annual average CO_2 emission rate of non-RGGI electric generation located in NYISO decreased by 95.2 lb CO_2/MWh, a decrease of 49.9 percent.

The annual average electric generation from all non-RGGI electric generation serving load in NYISO for 2019 to 2021 decreased by 609,204 MWh, or 0.6 percent, compared to the base period of 2006 to 2008. Annual average CO_2 emissions from this category of electric generation decreased by 8.1 million short tons of CO_2, or 51.9 percent, and the annual average CO_2 emission rate decreased by 160.0 lb CO_2/MWh, a decrease of 51.6 percent. (See Figures 30, 31, and 32.)

Net electricity imports into NYISO increased by 3.0 million MWh, or 14.9 percent, when comparing the annual average for the base period of 2006 to 2008 to the annual average for 2019 to 2021. (See Figure 33). Annual average CO_2 emissions related to these net electricity imports decreased by 4.1 million short tons of CO_2, or 52.2 percent, during this period. (See Figure 34). The annual average CO_2 emission rate of the electric generation supplying these imports decreased by 474.4 lb CO_2/MWh, a decrease of 60.0 percent.

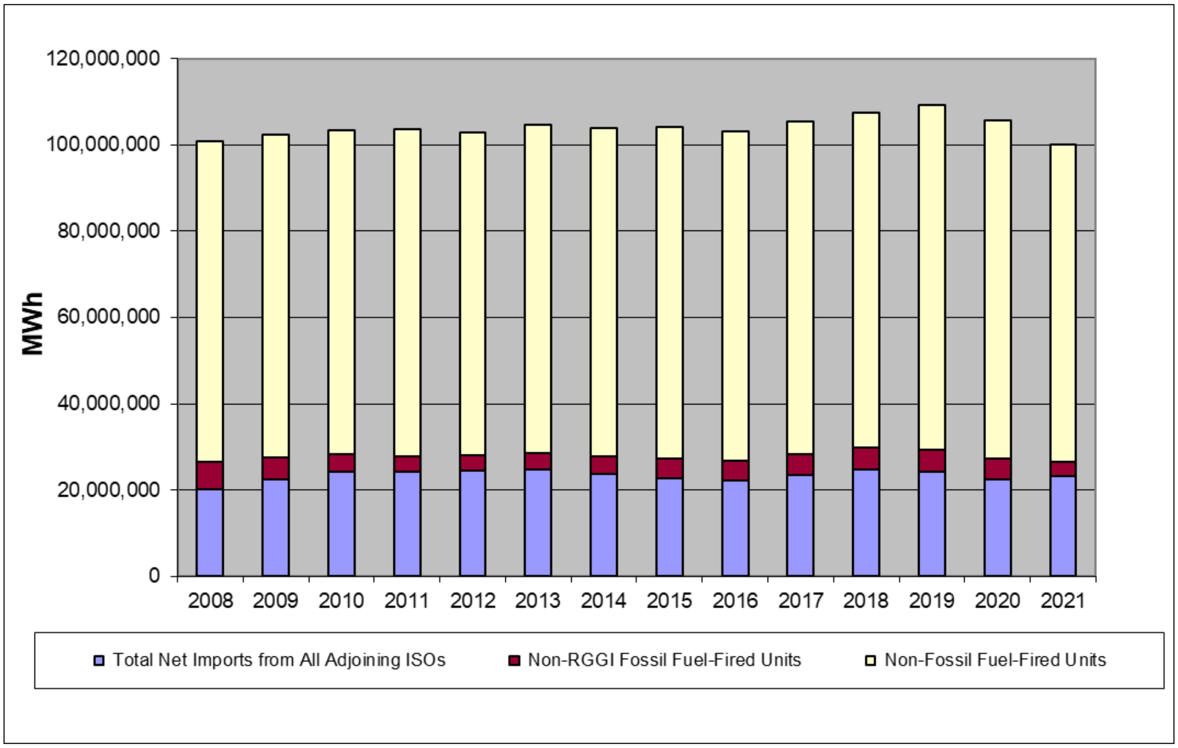

Figure 30. Non-RGGI Generation Serving Load in NYISO (MWh) (Three Year Trailing Average)

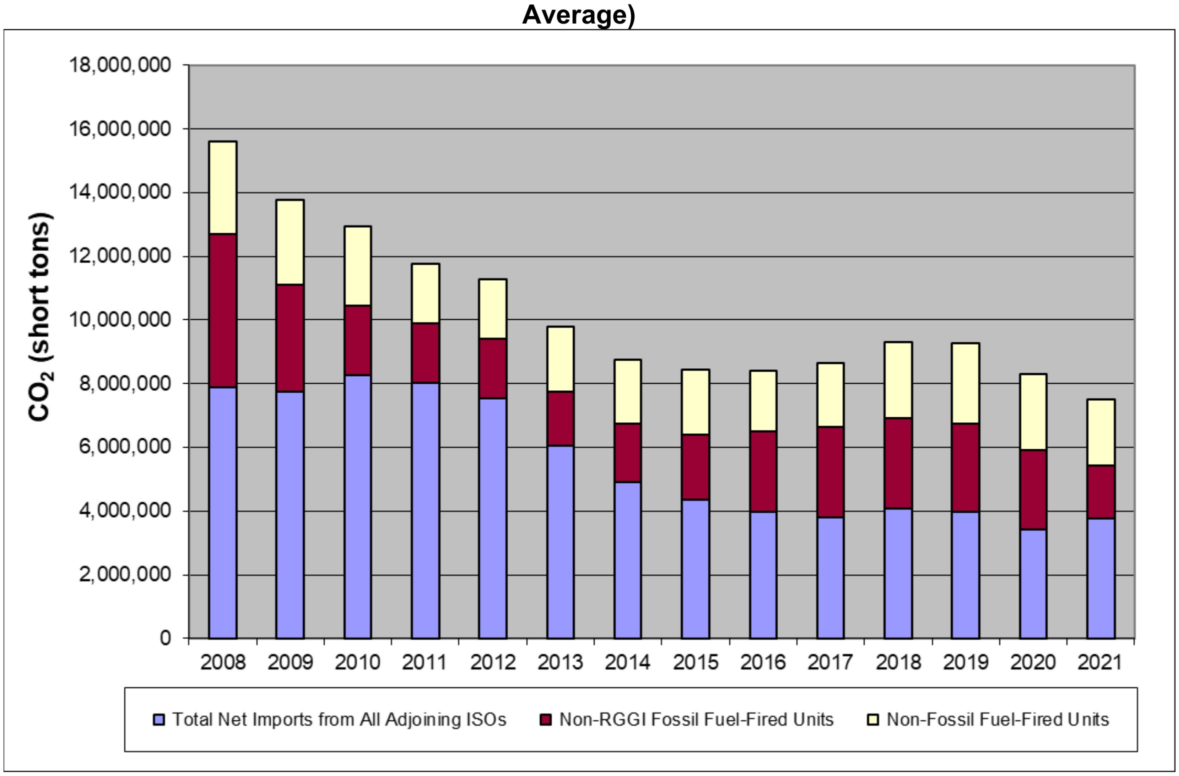

Figure 31. CO_2 Emissions from Non-RGGI Generation Serving Load in NYISO (short tons CO_2) (Three Year Trailing Average)

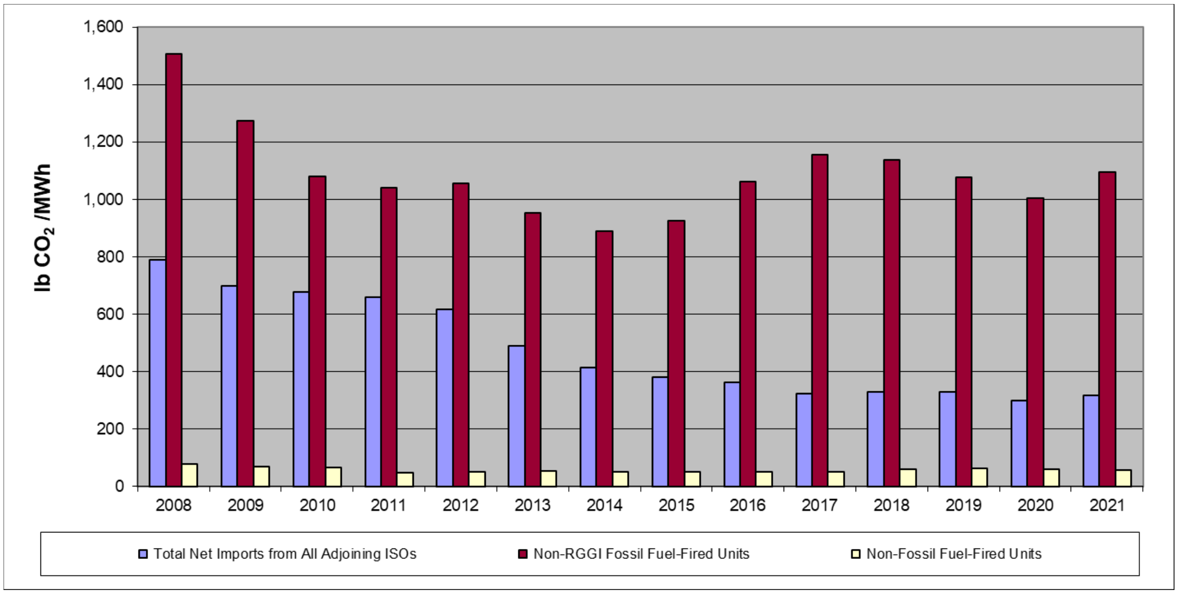

Figure 32. CO_2 Emission Rate for Non-RGGI Generation Serving Load in NYISO (lb CO_2/MWh) (Three Year Trailing Average)

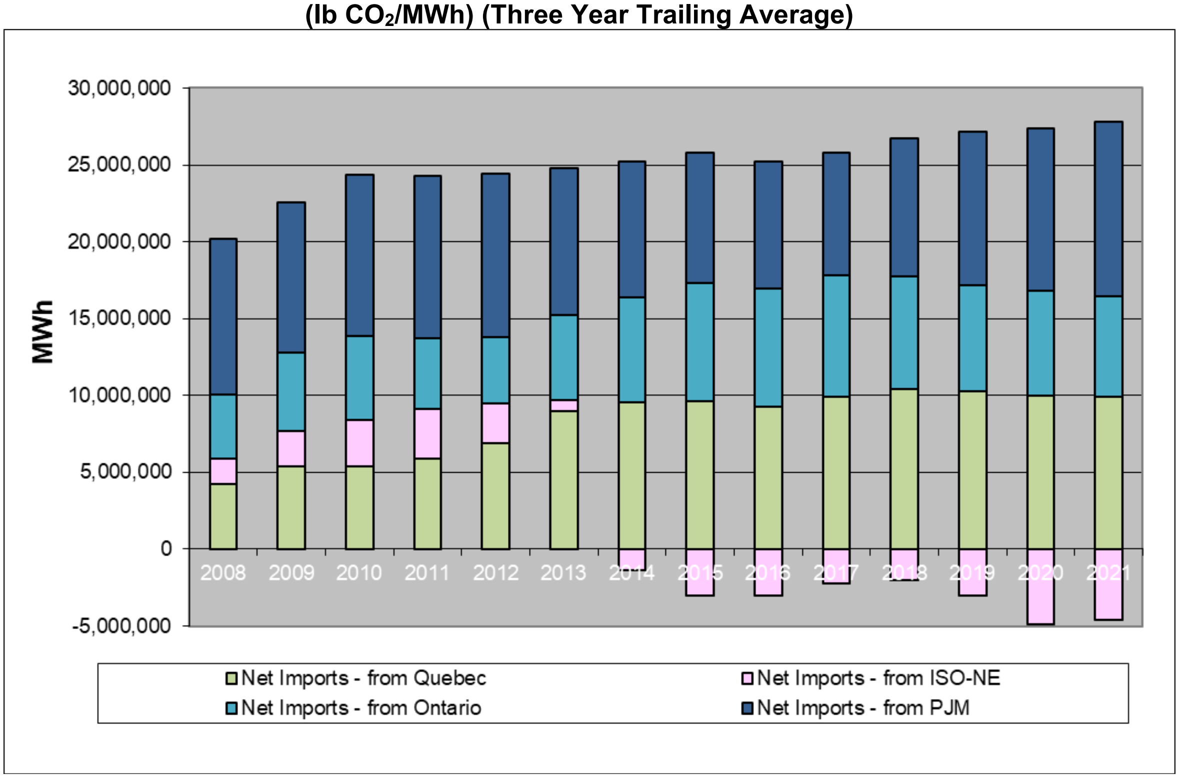

Figure 33. Net Electricity Imports to NYISO (MWh) (Three Year Trailing Average)

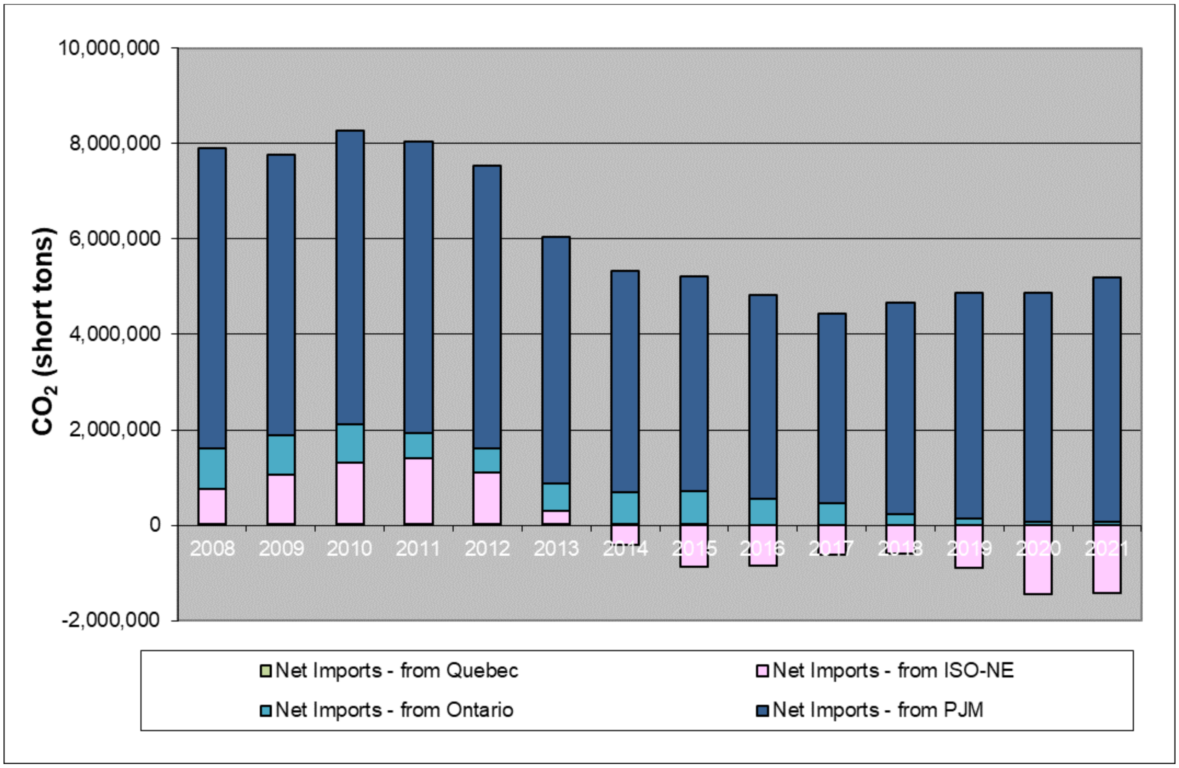

Figure 34. CO_2 Emissions Related to Net Electricity Imports to NYISO (short tons CO_2) (Three Year Trailing Average)

The monitoring results indicate the 2021 annual average electricity load in NYISO decreased by 16.3 million MWh, or 9.7 percent, compared to the 2006 to 2008 base period. The annual average 2021 electric generation from all sources in NYISO in 2021 decreased by 23.2 million MWh, or 15.7 percent, compared to the base period.

Compared to the annual average during the 2006 to 2008 base period, 2021 electric generation from RGGI generation in NYISO decreased by 8.4 million MWh, or 12.4 percent, and CO_2 emissions from RGGI generation in NYISO decreased by 24.7 million short tons of CO_2, a reduction of 46.9 percent. The CO_2 emission rate of RGGI electric generation decreased by 472.3 lb CO_2/MWh, a reduction of 30.4 percent. Compared to the 2006 to 2008 base period, 2021 electric generation from non-RGGI generation located in NYISO decreased by 14.8 million MWh, or 18.4 percent, and CO_2 emissions from this category decreased by 5.1 million short tons of CO_2, a reduction of 66.5 percent. The CO_2 emission rate of non-RGGI electric generation located in NYISO decreased by 112.3 lb CO_2/MWh, a reduction of 58.9 percent. (See Figures 35, 36, and 37).

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2021 from all non-RGGI electric generation sources serving load in NYISO decreased by 7.9 million MWh, a decrease of 7.8 percent. Compared to the base period, 2021 CO_2 emissions from this category of electric generation decreased by 7.7 million short tons of CO_2, a reduction of 49.4 percent, and the CO_2 emission rate decreased by 140.0 lb CO_2/MWh, a reduction of 45.2 percent.

Compared to the annual average during the 2006 to 2008 base period, 2021 net electricity imports into NYISO increased by 6.9 million MWh, or 34.3 percent. (See

Figure 38). CO_2 emissions related to these net electricity imports decreased by 2.6 million short tons of CO_2, or 32.7 percent. (See Figure 39). The CO_2 emission rate of the electric generation supplying these imports decreased by 399.3 lb CO_2/MWh, a reduction of 50.5 percent.

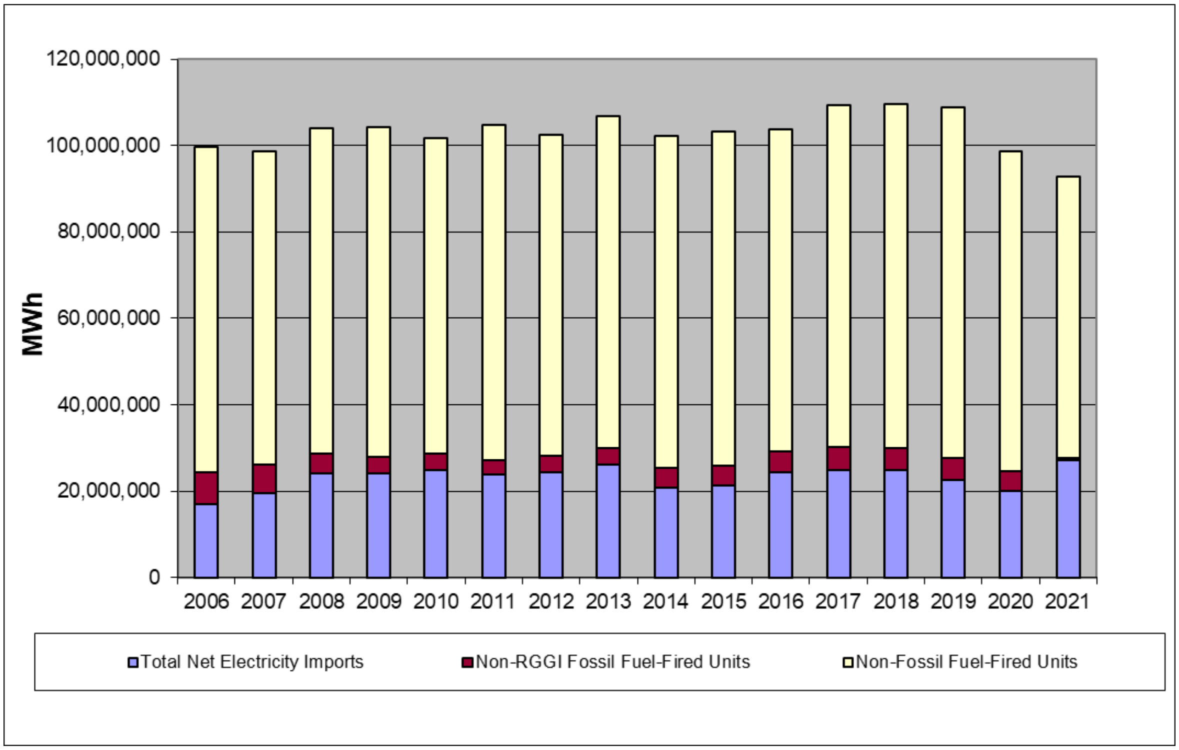

Figure 35. Non-RGGI Generation Serving Load in NYISO (MWh)

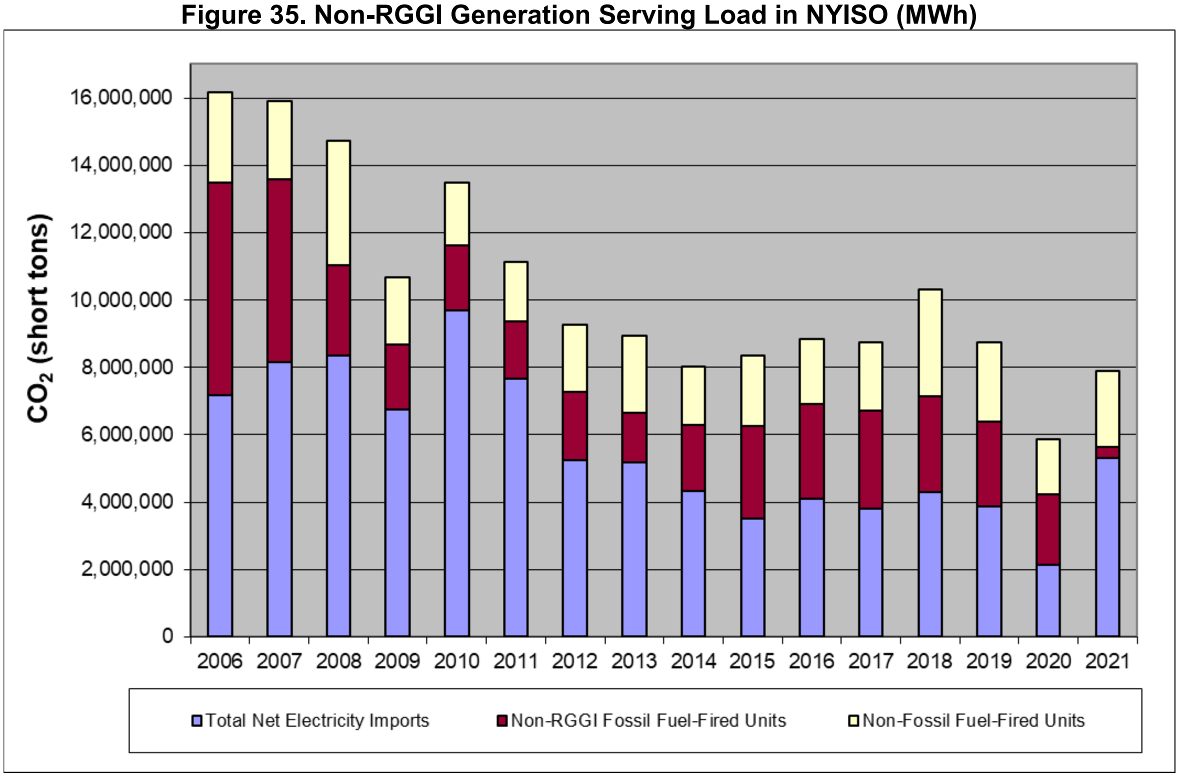

Figure 36. CO_2 Emissions from Non-RGGI Generation Serving Load in NYISO (short tons CO_2)

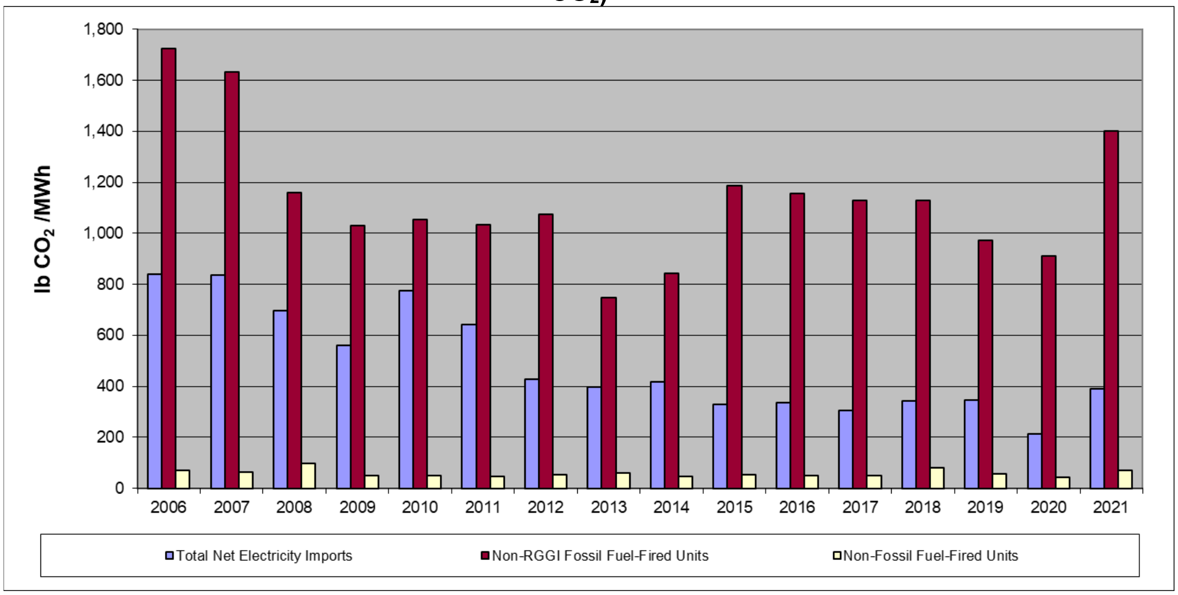

Figure 37. CO_2 Emission Rate for Non-RGGI Generation Serving Load in NYISO (lb CO_2/MWh)

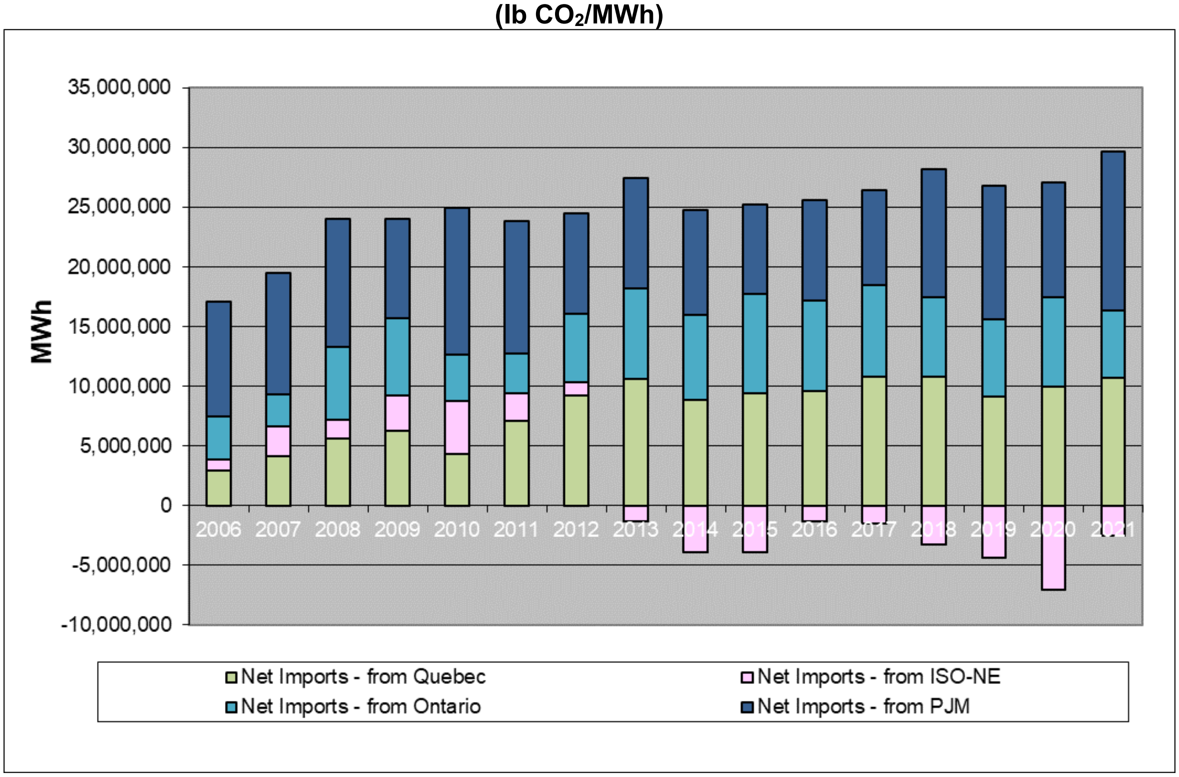

Figure 38. Net Electricity Imports to NYISO (MWh)

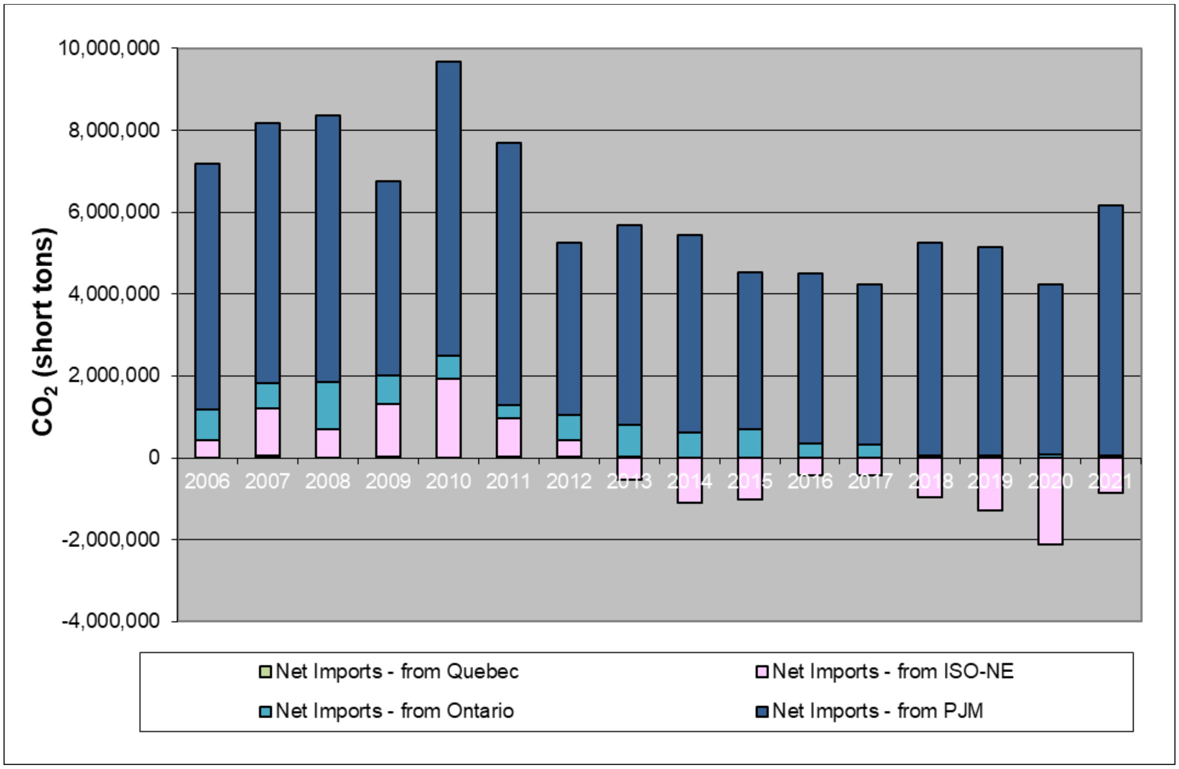

Figure 39. CO_2 Emissions Related to Net Electricity Imports to NYISO (short tons CO_2)

PJM (RGGI Portion)

Monitoring results for PJM for 2006 through 2021 are summarized below in Table 7 and Figures 40 through 49. Note that for PJM, the data presented below is for the RGGI geographic portion of PJM: Delaware, Maryland, New Jersey, and Virginia (RGGI PJM). Annual averages for calendar years 2006 to 2008 (baseline) and 2021 represent RGGI PJM. Annual averages for calendar years 2009 to 2011 and 2020 represent Delaware, Maryland, and New Jersey. Annual averages for calendar years 2012 to 2019 represent Delaware and Maryland only (RGGI PJM-2). Net "imports" represent inferred flows of electricity from the non-RGGI geographic portion of PJM (Non-RGGI PJM) to RGGI PJM to make up for shortfalls in electric generation relative to total electricity load for this subset of PJM.[51]

Table 7. 2006 – 2021 Monitoring Summary for RGGI PJM

	Electricity Demand				Electricity Generation					*Summary Data*
MWh	**Total Annual Electricity Load in ISO**	**Net Imports - from Non-RGGI PJM**	**Net Imports - from NYISO**	**Total Net Electricity Imports - from All Adjoining ISOs**	**Annual Electric Generation - RGGI-Affected Units**	**Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units**	**Annual Electric Generation - Non-Fossil Fuel-Fired Units**	**Annual Electric Generation - All Non-RGGI Units**	**Total Annual Electric Generation - All Units**	**Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)**
2006	274,443,982	94,471,071	-2,431,223	92,039,848	97,551,550	358,134	84,494,450	84,852,584	182,404,134	176,892,432
2007	280,782,709	91,096,901	-2,641,513	88,455,388	106,172,454	382,810	85,772,057	86,154,867	192,327,321	174,610,255
2008	272,655,818	91,516,082	-2,691,446	88,824,636	98,770,110	183,612	84,877,460	85,061,072	183,831,182	173,885,708
2009	158,657,456	56,299,698	-1,257,857	55,041,841	50,005,454	151,888	53,458,273	53,610,161	103,615,615	108,652,002
2010	165,047,534	58,001,518	-1,844,414	56,157,104	57,625,172	143,960	51,121,298	51,265,258	108,890,430	107,422,362
2011	160,923,846	55,406,781	-1,583,072	53,823,709	53,621,362	227,081	53,251,694	53,478,775	107,100,137	107,302,484
2012	78,802,312	34,442,085	-482,148	33,959,937	28,350,888	190,940	16,300,547	16,491,487	44,842,375	50,451,424
2013	77,458,942	35,843,247	-490,493	35,352,754	24,775,215	81,428	17,249,545	17,330,973	42,106,188	52,683,727
2014	76,359,729	32,656,507	-482,178	32,174,329	26,733,539	71,744	17,380,117	17,451,861	44,185,400	49,626,190
2015	77,903,165	35,680,933	-413,286	35,267,647	24,839,927	57,076	17,738,515	17,795,591	42,635,518	53,063,238
2016	77,822,567	33,910,113	-462,876	33,447,237	26,504,789	51,481	17,819,060	17,870,541	44,375,330	51,317,778

[51] This data is compiled from PJM GATS, which reports data for both the non-RGGI and RGGI geographic portions of PJM. Inferred net imports are based on total MWh load in the RGGI geographic portion of PJM minus total electric generation in the RGGI geographic portion of PJM. Any shortfall in generation relative to load is assumed to be met through an inferred "import" of electricity from the non-RGGI geographic portion of PJM into the RGGI geographic portion of PJM.

2017	75,384,095	35,770,266	-397,466	35,372,800	21,208,131	28,228	18,774,936	18,803,164	40,011,295	54,175,964
2018	77,912,067	30,085,536	-630,502	29,455,034	28,772,738	55,564	19,628,731	19,684,295	48,457,033	49,139,329
2019	74,279,654	32,136,849	-583,001	31,553,848	23,754,977	54,739	18,916,090	18,970,829	42,725,806	50,524,677
2020	143,958,375	51,196,818	-1,128,865	50,067,953	46,204,909	52,955	47,632,558	47,685,513	93,890,422	97,753,466
2021	269,668,867	81,775,715	-3,069,826	78,705,889	102,554,859	77,075	88,331,044	88,408,119	190,962,978	167,114,008

	Electricity Demand				**Electricity Generation**					***Summary Data***
CO_2	**Total Annual Electricity Load in ISO**	**Net Imports - from Non-RGGI PJM**	**Net Imports - from NYISO**	**Total Net Electricity Imports - from All Adjoining ISOs**	**Annual Electric Generation - RGGI-Affected Units**	**Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units**	**Annual Electric Generation - Non-Fossil Fuel-Fired Units**	**Annual Electric Generation - All Non-RGGI Units**	**Total Annual Electric Generation - All Units**	**Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)**
2006	159,221,364	59,911,033	-1,341,566	58,569,467	89,820,146	291,574	10,540,177	10,831,751	100,651,897	69,401,218
2007	162,463,477	57,269,645	-1,464,901	55,804,744	98,639,335	302,325	7,717,073	8,019,398	106,658,733	63,824,142
2008	153,805,789	56,969,639	-1,438,830	55,530,809	88,258,988	184,833	9,831,159	10,015,992	98,274,980	65,546,801
2009	78,593,331	33,537,149	-553,688	32,983,461	43,804,611	152,325	1,652,934	1,805,259	45,609,870	34,788,720
2010	87,087,382	35,150,499	-894,878	34,255,621	50,125,993	145,704	2,560,064	2,705,768	52,831,761	36,961,389
2011	78,909,078	33,048,520	-688,046	32,360,474	44,418,277	182,970	1,947,357	2,130,327	46,548,604	34,490,801
2012	45,342,236	18,627,737	-290,358	18,337,379	25,436,501	212,964	1,355,392	1,568,356	27,004,857	19,905,735
2013	43,873,524	19,867,713	-282,938	19,584,774	22,968,475	101,584	1,218,691	1,320,275	24,288,750	20,905,049
2014	43,832,735	17,971,031	-285,333	17,685,699	24,836,448	82,905	1,227,683	1,310,588	26,147,036	18,996,287
2015	40,731,169	17,989,208	-222,606	17,766,601	21,569,214	60,038	1,335,315	1,395,353	22,964,567	19,161,954
2016	40,573,262	16,699,087	-251,655	16,447,433	22,374,470	52,701	1,698,659	1,751,360	24,125,830	18,198,793
2017	34,169,771	17,052,989	-171,742	16,881,247	15,922,332	26,383	1,339,809	1,366,192	17,288,524	18,247,439
2018	34,987,263	13,913,167	-277,822	13,635,345	19,968,446	52,436	1,331,036	1,388,472	21,351,918	15,018,817
2019	31,119,015	15,110,127	-221,466	14,888,661	14,963,881	48,656	1,217,817	1,266,473	16,230,354	16,155,134
2020	48,839,122	23,345,135	-310,250	23,034,885	23,493,429	31,552	2,279,256	2,310,808	25,804,237	25,345,693
2021	98,016,496	41,794,827	-918,558	40,876,269	52,455,830	46,830	4,637,567	4,684,397	57,140,227	45,560,666

lb CO_2/ MWh	Electricity Demand				Electricity Generation					Summary Data
	Total Annual Electricity Load in ISO	Net Imports - from Non-RGGI PJM	Net Imports - from NYISO	Total Net Electricity Imports - from All Adjoining ISOs	Annual Electric Generation - RGGI-Affected Units	Annual Electric Generation - Non-RGGI Fossil Fuel-Fired Units	Annual Electric Generation - Non-Fossil Fuel-Fired Units	Annual Electric Generation - All Non-RGGI Units	Total Annual Electric Generation - All Units	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2006	1,160	1,268	1,104	1,273	1,841	1,628	249	255	1,104	785
2007	1,157	1,257	1,109	1,262	1,858	1,580	180	186	1,109	731
2008	1,128	1,245	1,069	1,250	1,787	2,013	232	236	1,069	754
2009	991	1,191	880	1,198	1,752	2,006	62	67	880	640
2010	1,055	1,212	970	1,220	1,740	2,024	100	106	970	688
2011	981	1,193	869	1,202	1,657	1,611	73	80	869	643
2012	1,151	1,082	1,204	1,080	1,794	2,231	166	190	1,204	789
2013	1,133	1,109	1,154	1,108	1,854	2,495	141	152	1,154	794
2014	1,148	1,101	1,184	1,099	1,858	2,311	141	150	1,184	766
2015	1,046	1,008	1,077	1,008	1,737	2,104	151	157	1,077	722
2016	1,043	985	1,087	983	1,688	2,047	191	196	1,087	709
2017	907	953	864	954	1,502	1,869	143	145	864	674
2018	898	925	881	926	1,388	1,887	136	141	881	611
2019	838	940	760	944	1,260	1,778	129	134	760	639
2020	679	912	550	920	1,017	1,192	96	97	550	519
2021	727	1,022	598	1,039	1,023	1,215	105	106	598	545

RGGI PJM-2 (Delaware and Maryland)

The monitoring results indicate that the annual average electricity load in RGGI PJM-2 for 2019 to 2021 decreased by 10.4 million MWh, or 12.5 percent, compared to the base period of 2006 to 2008. Annual average electric generation from all sources in RGGI PJM-2 for 2019 to 2021 decreased by 12.8 million MWh, or 23.6 percent, compared to the base period.

In RGGI PJM-2, annual average electric generation from RGGI generation for 2019 to 2021 decreased by 14.6 million MWh during this period, or 39.2 percent, and annual average CO_2 emissions from this category decreased by 24.5 million short tons of CO_2, or 63.6 percent. The annual average CO_2 emission rate of RGGI electric generation decreased by 832.9 lb CO_2/MWh, a reduction of 40.3 percent. Annual average electric generation from non-RGGI electric generation sources located in RGGI PJM-2 increased by 1.8 million MWh, or 10.3 percent, during this period, and annual average CO_2 emissions from this category decreased by 208,403 short tons of CO_2, a decrease of 14.9 percent. The annual average CO_2 emission rate of non-RGGI electric generation located in RGGI PJM-2 decreased by 27.2 lb CO_2/MWh, a decrease of 22.8 percent.

The annual average electric generation from all non-RGGI electric generation serving load in RGGI PJM-2 for 2019 to 2021 increased by 4.2 million MWh, or 9.2 percent, compared to the annual average during the 2006 to 2008 base period. Annual average CO_2 emissions from this category decreased by 2.7 million short tons of CO_2, a decrease of 14.5 percent, and the annual average CO_2 emission rate decreased by 178.4 lb CO_2/MWh, a decrease of 21.6 percent. (See Figures 40, 41, and 42.)

When comparing the annual average during the base period of 2006 to 2008 to the annual average for 2019 to 2021, net electricity imports into RGGI PJM-2 increased by 2.5 million MWh. (See Figure 43). Annual average CO_2 emissions related to these net electricity imports decreased by 2.5 million short tons of CO_2, or 14.4 percent, during this period. (See Figure 44). The annual average CO_2 emission rate of the electric generation supplying these imports decreased by 257.2 lb CO_2/MWh, a decrease of 21.1 percent.

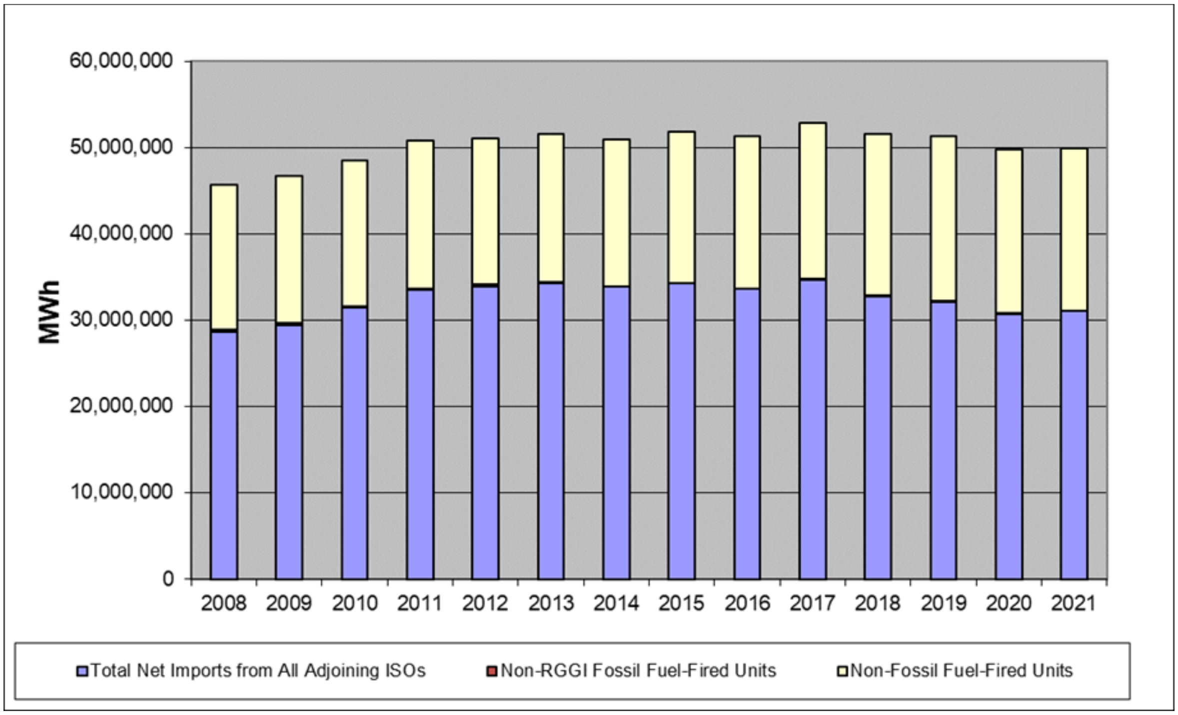

Figure 40. Non-RGGI Generation Serving Load in RGGI PJM-2 (MWh) (Three Year Trailing Average)

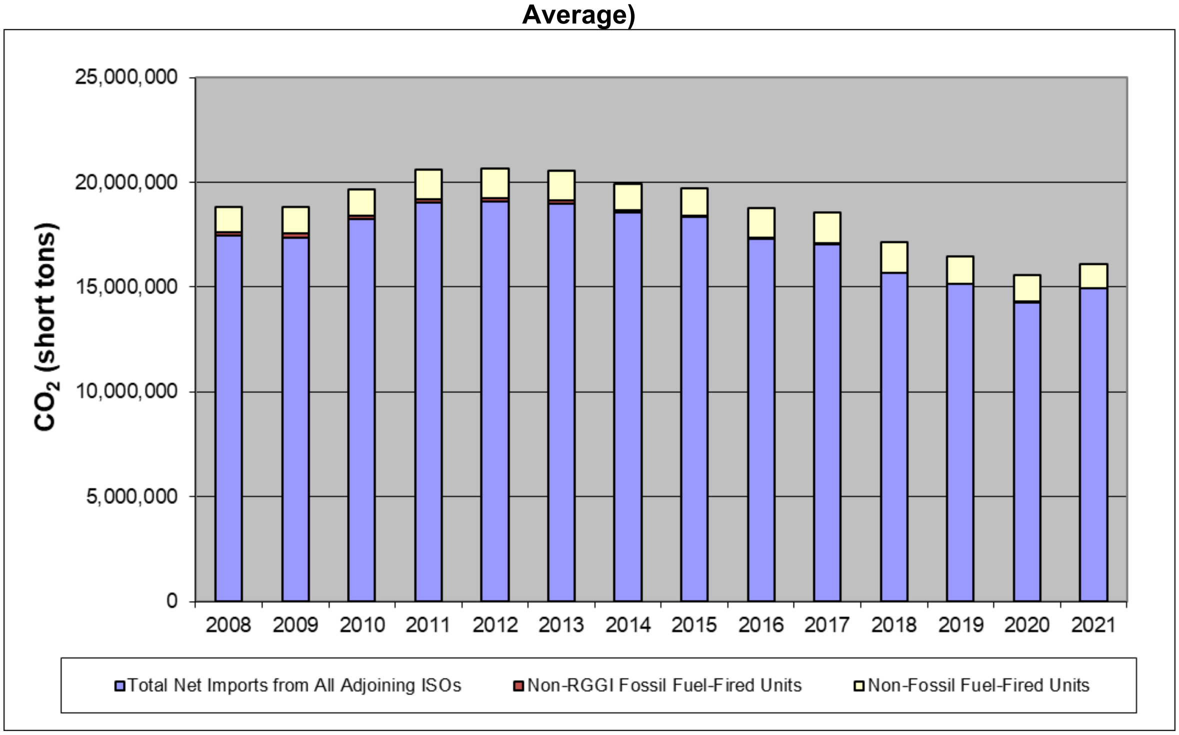

Figure 41. CO_2 Emissions from Non-RGGI Generation Serving Load in RGGI PJM-2 (short tons CO_2) (Three Year Trailing Average)

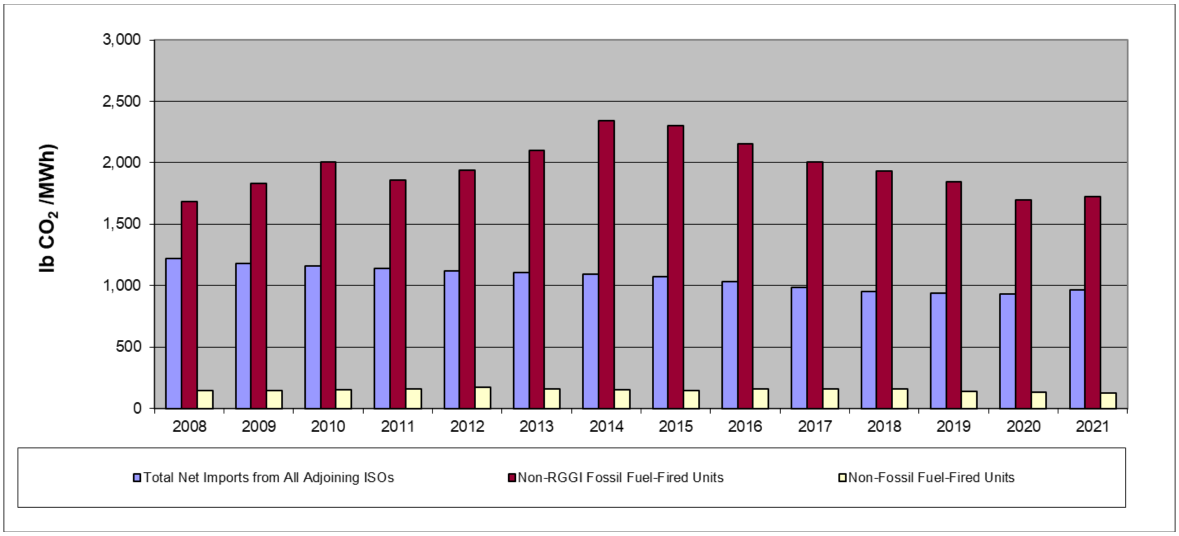

Figure 42. CO_2 Emission Rate for Non-RGGI Generation Serving Load in RGGI PJM-2 (lb CO_2/MWh) (Three Year Trailing Average)

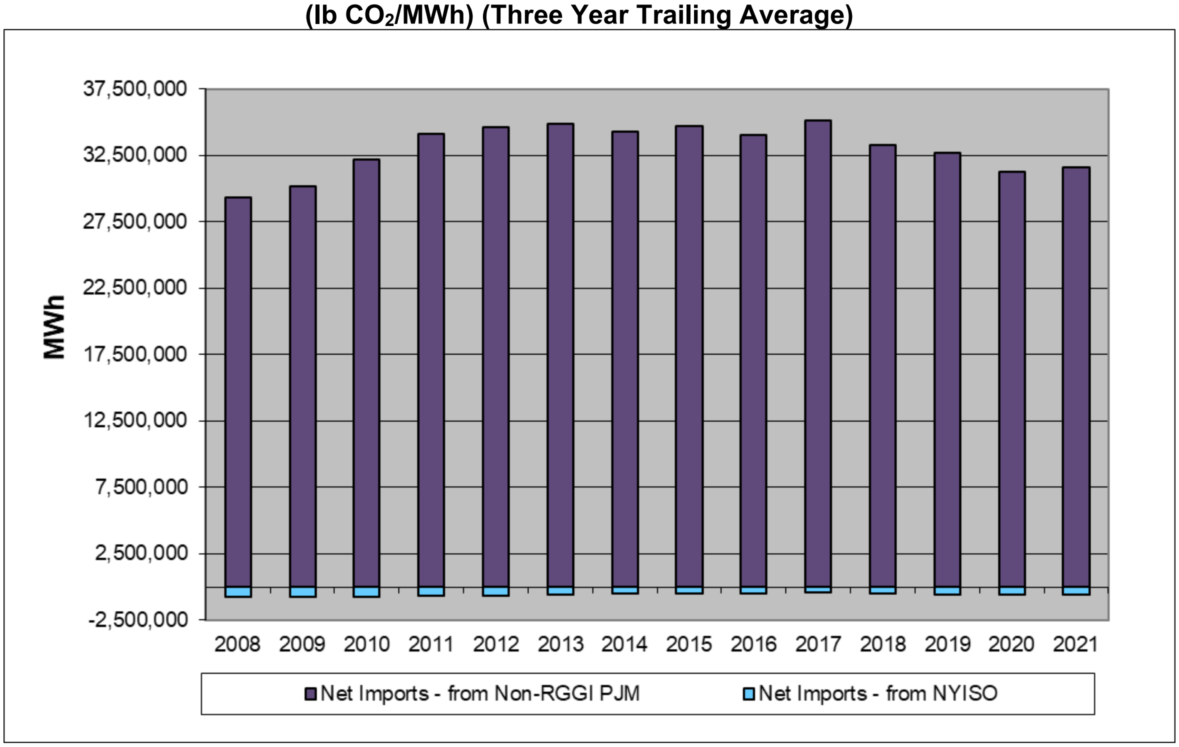

Figure 43. Net Electricity Imports to RGGI PJM-2 (MWh) (Three Year Trailing Average)

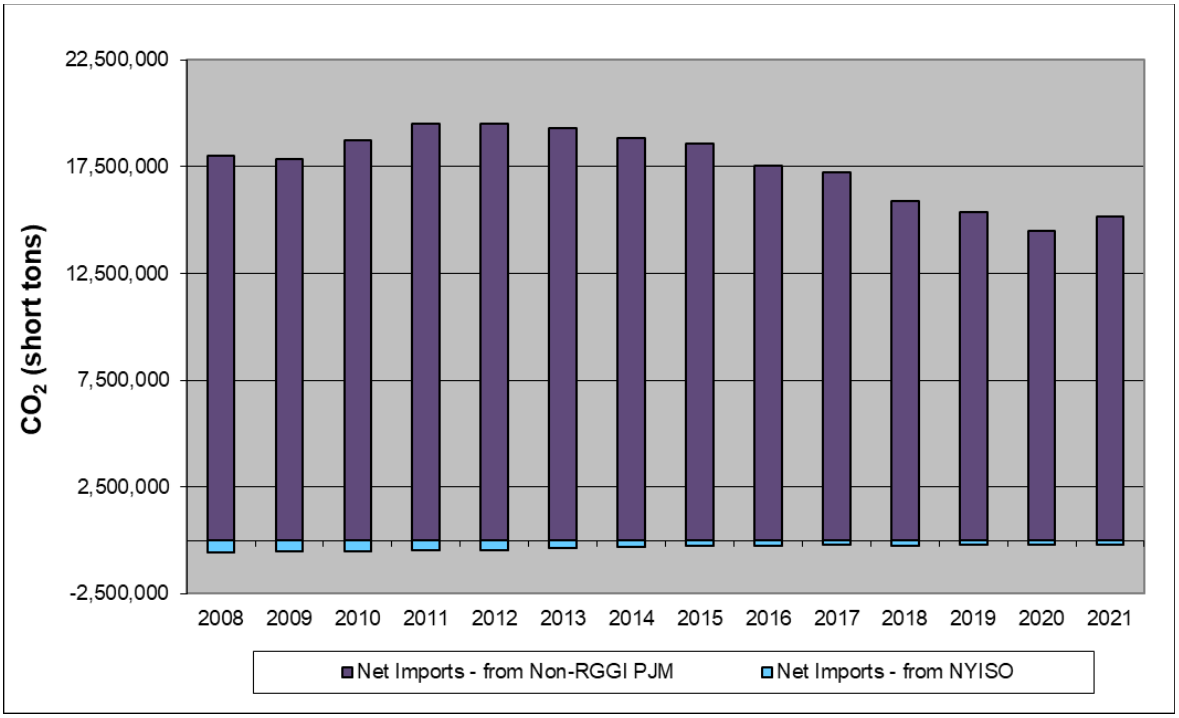

Figure 44. CO_2 Emissions Related to Net Electricity Imports to RGGI PJM-2 (short tons CO_2) (Three Year Trailing Average)

RGGI PJM (Delaware, Maryland, New Jersey, and Virginia)

The monitoring results indicate the 2021 annual average electricity load in RGGI PJM decreased by 6.3 million MWh, or 2.3 percent, compared to the 2006 to 2008 base period. The annual average 2021 electric generation from all sources in RGGI PJM decreased by 4.8 million MWh, or 2.6 percent, compared to the base period.

Compared to the annual average during the 2006 to 2008 base period, 2021 electric generation from RGGI generation in RGGI PJM decreased by 1.7 million MWh, or 1.7 percent, and CO_2 emissions from RGGI generation in RGGI PJM decreased by 39.8 million short tons of CO_2, or 43.1 percent. The CO_2 emission rate of RGGI electric generation decreased by 806 lb CO_2/MWh, a reduction of 44.1 percent. Compared to the 2006 to 2008 annual average, 2021 electric generation from non-RGGI generation located in RGGI PJM increased by 3.1 million MWh, or 3.6 percent, and CO_2 emissions from this category of electric generation decreased by 4.9 million short tons of CO_2 a decrease of 51.3 percent. The CO_2 emission rate of non-RGGI electric generation located in RGGI PJM decreased by 120 lb CO_2/MWh, a decrease of 53.0 percent (See Figures 45, 46, and 47).

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2021 from all non-RGGI electric generation sources serving load in RGGI PJM decreased by 8.0 million MWh, a decreased of 4.6 percent. Compared to the base period, 2021 CO_2 emissions from this category of electric generation decreased by 20.7 million short tons of CO_2, a decrease of 31.2 percent, and the CO_2 emission rate decreased by 211.3 lb CO_2/MWh, a reduction of 27.9 percent.

Compared to the annual average during the 2006 to 2008 base period, 2021 net electricity imports into RGGI PJM decreased by 11.1 million MWh, or 12.3 percent (See Figure 48). CO_2 emissions related to these net electricity imports decreased by 15.8 million short tons of CO_2, or 27.8 percent, during this period (See Figure 49). The average CO_2 emission rate of the electric generation supplying these imports decreased by 223 lb CO_2/MWh, a reduction of 17.7 percent.

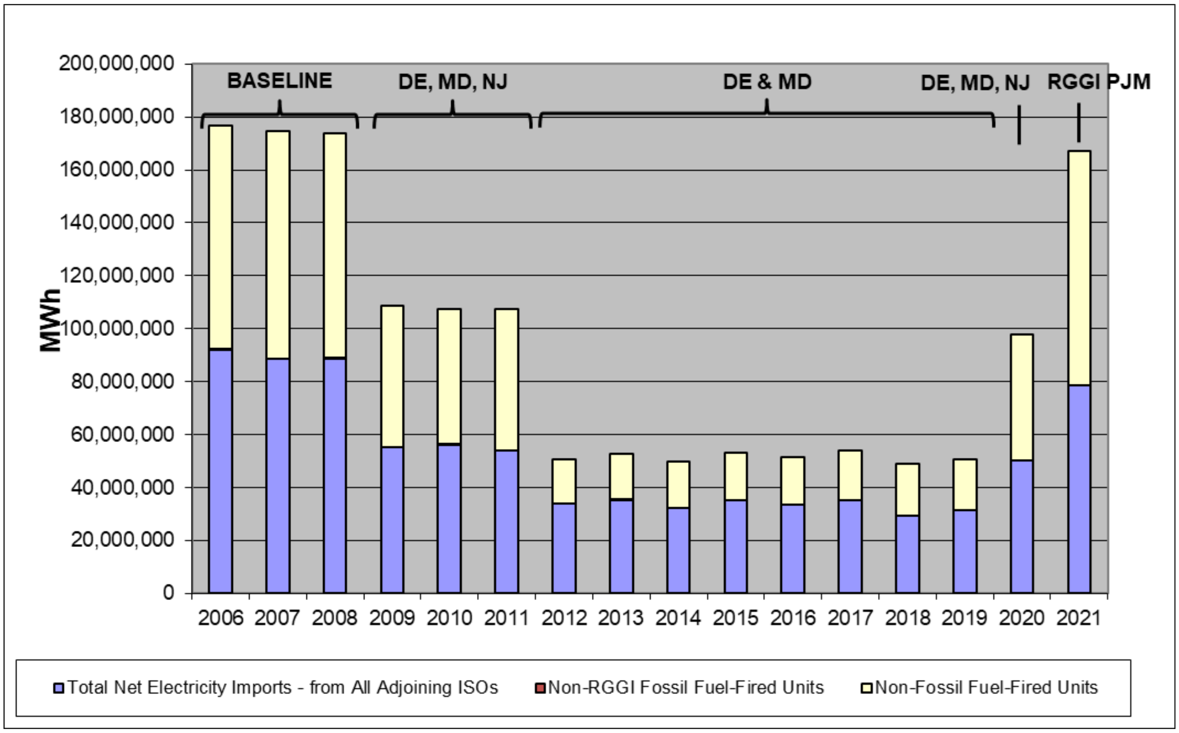

Figure 45. Non-RGGI Generation Serving Load in RGGI PJM (MWh). Annual averages for baseline years and 2021 represent RGGI PJM; 2009 to 2011 and 2020 include Delaware, Maryland, and New Jersey; 2012 to 2019 include Delaware and Maryland only (RGGI PJM-2).

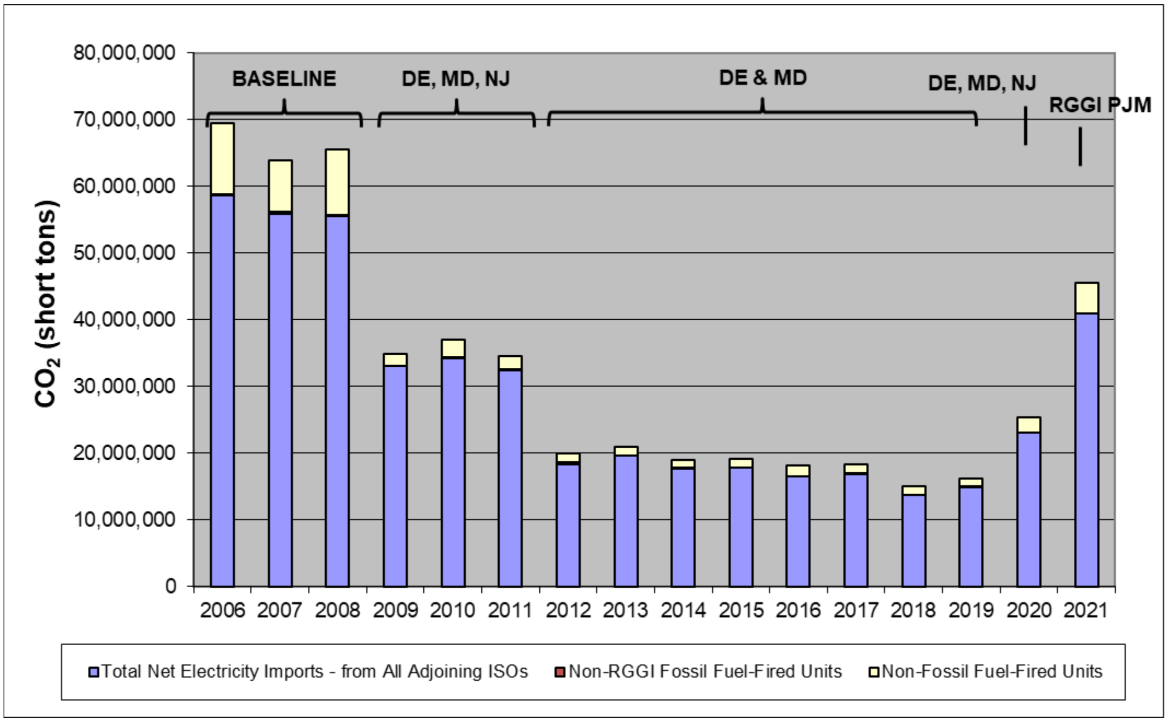

Figure 46. CO_2 Emissions from Non-RGGI Generation Serving Load in RGGI PJM (short tons CO_2). Annual averages for baseline years and 2021 represent RGGI PJM; 2009 to 2011 and 2020 include Delaware, Maryland, and New Jersey; 2012 to 2019 include Delaware and Maryland only (RGGI PJM-2).

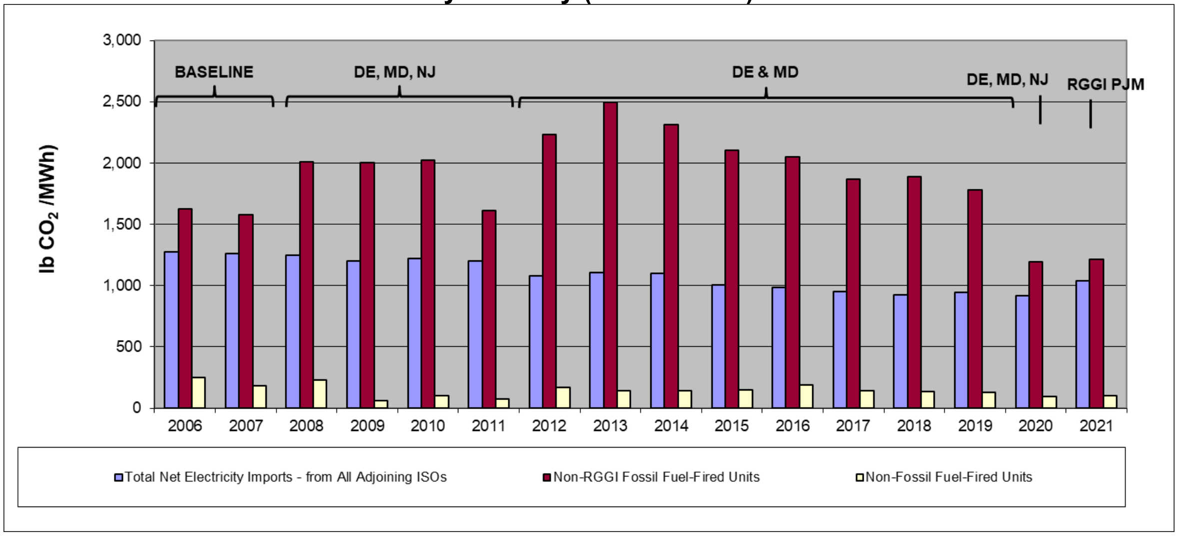

Figure 47. CO_2 Emission Rate for Non-RGGI Generation Serving Load in RGGI PJM (lb CO_2/MWh). Annual averages for baseline years and 2021 represent RGGI PJM; 2009 to 2011 and 2020 include Delaware, Maryland, and New Jersey; 2012 to 2019 include Delaware and Maryland only (RGGI PJM-2).

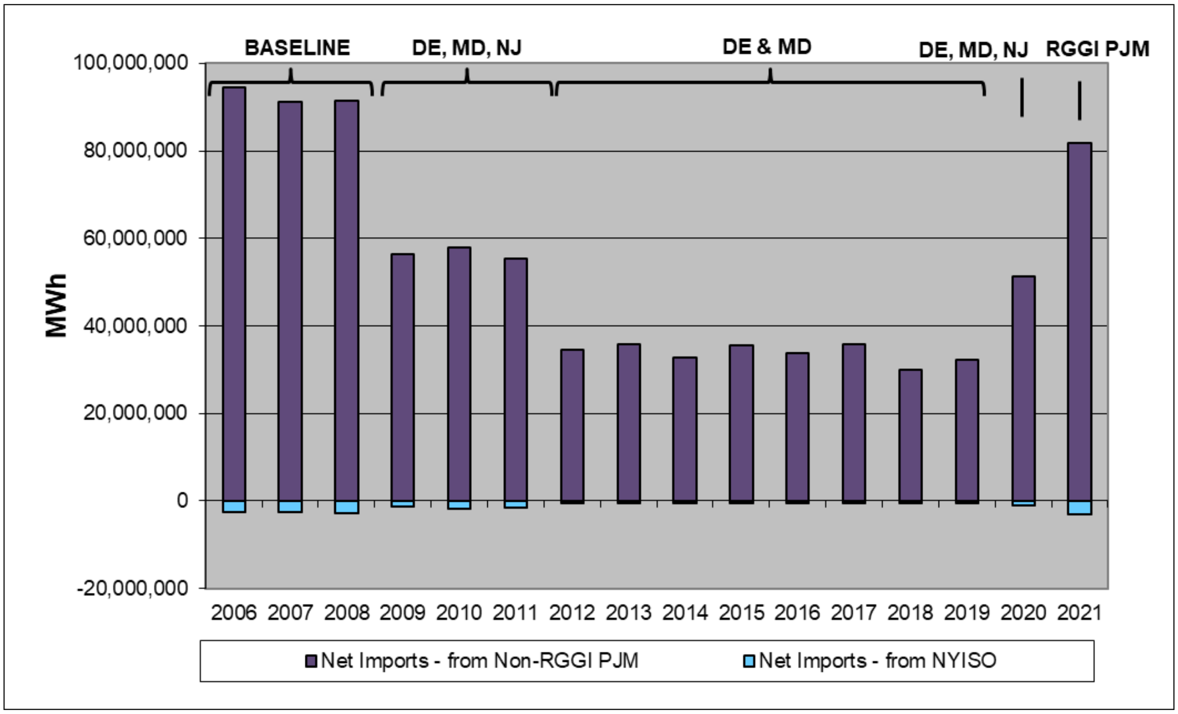

Figure 48. Net Electricity Imports to RGGI PJM (MWh). Annual averages for baseline years and 2021 represent RGGI PJM; 2009 to 2011 and 2020 include Delaware, Maryland, and New Jersey; 2012 to 2019 include Delaware and Maryland only (RGGI PJM-2).

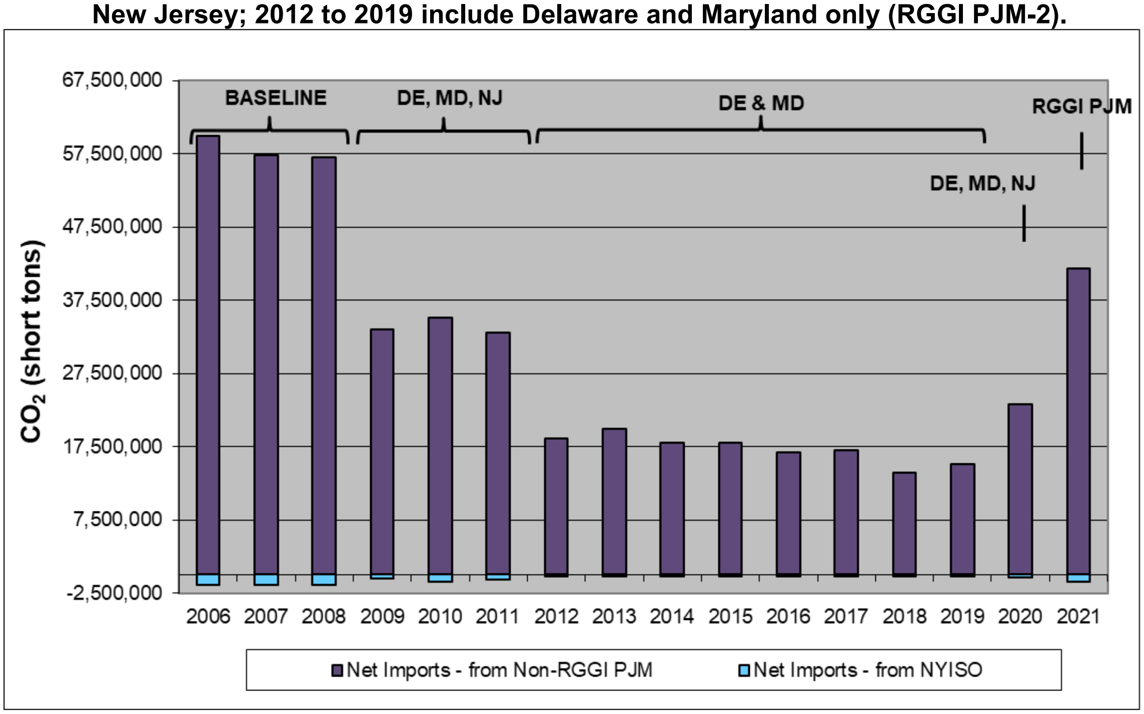

Figure 49. CO_2 Emissions Related to Net Electricity Imports to RGGI PJM (short tons CO_2). Annual averages for baseline years and 2021 represent RGGI PJM; 2009 to 2011 and 2020 include Delaware, Maryland, and New Jersey; 2012 to 2019 include Delaware and Maryland only (RGGI PJM-2).

Appendix C. Monitoring Trends

Detailed monitoring trends for the eleven-state RGGI region, ISO-NE, NYISO, and the RGGI portion of PJM are presented in Tables 8 through 11. The tables summarize the comparison between the 2006 to 2008 base period with the three-year average of RGGI operation (2019 to 2021) and the 2021 annual average.

Eleven-state RGGI Region

Table 8. Monitoring Trends for Eleven-state RGGI Region

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh
RGGI-9 annual average for 2006-2008 (base period)	158,231,279	20,137,889	254	172,296,470	138,362,771	1,605	55,997,235	25,224,000	904
Annual average for 2019-2021	154,843,532	18,148,917	234	122,515,399	62,201,901	1,016	75,609,539	21,285,378	563
Difference from base period	-3,387,747	-1,988,972	-20.41	-49,781,071	-76,160,870	-589.5	19,612,305	-3,962,585	-342.6
% change from base period	-2.1%	-9.9%	-8.0%	-28.9%	-55.0%	-36.7%	35.0%	-15.7%	-37.8%
RGGI-11 annual average for 2006-2008 (base period)	226,481,229	28,364,741	250	235,852,547	192,049,576	1,628.0	117,176,851	64,292,456	1,098
2021	213,073,336	19,706,591	185	212,343,014	104,322,755	983	124,629,648	47,902,428	769
Difference from base period	-13,407,893	-8,658,150	-65.4	-23,509,533	-87,726,821	-645.4	7,452,797	-16,390,028	-329.7
% change from base period	-5.9%	-30.5%	-26.1%	-10.0%	-45.7%	-39.6%	6.4%	-25.5%	-30.0%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	MWh
RGGI-9 annual average for 2006-2008 (base period)	214,228,514	45,361,889	424	330,527,749	386,423,646
Annual average for 2019-2021	230,453,072	39,434,295	342	277,358,931	343,615,972
Difference from base period	16,224,558	-5,951,557	-81.4	-53,168,818	-42,807,674
% change from base period	7.6%	-13.1%	-19.2%	-16.1%	-11.1%
RGGI-11 annual average for 2006-2008 (base period)	343,658,080	92,657,197	539.2	462,333,775	579,409,289
2021	337,702,984	67,609,019	400	425,416,350	540,603,673
Difference from base period	-5,955,096	-25,048,177	-138.8	-36,917,425	-38,805,616
% change from base period	-1.7%	-27.0%	-25.7%	-8.0%	-6.7%

ISO-NE

Table 9. Monitoring Trends for ISO-NE

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh
Annual average for 2006-2008 (base period)	60,527,897	11,046,433	365	67,414,107	47,242,267	1,401	7,196,667	-138,167	-48
Annual average for 2019-2021	58,882,053	12,443,940	423	50,561,269	23,969,439	948	18,788,004	1,697,982	181
Difference from base period	-1,645,844	1,397,507	57.9	-16,852,838	-23,272,828	-453.2	11,591,337	1,836,149	221.9
% change from base period	-2.7%	12.7%	15.9%	-25.0%	-49.3%	-32.3%	161.1%	1328.9%	539.2%
2021	58,985,136	13,227,965	448	47,308,826	22,049,617	932	21,825,001	2,429,144	220
Difference from base period	-1,542,761	2,181,532	83.6	-20,105,282	-25,192,649	-469.8	14,628,335	2,567,312	260.9
% change from base period	-2.5%	19.7%	22.9%	-29.8%	-53.3%	-33.5%	203.3%	1858.1%	634.0%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	MWh
Annual average for 2006-2008 (base period)	67,724,564	10,908,266	322	127,942,004	135,037,333
Annual average for 2018-2021	77,670,056	14,141,922	364	109,443,321	118,789,000
Difference from base period	9,945,493	3,233,656	42.1	-18,498,683	-16,248,333
% change from base period	14.7%	29.6%	13.1%	-14.5%	-12.0%
2021	80,810,138	15,657,109	387	106,293,962	118,300,333
Difference from base period	13,085,574	4,748,843	65.0	-21,648,042	-16,737,000
% change from base period	19.3%	43.5%	20.2%	-16.9%	-12.4%

NYISO

Table 10. Monitoring Trends for the NYCA

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh
Annual average for 2006-2008 (base period)	80,597,157	7,695,928	191	67,607,068	52,567,819	1,554	20,206,894	7,885,769	790
Annual average for 2019-2021	65,783,165	2,578,254	78	59,226,886	27,897,486	1,082	27,135,755	5,313,875	392
Difference from base period	-14,813,993	-5,117,673	-112.3	-8,380,182	-24,670,333	-472.3	6,928,861	-2,585,750	-399.3
% change from base period	-18.4%	-66.5%	-58.9%	-12.4%	-46.9%	-30.4%	34.3%	-32.7%	-50.5%
2021	76,987,182	3,733,827	95	52,528,655	26,111,315	1,045	23,207,666	3,773,825	317
Difference from base period	-3,609,976	-3,962,101	-95.2	-15,078,413	-26,456,504	-509.7	3,000,772	-4,125,800	-474.4
% change from base period	-4.5%	-51.5%	-49.9%	-22.3%	-50.3%	-32.8%	14.9%	-52.2%	-60.0%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	MWh
Annual average for 2006-2008 (base period)	100,804,051	15,581,697	309	148,204,225	168,411,119
Annual average for 2019-2021	92,918,919	7,892,130	170	125,010,051	152,145,806
Difference from base period	-7,885,132	-7,703,423	-140.0	-23,194,175	-16,265,313
% change from base period	-7.8%	-49.4%	-45.2%	-15.7%	-9.7%
2021	100,194,847	7,507,652	150	129,515,836	152,725,269
Difference from base period	-609,204	-8,087,901	-160.0	-18,688,389	-15,685,850
% change from base period	-0.6%	-51.9%	-51.6%	-12.6%	-9.3%

RGGI PJM

Table 11. Monitoring Trends for RGGI PJM

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	CO_2 Emissions	lb CO_2/MWh
RGGI PJM-2 annual average for 2006-2008 (base period)	17,106,225	1,395,529	163	37,275,295	38,552,685	2,068	28,593,674	17,444,734	1,220
Annual average for 2019-2021	18,871,214	1,187,126	126	22,677,919	14,040,969	1,236	31,041,237	14,927,960	963
Difference from base period	1,764,990	-208,403	-37.2	-14,597,376	-24,511,716	-832.9	2,447,563	-2,516,774	-257.2
% change from base period	10.3%	-14.9%	-22.8%	-39.2%	-63.6%	-40.3%	8.6%	-14.4%	-21.1%
RGGI PJM annual average for 2006-2008 (base period)	85,356,174	9,622,380	226	100,831,371	92,239,490	1,829	89,773,291	56,635,007	1,262
2021	88,408,119	4,684,397	106	102,554,859	52,455,830	1,023	78,705,889	40,876,269	1,039
Difference from base period	3,051,945	-4,937,983	-119.7	1,723,488	-39,783,660	-805.9	-11,067,401	-15,758,738	-222.9
% change from base period	3.6%	-51.3%	-53.0%	1.7%	-43.1%	-44.1%	-12.3%	-27.8%	-17.7%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO_2 Emissions	lb CO_2/MWh	MWh	MWh
RGGI PJM-2 annual average for 2006-2008 (base period)	45,699,899	18,840,263	824	54,381,519	82,975,194
Annual average for 2019-2021	49,912,452	16,115,086	646	41,549,133	72,590,370
Difference from base period	4,212,553	-2,725,177	-178.4	-12,832,386	-10,384,823
% change from base period	9.2%	-14.5%	-21.6%	-23.6%	-12.5%
RGGI PJM annual average for 2006-2008 (base period)	175,129,465	66,257,387	757	186,187,546	275,960,837
2021	167,114,008	45,560,666	545	190,962,978	269,668,867
Difference from base period	-8,015,457	-20,696,721	-211.3	4,775,432	-6,291,969
% change from base period	-4.6%	-31.2%	-27.9%	2.6%	-2.3%

Appendix D. Concept of "Emissions Leakage"

"Emissions leakage" is the concept that the RGGI CO_2 compliance obligation and related CO_2 compliance costs for electric generators could result in a shift of electricity generation from CO_2-emitting sources subject to the RGGI CO_2 Budget Trading Program to higher-emitting CO_2 sources not subject to RGGI. Key to this concept is that the cause of such a shift would be due to the RGGI CO_2 Budget Trading Program rather than other factors that influence electric power sector CO_2 emissions. The concept of emissions leakage presumes that an increase in electricity production costs for certain electric generators due to RGGI CO_2 compliance costs would be the driver of changes in the operation of the electric power system that result in an increase in CO_2 emissions from electric generation that is not subject to the RGGI CO_2 Budget Trading Program.

Factors that Influence Electric Generator Dispatch and CO_2 Emissions

In New England and the Mid-Atlantic, electric generation is deregulated and subject to competitive wholesale electricity markets. In the simplest terms, wholesale electricity markets are used to determine which power plants run to meet electricity demand and determine the wholesale price of electricity. Electric generators bid into day-ahead and real-time auctions for generation supply, in which the lowest priced plants are selected one by one until electricity demand is met. The last plant selected, or "dispatched," to meet demand is referred to as the marginal unit and sets the wholesale clearing price. A number of elements factor into the bid offers made by individual electric generators, including fuel prices, operation and maintenance costs, and environmental compliance costs. For this latter category, certain environmental compliance costs are represented by the market value of emissions allowances, such as CO_2, NO_X, and SO_2 allowances. The market value of these emission allowances influences the production costs of individual electric generators in a similar manner as fuel costs and therefore play a role in influencing the dispatch of electric generators and the wholesale market clearing price of electricity.

In addition to the production costs of electric generators, such as natural gas supply and costs which can be influenced by pipeline constraints, the dispatch of electric generators and wholesale electricity prices are also influenced by electricity demand and electricity transmission constraints. Since electricity cannot be stored, it must be delivered instantaneously to where it is needed. In locations where electric demand is high, transmission capability may be constrained, meaning that electric generation has different values in different areas because the lowest cost electric generation cannot always be delivered to where it is needed based on transmission limitations. As a result, wholesale electricity prices also differ by location, a concept referred to as locational marginal pricing.

All of the above, including production costs, market factors, and physical limitations, impact the dispatch of electric generation, and related CO_2 emissions, through a highly dynamic wholesale electricity market.

The concept of emissions leakage assumes a scenario in which only a subset of CO_2-emitting electric generators are subject to a CO_2 allowance requirement.[52] As a result, certain electric generators are subject to an additional production cost – the cost of CO_2 allowances – that is not faced by other CO_2-emitting electric generators. In theory, this could result in a shift in electric generation to emitting units that do not face a CO_2 compliance cost. If such a shift results in an increase in CO_2 emissions from electric generation as a whole, such an increase is referred to as emissions leakage.

[52] The RGGI region does not completely align with the geographic footprint of wholesale electricity markets in the greater New England and Mid-Atlantic region, and electric power can flow across multiple wholesale markets in North America.

If emissions leakage were to occur, it would result from an increase in dispatch (and related CO_2 emissions) from: (a) in-region non-RGGI units (i.e., fossil fuel-fired units in the RGGI region with a capacity less than 25 MWe, which are not subject to RGGI); (b) electric generation outside the RGGI region (represented as electricity imports); or (c) a combination of the two, both of which are referred to in this report as “non-RGGI generation.”