



**The Regional Greenhouse Gas Initiative**

an initiative of Eastern States of the US

**CO<sub>2</sub> Emissions from Electricity Generation and  
Imports in the Regional Greenhouse Gas Initiative:  
2019 Monitoring Report**

**June 15, 2022**

The 2019 Monitoring Report on CO<sub>2</sub> Emissions from Electricity Generation and Imports in the Regional Greenhouse Gas Initiative (2019 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, Rhode Island, Vermont, and Virginia.<sup>1</sup> 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<sub>2</sub>), 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.

---

<sup>1</sup> This report summarizes data for the nine states participating in RGGI in 2019: Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey resumed participation in RGGI in 2020 and Virginia began participation in 2021. Therefore, New Jersey and Virginia data are not included in this report.

## Table of Contents

Executive Summary.....	4
Summary of Results.....	4
Change in Annual Average Electric Load (Demand for Electricity) and Annual Average Generation.....	4
Change in Annual Average Non-RGGI Emissions, Non-RGGI Emissions Rate, and Non- RGGI Generation .....	7
Change in Annual Average RGGI Emissions, RGGI Emissions Rate, and RGGI Generation	8
Conclusions.....	8
I. Background.....	10
II. Monitoring Approach .....	10
III. Evaluation of Monitoring Data .....	11
Base Period.....	11
Key Metrics .....	12
General Limitations .....	12
IV. Methodology.....	13
Data Sources .....	13
Monitoring Limitations.....	14
V. Monitoring Results .....	15
VI. Discussion.....	25
VII. Conclusions.....	28
Appendix A. Nine-State ISO Monitoring Sources.....	30
Appendix B. ISO-Specific Monitoring Results .....	32
ISO-NE.....	32
NYISO.....	42
PJM (RGGI Portion).....	52
Appendix C. Monitoring Trends.....	62
Nine-State RGGI Region .....	62
ISO-NE.....	63
NYISO.....	64
RGGI PJM.....	65
Appendix D. Concept of “Emissions Leakage”.....	66

## Executive Summary

The 2019 Electricity Monitoring Report, the eleventh report in a series of annual monitoring reports, summarizes data for the period from 2005 through 2019, for electricity generation, net electricity imports, and related carbon dioxide (CO<sub>2</sub>) emissions for the nine states<sup>2</sup> participating in the Regional Greenhouse Gas Initiative (RGGI) in 2019. 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<sub>2</sub> Budget Trading Program to cause CO<sub>2</sub> emissions from generation serving load in the RGGI region to shift towards sources that are not subject to RGGI.<sup>3</sup> This potential shift has been referred to as “emissions leakage.”

In the New England and Mid-Atlantic states, CO<sub>2</sub> emissions from the regional electric power sector are a function of highly dynamic wholesale electricity markets. The cost of compliance with the RGGI CO<sub>2</sub> Budget Trading Program is only one of multiple factors that influence the dispatch of electric generation, and resulting CO<sub>2</sub> 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<sub>2</sub> emissions from all non-RGGI electric generation serving electricity load in the nine-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<sub>2</sub> emissions leakage.

The 2019 Electricity Monitoring Report tracks electricity generation, net electricity imports, and related CO<sub>2</sub> emissions during the three-year current period of 2017 to 2019 relative to 2006 to 2008, a three-year base period prior to the start of the first RGGI control period. The observed trends in electricity demand, electricity generation, and net electricity imports show there has been a small decrease in CO<sub>2</sub> emissions from total non-RGGI electric generation serving load in the nine-state RGGI region during the period of 2017 to 2019 and during the 2019 calendar year when compared to the base period.

### Summary of Results

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

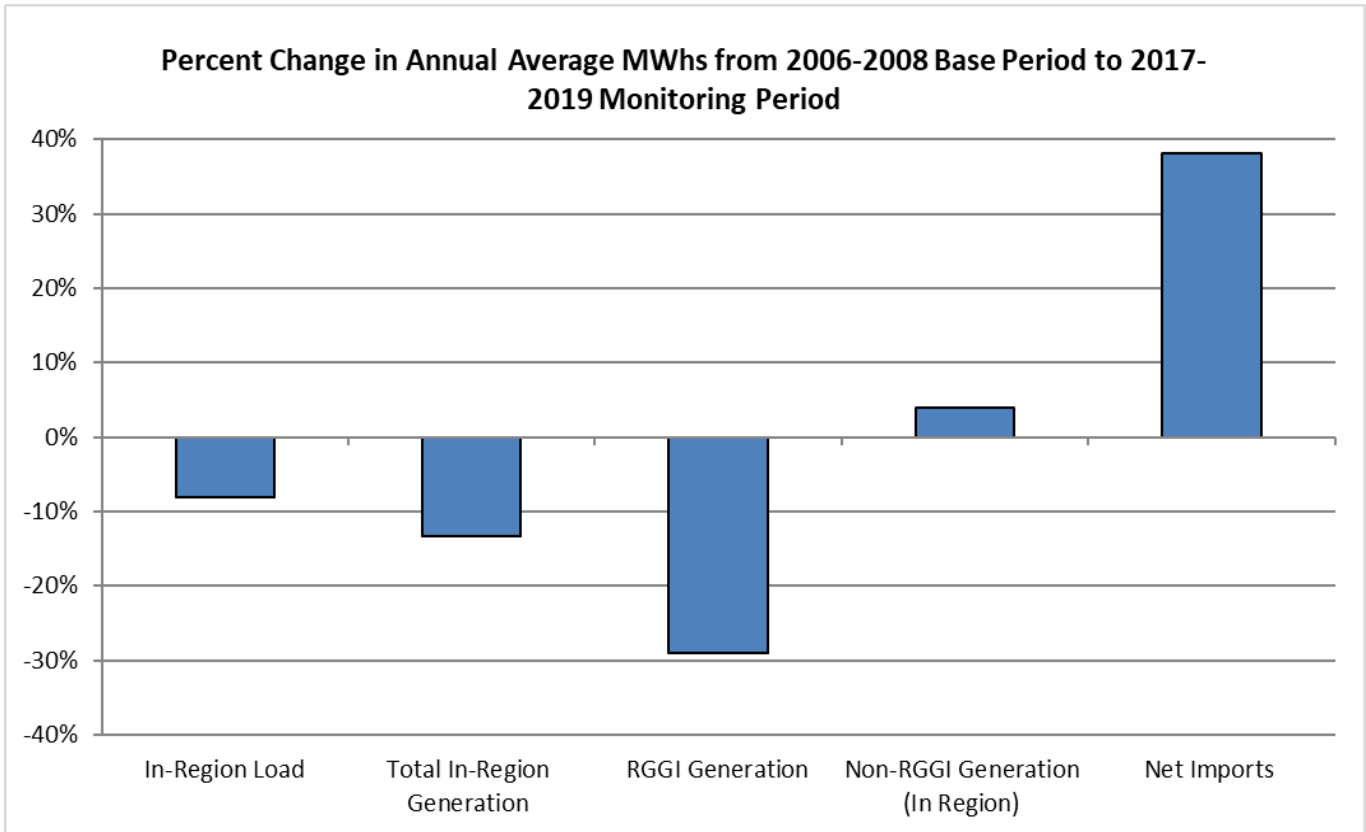
- The annual average **electric load** in the nine-state RGGI region from 2017 to 2019 decreased by 31.5 million MWh, or 8.1 percent, compared to the average for 2006 to 2008. (See Figures 1 and 2.)
- The annual average **electric generation** from all sources in the nine-state RGGI region from 2017 to 2019 decreased by 43.9 million MWh, or 13.3 percent, compared to the average for 2006 to 2008. (See Figures 1 and 2.)

---

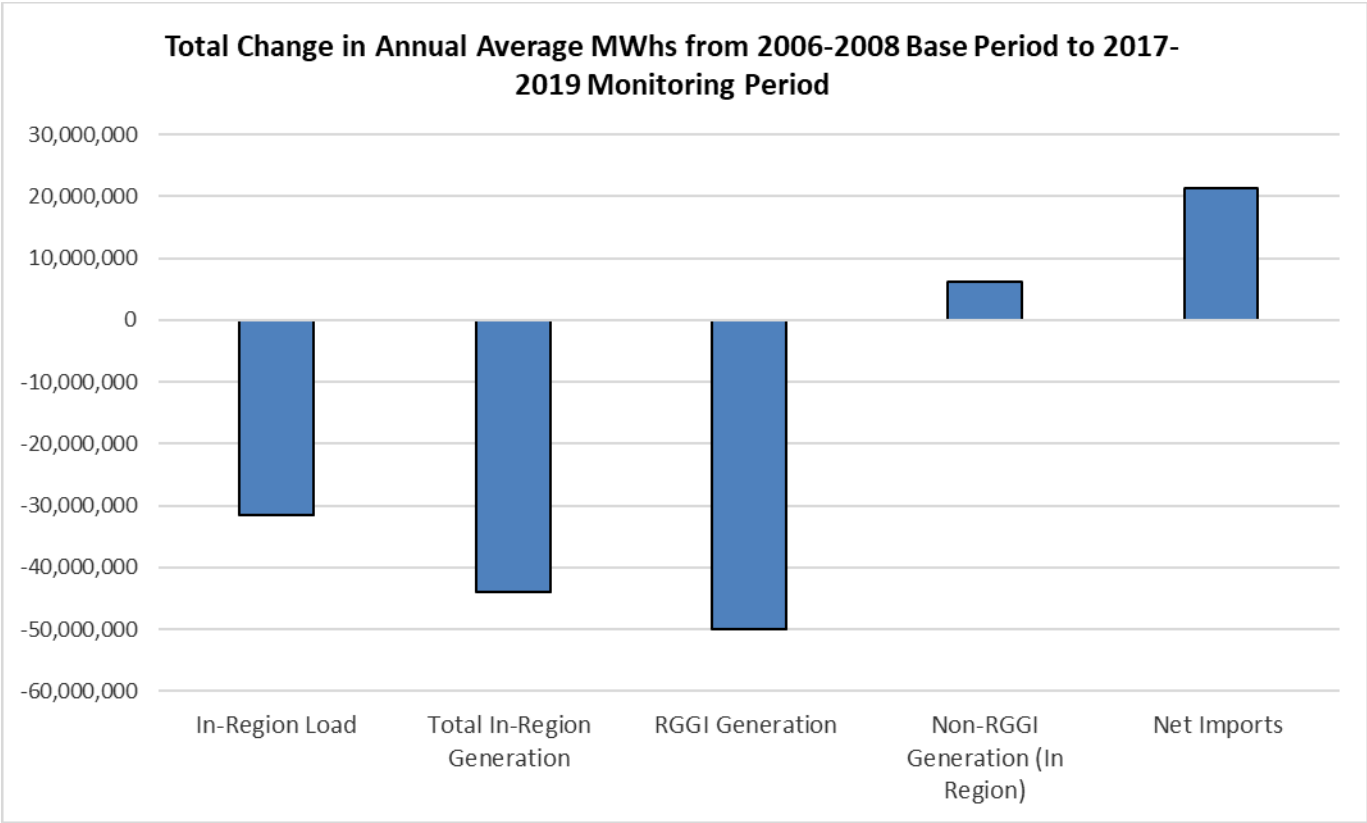
<sup>2</sup> The “nine-state RGGI region” consists of Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey resumed participation in RGGI in 2020 and Virginia began participation in 2021. Therefore, New Jersey and Virginia are not included in the region for this report.

<sup>3</sup> The Memorandum of Understanding called for monitoring electricity imports into the RGGI participating states commencing from the start of the RGGI CO<sub>2</sub> Budget Trading Program and reporting the results of such monitoring on an annual basis beginning in 2010.

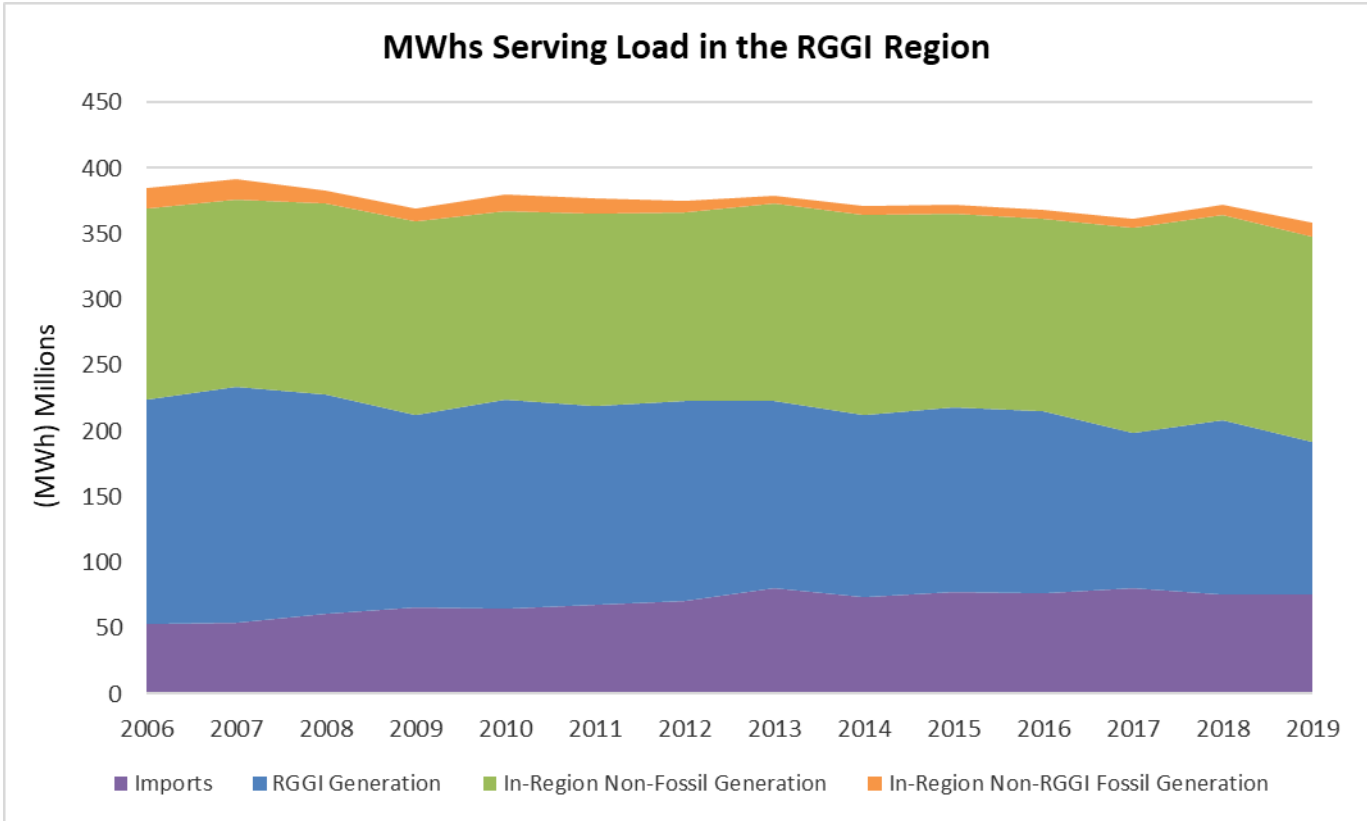
- Annual average net imports into the nine-state RGGI region from 2017 to 2019 increased by 21.3 million MWh, or 38.1 percent, compared to the average for 2006 to 2008. (See Figures 1 and 2.)
- For the 2019 calendar year, **electric load** and **electric generation** in the nine-state region show a similar reduction compared to the annual average during the base period from 2006 to 2008.



**Figure 1. Percentage change in annual average electricity load and generation serving the nine-state RGGI region for 2017 to 2019, relative to the base period of 2006 to 2008.**



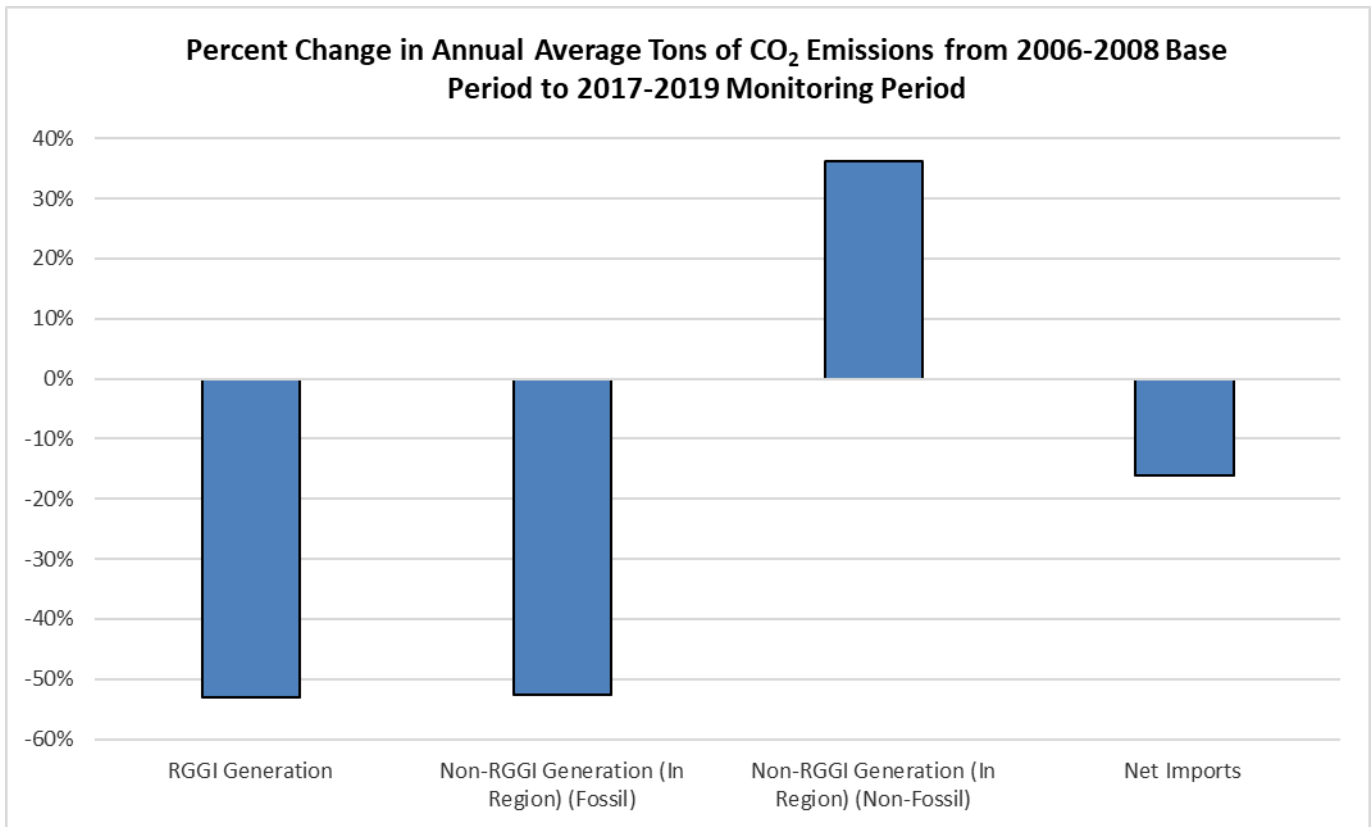
**Figure 2. Change in MWhs of annual average electricity load and generation serving the nine-state RGGI Region for 2017 to 2019, relative to the base period of 2006 to 2008.**



**Figure 3. MWhs of generation serving load in the RGGI region from 2006-2019.**

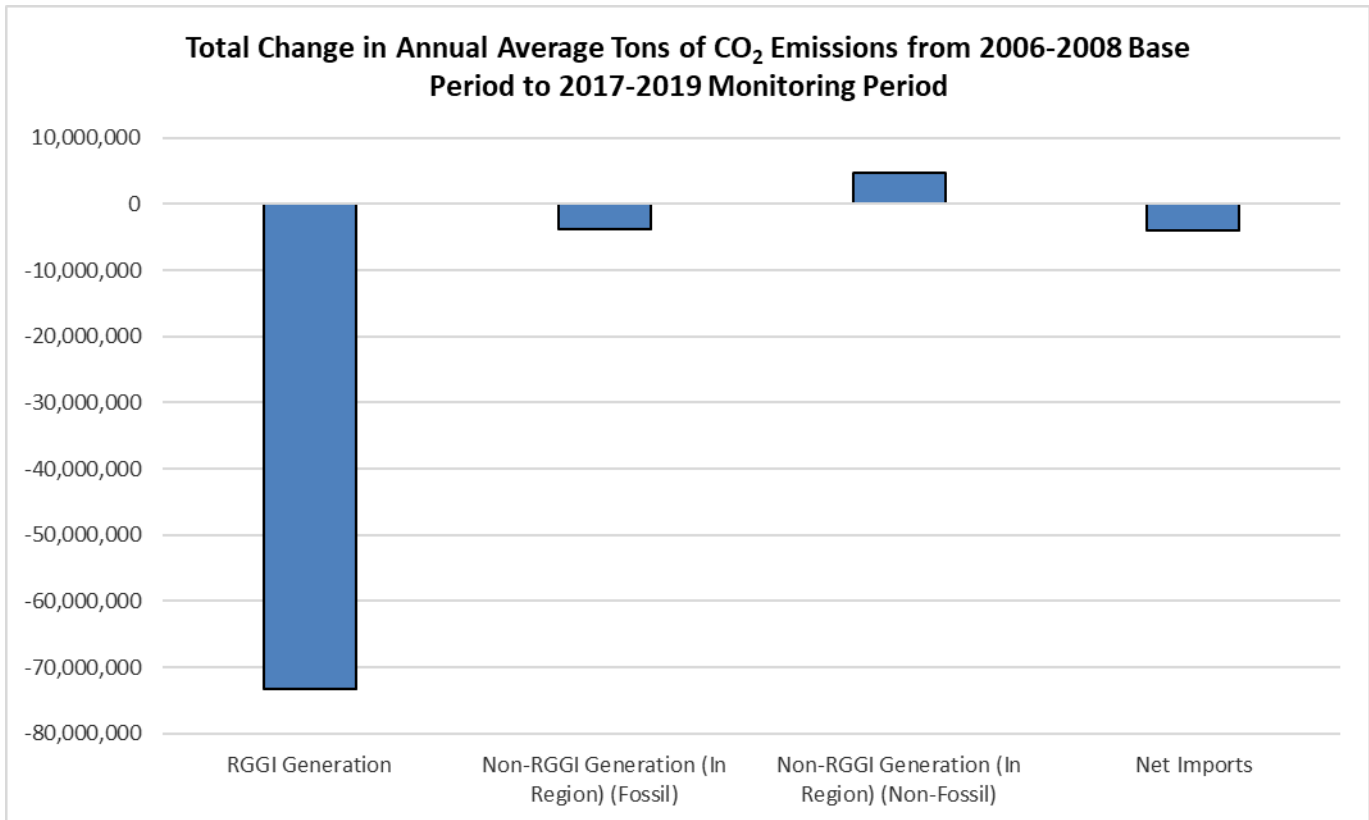
### Change in Annual Average Non-RGGI Emissions, Non-RGGI Emissions Rate, and Non-RGGI Generation

- The monitoring results indicate there was a decrease of 3.3 million short tons of CO<sub>2</sub>, or 7.3 percent, in **CO<sub>2</sub> emissions** from non-RGGI electric generation serving load in the nine-state RGGI region for 2017 to 2019 relative to the base period of 2006 to 2008. The CO<sub>2</sub> emissions from this category for the 2019 calendar year show there has been a similar decrease of 8.7 percent when compared to the base period.<sup>4</sup>
- The annual average **CO<sub>2</sub> emissions rate** from all non-RGGI electric generation sources serving load in the RGGI region for 2017 to 2019 decreased by 75.6 lb CO<sub>2</sub>/MWh, or 17.9 percent, compared to the base period of 2006 to 2008.
- The annual average **electric generation** from all non-RGGI electric generation sources serving load in the RGGI region for 2017 to 2019 increased by 27.5 million MWh, or 12.8 percent, compared to the base period of 2006 to 2008.



**Figure 4. Percent change in annual average CO<sub>2</sub> emissions from generation serving load in the nine-state RGGI region for 2017 to 2019, relative to the base period of 2006 to 2008.**

<sup>4</sup> In the calendar year 2019, non-RGGI electric generation was comprised of 64.4% in-region non-fossil fuel-fired generation, 31.3% net imports, and 4.3% in-region non-RGGI fossil fuel-fired generation. Further details on non-RGGI electric generation sources, including emissions intensity, can be found in Table 1.



**Figure 5. Change in annual average CO<sub>2</sub> emissions from generation serving load in the nine-state RGGI region for 2017 to 2019, relative to the base period of 2006 to 2008.**

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

- The annual average **CO<sub>2</sub> emissions** from RGGI electric generation sources from 2017 to 2019 decreased by 73.3 million short tons of CO<sub>2</sub>, or 53.0 percent, compared to the base period of 2006 to 2008. (See Figures 4 and 5.)
- The annual average **CO<sub>2</sub> emissions rate** from RGGI electric generation sources from 2017 to 2019 decreased by 540.9 lb CO<sub>2</sub>/MWh, or 33.7 percent, compared to the base period of 2006 to 2008.
- The annual average **electric generation** from RGGI electric generation sources from 2017 to 2019 decreased by 50.1 million MWh, or 29.1 percent, compared to the base period of 2006 to 2008. (See Figures 1 and 2.)
- Both **electric generation** and **CO<sub>2</sub> emissions** from RGGI electric generation sources in the 2019 calendar year show a similar reduction compared to the annual average for the base period of 2006 to 2008.

### **Conclusions**

It should be emphasized that this report does not provide indicators of CO<sub>2</sub> emissions leakage, but rather tracks electricity generation and imports, and related CO<sub>2</sub> 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<sub>2</sub> emissions from all non-RGGI electric generation serving electric load in the nine-state 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<sub>2</sub> emissions rate of this generation, which largely offsets the increase in generation. Specifically, there has been a 7.3 percent decrease in average annual CO<sub>2</sub> emissions from non-RGGI electric generation serving load in the RGGI region during the period of 2017 to 2019 when compared to the base period of 2006 to 2008, and a similar decrease for the calendar year 2019 when compared to the base period.

## I. Background

The 2019 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<sub>2</sub> emissions related to these categories of electric generation in the nine-state RGGI region, for the period from 2006 through 2019.<sup>5</sup> This monitoring was called for in the 2005 RGGI MOU in response to expressed concerns about the potential for the nine RGGI CO<sub>2</sub> Budget Trading Programs<sup>6</sup> to result in “emissions leakage”.<sup>7</sup> 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*.<sup>8</sup>

The report should not be used to draw definitive conclusions about whether CO<sub>2</sub> emissions leakage has occurred, as it does not address the causes of observed trends among different categories of electric generation serving load in the nine-state RGGI region. This report is an analysis of CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> emissions related to the generation of this electricity, and the associated lb CO<sub>2</sub>/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

---

<sup>5</sup> This 2019 report is the eighth of the annual monitoring reports to review the data as a nine-state initiative after New Jersey’s withdrawal from RGGI at the end of 2011. New Jersey resumed its participation in RGGI on January 1, 2020.

<sup>6</sup> RGGI is comprised of state CO<sub>2</sub> Budget Trading Programs. Under each of these state programs, a regulated power plant must hold CO<sub>2</sub> 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<sub>2</sub> allowances equal to 50% of its emissions to demonstrate compliance during each of the first two years of a three-year control period. CO<sub>2</sub> allowances are issued by participating states in a finite amount, or “budget”, resulting in a regional cap on CO<sub>2</sub> 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.

<sup>7</sup> Specifically, the MOU called for monitoring electricity imports into the RGGI participating states from the start of the RGGI CO<sub>2</sub> Budget Trading Program and reporting the results of such monitoring on an annual basis beginning in 2010.

<sup>8</sup> 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](https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf).

and power and solar photovoltaics). The electric generation MWh output that is used on-site is not included in the monitoring results.<sup>9</sup>

For each year 2005 through 2019, the following categories of data are presented for the nine-state RGGI region as well as for each ISO:

- **RGGI Generation**: Electric generation (MWh), CO<sub>2</sub> emissions (short tons), and emission rate (lb CO<sub>2</sub>/MWh) for electric generating units subject to a CO<sub>2</sub> allowance compliance obligation under state CO<sub>2</sub> Budget Trading Program regulations.<sup>10</sup>
- **Non-RGGI Generation**: Electricity generation (MWh), CO<sub>2</sub> emissions (short tons), and emission rate (lb CO<sub>2</sub>/MWh) for all non-RGGI electric generation serving electric load in the nine-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 nine-state RGGI region that are not subject to a CO<sub>2</sub> allowance compliance obligation (e.g., generators under 25 megawatts electrical (MWe) capacity and non-fossil fuel-fired electric generators).
  - **Net Imports**: Electric generation from net electricity imports (MWh) from adjacent control areas, or portion of a control area, outside the nine-state RGGI region (can be fossil or non-fossil generation).<sup>11</sup>

### 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 2017 to 2019 to a base period of 2006 to 2008. 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.

---

<sup>9</sup> 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 (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<sub>2</sub> 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<sub>2</sub>/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.

<sup>10</sup> For the purposes of this report, this category does not include electric generators that may be subject to a state CO<sub>2</sub> Budget Trading Program regulation, or portion of such regulation, but that are not subject to a CO<sub>2</sub> allowance compliance obligation that requires the generator to submit CO<sub>2</sub> allowances equivalent to its CO<sub>2</sub> emissions. For example, under Maryland's CO<sub>2</sub> Budget Trading Program regulations, certain industrial cogenerators may be subject to alternative CO<sub>2</sub> compliance obligations under certain conditions in lieu of submission of CO<sub>2</sub> allowances.

<sup>11</sup> 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, and 2011, data comparisons were made to the base period for the ten-state region. 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.<sup>12</sup>

### 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<sub>2</sub> emissions from all non-RGGI electric generation serving electric load in the nine-state RGGI region. This includes electric generation in the nine-state RGGI region from electric generating units that are not subject to a CO<sub>2</sub> allowance compliance obligation under a state CO<sub>2</sub> 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 nine-state RGGI region. If CO<sub>2</sub> emissions leakage were to occur, it would manifest as an increase in CO<sub>2</sub> emissions from this category of non-RGGI electric generation, assuming all other factors that impact electricity system dispatch and CO<sub>2</sub> emissions (such as electricity demand, relative fossil fuel prices, and wholesale electricity prices) did not change. As a result, an increase in CO<sub>2</sub> 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<sub>2</sub> emissions leakage.

### General Limitations

It should be emphasized that this report does not provide indicators of CO<sub>2</sub> emissions leakage, but rather tracks electricity generation and net electricity imports and related CO<sub>2</sub> emissions in the RGGI region for 2017 to 2019, relative to baseline years prior to implementation of RGGI. Determining whether CO<sub>2</sub> emissions leakage has occurred requires the evaluation of a hypothetical counterfactual – the amount of CO<sub>2</sub> emissions from non-RGGI electric generation that would occur, assuming there is no shift in electric generation to CO<sub>2</sub>-emitting non-RGGI electric generators as a result of the implementation of the RGGI CO<sub>2</sub> Budget Trading Program. In theory, an increase in CO<sub>2</sub> emissions or CO<sub>2</sub> emission rate from non-RGGI electric generation as compared to a historical baseline year could occur in a scenario in which CO<sub>2</sub> emissions leakage does not occur. Conversely, leakage could theoretically occur in a scenario in which CO<sub>2</sub> emissions and CO<sub>2</sub> 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<sub>2</sub> emissions leakage occurs.

Changes in these data over time may point to *potential* CO<sub>2</sub> emissions leakage as a result of states implementing the CO<sub>2</sub> 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<sub>2</sub> Budget Trading Program, or a combination of these factors.

---

<sup>12</sup> ISO-NE data for years 2005-2015 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 2005-2009 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<sub>2</sub> 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<sub>2</sub> and the lb CO<sub>2</sub>/MWh emission rates from non-RGGI non-fossil fuel units in this report do not reflect the biomass lifecycle carbon reduction of atmospheric CO<sub>2</sub> levels resulting from uptake of CO<sub>2</sub> from the atmosphere as a result of forest and biomass growth. Likewise, for municipal solid waste combustors, direct emissions of CO<sub>2</sub> 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),<sup>13</sup> supplemented by ISO electricity import/export data, and CO<sub>2</sub> emissions data for RGGI electric generation from the RGGI CO<sub>2</sub> 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<sub>2</sub> emissions are based on CO<sub>2</sub> 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 2005-2015 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<sub>2</sub> emissions data compiled by the New York State Department of Environmental Conservation (NYSDEC), the EPA, and validated self-reporting in NYGATS. CO<sub>2</sub> emissions data for RGGI electric generation units were compiled from RGGI COATS and from NYSDEC emissions statement program data. CO<sub>2</sub> 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<sub>2</sub> emissions related to net electricity imports from each adjacent control area<sup>14</sup> are the product of a lb CO<sub>2</sub>/MWh emission rate and the reported MWh of net imports. The CO<sub>2</sub> emission rate for electricity imports is based on the system average CO<sub>2</sub> emission rate for the respective exporting adjacent control area.<sup>15</sup> For ISO-NE and NYISO, net electricity imports are based on actual flow data for electricity transfers

---

<sup>13</sup> 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](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).

<sup>14</sup> For PJM, this represents inferred imports from the non-RGGI geographic portion of PJM.

<sup>15</sup> 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.<sup>16</sup> 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 and Maryland). 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.<sup>17</sup>

When aggregating individual ISO net import data, the reported regional net imports of electricity and related CO<sub>2</sub> emissions from net imports presented in this report represent net imports from adjacent regions not subject to the RGGI CO<sub>2</sub> 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<sub>2</sub> Budget Trading Program (e.g., from ISO-NE into NYISO and vice versa). To avoid inappropriate double counting of MWh and related CO<sub>2</sub> emissions, the net import subtotals from adjacent ISOs or portion of an ISO subject to the RGGI CO<sub>2</sub> Budget Trading Program were not included when rolling up the individual ISO data into regional summary totals, as the electricity and CO<sub>2</sub> 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 the nine-state RGGI region.

For ISO-NE and NYISO, net electricity import data is based on the tracking of actual electricity flows between adjacent control areas.<sup>18</sup> 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 two-state RGGI portion of PJM (Delaware and Maryland) 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

---

<sup>16</sup> 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.

<sup>17</sup> This category of data does not technically represent an import of electricity, as PJM is dispatched as a single control area.

<sup>18</sup> The exception is net import data from Hydro Quebec into NYISO, which represents net scheduled electricity imports.

report, this proration is based on the annual percentage of electric generation in the non-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.<sup>19</sup>

## V. Monitoring Results

Monitoring results are provided in this section for the full nine-state RGGI region. These results provide a compilation of data from each ISO fully or partially subject to the RGGI CO<sub>2</sub> 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 two-state portion of PJM subject to RGGI (Delaware and Maryland). Monitoring data for each ISO is presented in Appendix B.

Monitoring results for the nine-state RGGI region for 2005 through 2019 are summarized in Table 1.<sup>20</sup>

---

<sup>19</sup> See footnote 9.

<sup>20</sup> 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<sub>2</sub> Budget Trading Program. As a result, the net electricity imports and related CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> Budget Trading Program. In order to avoid inappropriate double counting of MWh and related CO<sub>2</sub> emissions, these net import subtotals were not included when rolling up the individual ISO data into regional summary totals, as the electricity and CO<sub>2</sub> emissions represented by these net imports are included in the electric generation subtotals for each ISO.

**Table 1. 2005 – 2019 Monitoring Summary for Nine-State RGGI 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 <sup>21</sup>	Non-RGGI Generation (Non-RGGI Generation within RGGI + Net Imports)
2005	393,135,125	1,898,020	7,375,317	1,620,000	6,967,235	31,878,151	49,738,723	182,340,181	15,355,763	145,831,734	161,187,497	343,396,401	210,926,220
2006	384,993,562	3,672,282	8,982,749	1,047,000	8,837,899	30,716,157	53,256,087	170,330,583	15,585,075	146,057,863	161,642,938	331,737,475	214,899,025
2007	391,243,211	2,637,442	11,912,292	896,000	9,452,157	28,944,540	53,842,431	180,079,639	15,377,543	142,160,325	157,537,868	337,400,780	211,380,299
2008	383,034,165	6,162,902	15,141,014	1,285,000	9,917,356	28,386,914	60,893,186	166,479,188	10,185,713	145,327,318	155,513,031	322,140,979	216,406,217
2009	368,848,273	6,463,657	17,065,805	1,569,000	7,760,904	33,089,871	65,949,237	146,453,756	10,341,603	146,563,495	156,905,098	302,899,036	222,854,335
2010	378,723,230	3,872,635	13,549,209	737,000	11,489,286	35,142,720	64,790,850	159,407,982	11,890,764	143,423,050	155,313,814	313,931,380	220,104,664
2011	375,309,279	3,318,681	18,681,204	846,000	10,452,544	34,250,993	67,549,422	151,036,118	11,356,368	146,908,941	158,265,309	307,759,857	225,814,731
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

CO <sub>2</sub>	Tons of CO <sub>2</sub> from Electricity Serving In-Region Demand							Tons of CO <sub>2</sub> 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)
2005	203,397,003	460,286	30,081	714,298	4,460,362	20,408,108	26,073,134	159,287,880	10,025,160	8,010,829	18,035,989	177,323,869	44,109,123
2006	187,356,738	769,120	39,607	547,053	5,484,024	19,059,750	25,899,553	139,924,128	8,820,383	12,712,674	21,533,057	161,457,185	47,432,610
2007	191,288,853	604,715	39,262	455,316	5,801,823	17,766,431	24,667,547	145,789,425	8,615,550	12,216,331	20,831,882	166,621,306	45,499,428
2008	172,528,388	1,154,884	41,725	736,564	5,999,390	17,172,335	25,104,898	129,374,761	4,650,564	13,398,165	18,048,729	147,423,490	43,153,628
2009	147,927,352	712,496	67,723	968,535	4,381,845	18,682,706	24,813,304	105,958,243	4,812,778	12,343,028	17,155,806	123,114,048	41,969,110
2010	163,080,863	554,950	37,339	406,202	6,656,944	20,361,849	28,017,283	116,053,938	5,405,123	13,604,519	19,009,642	135,063,580	47,026,925
2011	147,249,900	336,556	47,363	410,324	5,952,203	19,504,235	26,250,682	101,597,445	5,148,933	14,382,554	19,531,487	121,128,933	45,782,170

<sup>21</sup> See Appendix A, Table 2, Table Note 1.



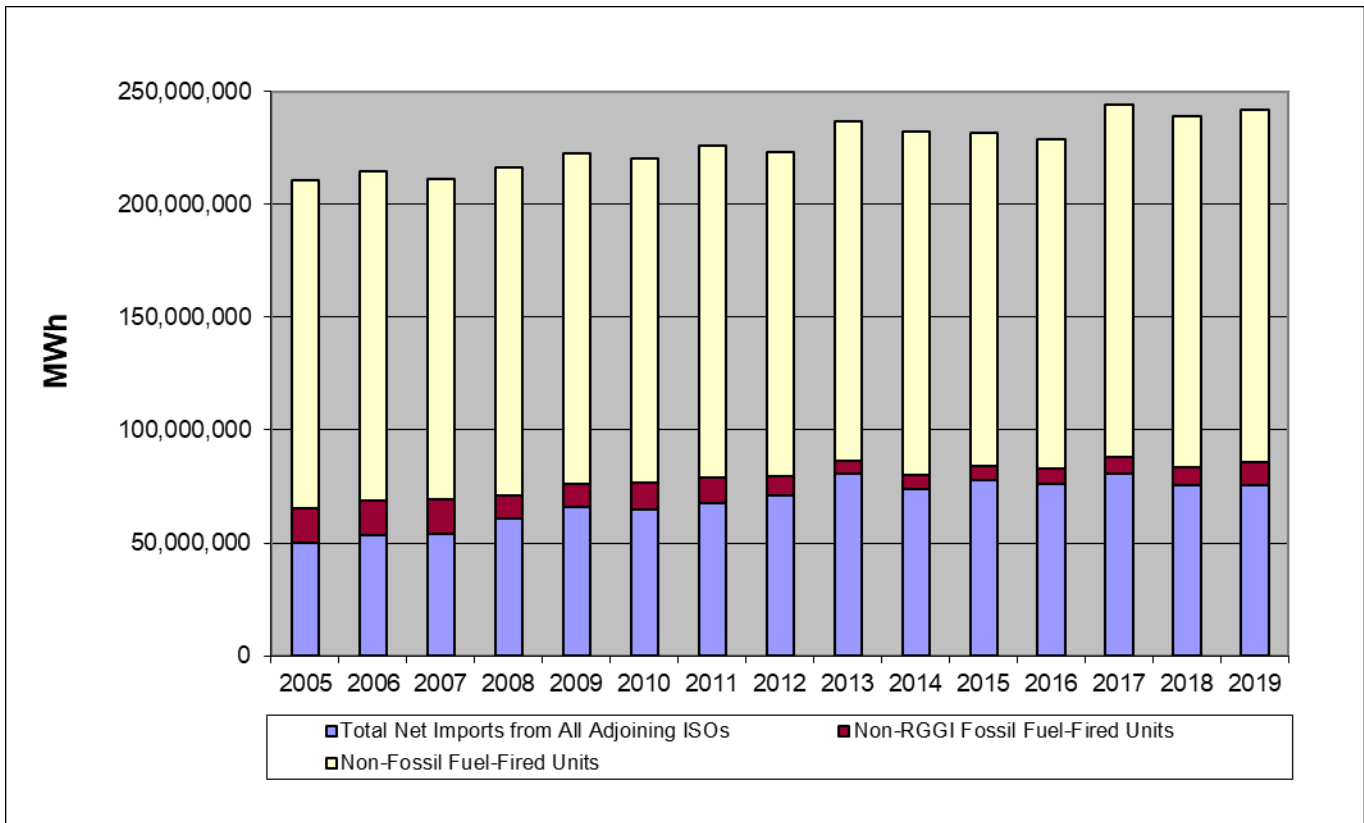
<b>2012</b>	135,245,657	602,081	66,408	297,690	4,287,069	18,627,737	23,880,985	92,734,116	4,037,376	14,593,226	18,630,601	111,364,717	42,511,586
<b>2013</b>	132,502,742	795,236	54,159	1,186,296	4,822,624	19,867,713	26,726,027	86,618,562	2,191,307	16,967,034	19,158,342	105,776,903	45,884,369
<b>2014</b>	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
<b>2015</b>	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
<b>2016</b>	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
<b>2017</b>	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
<b>2018</b>	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
<b>2019</b>	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
	<b>Emissions Rate for Electricity Serving In-Region Demand</b>							<b>Emissions Rate for In-Region Electricity Generation</b>					<b>Summary Data</b>
<b>lb CO<sub>2</sub>/MWh</b>	<b>Total in RGGI</b>	<b>Net Imports - from Ontario to NYISO</b>	<b>Net Imports - from Quebec to NY &amp; NE</b>	<b>Net Imports - from New Brunswick to NE</b>	<b>Net Imports - from non-RGGI PJM to NY</b>	<b>Net Imports - from non-RGGI PJM to RGGI PJM</b>	<b>Total Net Imports - from All Adjoining ISOs</b>	<b>RGGI-Affected Units</b>	<b>Non-RGGI Fossil Fuel-Fired Units</b>	<b>Non-Fossil Fuel-Fired Units</b>	<b>All Non-RGGI Units</b>	<b>All Units</b>	<b>Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)</b>
<b>2005</b>	1,035	485	8	882	1,280	1,280	1,048	1,747	1,306	110	224	1,033	418
<b>2006</b>	973	419	9	1,045	1,241	1,241	973	1,643	1,132	174	266	973	441
<b>2007</b>	978	459	7	1,016	1,228	1,228	916	1,619	1,121	172	264	988	430
<b>2008</b>	901	375	6	1,146	1,210	1,210	825	1,554	913	184	232	915	399
<b>2009</b>	802	220	8	1,235	1,129	1,129	752	1,447	931	168	219	813	377
<b>2010</b>	861	287	6	1,102	1,159	1,159	865	1,456	909	190	245	860	427
<b>2011</b>	785	203	5	970	1,139	1,139	777	1,345	907	196	247	787	405
<b>2012</b>	727	209	6	926	1,082	1,082	672	1,222	980	203	245	740	381
<b>2013</b>	707	209	4	639	1,109	1,109	665	1,218	771	226	245	718	381
<b>2014</b>	719	168	3	617	1,101	1,101	658	1,248	814	231	255	730	383
<b>2015</b>	694	168	2	639	1,008	1,008	609	1,181	1,063	224	259	710	376
<b>2016</b>	673	88	3	728	985	985	597	1,136	1,008	229	265	692	375
<b>2017</b>	610	77	3	683	953	953	557	1,096	961	220	254	623	354
<b>2018</b>	621	14	3	617	925	925	527	1,070	935	231	264	642	347
<b>2019</b>	579	14	3	573	940	940	558	1,027	637	219	244	584	343

The monitoring results indicate that the 2017 to 2019 annual average electricity load in the nine-state RGGI region decreased by 31.5 million MWh, or 8.1 percent, compared to the 2006 to 2008 base period. Annual average electric generation from all sources in the nine-state RGGI region decreased by 43.9 million MWh, or 13.3 percent, compared to the base period.

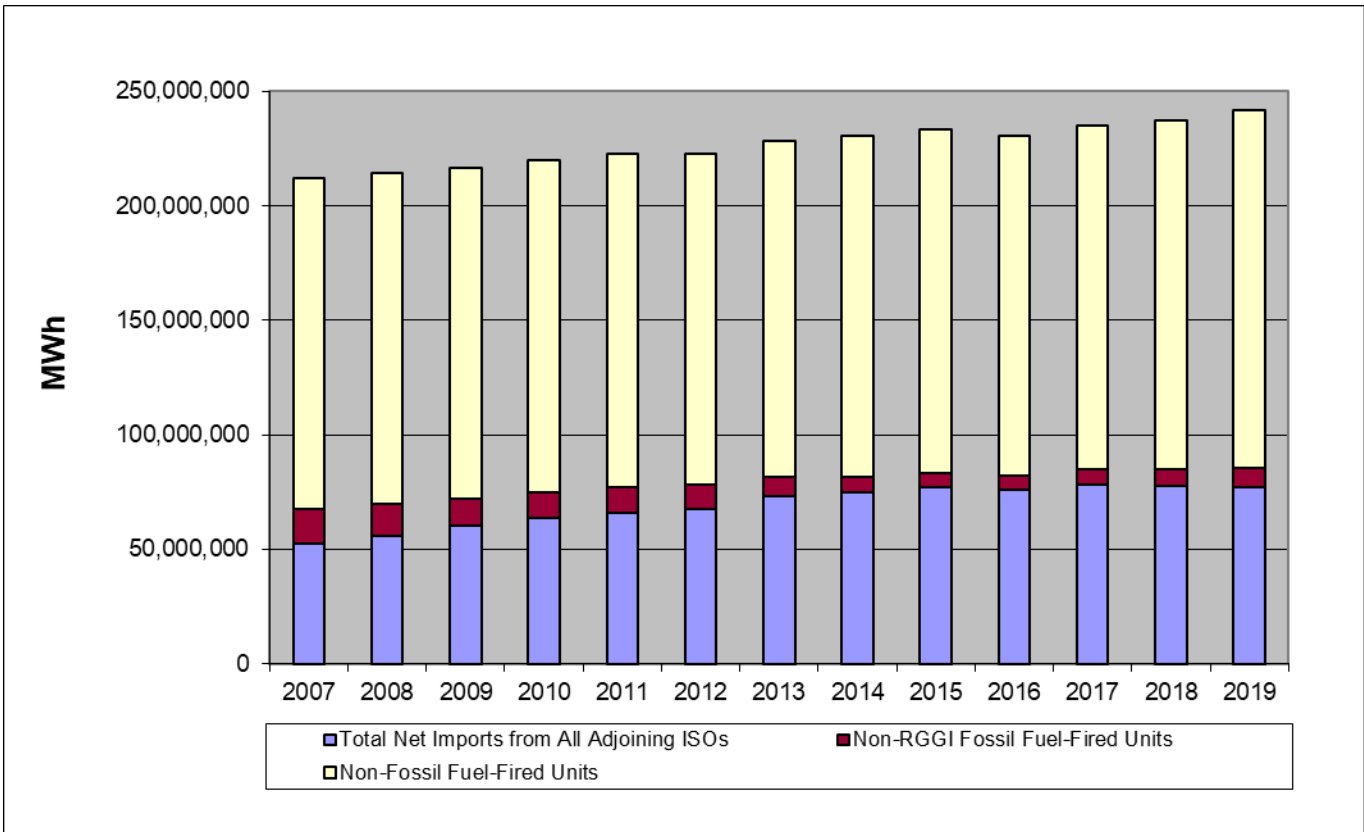
Annual average electric generation from RGGI generation in 2017 to 2019 decreased by 50.1 million MWh, or 29.1 percent, compared to the three-year base period, and annual average CO<sub>2</sub> emissions from RGGI generation decreased by 73.3 million short tons, or 53.0 percent. The annual average CO<sub>2</sub> emission rate of RGGI generation decreased by 540.9 lb CO<sub>2</sub>/MWh from 1,605 to 1,065 lb CO<sub>2</sub>/MWh, a decrease of 33.7 percent. Annual average electric generation from non-RGGI generation sources located in the nine-state RGGI region increased by 6.2 million MWh, or 3.9 percent, during this period, and annual average CO<sub>2</sub> emissions from this category increased by 754,351 short tons. The annual average CO<sub>2</sub> emission rate of non-RGGI electric generation located in the nine-state RGGI region decreased by 0.1 lb CO<sub>2</sub>/MWh, or 0.04% percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electricity load in the nine-state RGGI region decreased by 37.1 million MWh, or 9.6 percent, and 2019 electric generation from all sources in the nine-state RGGI region decreased by 48.2 million MWh, or 14.6 percent.

For 2017 to 2019, annual average electric generation from all non-RGGI electric generation serving load in the nine-state RGGI region increased by 27.5 million MWh, an increase of 12.8 percent, compared to the annual average generation for the base period. The CO<sub>2</sub> emissions from this category decreased by 3.3 million short tons, a reduction of 7.3 percent, and the CO<sub>2</sub> emission rate decreased by 75.6 lb CO<sub>2</sub>/MWh from 424 to 348 lb CO<sub>2</sub>/MWh, a reduction of 17.9 percent. The CO<sub>2</sub> emissions from this category of electric generation for the calendar year 2019 decreased by 3.9 million short tons, or 8.7 percent, when compared to the base period. (See Figures 6, 8, and 10.) This increase of imported electric generation is due to an increase of imported hydroelectricity from Canada, resulting in a decrease of CO<sub>2</sub> emissions and CO<sub>2</sub> emission rate. Other import sources have remained stable since 2010.



**Figure 6. Non-RGGI Generation Serving Load in RGGI Region (MWh)**



**Figure 7. Non-RGGI Generation Serving Load in RGGI Region (MWh) (Three Year Trailing Average)**

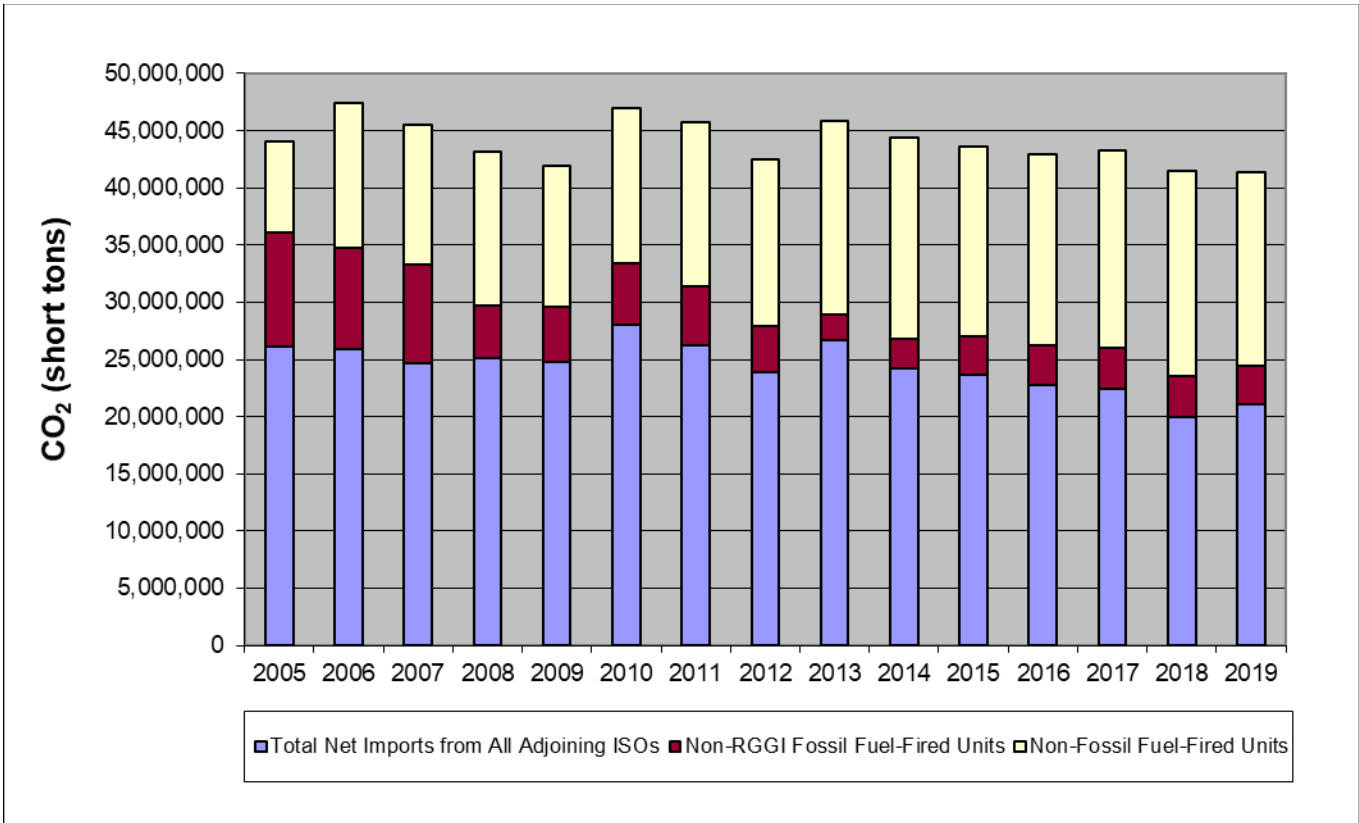


Figure 8. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in RGGI Region (short tons CO<sub>2</sub>)

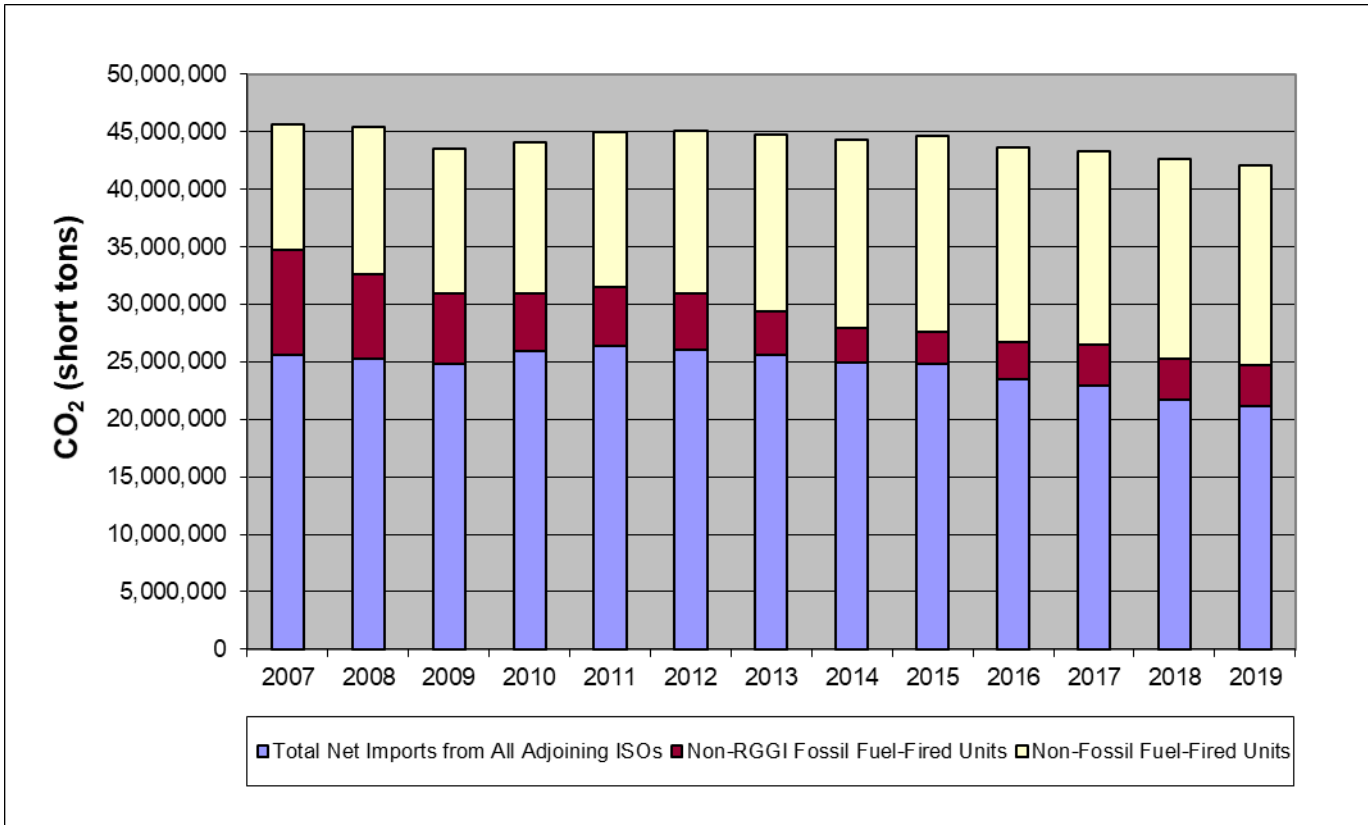
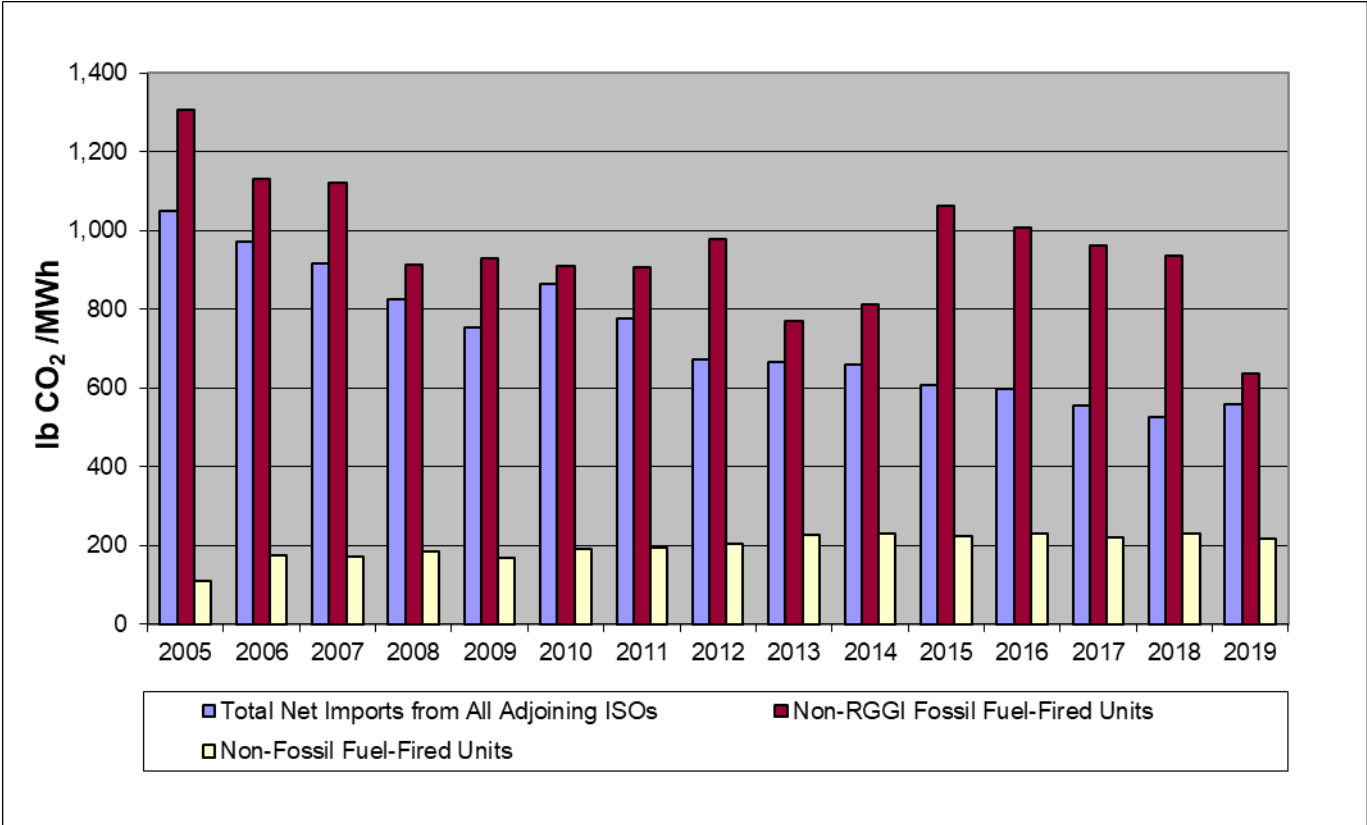
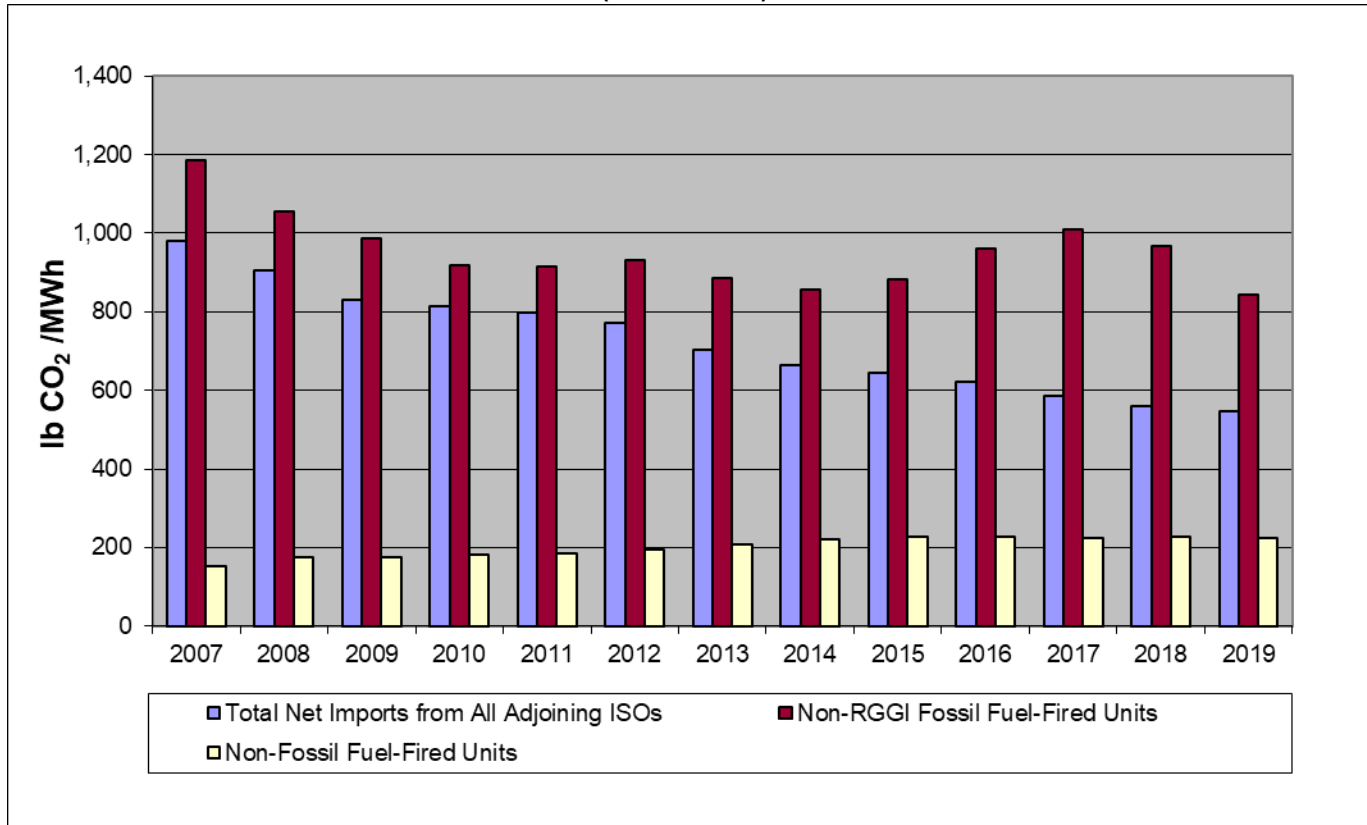


Figure 9. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in RGGI Region (short tons CO<sub>2</sub>) (Three Year Trailing Average)

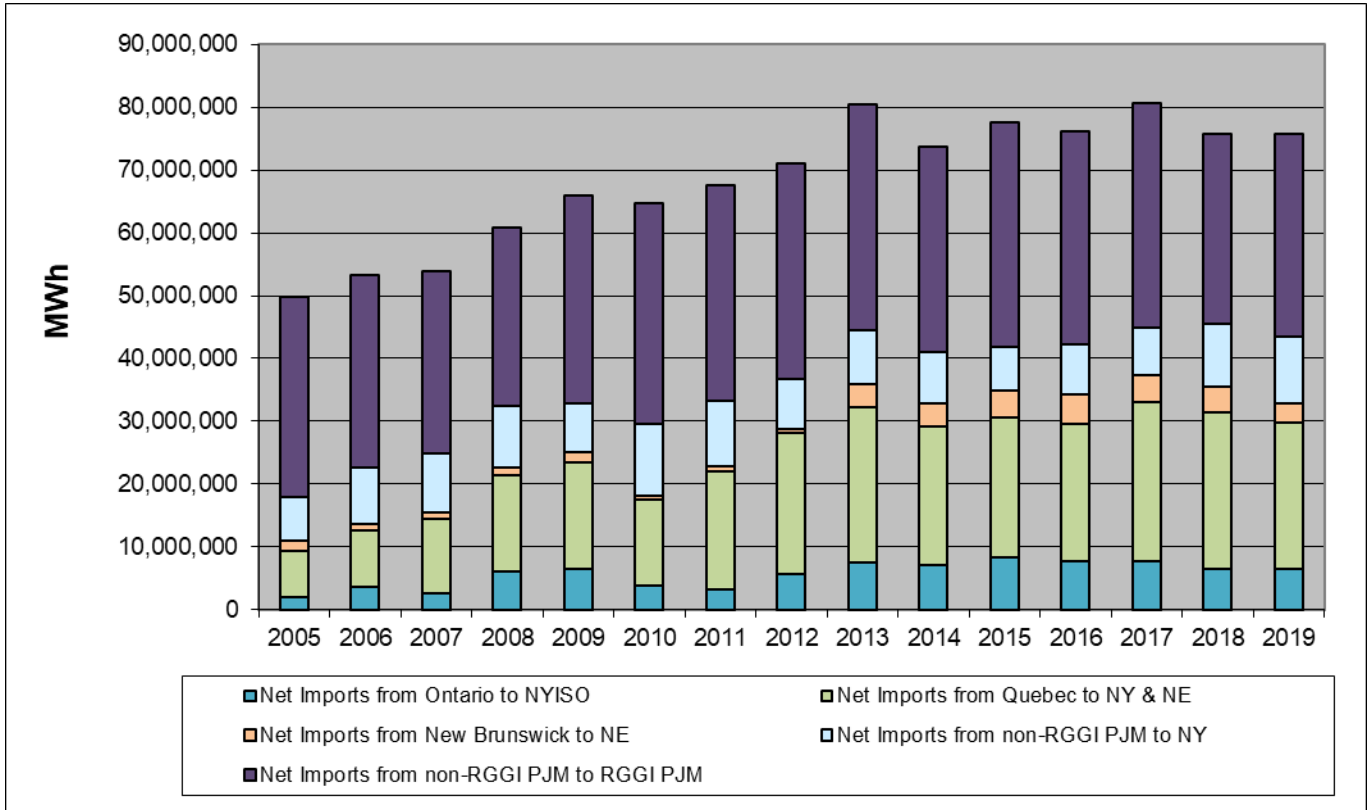


**Figure 10. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in RGGI Region (Ib CO<sub>2</sub>/MWh)**



**Figure 11. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in RGGI Region (Ib CO<sub>2</sub>/MWh) (Three Year Trailing Average)**

Annual average net electricity imports into the nine-state RGGI region increased by 21.3 million MWh, or 38.1 percent, in 2017 to 2019 compared to the 2006 to 2008 base period. CO<sub>2</sub> emissions related to these net electricity imports during this period decreased by 4.1 million short tons, or 16.1 percent, and the average CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased by 357.3 lb CO<sub>2</sub>/MWh from 904 to 547 lb CO<sub>2</sub>/MWh, a reduction of 39.5 percent. (See Figures 12 and 14.)



**Figure 12. Net Electricity Imports to Nine-State RGGI Region (MWh)**

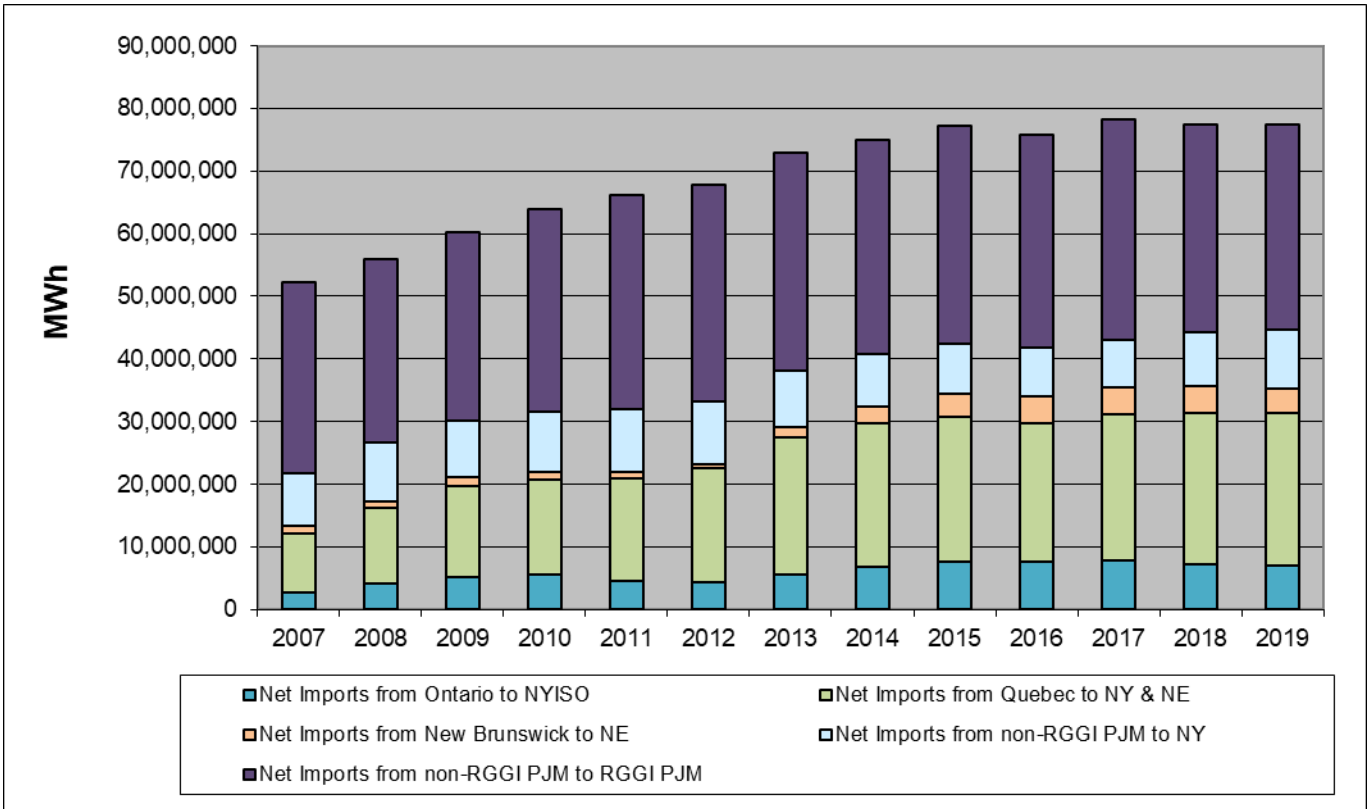


Figure 13. Net Electricity Imports to Nine-State RGGI Region (MWh) (Three Year Trailing Average)

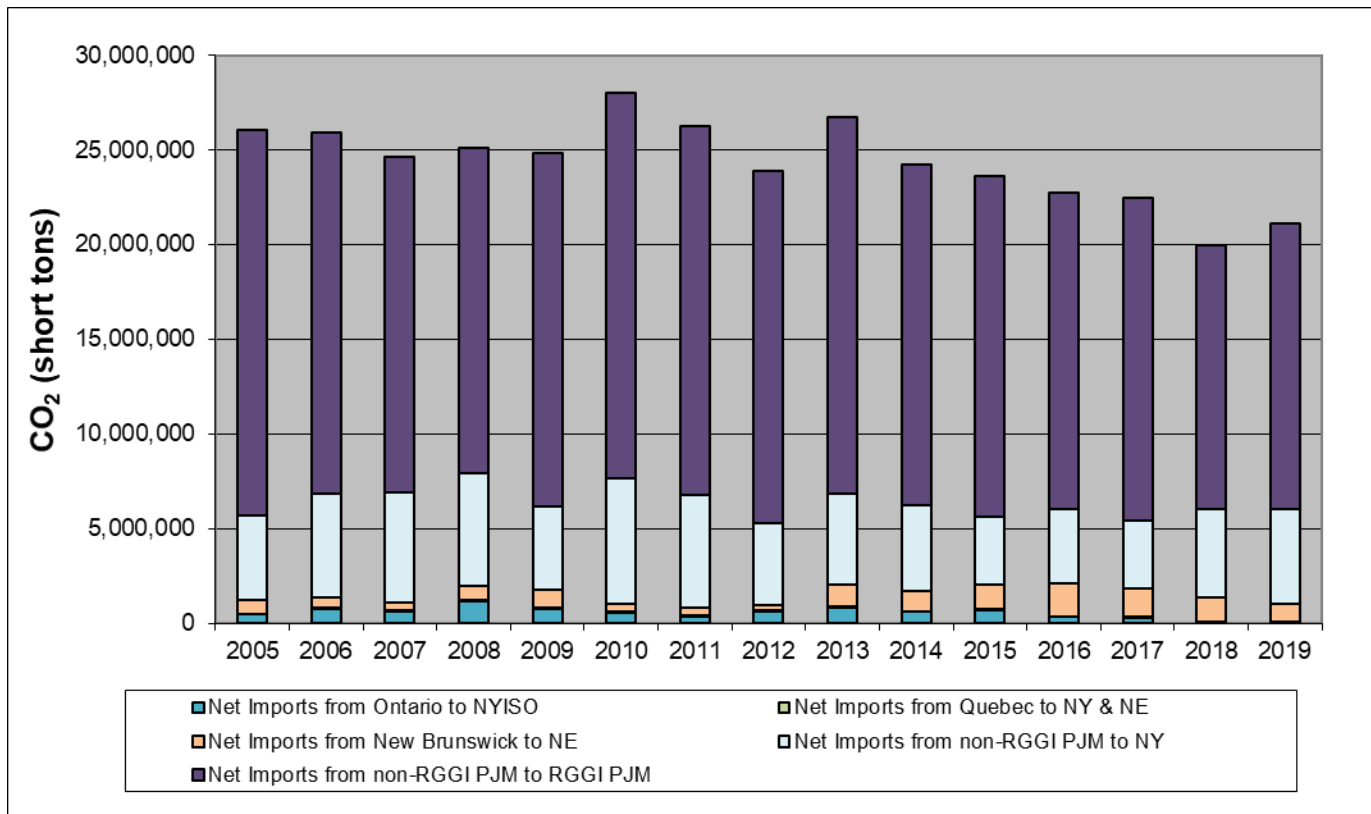
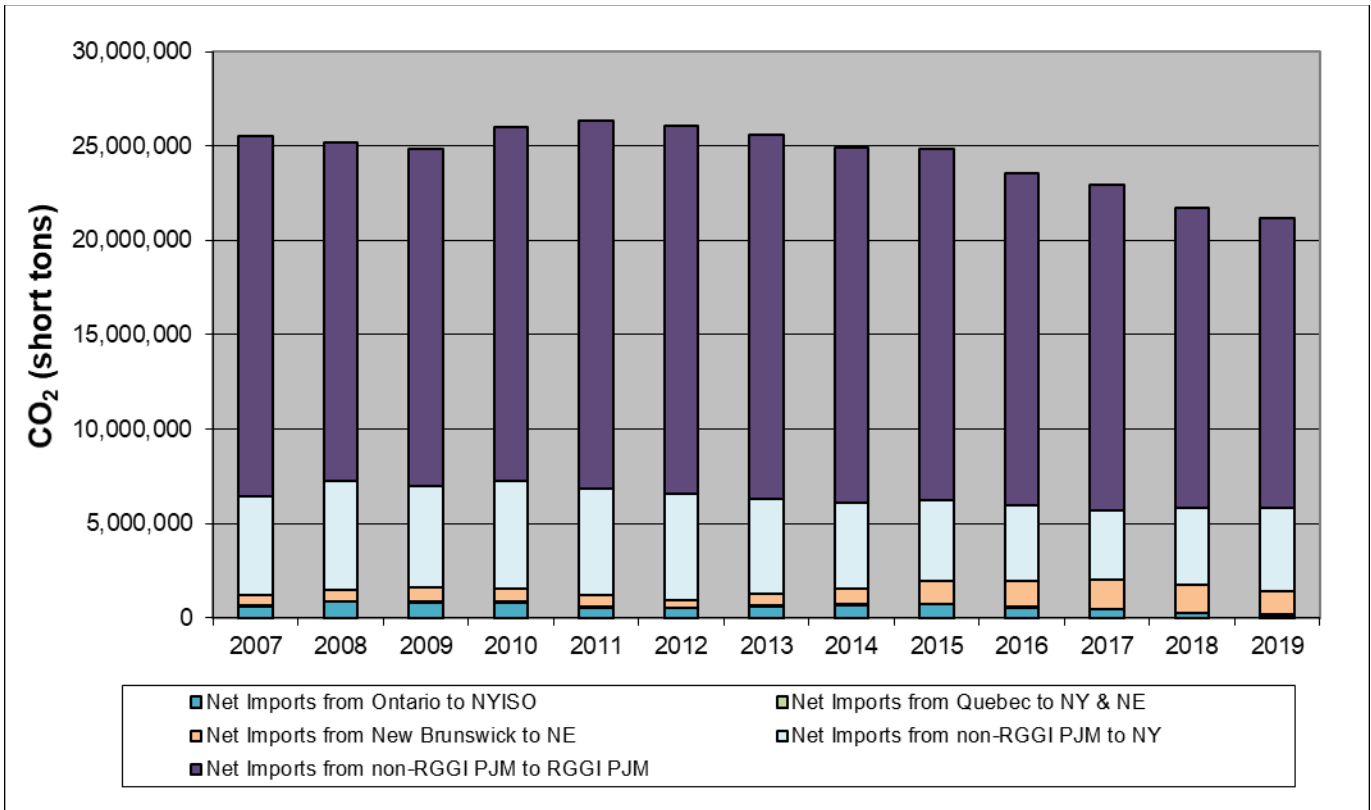


Figure 14. CO<sub>2</sub> Emissions Related to Net Electricity Imports to Nine-State RGGI Region (short tons CO<sub>2</sub>)



**Figure 15. CO<sub>2</sub> Emissions Related to Net Electricity Imports to Nine-State RGGI Region (short tons CO<sub>2</sub>) (Three Year Trailing Average)**

Compared to the annual average during the 2006 to 2008 base period, 2019 RGGI generation decreased by 56.1 million MWh, or 32.6 percent, and CO<sub>2</sub> emissions from RGGI generation decreased by 78.7 million short tons of CO<sub>2</sub>, or 56.9 percent. Compared to the base period, the CO<sub>2</sub> emission rate of RGGI electric generation in 2019 decreased by 578.4 lb CO<sub>2</sub>/MWh from 1,605 to 1,027 lb CO<sub>2</sub>/MWh, a reduction of 36.0 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electric generation from non-RGGI generation sources located in the nine-state RGGI region increased by 8.0 million MWh, or 5.0 percent. CO<sub>2</sub> emissions from this category increased by 179,354 short tons, or 0.9 percent, and the CO<sub>2</sub> emission rate decreased by 9.9 lb CO<sub>2</sub>/MWh from 254 to 244 lb CO<sub>2</sub>/MWh, or 3.9 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 net electricity imports into the nine-state RGGI region increased by 19.7 million MWh, or 35.2 percent. CO<sub>2</sub> emissions related to these net electricity imports decreased by 4.1 million short tons of CO<sub>2</sub>, or 16.3 percent, during this period. The average CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased 346.7 lb CO<sub>2</sub>/MWh from 904 to 558 lb CO<sub>2</sub>/MWh, a reduction of 38.3 percent.



## VI. Discussion

As mentioned earlier in this report, multiple market factors interact to influence the dispatch of electric generation. CO<sub>2</sub> 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<sub>2</sub> allowance costs accounted for 4.0 percent of the average all-in wholesale electricity price for ISO-NE, 9.2 percent of the average all-in wholesale electricity price for NYISO, and 0.8 percent of the average all-in locational marginal price on a per MWh basis for PJM in 2019.<sup>22</sup> 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, and third three-year control periods, finding that RGGI is reducing consumer energy bills and generating net economic benefits on the order of \$4 billion.<sup>23</sup> 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.

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.<sup>24</sup> This decline in electricity prices continued through 2012 as the price of natural gas continued to fall

---

<sup>22</sup> For 2019, the average all-in wholesale electricity price was \$43.74/MWh for ISO-NE and \$32.59/MWh for NYISO, and the load-weighted average locational marginal price was \$27.32/MWh for PJM (energy only) (see *ISO-NE Monthly Wholesale Load Cost Report*; *NYISO Power Trends 2020*; *2019 State of the Market Report for PJM*). The CO<sub>2</sub> allowance component is based on a 2019 average CO<sub>2</sub> allowance spot price of \$5.43 per CO<sub>2</sub> allowance (See Potomac Economics, *Annual Report on the Market for RGGI CO<sub>2</sub> Allowances: 2019*). For PJM, the CO<sub>2</sub> allowance component of the Locational Marginal Price (LMP) for 2019 was \$0.21 per MWh (See *2019 State of the Market Report for PJM*). ISO-NE and NYISO do not report the CO<sub>2</sub> allowance component of wholesale electricity prices. The New England and New York analyses used a 2019 average CO<sub>2</sub> allowance spot price of \$5.43 as a starting point for deriving a CO<sub>2</sub> allowance wholesale price component. For both ISO-NE and NYISO, the CO<sub>2</sub> emission rate of the assumed marginal unit was used to translate the annual average spot price for CO<sub>2</sub> allowances into a dollar per MWh value. For ISO-NE, this resulted in an average CO<sub>2</sub> allowance wholesale price component of approximately \$1.76 per MWh. For NYISO, this resulted in an average CO<sub>2</sub> allowance wholesale price component of \$3.00 per MWh.

<sup>23</sup> ["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.

<sup>24</sup> See, for example, Monitoring Analytics, *2011 State of the Market Report for PJM*, Section 1, Introduction.

and temperatures remained mild through the winter. Higher natural gas prices, especially during winter months, resulted in higher electricity prices in 2013.<sup>25</sup> 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.<sup>26</sup> 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.<sup>27</sup> 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.<sup>28</sup> In 2019, wholesale prices decreased in all ISOs, with prices dropping to a record low in NYISO's market.<sup>29</sup> 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.<sup>30</sup>

A number of market drivers have changed dramatically during the 2005 through 2019 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<sub>2</sub> emissions in the 10-state RGGI region<sup>31</sup> from 2005 to 2009, was completed by the New York State Energy Research and Development Authority (NYSERDA).<sup>32</sup> 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.<sup>33</sup> 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.<sup>34</sup>

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<sub>2</sub> 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.

---

<sup>25</sup> See, for example, *NYISO 2013 Annual Report*, p. 13.

<sup>26</sup> See, for example *NYISO 2014 Annual Report*, p. ii.

<sup>27</sup> See, for example, *ISO-NE 2018 Annual Markets Report*, p. 4.

<sup>28</sup> See, for example, *NYISO Power Trends 2019*, p. 30.

<sup>29</sup> See, for example, *NYISO Power Trends, 2020*, p. 7

<sup>30</sup> Potomac Economics, *2019 State of the Market Report for the New York ISO Markets*, p. 4.

<sup>31</sup> The 10-state RGGI region includes New Jersey.

<sup>32</sup> New York State Energy Research and Development Authority (NYSERDA), *Relative Effects of Various Factors on RGGI Electricity Sector CO<sub>2</sub> Emissions: 2009 Compared to 2005*, November 2010; available at [Retrospective Analysis Draft White Paper.pdf](#).

<sup>33</sup> 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.

<sup>34</sup> Congressional Research Service. *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress*, July 2019, available at <https://fas.org/sqp/crs/misc/R41836.pdf>.

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<sub>2</sub> regulation. The extent of this impact is likely to depend, at least in part, on the market value of CO<sub>2</sub> allowances (and the related \$/MWh CO<sub>2</sub> costs incorporated into bids by generators subject to the RGGI CO<sub>2</sub> Budget Trading Program) in relation to other economic factors associated with the generation and delivery of electricity. If the cost of RGGI CO<sub>2</sub> 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<sub>2</sub> allowance price signal<sup>35</sup> include:

- **Existing Generator Economics:** Including a CO<sub>2</sub> 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<sub>2</sub> 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<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and CO<sub>2</sub>. As a result, inclusion of a CO<sub>2</sub> 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<sub>2</sub> 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. For example, in 2019, the real-time average LMP by jurisdiction in MD was \$2.25 per MWh higher than the average PJM LMP, indicating the presence of some existing transmission congestion and line losses.<sup>36</sup>

---

<sup>35</sup> Some of these factors may also impact the economics of shifting dispatch to smaller in-region fossil fuel-fired electric generation in the nine-state RGGI region that is not subject to regulation of CO<sub>2</sub>.

<sup>36</sup> Monitoring Analytics, *2019 State of the Market for PJM*; Volume 2, Energy Market, Table 3-23, p. 151; and Monitoring Analytics, *2019 State of the Market for PJM*; Appendix C, Table B-16, p. 24.

- **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<sub>2</sub> 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.<sup>37</sup>
- **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 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.<sup>38</sup>
- **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.<sup>39</sup>

## VII. Conclusions

This report presents data and trends for electricity generation, net electricity imports, and related CO<sub>2</sub> emissions of electric generation serving load in the nine-state 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

<sup>37</sup> For example, the congestion component of the 2019 average day-ahead, load weighted LMP in the Delmarva Power & Light zone (Delaware and Maryland) of PJM was -\$0.47 per MWh. For the Baltimore Gas & Electric zone (Maryland), the congestion component was \$2.89 per MWh. Source: Monitoring Analytics, *2019 State of the Market for PJM*; Section 11, Table 11-7, p. 525.

<sup>38</sup> For example, the line loss component of the 2019 average day-ahead, load weighted LMP in the Delmarva Power & Light zone (Delaware and Maryland) of PJM was \$0.40 per MWh. Similarly, for the Baltimore Gas & Electric zone (Maryland), the line loss component of LMP was \$0.71 per MWh. Source: Monitoring Analytics, *2019 State of the Market for PJM*; Section 11, Table 11-7, p. 525.

<sup>39</sup> Heat rate is a measure of electric generator energy efficiency, represented as Btu of fuel input per kWh of electricity output.

electric generation serving load in the RGGI region, combined with a decrease in the CO<sub>2</sub> emissions rate of this generation. These two trends largely offset one another. Overall, the monitoring results show that there has been a 7.3 percent decrease in average annual CO<sub>2</sub> emissions from non-RGGI electric generation serving load in the RGGI region during the period of 2017 to 2019, compared to the annual average annual CO<sub>2</sub> emissions during the base period of 2006 to 2008.

Emissions leakage may manifest through an increase in CO<sub>2</sub> 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<sub>2</sub> allowance price in 2019 represented approximately 9.2 percent or less of 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<sub>2</sub> allowance prices that result in CO<sub>2</sub> 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 eleventh 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<sub>2</sub> emissions related to electricity generation and imports in the RGGI region.

## Appendix A. Nine-State ISO Monitoring Sources

### Table 2. Summary of Data Sources for ISO-NE

Code	Electricity Demand (Annual)					Electricity Generation (Annual)				
	A-1	A-2	A-2	A-2	A-3	B-1	B-2	B-3	B-4	B-5
<b>Monitoring Category</b>	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
<b>MWh</b>	ISO-NE <sup>1</sup>	NYS PSC Calculation (2014-2018) ISO-NE <sup>1</sup> (2019)	ISO-NE <sup>1</sup>	ISO-NE <sup>1</sup>	Sum of A2s	NEPOOL-GIS <sup>2</sup>	NEPOOL-GIS <sup>2</sup>	NEPOOL-GIS <sup>2</sup>	Sum of B-2 and B-3	ISO-NE <sup>1</sup>
<b>CO<sub>2</sub> Tons</b>	Sum of A-3 and B-5	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	Sum of A-2s	State reported data for 2005-2008; RGGI COATS for 2009 to 2016. <sup>4</sup> Includes only sources subject to a state CO <sub>2</sub> Budget Trading Program CO <sub>2</sub> allowance compliance obligation. Does not include biomass-derived CO <sub>2</sub> emissions.	NEPOOL-GIS <sup>2</sup>	NEPOOL-GIS <sup>2</sup>	Sum of B-2 and B-3	Sum of B-1 and B-4
<b>CO<sub>2</sub> lb/MWh</b>	CO <sub>2</sub> tons divided by MWh	NYISO A-2 in Table 3 below	Environment and Climate Change Canada <sup>3</sup>	Environment and Climate Change Canada <sup>3</sup>	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh

**Table Notes:**

- 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.
- NEPOOL Generation Information System. Available at <https://www.nepoolgis.com/>.
- National Inventory Report 1990–2018: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada, 2021. In Part 3. Available at <https://unfccc.int/documents/271493>. Note that New Brunswick and Quebec emission factors are updated for every year, as compared to the previous year's report.
- Historical 2005 – 2008 CO<sub>2</sub> emissions data reported by RGGI participating states compiled from CO<sub>2</sub> emissions data reported to U.S. EPA pursuant 40 CFR Part 75 and from CO<sub>2</sub> emissions and fuel use data reported to state emissions statement programs. 2009 through 2019 CO<sub>2</sub> emissions data is from data reported to the RGGI CO<sub>2</sub> Allowance Tracking System (RGGI COATS), available at [rggi-coats.org](http://rggi-coats.org).

### Table 3. Summary of Data Sources for NYISO

Code	Electricity Demand (Annual)					Electricity Generation (Annual)					
	A-1	A-2	A-2	A-2	A-3	B-1	B-2	B-3	B-4	B-5	
<b>Monitoring Category</b>	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
<b>MWh</b>	NYS PSC Calculation (2005-2015); NYGATS from NYISO data feeds (2016-2019)	Hydro Quebec <sup>1</sup> (2005-2015); NYGATS from NYISO data feeds (2016-2019)	ISO-NE <sup>2</sup> (2005-2015); NYGATS from NYISO/NEPOOL GIS data feeds (2016-2019)	Ontario Independent Electricity System Operator <sup>3</sup>	PJM Annual State of the Market Report <sup>4</sup>	Sum of A-2s	NYS PSC Calculation <sup>5</sup> (2005-2015); NYGATS from NYISO data feeds (2016-2019)	NYS PSC Calculation <sup>5,8</sup> (2005-2015); NYGATS from NYISO data feeds (2016-2019)	NYS PSC Calculation <sup>5</sup> (2005-2015); NYGATS from NYISO data feeds (2016-2019)	Sum of B-2 and B-3	Sum of B-1 and B-4
<b>CO<sub>2</sub> Tons</b>	Sum of A-3 and B-5	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	Sum of A-2s	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	Sum of B-2 and B-3	Sum of B-1 and B-4
<b>CO<sub>2</sub> lb/MWh</b>	CO <sub>2</sub> tons divided by MWh	Environment and Climate Change Canada <sup>6</sup>	ISO-NE system average (2005-2015); NYS PSC Calculation(2014-2017)	Environment and Climate Change Canada <sup>5</sup>	PJM GATS <sup>7</sup>	CO <sub>2</sub> tons divided by MWh	NYS PSC Calculation	NYS PSC Calculation	NYS PSC Calculation	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh

**Table Notes:**

- 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* (2005 through 2019 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 1990–2018: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada, 2021. In Part 3. Available at <https://unfccc.int/documents/271493>. 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<sub>2</sub> 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**

Code	Electricity Demand (Annual)				Electricity Generation (Annual)				
	A-1	A-2	A-2	A-3	B-1	B-2	B-3	B-4	B-5
<b>Monitoring Category</b>	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
<b>MWh</b>	Sum of A-3 and B-5	PJM GATS <sup>1</sup>	PJM GATS <sup>1</sup>	Sum of A-2s	PJM GATS <sup>1</sup>	PJM GATS <sup>1</sup>	PJM GATS <sup>1</sup>	Sum of B-2 and B-3	Sum of B-1 and B-4
<b>CO<sub>2</sub> Tons</b>	Sum of A-3 and B-5	MWh multiplied by CO <sub>2</sub> /MWh	MWh multiplied by CO <sub>2</sub> /MWh	Sum of A-2s	State reported data for 2005-2008; RGGI COATS for 2009 through 2019. Includes only sources subject to a state CO <sub>2</sub> Budget Trading Program CO <sub>2</sub> allowance compliance obligation; does not include Maryland LIESA sources; does not include Linden Cogeneration units 005001-009001. <sup>2,3</sup>	PJM GATS <sup>1</sup>	PJM GATS <sup>1</sup>	Sum of B-2 and B-3	Sum of B-1 and B-4
<b>CO<sub>2</sub> lb/MWh</b>	CO <sub>2</sub> tons divided by MWh	PJM GATS <sup>1</sup>	B-5	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh	CO <sub>2</sub> tons divided by MWh

**Table Notes:**

1. PJM Generation Attribute Tracking System, accessible at <https://www.pjm-eis.com/>.
2. Historical 2005 – 2008 CO<sub>2</sub> emissions data reported by RGGI participating states compiled from CO<sub>2</sub> emissions data reported to U.S. EPA pursuant 40 CFR Part 75 and from CO<sub>2</sub> emissions and fuel use data reported to state emissions statement programs. 2009 through 2017 CO<sub>2</sub> emissions data is from data reported to the RGGI CO<sub>2</sub> Allowance Tracking System (RGGI COATS), available at [rggi-coats.org](http://rggi-coats.org).
3. MWh and CO<sub>2</sub> emissions data do not include Maryland Limited Industrial Exemption Set-aside (LIESA) sources. LIESA sources for 2009-2019 include Severstal Sparrows Point LLC, Luke Paper Company, and Cove Point LNG Terminal. LIESA sources refer to certain industrial cogenerators under Maryland's CO<sub>2</sub> Budget Trading Program regulations that are subject to alternative CO<sub>2</sub> compliance obligations under certain conditions in lieu of submission of CO<sub>2</sub> allowances.

## Appendix B. ISO-Specific Monitoring Results

Detailed monitoring results for ISO-NE, NYISO, and the RGGI portion of PJM are presented below.<sup>40</sup>

### ISO-NE

Monitoring results for ISO-NE for 2005 through 2019 are summarized below in Table 5 and Figures 16 through 25.

**Table 5. 2005 – 2019 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 <sup>41</sup>	Non-RGGI Generation Serving Load in ISO (Non-RGGI Generation within ISO + Net Imports)
2005	138,174,000	-115,000	4,792,000	1,620,000	6,297,000	73,032,078	7,932,957	51,043,242	58,976,199	131,877,000	65,273,199
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

<sup>40</sup> Short tons of CO<sub>2</sub> emitted and the lb CO<sub>2</sub>/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.

<sup>41</sup> See Appendix A, Table 2, Table Note 1.



2019	119,237,000	5,739,000	14,091,000	3,233,000	23,063,000 <sup>42</sup>	45,498,548	5,093,268	55,677,702	60,770,970	97,890,000	83,833,970
------	-------------	-----------	------------	-----------	--------------------------	------------	-----------	------------	------------	------------	------------

CO <sub>2</sub>	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)
2005	65,211,430	-56,275	19,544	714,298	677,567	54,223,939	3,807,116	6,502,808	10,309,924	64,533,863	10,987,491
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

lb CO <sub>2</sub> /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)
2005	944	979	8	882	215	1,485	960	255	350	979	337
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

<sup>42</sup> The total for 2019 includes 1,349,000 MWhs wheeled through from Canada via New York.

<b>2008</b>	810	878	6	1,146	20	1,338	672	320	353	878	307
<b>2009</b>	688	850	8	1,235	-59	1,284	849	347	402	850	339
<b>2010</b>	666	876	6	1,102	-542	1,278	825	384	442	876	361
<b>2011</b>	666	826	5	970	-97	1,131	835	430	484	826	399
<b>2012</b>	598	765	6	926	-12	1,019	842	423	454	765	370
<b>2013</b>	702	790	4	639	183	1,045	738	476	484	790	410
<b>2014</b>	708	540	3	617	210	1,033	672	505	510	791	433
<b>2015</b>	712	517	2	639	223	989	700	501	508	790	428
<b>2016</b>	677	621	3	728	237	944	627	489	494	753	430
<b>2017</b>	667	570	3	683	189	970	580	477	481	750	407
<b>2018</b>	652	588	3	617	210	909	519	478	480	733	408
<b>2019</b>	625	587	3	573	228	900	282	483	466	708	401

The monitoring results indicate that the annual average electricity load in ISO-NE for 2017 to 2019 decreased by 13.7 million MWh, or 10.2 percent, compared to the annual average for the baseline period of 2006 to 2008. Electric generation from all sources in ISO-NE decreased by 18.7 million MWh, or 14.6 percent, compared to the base period.

Annual average electric generation from RGGI generation in ISO-NE decreased by 18.3 million MWh during this period, or 27.1 percent, and annual average CO<sub>2</sub> emissions from RGGI electric generation in ISO-NE decreased by 24.5 million short tons of CO<sub>2</sub>, or 51.8 percent. The CO<sub>2</sub> emission rate of RGGI electric generation decreased by 475.0 lb CO<sub>2</sub>/MWh, or 33.9 percent. Annual average electric generation from non-RGGI electric generation sources located in ISO-NE decreased by 478,356 MWh, or 0.8 percent, during this period, and CO<sub>2</sub> emissions from this category of electric generation increased by 3.2 million short tons of CO<sub>2</sub>, an increase of 29.2 percent. The annual average CO<sub>2</sub> emission rate of non-RGGI electric generation located in ISO-NE increased by 110.7 lb CO<sub>2</sub>/MWh, an increase of 30.4 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 total electricity load in ISO-NE decreased by 15.8 million MWh, or 11.7 percent. Compared to the 2006 to 2008 annual average, 2019 total electric generation in ISO-NE decreased by 21.7 million MWh, or 16.9 percent.

When the 2017 to 2019 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 13.9 million MWh, or 20.5 percent. The CO<sub>2</sub> emissions from this category of electric generation increased by 5.6 million short tons of CO<sub>2</sub>, or 51.6 percent, and the CO<sub>2</sub> emission rate increased by 83.3 lb CO<sub>2</sub>/MWh, or 25.8 percent. (See Figures 16, 18, and 20.)

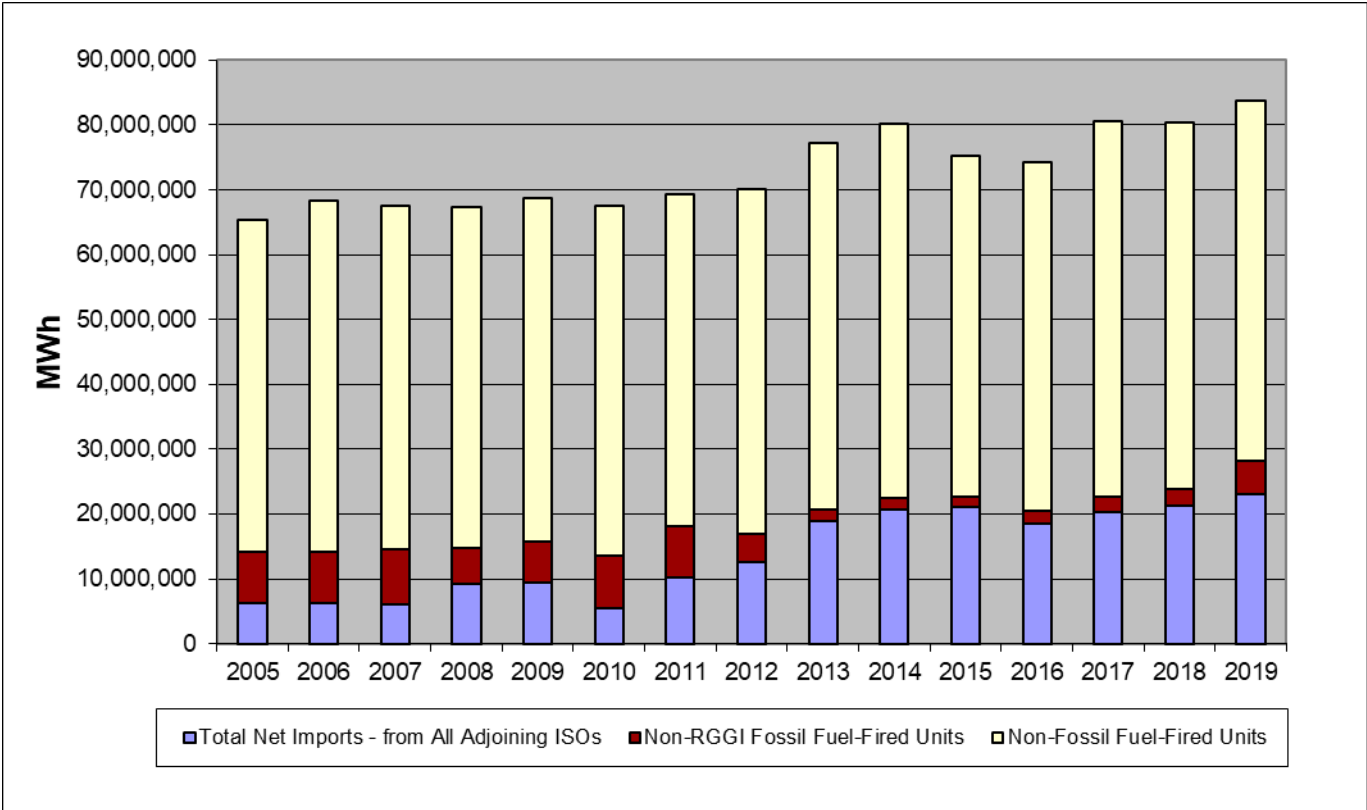


Figure 16. Non-RGGI Generation Serving Load in ISO-NE (MWh)

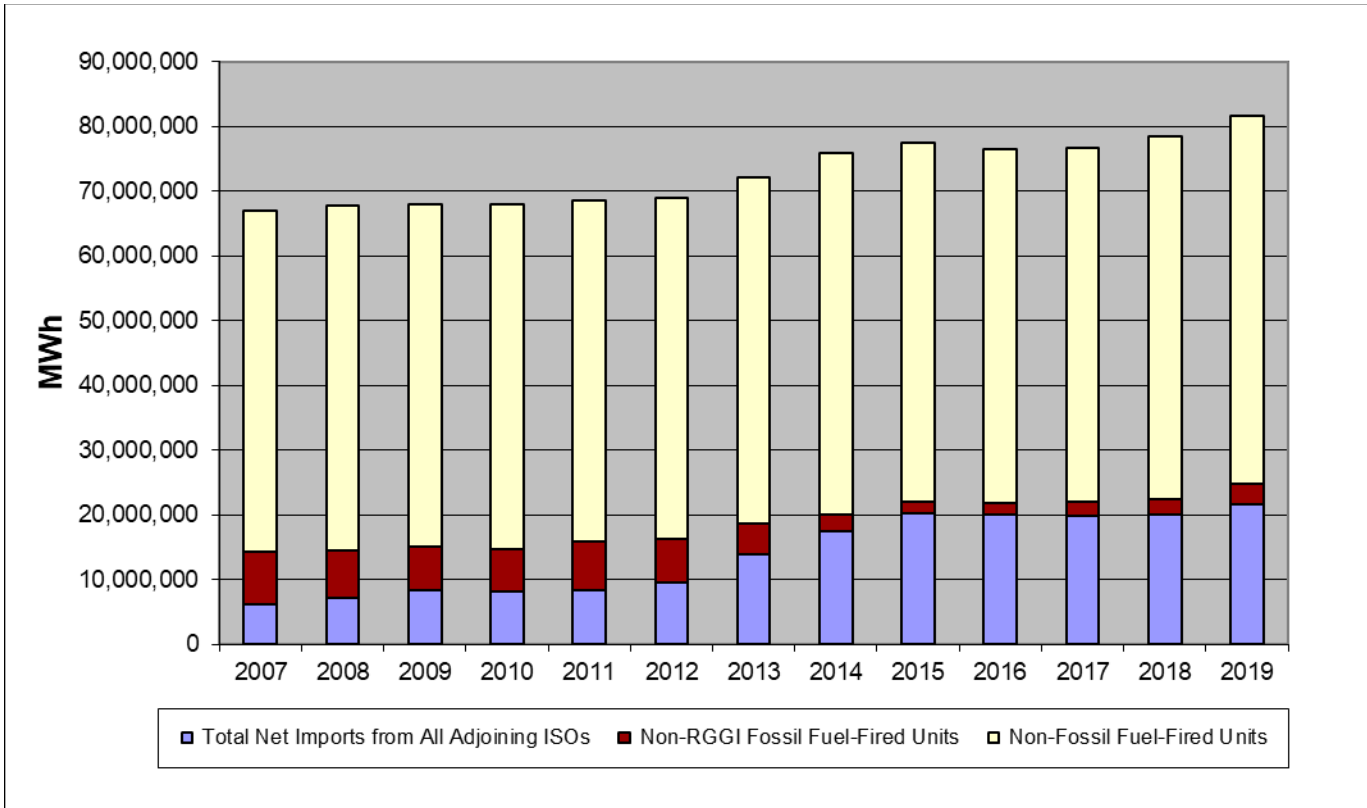


Figure 17. Non-RGGI Generation Serving Load in ISO-NE (MWh) (Three Year Trailing Average)

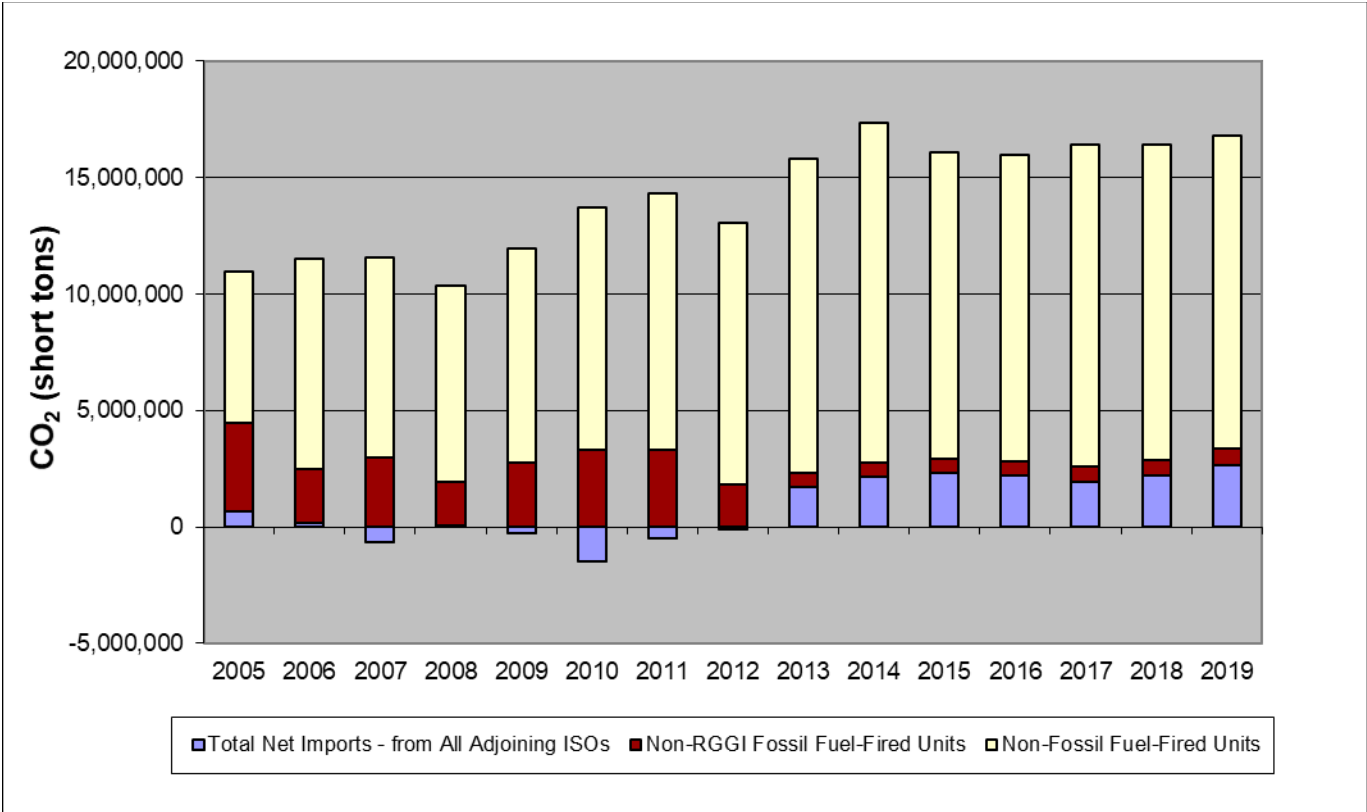


Figure 18. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in ISO-NE (short tons CO<sub>2</sub>)

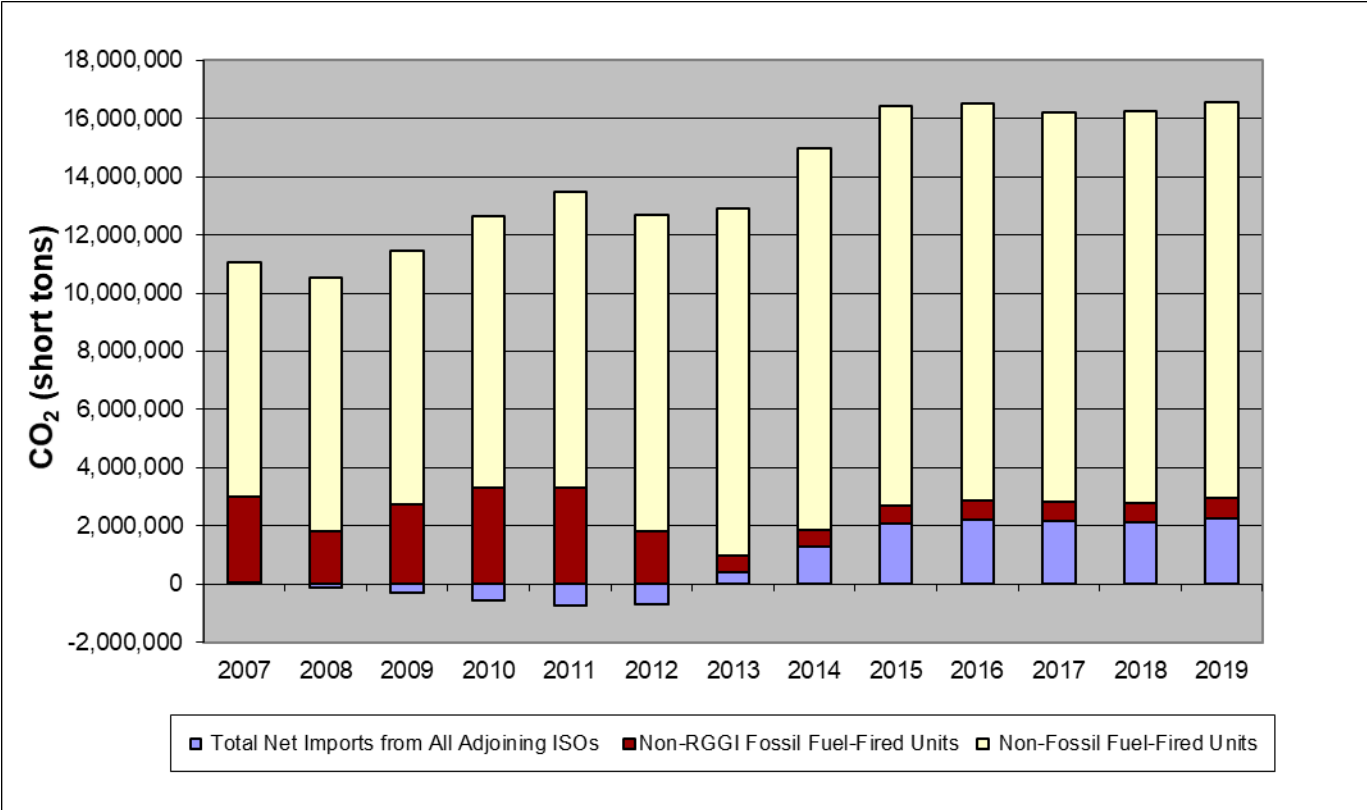
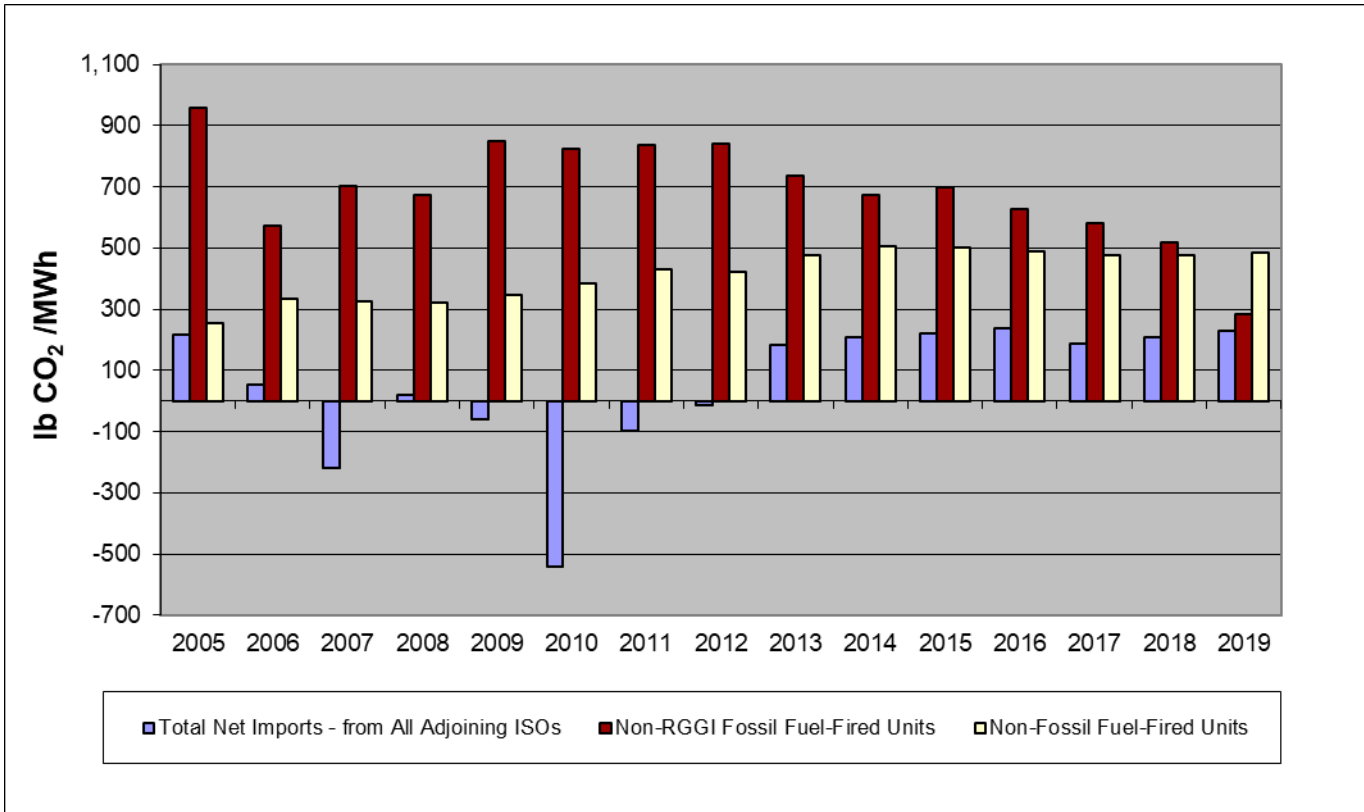
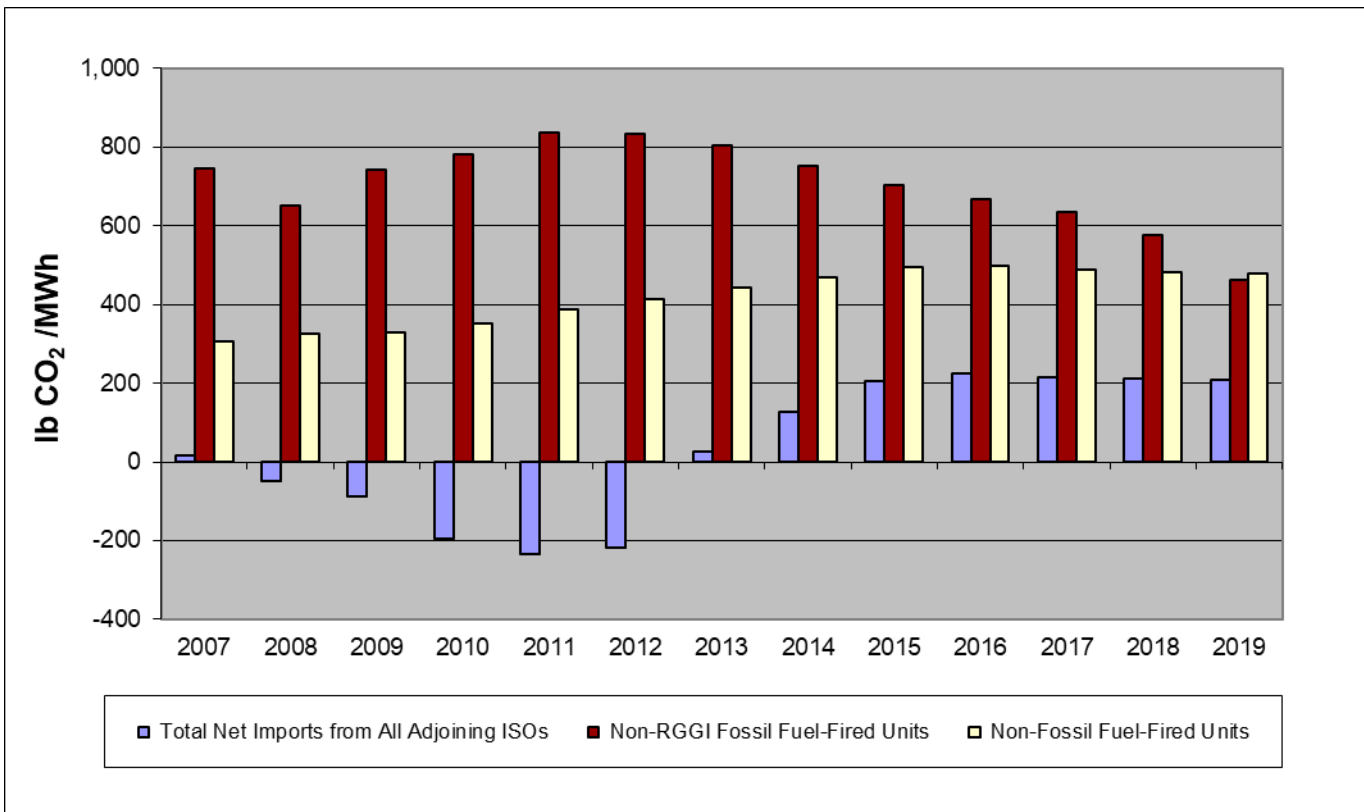


Figure 19. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in ISO-NE (short tons CO<sub>2</sub>) (Three Year Trailing Average)

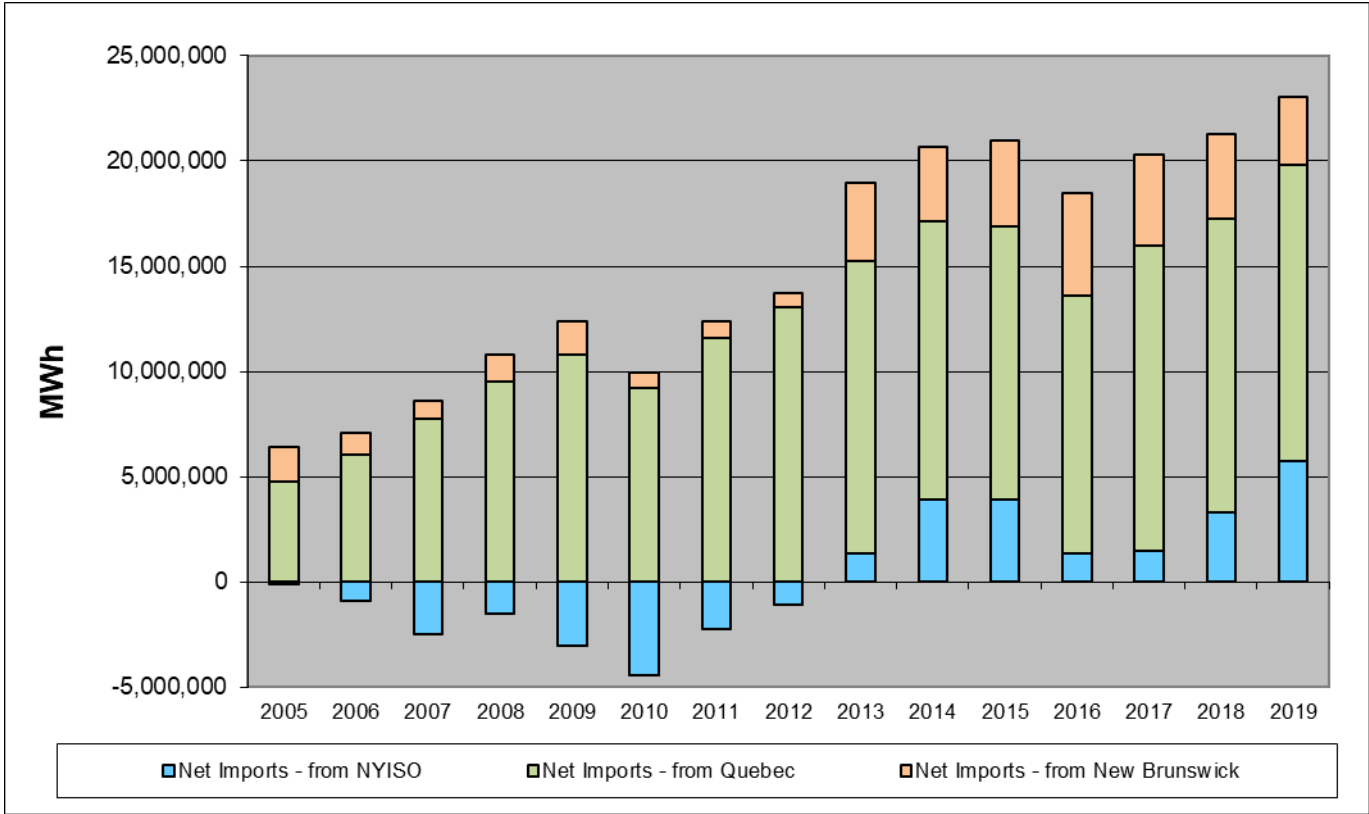


**Figure 20. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in ISO-NE (lb CO<sub>2</sub>/MWh)**



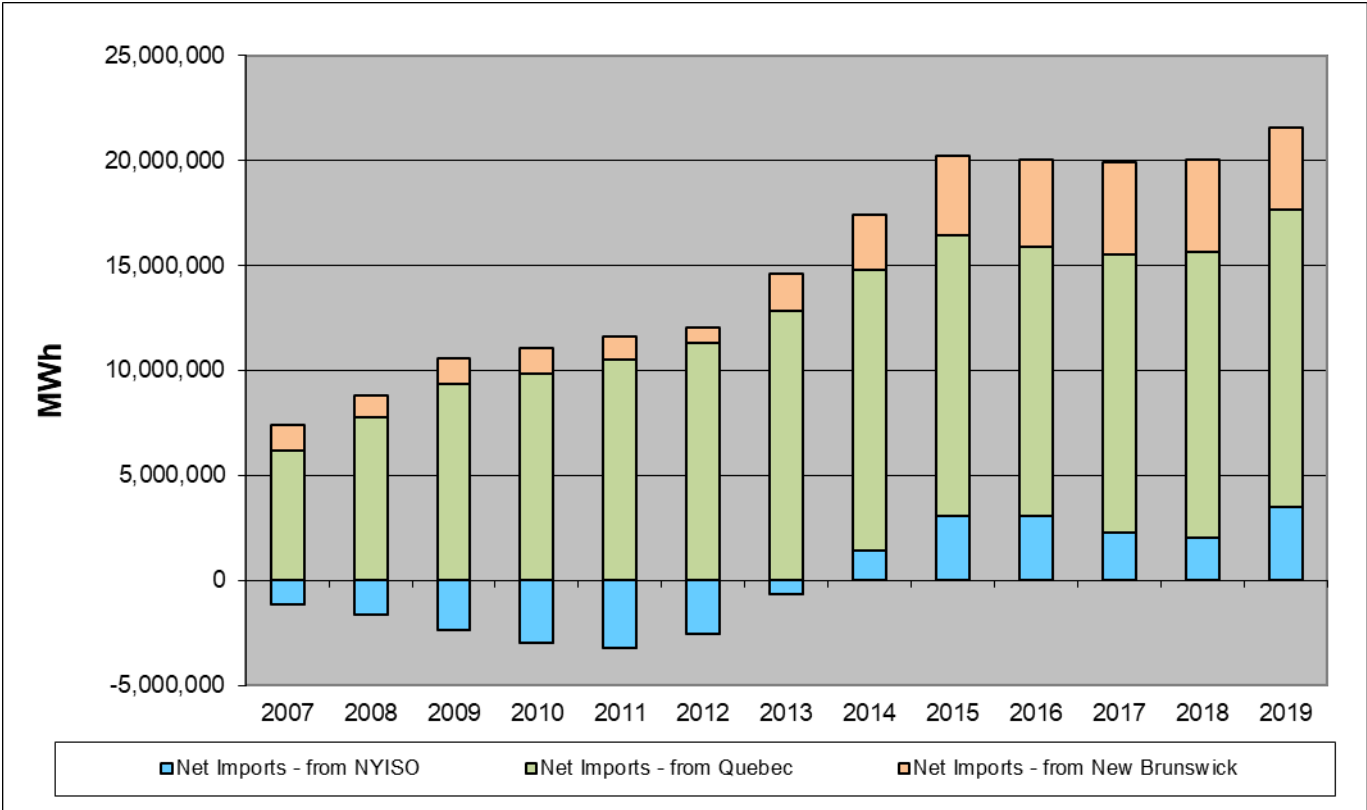
**Figure 21. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in ISO-NE (lb CO<sub>2</sub>/MWh) (Three Year Trailing Average)**

Annual average net electricity imports into ISO-NE for 2017 to 2019 increased by 14.4 million MWh compared to the base period annual average for 2006 to 2008. Annual average CO<sub>2</sub> emissions related to these net electricity imports increased by 2.4 million short tons of CO<sub>2</sub> during this period.<sup>43</sup> The annual average CO<sub>2</sub> emission rate of the electric generation supplying these imports increased by 257.2 lb CO<sub>2</sub>/MWh.

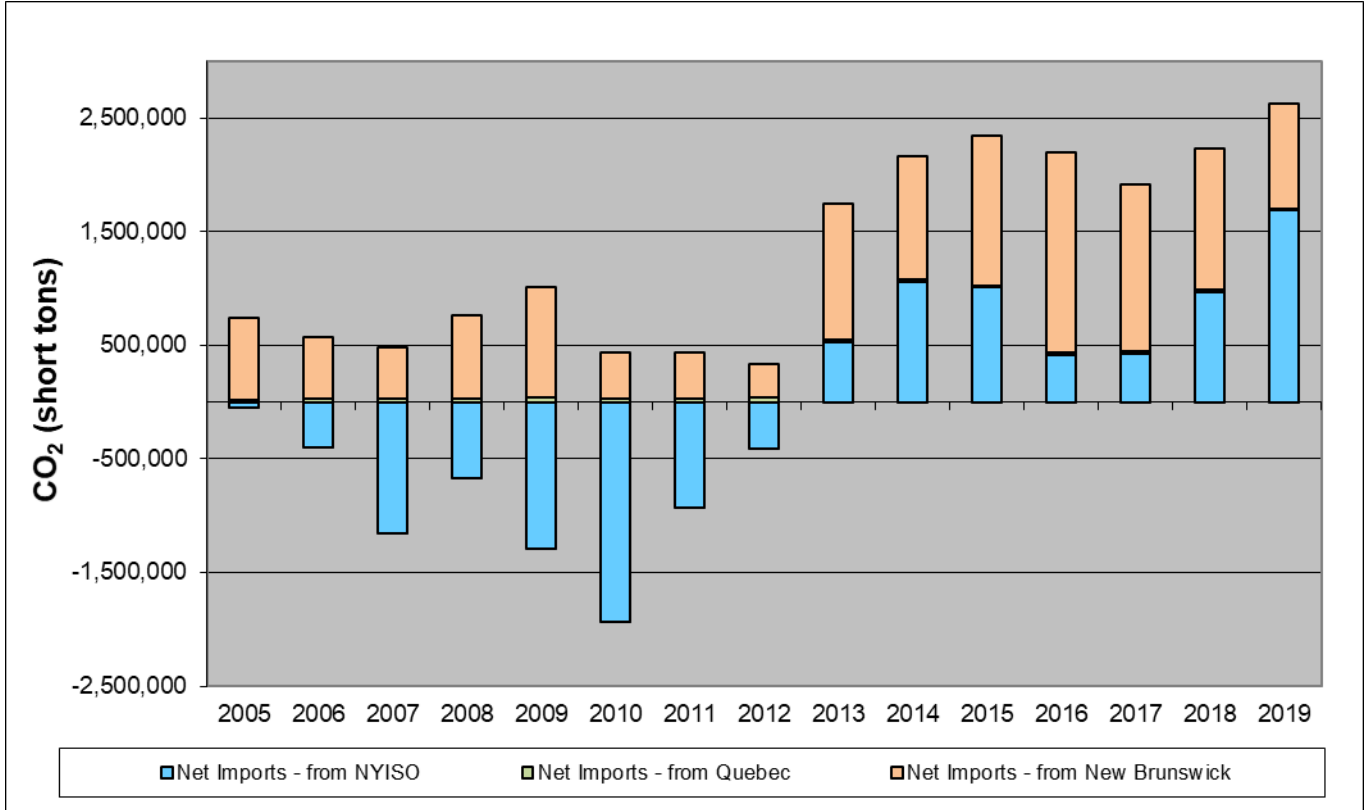


**Figure 22. Net Electricity Imports to ISO-NE (MWh)**

<sup>43</sup> ISO-NE net exports to NYISO doubled from 2008 to 2009 and increased again in 2010. Negative values for MWh and CO<sub>2</sub> 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<sub>2</sub> emissions debited from the ISO-NE net import total, resulting in a negative CO<sub>2</sub> emissions value for total CO<sub>2</sub> 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.

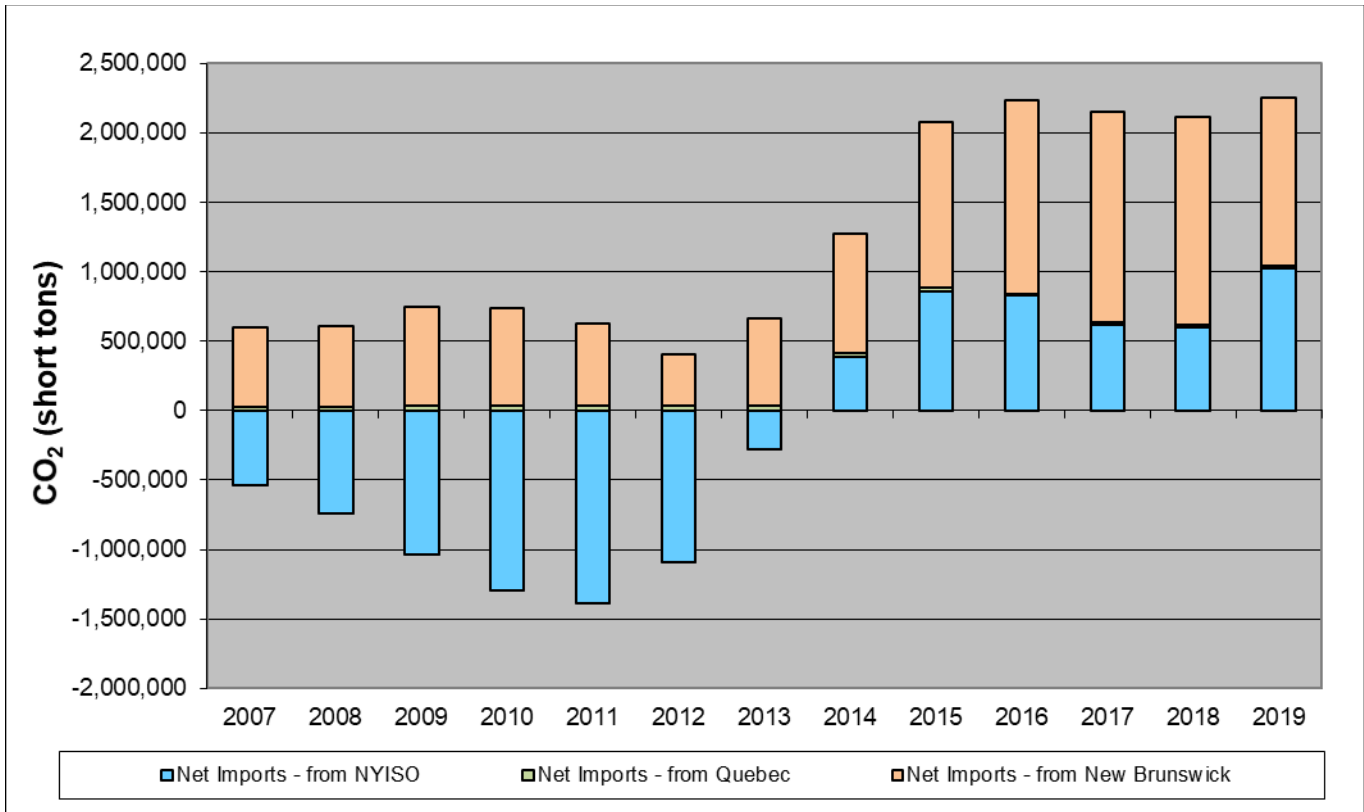


**Figure 23. Net Electricity Imports to ISO-NE (MWh) (Three Year Lagging)**



**Figure 24. CO<sub>2</sub> Emissions Related to Net Electricity Imports to ISO-NE (short tons CO<sub>2</sub>)**





**Figure 25. CO<sub>2</sub> Emissions Related to Net Electricity Imports to ISO-NE (short tons CO<sub>2</sub>) (Three Year Lagging)**

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2019 from all non-RGGI electric generation sources serving load in ISO-NE increased by 16.1 million MWh, an increase of 23.8 percent. Compared to the 2006 to 2008 annual average, 2019 CO<sub>2</sub> emissions from this category of electric generation increased by 5.8 million short tons of CO<sub>2</sub>, an increase of 53.9 percent, and the CO<sub>2</sub> emission rate increased by 78.5 lb CO<sub>2</sub>/MWh, an increase of 24.4 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 RGGI electric generation in ISO-NE decreased by 21.9 million MWh, or 32.5 percent, and CO<sub>2</sub> emissions from RGGI generation in ISO-NE decreased by 26.8 million short tons of CO<sub>2</sub>, or 56.7 percent. The CO<sub>2</sub> emission rate of RGGI electric generation decreased by 501.7 lb CO<sub>2</sub>/MWh, a reduction of 35.8 percent. Compared to the 2006 to 2008 annual average, 2019 electric generation from non-RGGI generation located in ISO-NE decreased by 243,073 MWh, or 0.4 percent, and CO<sub>2</sub> emissions from this category increased by 3.1 million short tons of CO<sub>2</sub>, an increase of 28.2 percent. The CO<sub>2</sub> emission rate of non-RGGI electric generation located in ISO-NE increased by 101.3 lb CO<sub>2</sub>/MWh, an increase of 27.8 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 net electricity imports into ISO-NE increased by 15.9 million MWh. CO<sub>2</sub> emissions related to these net electricity imports increased by 2.8 million short tons of CO<sub>2</sub> during this period. The CO<sub>2</sub> emission rate of the electric generation supplying these imports increased by 276.4 lb CO<sub>2</sub>/MWh.

NYISO

Monitoring results for NYISO for 2005 through 2019 are summarized below in Table 6 and Figures 26 through 35.

**Table 6. 2005 – 2019 Monitoring Summary for NYISO**

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)
2005	164,783,642	2,583,317	115,000	1,898,020	7,604,000	12,200,337	67,835,907	7,029,219	77,718,179	84,747,398	152,583,305	96,947,735
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

CO <sub>2</sub>	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)
2005	74,759,800	10,536	56,275	460,286	4,912,184	5,439,281	62,718,683	5,933,822	668,014	6,601,836	69,320,519	12,041,117
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
lb CO <sub>2</sub> /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)
2005	907	8	979	485	1,292	892	1,849	1,688	17	156	909	248
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

<b>2010</b>	677	6	876	287	1,167	777	1,347	1,055	50	99	659	265
<b>2011</b>	589	5	826	203	1,146	644	1,257	1,035	45	85	580	213
<b>2012</b>	549	6	765	209	1,002	429	1,163	1,075	54	103	570	181
<b>2013</b>	510	4	790	209	1,060	396	1,122	749	59	93	531	167
<b>2014</b>	524	3	566	168	1,107	416	1,165	844	45	90	540	157
<b>2015</b>	509	2	517	168	1,014	331	1,191	1,187	53	117	536	161
<b>2016</b>	491	3	621	88	991	337	1,108	1,155	51	119	517	170
<b>2017</b>	426	3	570	77	986	305	1,112	1,129	51	117	449	160
<b>2018</b>	466	3	588	14	963	344	1,057	1,130	79	142	488	188
<b>2019</b>	423	3	587	14	909	345	1,033	974	58	113	436	161

The monitoring results indicate that the annual average electricity load in NYISO for 2017 to 2019 decreased by 10.6 million MWh, or 6.3 percent, compared to the annual average for the baseline period of 2006 to 2008. Annual average electric generation from all sources in NYISO decreased by 14.6 million MWh, or 9.8 percent, compared to the base period.

Annual average electric generation from RGGI generation in NYISO decreased by 19.1 million MWh during this period, or 28.3 percent, and annual average CO<sub>2</sub> emissions from RGGI electric generation in NYISO decreased by 27.2 million short tons of CO<sub>2</sub>, or 51.8 percent. The annual average CO<sub>2</sub> emission rate of RGGI electric generation decreased by 486.8 lb CO<sub>2</sub>/MWh, a reduction of 31.3 percent. Annual average electric generation from non-RGGI sources located in NYISO increased by 4.6 million MWh, or 5.7 percent, during this period, and average annual CO<sub>2</sub> emissions from this category decreased by 2.4 million short tons of CO<sub>2</sub>, a decrease of 31.4 percent. The annual average CO<sub>2</sub> emission rate of non-RGGI electric generation located in NYISO decreased by 66.7 lb CO<sub>2</sub>/MWh, a decrease of 35.0 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electric load in NYISO decreased by 12.6 million MWh, or 7.5 percent, and electric generation from all sources in NYISO in 2019 decreased by 20.7 million MWh, or 30.6 percent.

The annual average non-RGGI electric generation serving load in NYISO for 2017 to 2019 increased by 8.5 million MWh, or 8.4 percent, compared to the base period of 2006 to 2008. Annual average CO<sub>2</sub> emissions from this category of electric generation decreased by 6.3 million short tons of CO<sub>2</sub>, or 40.5 percent, and the annual average CO<sub>2</sub> emission rate decreased by 140.1 lb CO<sub>2</sub>/MWh, a decrease of 45.2 percent. (See Figures 26, 28, and 30.)

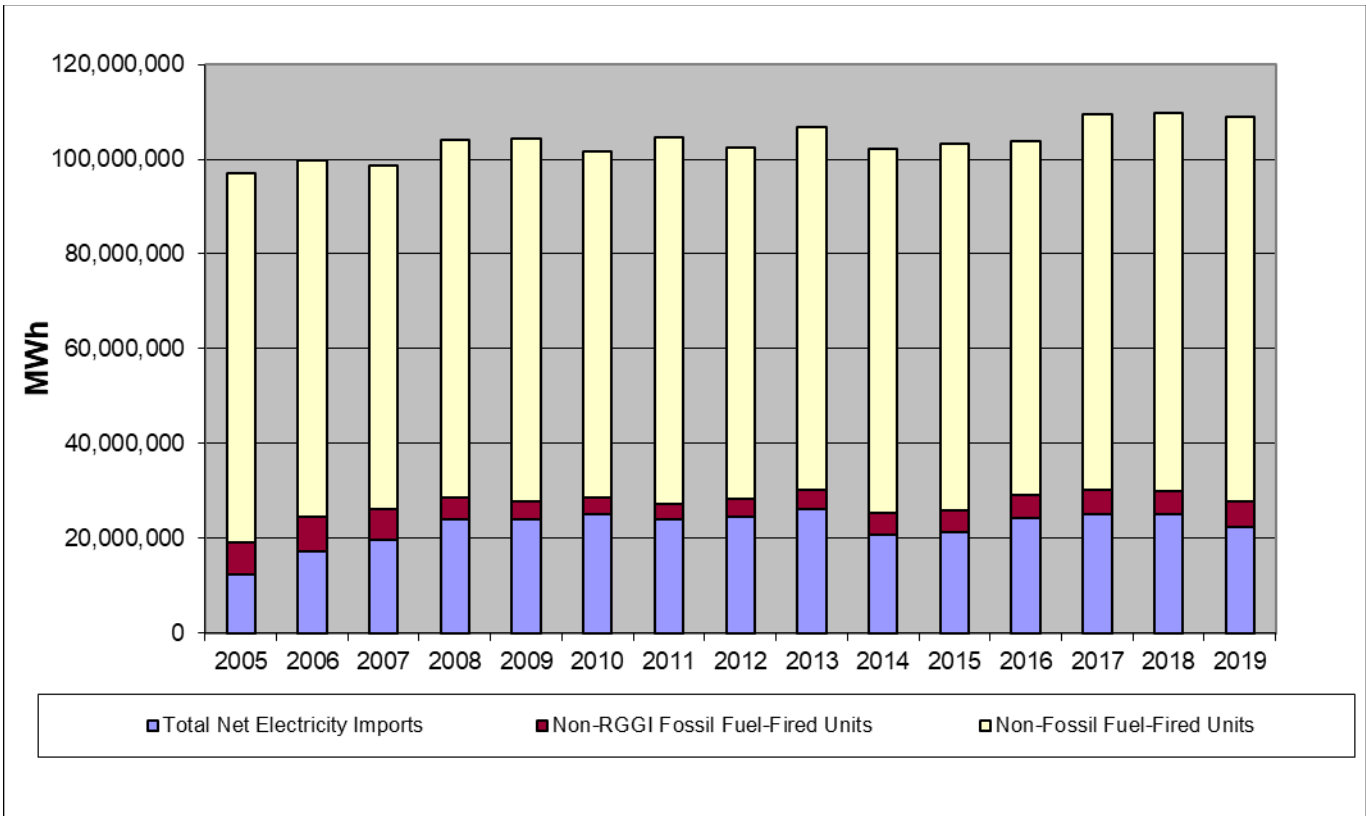


Figure 26. Non-RGGI Generation Serving Load in NYISO (MWh)

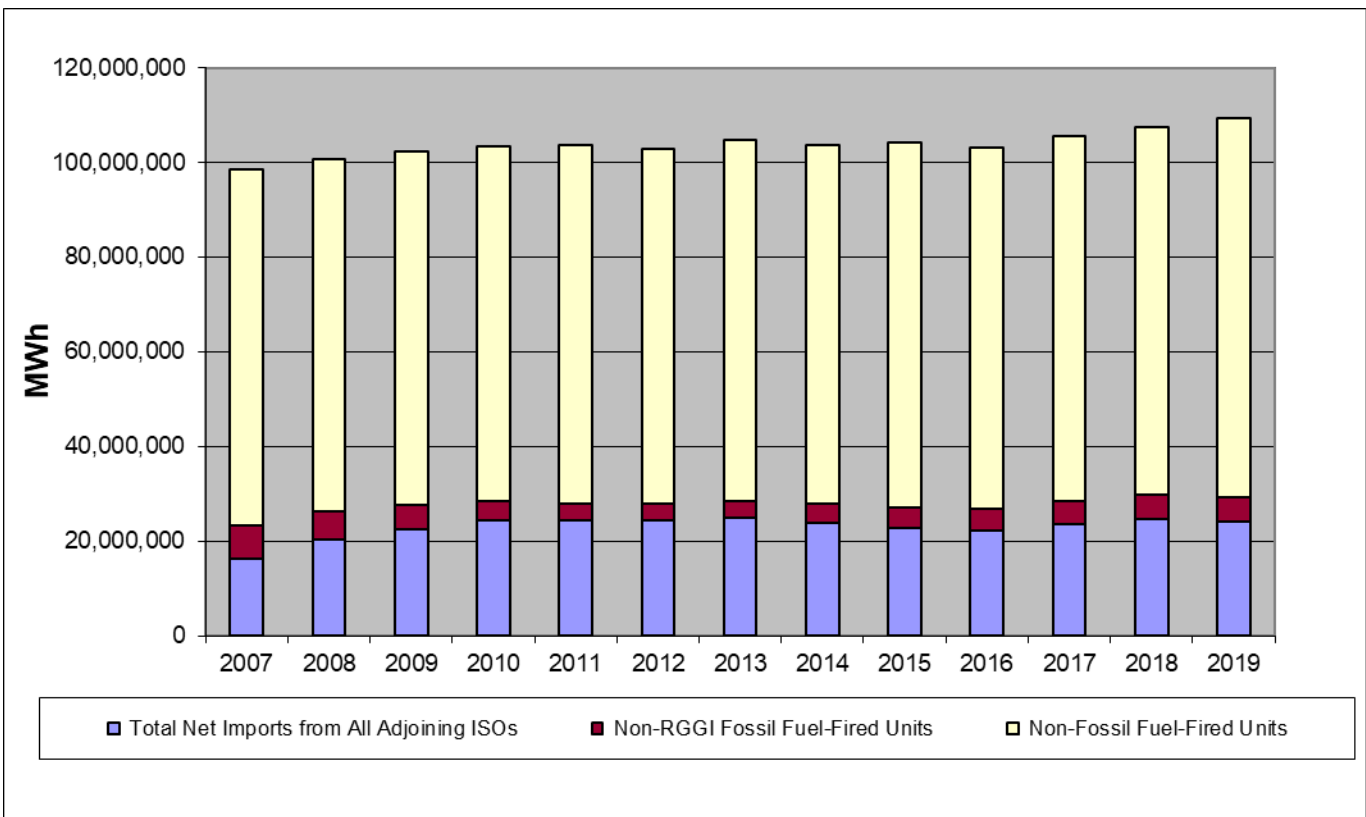


Figure 27. Non-RGGI Generation Serving Load in NYISO (MWh) (Three Year Trailing Average)

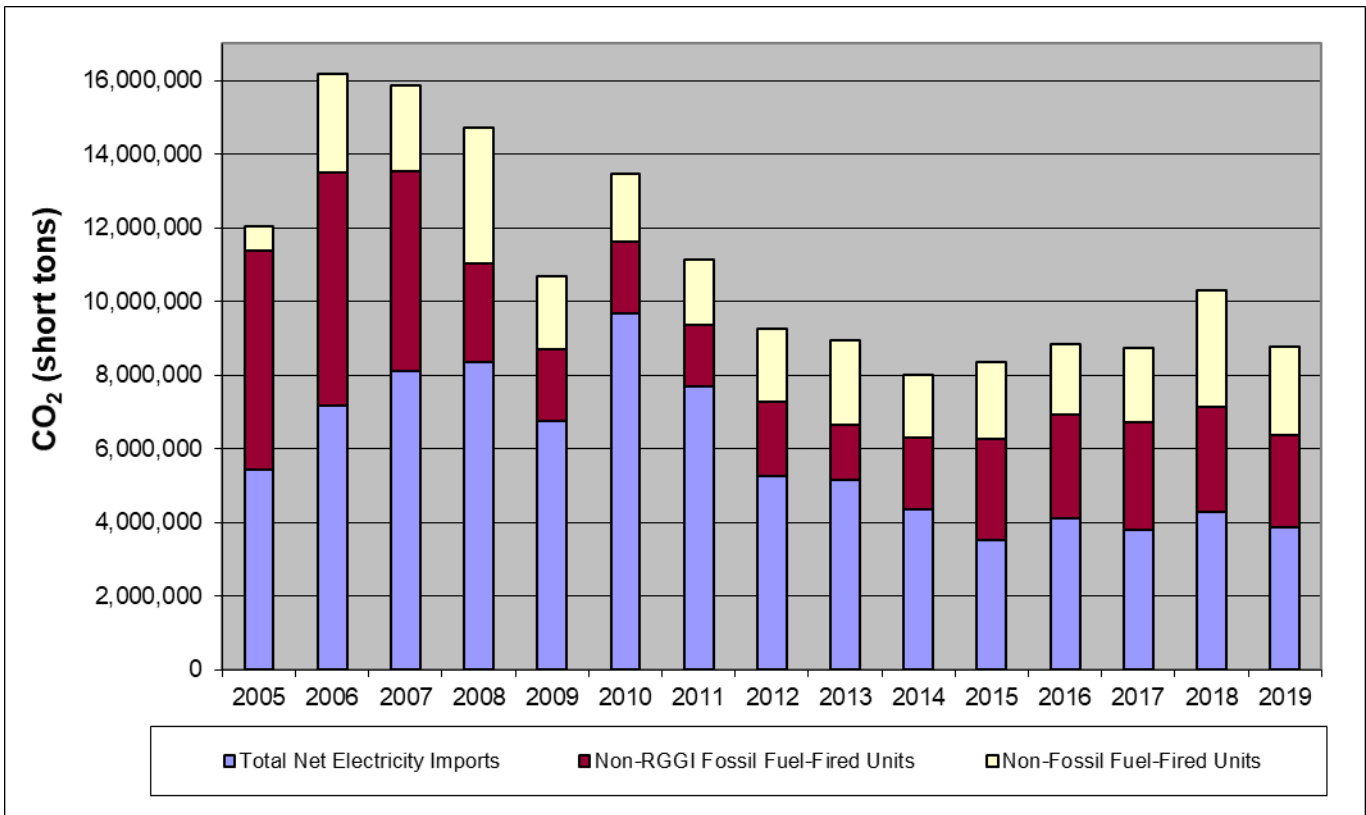


Figure 28. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in NYISO (short tons CO<sub>2</sub>)

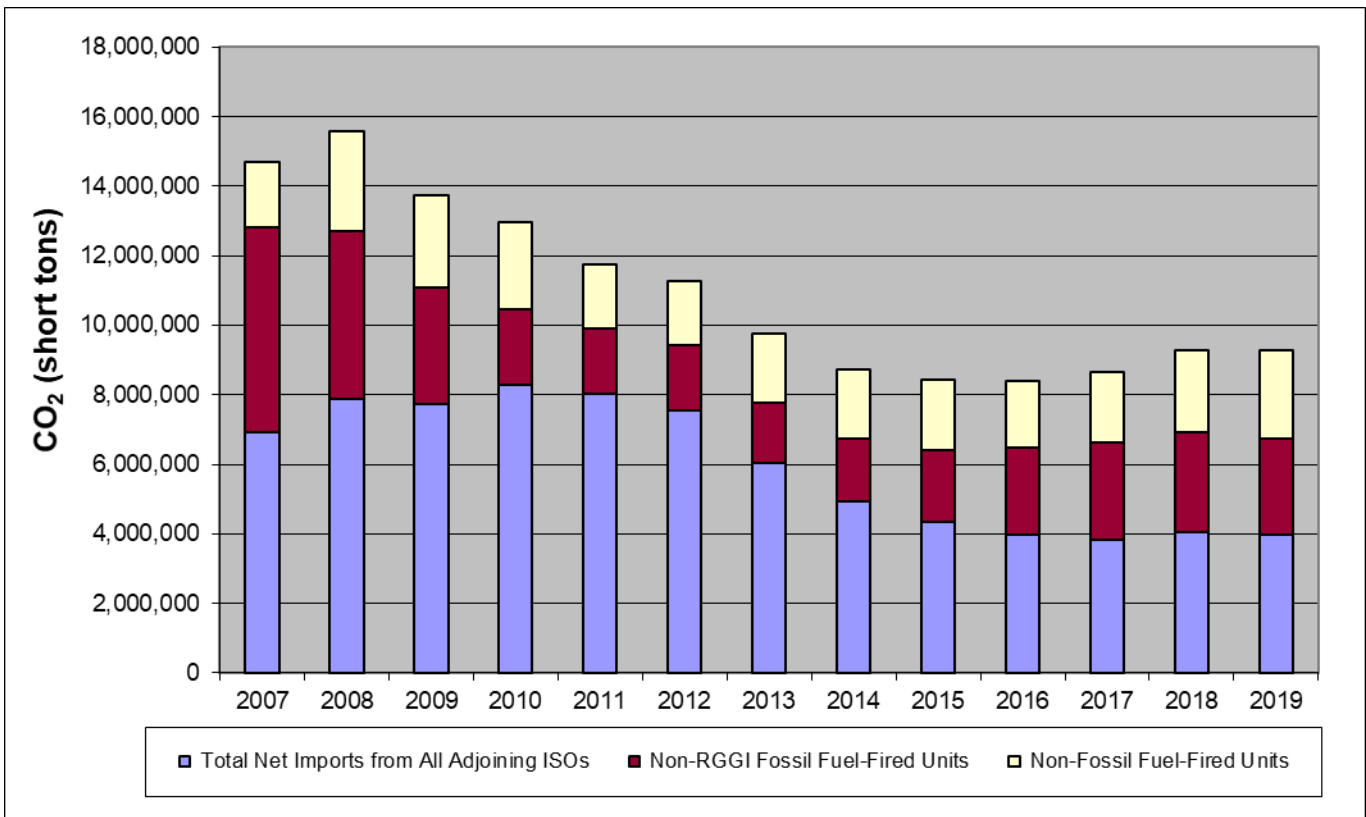
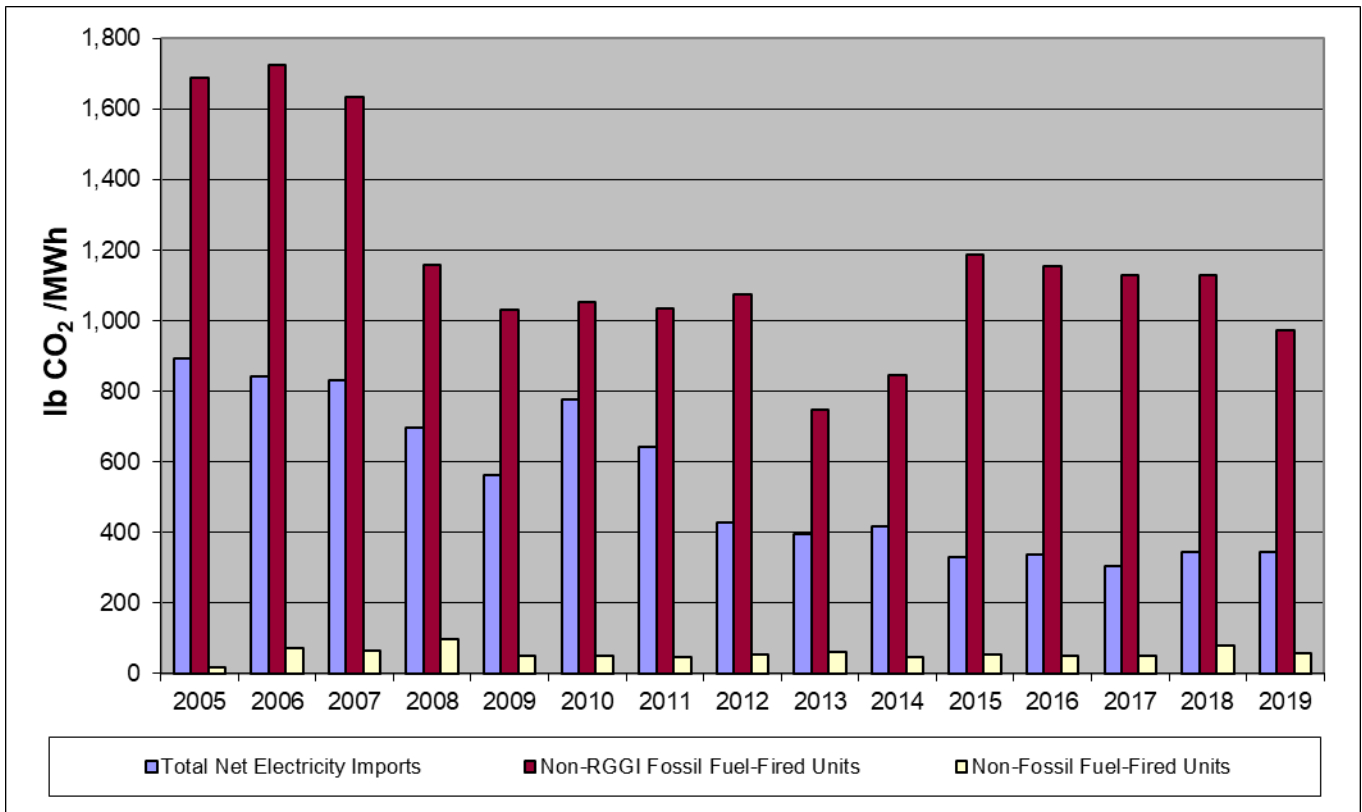
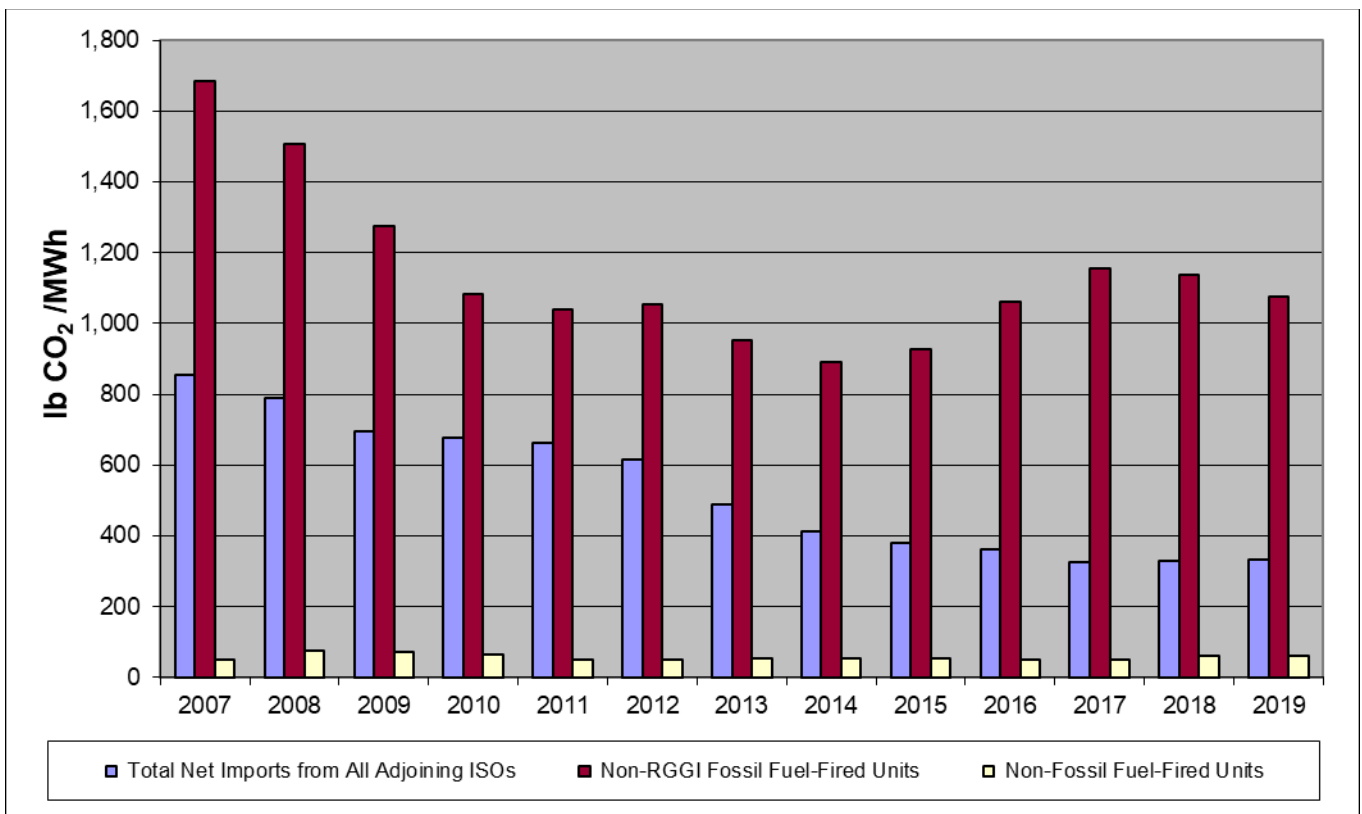


Figure 29. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in NYISO (short tons CO<sub>2</sub>) (Three Year Trailing Average)



**Figure 30. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in NYISO (lb CO<sub>2</sub>/MWh)**



**Figure 31. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in NYISO (lb CO<sub>2</sub>/MWh) (Three Year Trailing Average)**



Net electricity imports into NYISO increased by 3.9 million MWh, when comparing the annual average for the base period of 2006 to 2008 to the annual average for 2017 to 2019. Annual average CO<sub>2</sub> emissions related to these net electricity imports decreased by 3.9 million short tons of CO<sub>2</sub>, or 49.4 percent, during this period. The annual average CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased by 458.3 lb CO<sub>2</sub>/MWh, a decrease of 58.1 percent. (See Figures 32 and 34.)

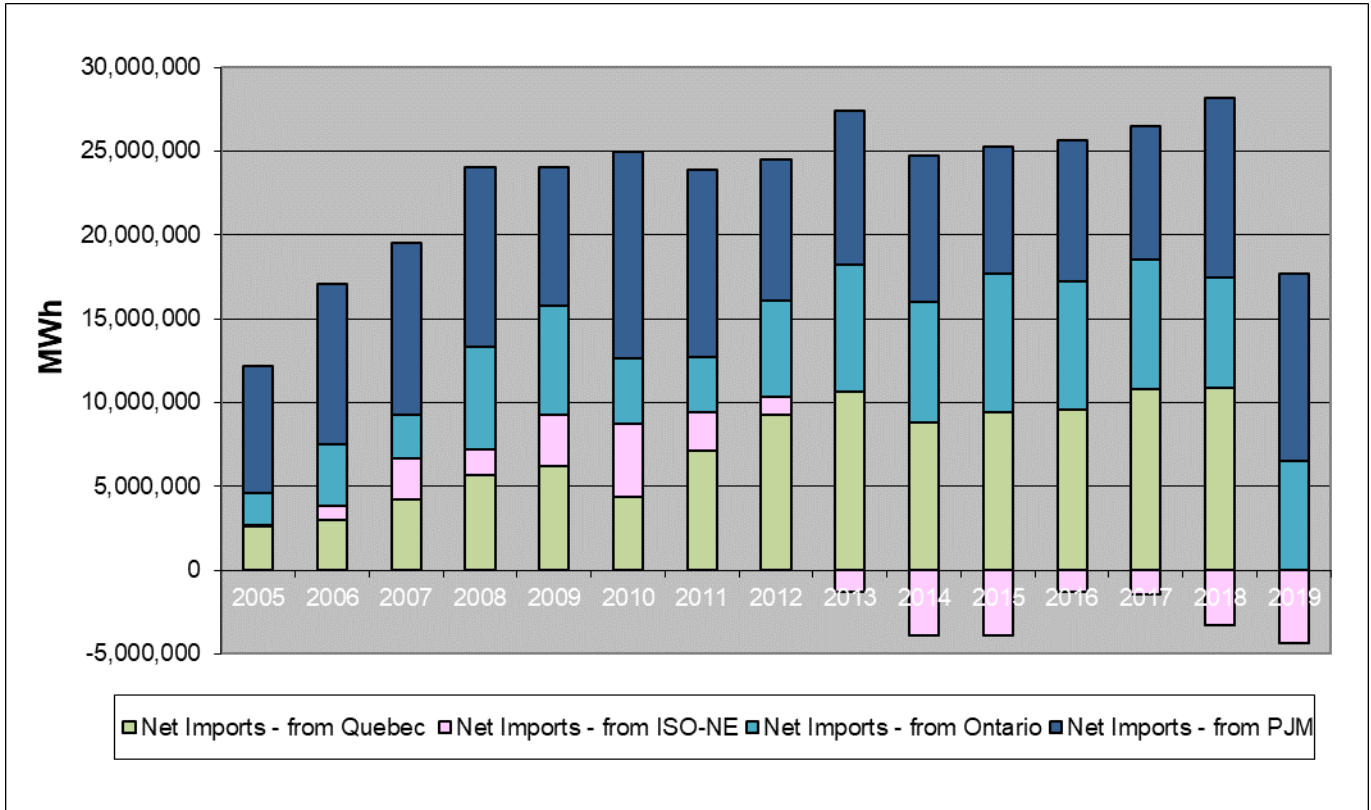


Figure 32. Net Electricity Imports to NYISO (MWh)

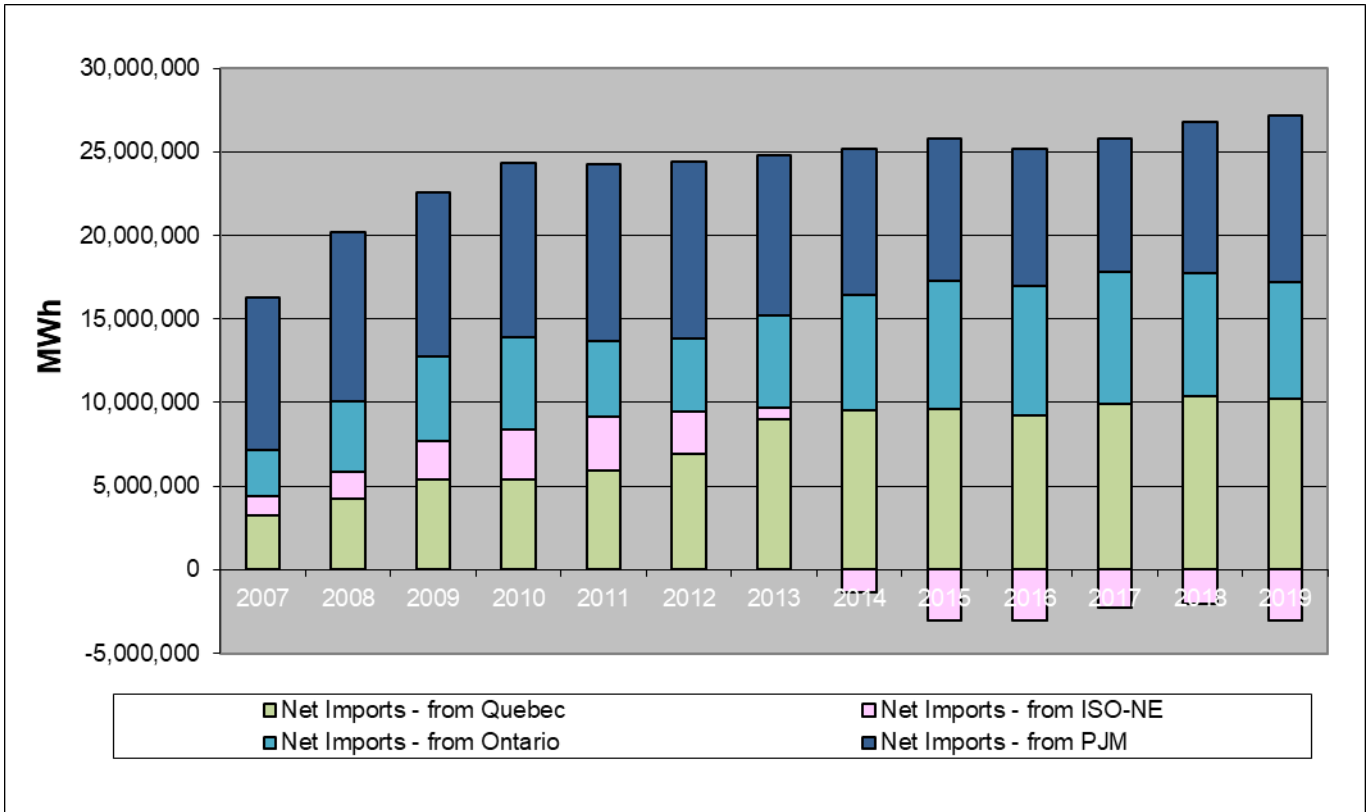


Figure 33. Net Electricity Imports to NYISO (MWh) (Three Year Trailing Average)

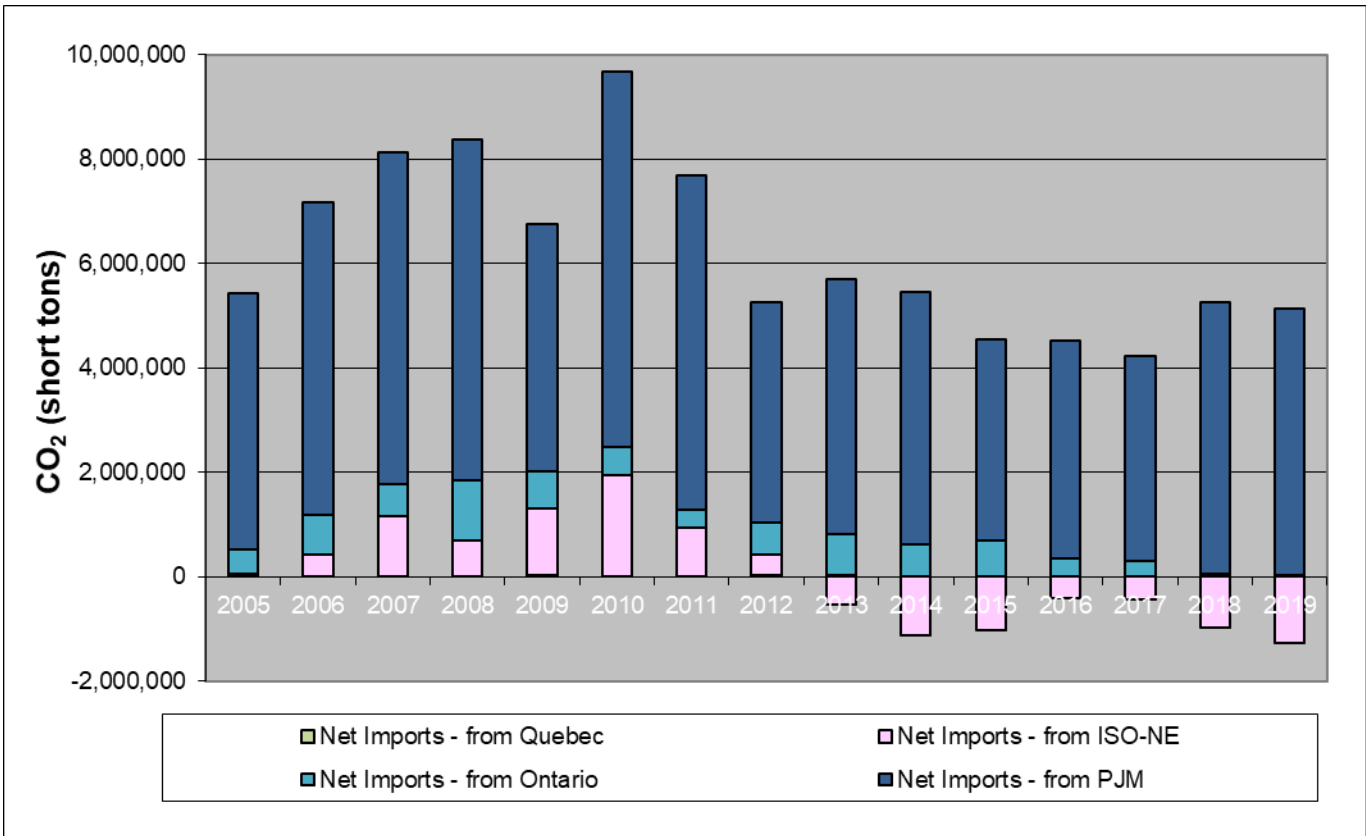
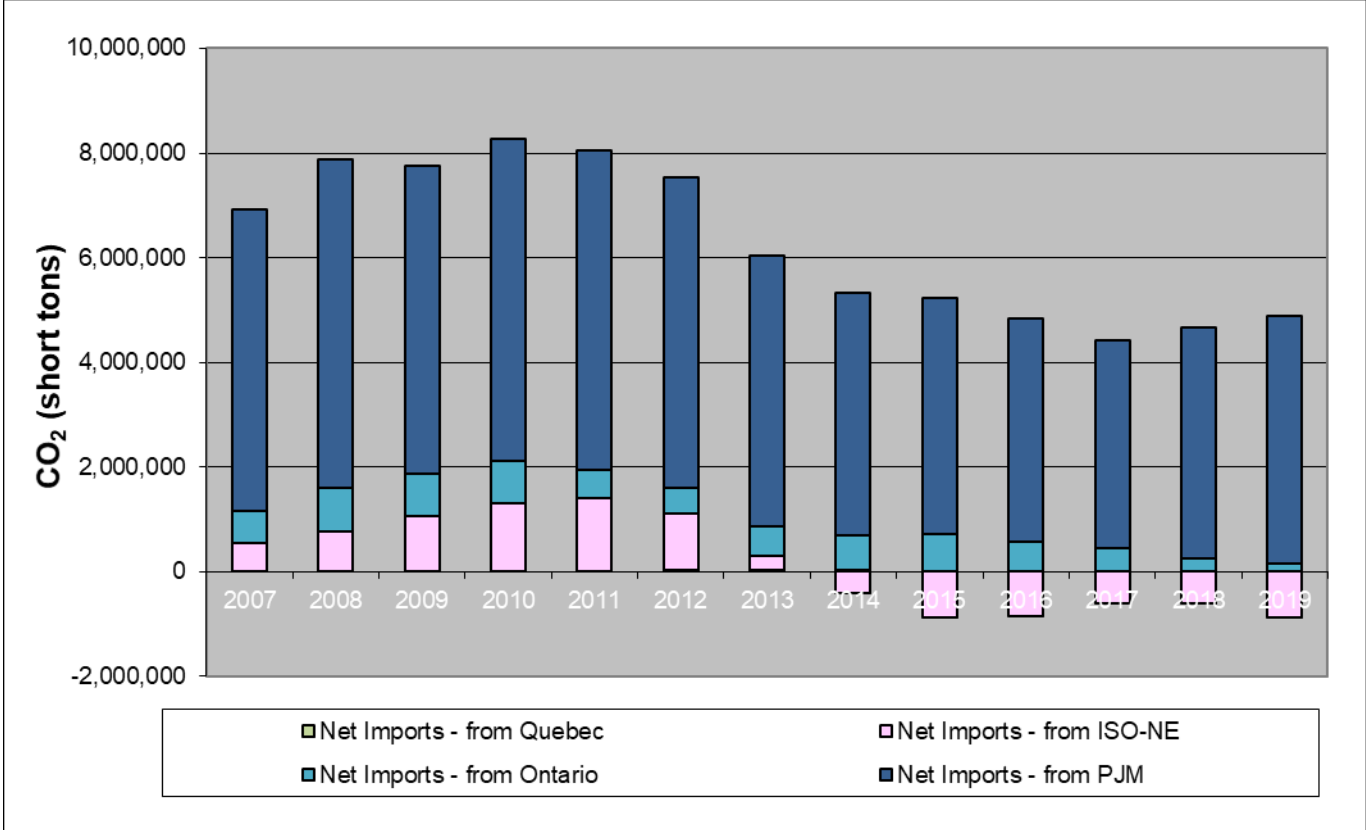


Figure 34. CO2 Emissions Related to Net Electricity Imports to NYISO (short tons CO2)



**Figure 35. CO<sub>2</sub> Emissions Related to Net Electricity Imports to NYISO (short tons CO<sub>2</sub>) (Three Year Trailing Average)**

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2019 from all non-RGGI electric generation sources serving load in NYISO increased by 8.1 million MWh, an increase of 8.1 percent. Compared to the base period, 2019 CO<sub>2</sub> emissions from this category of electric generation decreased by 6.8 million short tons of CO<sub>2</sub>, a reduction of 43.8 percent, and the CO<sub>2</sub> emission rate decreased by 148.7 lb CO<sub>2</sub>/MWh, a reduction of 48.0 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electric generation from RGGI generation in NYISO decreased by 20.7 million MWh, or 30.9 percent, and CO<sub>2</sub> emissions from RGGI generation in NYISO decreased by 28.3 million short tons of CO<sub>2</sub>, a reduction of 53.9 percent. The CO<sub>2</sub> emission rate of RGGI electric generation decreased by 521.5 lb CO<sub>2</sub>/MWh, a reduction of 33.6 percent. Compared to the 2006 to 2008 base period, 2019 electric generation from non-RGGI generation located in NYISO increased by 5.9 million MWh, or 7.3 percent, and CO<sub>2</sub> emissions from this category decreased by 2.8 million short tons of CO<sub>2</sub>, a reduction of 36.5 percent. The CO<sub>2</sub> emission rate of non-RGGI electric generation located in NYISO decreased by 77.6 lb CO<sub>2</sub>/MWh, a reduction of 40.7 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 net electricity imports into NYISO increased by 2.3 million MWh. CO<sub>2</sub> emissions related to these net electricity imports decreased by 4.0 million short tons of CO<sub>2</sub>, or 50.9 percent. The CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased by 444.7 lb CO<sub>2</sub>/MWh, a reduction of 56.3 percent.

PJM (RGGI Portion)

Monitoring results for PJM for 2005 through 2019 are summarized below in Table 7 and Figures 36 through 45. Note that for PJM, the data presented below is for the RGGI geographic portion of PJM: Delaware and Maryland (RGGI PJM). 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.<sup>44</sup>

**Table 7. 2005 – 2019 Monitoring Summary for RGGI PJM**

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)
2005	90,177,482	31,878,151	-636,765	31,241,386	41,472,196	393,587	17,070,313	17,463,900	58,936,096	48,705,286
2006	84,096,149	30,716,157	-721,101	29,995,056	37,230,890	267,732	16,602,471	16,870,203	54,101,093	46,865,259
2007	84,442,034	28,944,540	-772,843	28,171,697	39,254,875	298,635	16,716,827	17,015,462	56,270,337	45,187,159
2008	80,387,398	28,386,914	-772,644	27,614,270	35,340,119	150,718	17,282,291	17,433,009	52,773,128	45,047,279
2009	79,481,311	33,089,871	-570,096	32,519,775	29,732,886	147,837	17,080,813	17,228,650	46,961,536	49,748,425
2010	82,485,086	35,142,720	-815,714	34,327,006	31,641,822	129,655	16,386,603	16,516,258	48,158,080	50,843,264
2011	80,738,794	34,250,993	-697,456	33,553,537	28,980,019	216,967	17,988,271	18,205,238	47,185,257	51,758,775
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
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

<sup>44</sup> 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.

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
------	------------	------------	----------	------------	------------	--------	------------	------------	------------	------------

CO <sub>2</sub>	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)
2005	63,407,937	20,408,108	-469,658	19,938,450	42,345,258	284,222	840,007	1,124,229	43,469,487	21,062,679
2006	58,224,181	19,059,750	-529,065	18,530,684	38,502,576	206,808	984,113	1,190,921	39,693,497	19,721,605
2007	59,369,215	17,766,431	-579,349	17,187,082	40,637,296	221,499	1,323,338	1,544,837	42,182,133	18,731,919
2008	54,585,448	17,172,335	-555,899	16,616,436	36,518,184	152,927	1,297,901	1,450,828	37,969,012	18,067,264
2009	48,909,286	18,682,706	-371,449	18,311,256	29,281,274	147,125	1,169,631	1,316,756	30,598,030	19,628,012
2010	53,575,513	20,361,849	-572,275	19,789,574	32,258,228	129,412	1,398,299	1,527,711	33,785,939	21,317,285
2011	49,662,062	19,504,235	-452,458	19,051,778	28,850,034	171,564	1,588,686	1,760,250	30,610,284	20,812,028
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

lb CO <sub>2</sub> /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)
2005	1,406	1,280	1,475	1,276	2,042	1,444	98	129	1,475	865
2006	1,385	1,241	1,467	1,236	2,068	1,545	119	141	1,467	842

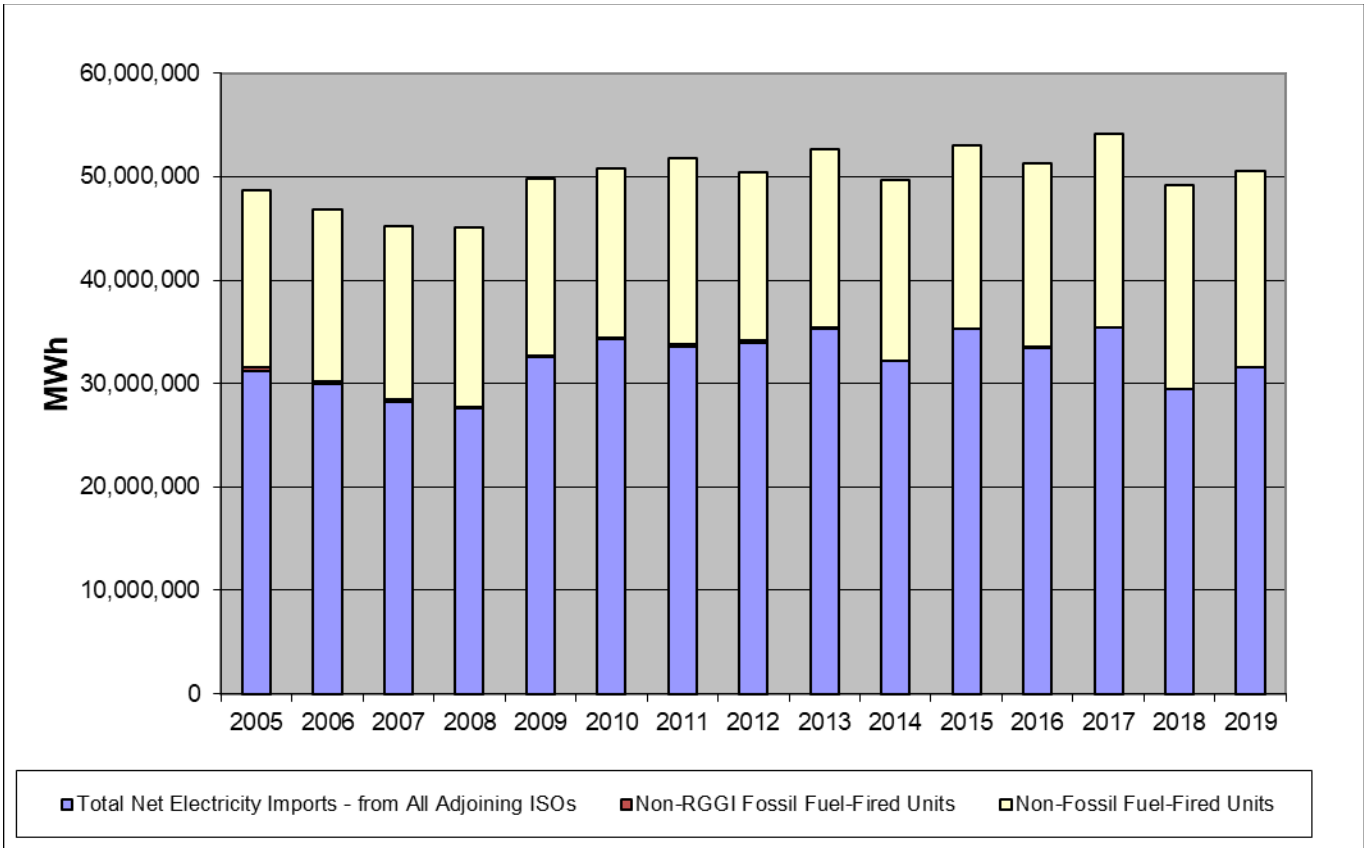
<b>2007</b>	1,406	1,228	1,499	1,220	2,070	1,483	158	182	1,499	829
<b>2008</b>	1,358	1,210	1,439	1,203	2,067	2,029	150	166	1,439	802
<b>2009</b>	1,231	1,129	1,303	1,126	1,970	1,990	137	153	1,303	789
<b>2010</b>	1,299	1,159	1,403	1,153	2,039	1,996	171	185	1,403	839
<b>2011</b>	1,230	1,139	1,297	1,136	1,991	1,581	177	193	1,297	804
<b>2012</b>	1,151	1,082	1,204	1,080	1,794	2,231	166	190	1,204	789
<b>2013</b>	1,133	1,109	1,154	1,108	1,854	2,495	141	152	1,154	794
<b>2014</b>	1,148	1,101	1,184	1,099	1,858	2,311	141	150	1,184	766
<b>2015</b>	1,046	1,008	1,077	1,008	1,737	2,104	151	157	1,077	722
<b>2016</b>	1,043	985	1,087	983	1,688	2,047	191	196	1,087	709
<b>2017</b>	907	953	864	954	1,502	1,869	143	145	864	674
<b>2018</b>	898	925	881	926	1,388	1,887	136	141	881	611
<b>2019</b>	838	940	760	944	1,260	1,778	129	134	760	639

The monitoring results indicate that the annual average electricity load in RGGI PJM for 2017 to 2019 decreased by 7.1 million MWh, or 8.6 percent, compared to the base period of 2006 to 2008. Annual average electric generation from all sources in RGGI PJM decreased by 10.7 million MWh, or 19.6 percent, compared to the base period.

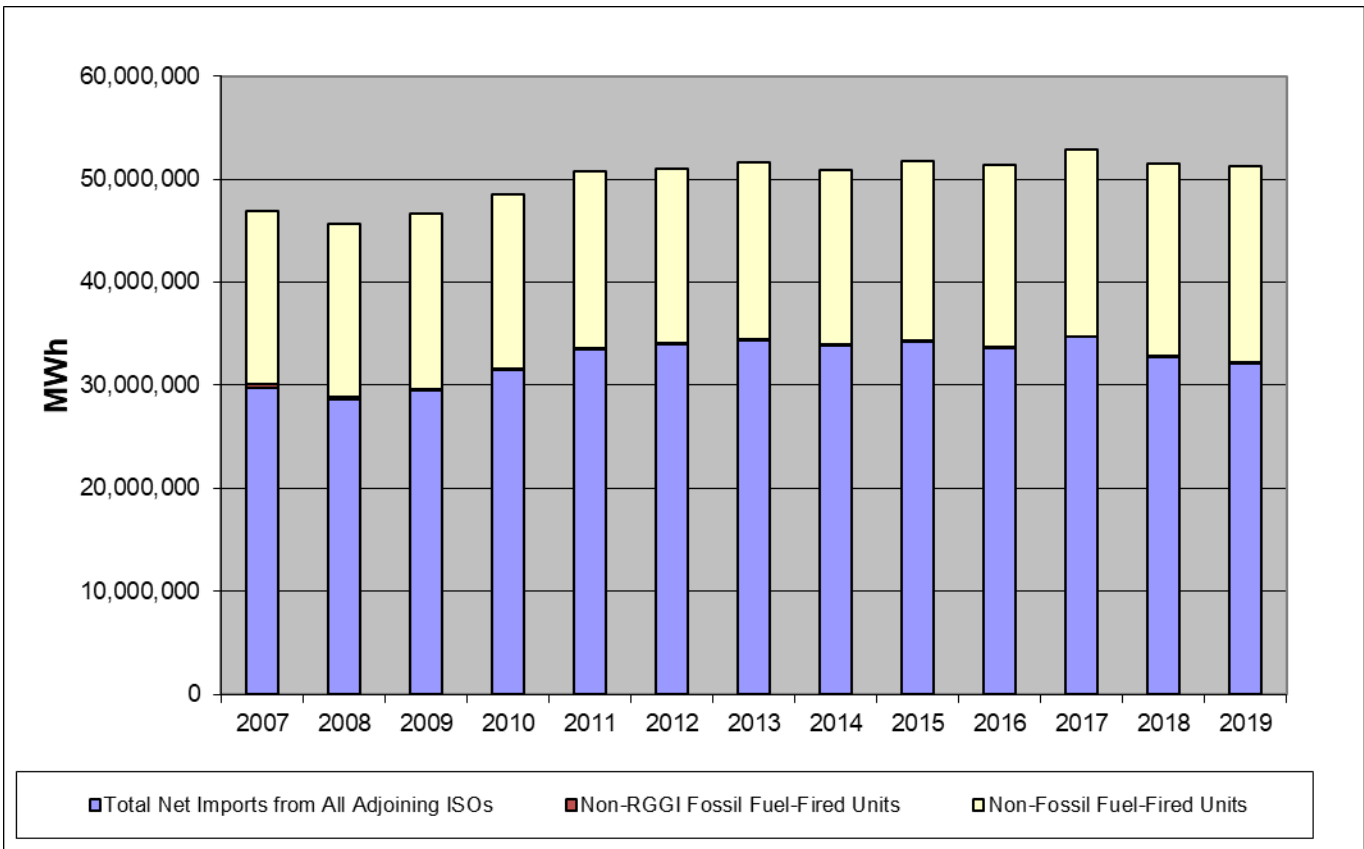
Annual average electric generation from RGGI generation in RGGI PJM decreased by 12.7 million MWh during this period, or 34.1 percent, and annual average CO<sub>2</sub> emissions from this category decreased by 21.6 million short tons of CO<sub>2</sub>, or 56.0 percent. The annual average CO<sub>2</sub> emission rate of RGGI electric generation decreased by 685.3 lb CO<sub>2</sub>/MWh, a reduction of 33.1 percent. Annual average electric generation from non-RGGI electric generation sources located in RGGI PJM increased by 2.0 million MWh, or 12.0 percent, during this period, and annual average CO<sub>2</sub> emissions from this category decreased by 56,816 short tons of CO<sub>2</sub>, a decrease of 4.1 percent. The annual average CO<sub>2</sub> emission rate of non-RGGI electric generation located in RGGI PJM decreased by 23.3 lb CO<sub>2</sub>/MWh, a decrease of 14.3 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electricity load in RGGI PJM decreased by 8.7 million MWh, or 10.5 percent. Compared to the 2006 to 2008 base period, 2019 electric generation from all sources in RGGI PJM decreased by 13.5 million MWh, or 36.3 percent.

The annual average electric generation from all non-RGGI electric generation serving load in RGGI PJM for 2017 to 2019 increased by 5.6 million MWh, or 12.2 percent, compared to the annual average during the 2006 to 2008 base period. Annual average CO<sub>2</sub> emissions from this category decreased by 2.4 million short tons of CO<sub>2</sub>, a decrease of 12.6 percent, and the annual average CO<sub>2</sub> emission rate decreased by 182.8 lb CO<sub>2</sub>/MWh, a decrease of 22.2 percent. (See Figures 36, 38, and 40.)



**Figure 36. Non-RGGI Generation Serving Load in RGGI PJM (MWh)**



**Figure 37. Non-RGGI Generation Serving Load in RGGI PJM (MWh) (Three Year Trailing Average)**



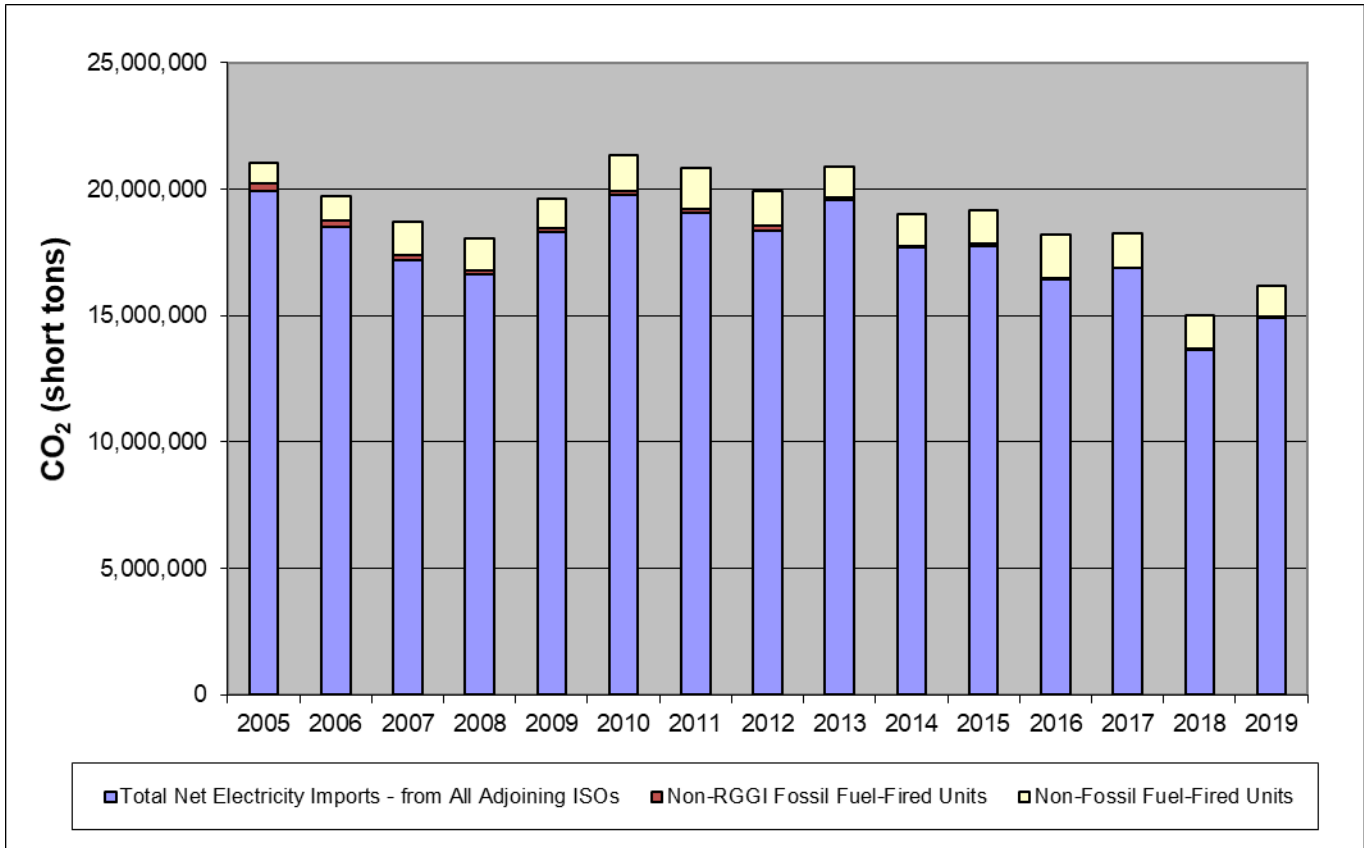


Figure 38. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in RGGI PJM (short tons CO<sub>2</sub>)

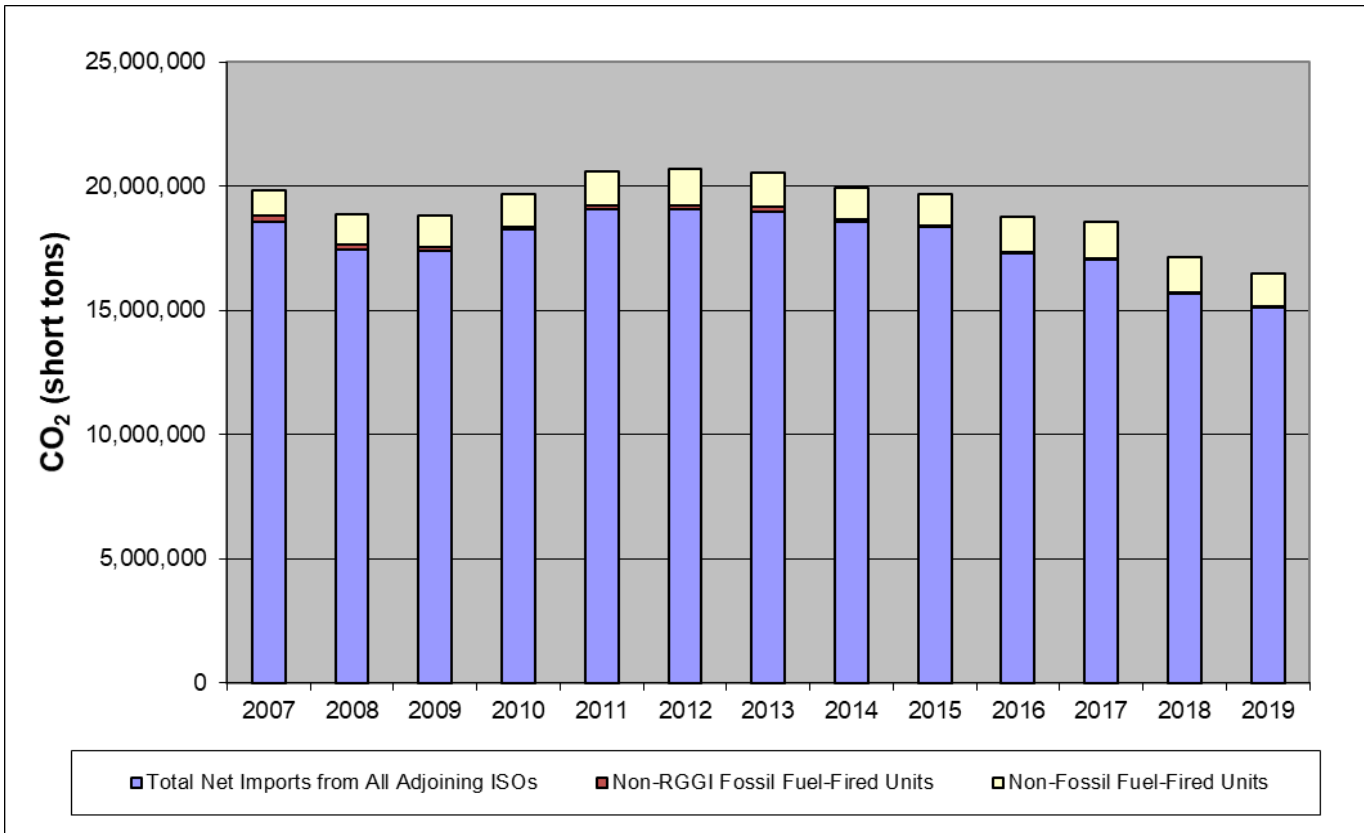
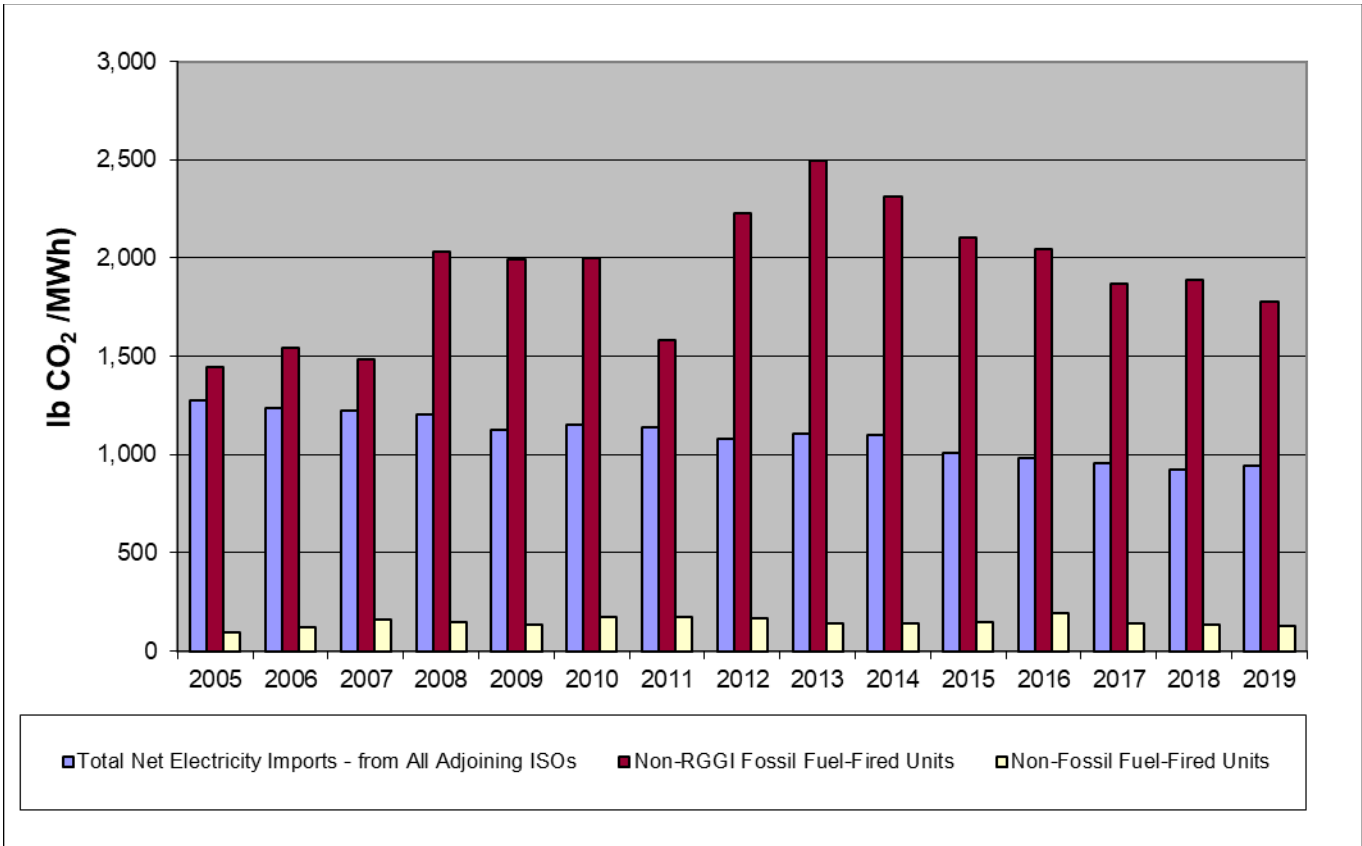
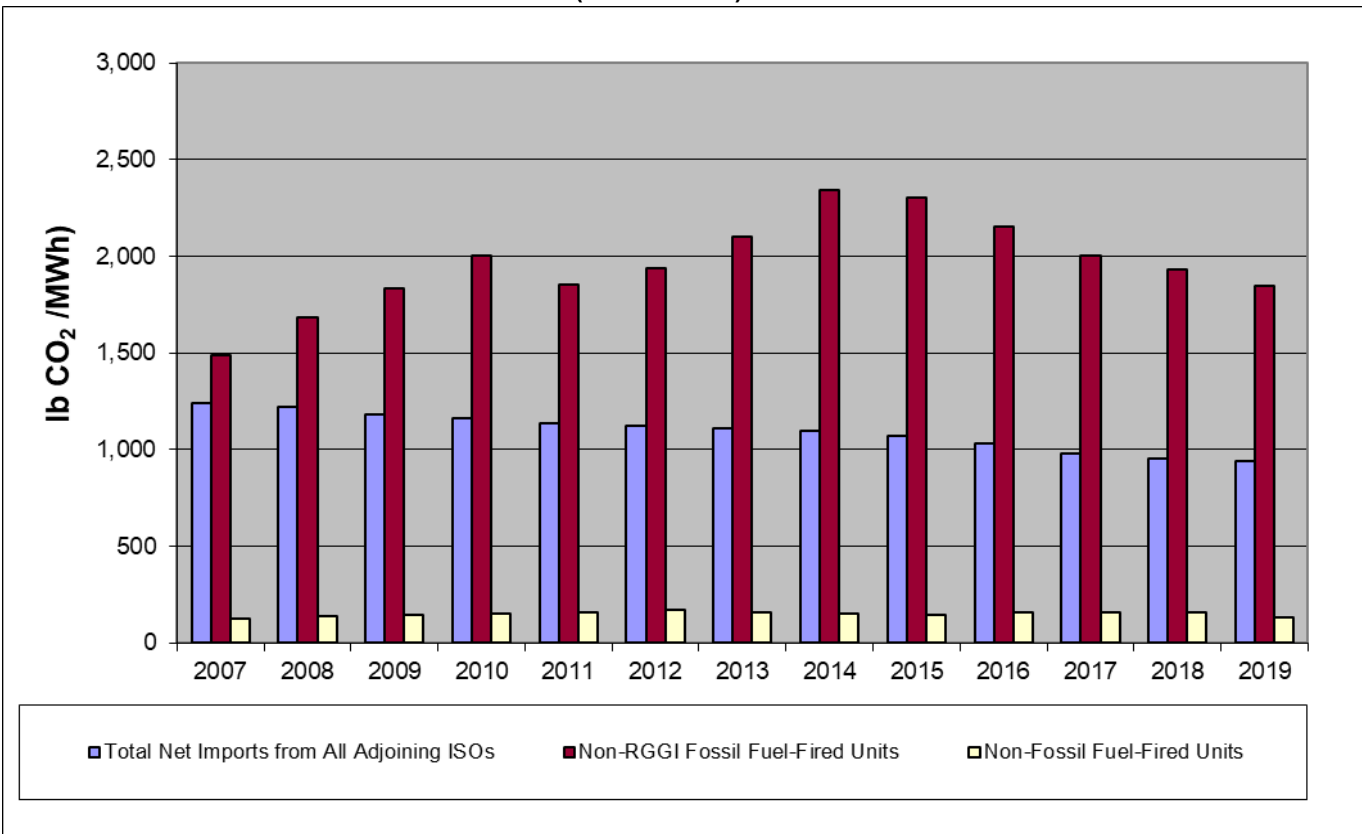


Figure 39. CO<sub>2</sub> Emissions from Non-RGGI Generation Serving Load in RGGI PJM (short tons CO<sub>2</sub>) (Three Year Trailing Average)



**Figure 40. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in RGGI PJM (lb CO<sub>2</sub>/MWh)**



**Figure 41. CO<sub>2</sub> Emission Rate for Non-RGGI Generation Serving Load in RGGI PJM (lb CO<sub>2</sub>/MWh) (Three Year Trailing Average)**

Net electricity imports into RGGI PJM increased by 3.5 million MWh, when comparing the annual average during the base period of 2006 to 2008 to the annual average for 2017 to 2019. Annual average CO<sub>2</sub> emissions related to these net electricity imports decreased by 2.3 million short tons of CO<sub>2</sub>, or 13.2 percent, during this period. The annual average CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased by 278.4 lb CO<sub>2</sub>/MWh, a decrease of 22.8 percent. (See Figures 42 and 44.)

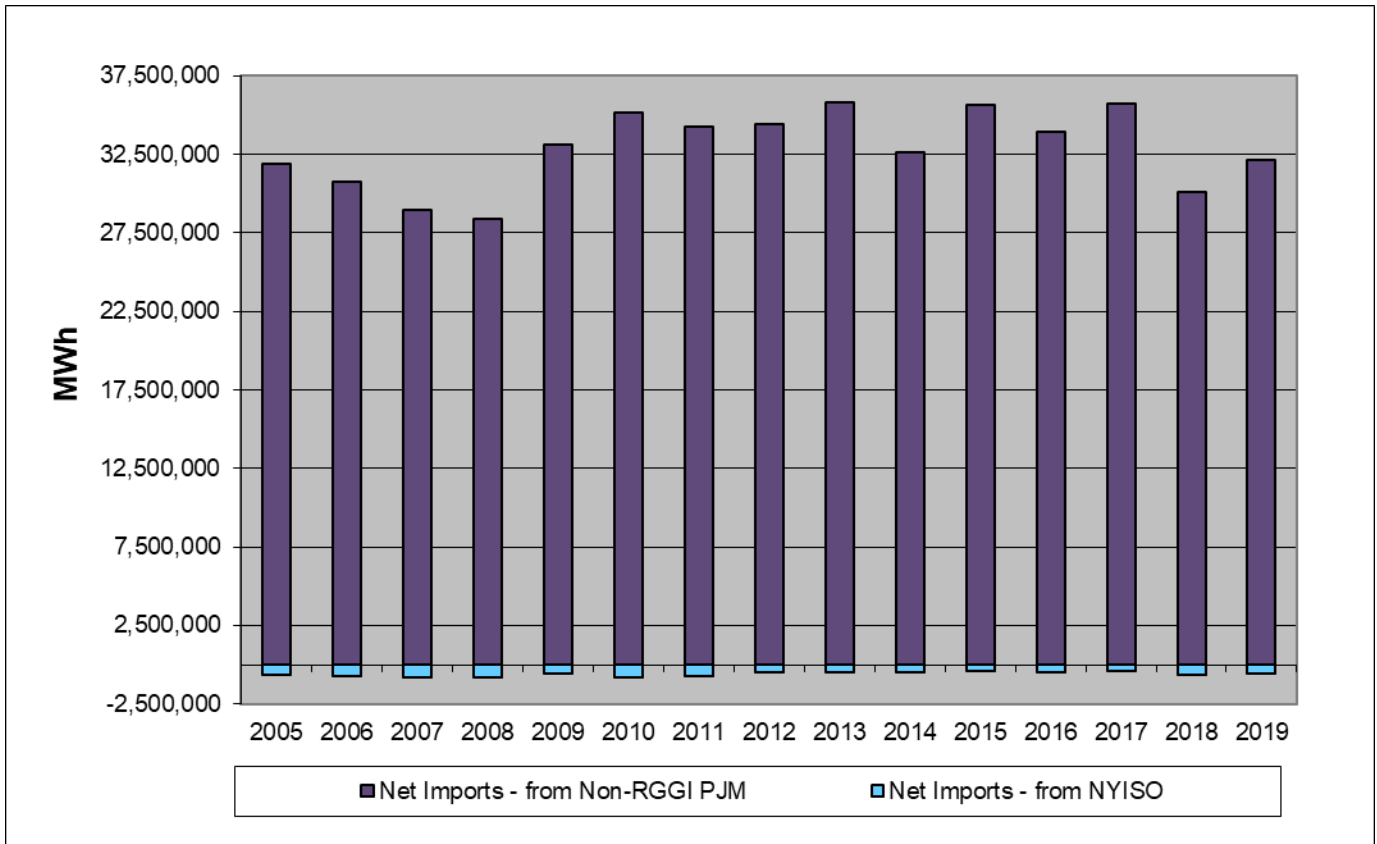
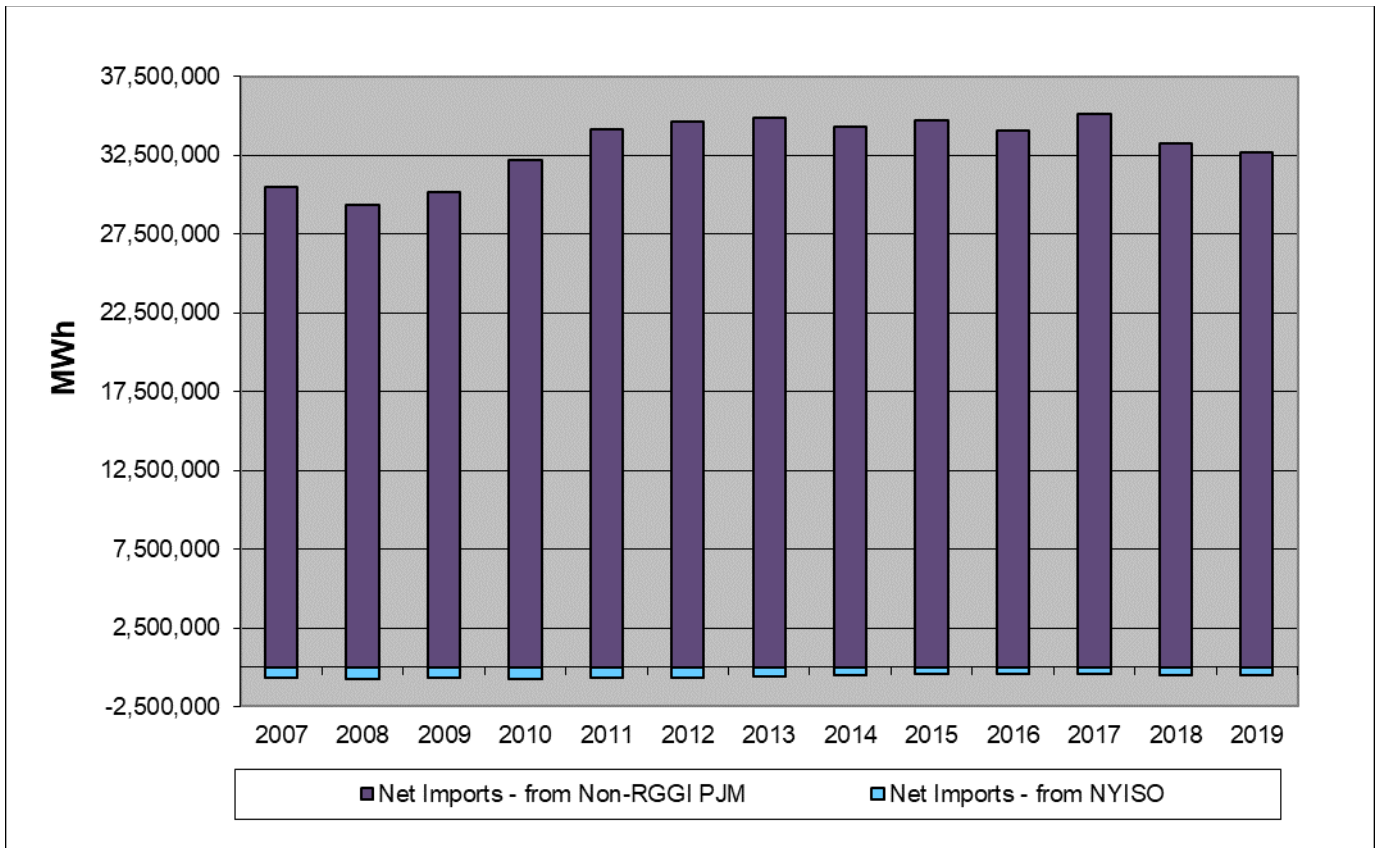
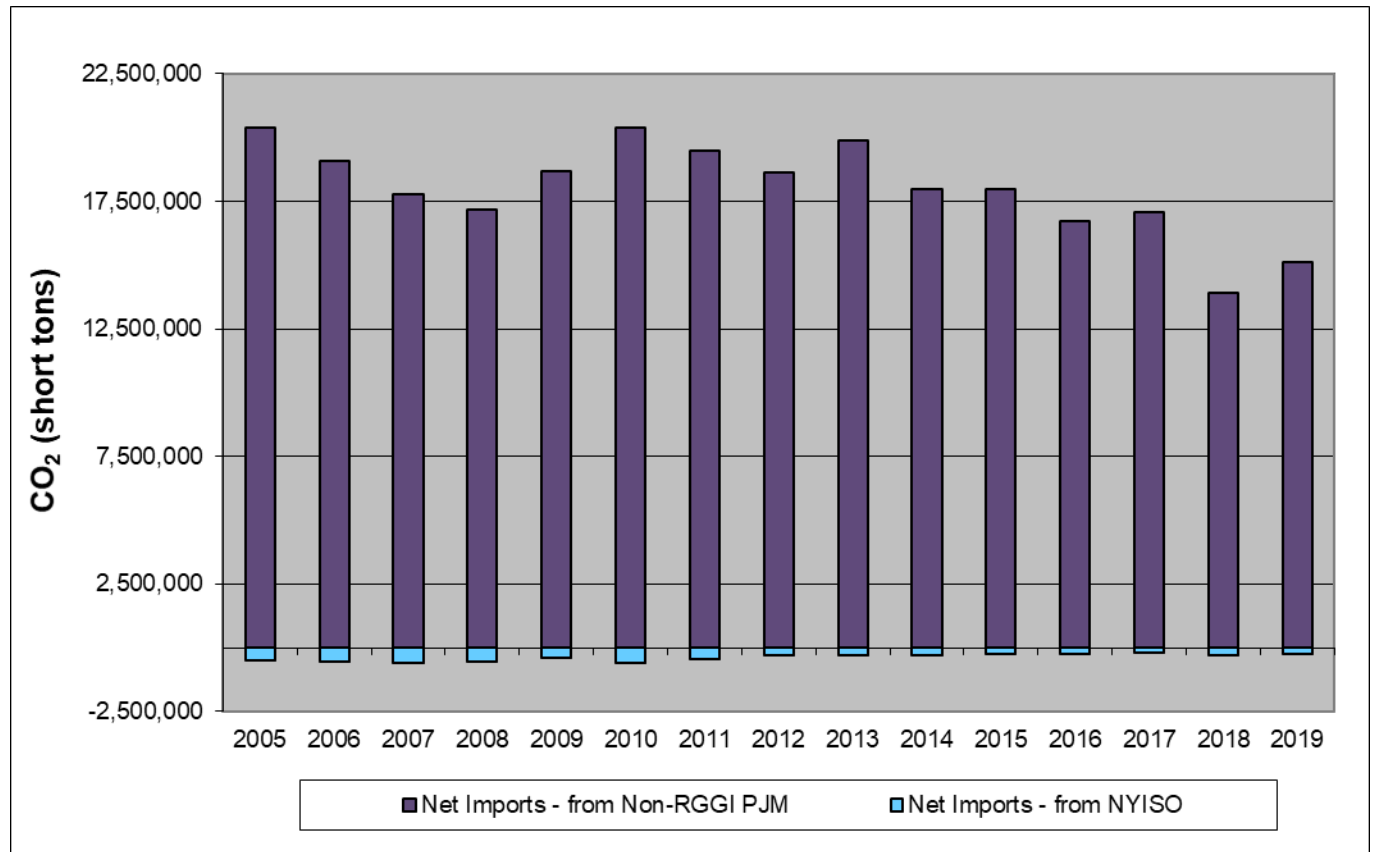


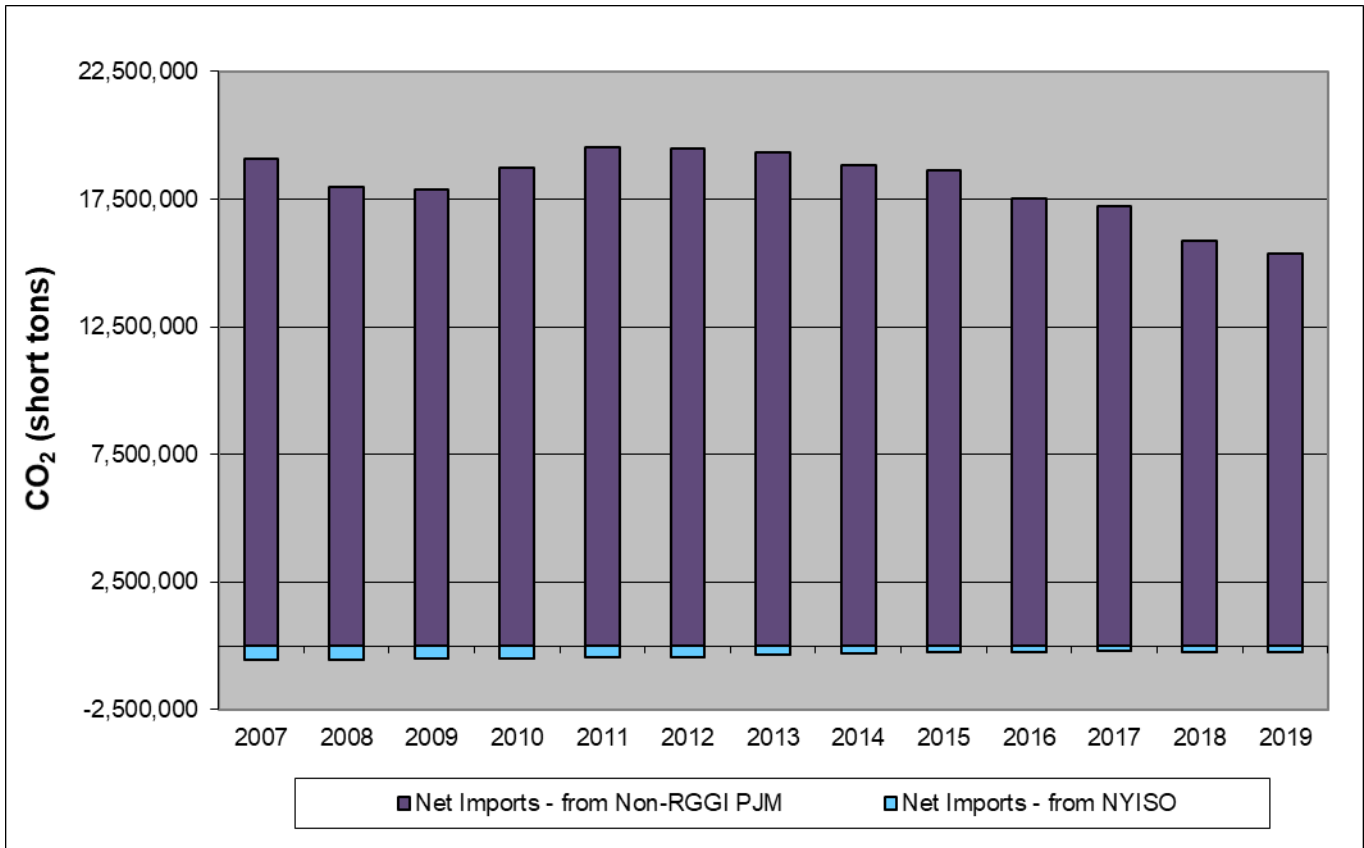
Figure 42. Net Electricity Imports to RGGI PJM (MWh)



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



**Figure 44. CO2 Emissions Related to Net Electricity Imports to RGGI PJM (short tons CO2)**



**Figure 45. CO<sub>2</sub> Emissions Related to Net Electricity Imports to RGGI PJM (short tons CO<sub>2</sub>)**

Compared to the annual average during the 2006 to 2008 base period, electric generation in 2019 from all non-RGGI electric generation sources serving load in RGGI PJM increased by 4.8 million MWh, an increase of 10.6 percent. Compared to the base period, 2019 CO<sub>2</sub> emissions from this category of electric generation decreased by 2.7 million short tons of CO<sub>2</sub>, a decrease of 14.3 percent, and the CO<sub>2</sub> emission rate decreased by 184.8 lb CO<sub>2</sub>/MWh, a reduction of 22.4 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 electric generation from RGGI generation in RGGI PJM decreased by 13.5 million MWh, or 36.3 percent, and CO<sub>2</sub> emissions from RGGI generation in RGGI PJM decreased by 23.6 million short tons of CO<sub>2</sub>, or 61.2 percent. The CO<sub>2</sub> emission rate of RGGI electric generation decreased by 808.6 lb CO<sub>2</sub>/MWh, a reduction of 39.1 percent. Compared to the 2006 to 2008 annual average, 2019 electric generation from non-RGGI generation located in RGGI PJM increased by 1.9 million MWh, or 10.9 percent, and CO<sub>2</sub> emissions from this category of electric generation decreased by 129,056 short tons of CO<sub>2</sub> a reduction of 9.2 percent. The CO<sub>2</sub> emission rate of non-RGGI electric generation located in RGGI PJM decreased by 29.6 lb CO<sub>2</sub>/MWh, a decrease of 18.1 percent.

Compared to the annual average during the 2006 to 2008 base period, 2019 net electricity imports into RGGI PJM increased by 3.0 million MWh. CO<sub>2</sub> emissions related to these net electricity imports decreased by 2.6 million short tons of CO<sub>2</sub>, or 14.7 percent, during this period. The average CO<sub>2</sub> emission rate of the electric generation supplying these imports decreased by 276.0 lb CO<sub>2</sub>/MWh, a reduction of 22.6 percent.

## Appendix C. Monitoring Trends

Detailed monitoring trends for the nine-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 and three years of RGGI operation, 2016 to 2019.

### Nine-State RGGI Region

**Table 8. Monitoring Trends for Nine-State RGGI Region**

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh
<b>Annual average for 2006-2008 (base period)</b>	158,231,279	20,137,889	254	172,296,470	138,362,771	1,605	55,997,235	25,224,000	904
<b>Annual average for 2017-2019</b>	164,390,289	20,892,240	254	122,195,822	65,065,596	1,065	77,329,738	21,165,767	547
<b>Difference from base period</b>	6,159,010	754,351	-0.11	-50,100,648	-73,297,175	-540.9	21,332,503	-4,058,233	-357.3
<b>% change from base period</b>	3.9%	3.7%	-0.04%	-29.1%	-53.0%	-33.7%	38.1%	-16.1%	-39.5%
<b>2019</b>	166,206,138	20,317,243	244	116,153,644	59,648,430	1,027	75,685,996	21,107,288	558
<b>Difference from base period</b>	7,974,859	179,354	-9.9	-56,142,826	-78,714,341	-578.4	19,688,761	-4,116,712	-346.7
<b>% change from base period</b>	5.0%	0.9%	-3.9%	-32.6%	-56.9%	-36.0%	35.2%	-16.3%	-38.3%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	MWh
<b>Annual average for 2006-2008 (base period)</b>	214,228,514	45,361,889	424	330,527,749	386,423,646
<b>Annual average for 2017-2019</b>	241,720,026	42,058,007	348	286,586,111	354,940,272
<b>Difference from base period</b>	27,491,513	-3,303,882	-75.6	-43,941,638	-31,483,374
<b>% change from base period</b>	12.8%	-7.3%	-17.9%	-13.3%	-8.1%
<b>2019</b>	241,892,134	41,424,531	343	282,359,782	349,348,654
<b>Difference from base period</b>	27,663,620	-3,937,358	-81	-48,167,967	-37,074,993
<b>% change from base period</b>	12.9%	-8.7%	-19.1%	-14.6%	-9.6%

**Table 9. Monitoring Trends for ISO-NE**

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh
<b>Annual average for 2006-2008 (base period)</b>	60,527,897	11,046,433	365	67,414,107	47,242,267	1,401	7,196,667	-138,167	-48
<b>Annual average for 2017-2019</b>	60,049,541	14,275,361	476	49,155,898	22,776,541	926	21,545,936	2,258,180	209
<b>Difference from base period</b>	-478,356	3,228,928	110.7	-18,258,209	-24,465,726	-475.0	14,349,269	2,396,347	257.2
<b>% change from base period</b>	-0.8%	29.2%	30.4%	-27.1%	-51.8%	-33.9%	199.4%	1734.4%	531.0%
<b>2019</b>	60,770,970	14,162,945	466	45,498,548	20,465,688	900	23,063,000	2,628,551	228
<b>Difference from base period</b>	243,073	3,116,512	101.3	-21,915,559	-26,776,578	-501.7	15,866,333	2,766,718	276.4
<b>% change from base period</b>	0.4%	28.2%	27.8%	-32.5%	-56.7%	-35.8%	220.5%	2002.4%	570.6%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	MWh
<b>Annual average for 2006-2008 (base period)</b>	67,724,564	10,908,266	322	127,942,004	135,037,333
<b>Annual average for 2017-2019</b>	81,595,477	16,533,540	405	109,205,439	121,309,667
<b>Difference from base period</b>	13,870,913	5,625,275	83.3	-18,736,565	-13,727,667
<b>% change from base period</b>	20.5%	51.6%	25.8%	-14.6%	-10.2%
<b>2019</b>	83,833,970	16,791,496	401	106,269,518	119,237,000
<b>Difference from base period</b>	16,109,407	5,883,230	78.5	-21,672,486	-15,800,333
<b>% change from base period</b>	23.8%	53.9%	24.4%	-16.9%	-11.7%

**Table 10. Monitoring Trends for NYISO**

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh
<b>Annual average for 2006-2008 (base period)</b>	80,597,157	7,695,928	191	67,607,068	52,567,819	1,554	20,206,894	7,885,769	790
<b>Annual average for 2017-2019</b>	85,187,985	5,278,167	124	48,461,309	25,337,502	1,067	24,120,940	3,988,024	331
<b>Difference from base period</b>	4,590,827	-2,417,760	-66.7	-19,145,759	-27,230,317	-486.8	3,914,046	-3,897,745	-458.3
<b>% change from base period</b>	5.7%	-31.4%	-35.0%	-28.3%	-51.8%	-31.3%	19.4%	-49.4%	-58.1%
<b>2019</b>	86,464,339	4,887,825	113	46,900,119	24,218,861	1,033	22,462,243	3,872,545	345
<b>Difference from base period</b>	5,867,182	-2,808,103	-77.6	-20,706,949	-28,348,958	-521.5	2,255,349	-4,013,224	-444.7
<b>% change from base period</b>	7.3%	-36.5%	-40.7%	-30.6%	-53.9%	-33.6%	11.2%	-50.9%	-56.3%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	MWh
<b>Annual average for 2006-2008 (base period)</b>	100,804,051	15,581,697	309	148,204,225	168,411,119
<b>Annual average for 2017-2019</b>	109,308,925	9,266,191	170	133,649,294	157,772,000
<b>Difference from base period</b>	8,504,874	-6,315,505	-140.1	-14,554,932	-10,639,119
<b>% change from base period</b>	8.4%	-40.5%	-45.2%	-9.8%	-6.3%
<b>2019</b>	108,926,582	8,760,370	161	133,364,458	155,832,000
<b>Difference from base period</b>	8,122,531	-6,821,327	-148.7	-14,839,767	-12,579,119
<b>% change from base period</b>	8.1%	-43.8%	-48.0%	-10.0%	-7.5%



**Table 11. Monitoring Trends for RGGI PJM**

	Non-RGGI Generation (In-Region)			RGGI Generation			Net Imports		
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh
<b>Annual average for 2006-2008 (base period)</b>	17,106,225	1,395,529	163	37,275,295	38,552,685	2,068	28,593,674	17,444,734	1,220
<b>Annual average for 2017-2019</b>	19,152,763	1,338,712	140	24,578,615	16,951,553	1,383	32,127,227	15,135,084	941
<b>Difference from base period</b>	2,046,538	-56,816	-23.3	-12,696,679	-21,601,132	-685.3	3,533,553	-2,309,650	-278.4
<b>% change from base period</b>	12.0%	-4.1%	-14.3%	-34.1%	-56.0%	-33.1%	12.4%	-13.2%	-22.8%
<b>2019</b>	18,970,829	1,266,473	134	23,754,977	14,963,881	1,260	31,553,848	14,888,661	944
<b>Difference from base period</b>	1,864,604	-129,056	-29.6	-13,520,318	-23,588,804	-808.6	2,960,173	-2,556,073	-276.0
<b>% change from base period</b>	10.9%	-9.2%	-18.1%	-36.3%	-61.2%	-39.1%	10.4%	-14.7%	-22.6%

	Non-RGGI Generation (Non-RGGI In-Region + Net Imports)			In-Region Generation	In-Region Load
	MWh	CO <sub>2</sub> Emissions	lb CO <sub>2</sub> /MWh	MWh	MWh
<b>Annual average for 2006-2008 (base period)</b>	45,699,899	18,840,263	824	54,381,519	82,975,194
<b>Annual average for 2017-2019</b>	51,279,990	16,473,797	641	43,731,378	74,279,654
<b>Difference from base period</b>	5,580,091	-2,366,466	-182.8	-10,650,141	-8,695,540
<b>% change from base period</b>	12.2%	-12.6%	-22.2%	-19.6%	-10.5%
<b>2019</b>	50,524,677	16,155,134	639	42,725,806	75,858,605
<b>Difference from base period</b>	4,824,777	-2,685,129	-184.8	-11,655,713	-7,116,589
<b>% change from base period</b>	10.6%	-14.3%	-22.4%	-21.4%	-8.6%

## Appendix D. Concept of “Emissions Leakage”

“Emissions leakage” is the concept that the RGGI CO<sub>2</sub> compliance obligation and related CO<sub>2</sub> compliance costs for electric generators could result in a shift of electricity generation from CO<sub>2</sub>-emitting sources subject to the RGGI CO<sub>2</sub> Budget Trading Program to CO<sub>2</sub>-emitting sources not subject to RGGI. Key to this concept is that the cause of such a shift would be due to the RGGI CO<sub>2</sub> Budget Trading Program rather than other factors that influence electric power sector CO<sub>2</sub> emissions. The concept of emissions leakage presumes that an increase in electricity production costs for certain electric generators due to RGGI CO<sub>2</sub> compliance costs would be the driver of changes in the operation of the electric power system that result in an increase in CO<sub>2</sub> emissions from electric generation that is not subject to the RGGI CO<sub>2</sub> Budget Trading Program.

### Factors that Influence Electric Generator Dispatch and CO<sub>2</sub> 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<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub> 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<sub>2</sub> emissions, through a highly dynamic wholesale electricity market.

The concept of emissions leakage assumes a scenario in which only a subset of CO<sub>2</sub>-emitting electric generators are subject to a CO<sub>2</sub> allowance requirement.<sup>45</sup> As a result, certain electric generators are subject to an additional production cost – the cost of CO<sub>2</sub> allowances – that is not faced by other CO<sub>2</sub>-emitting electric generators. In theory, this could result in a shift in electric generation to emitting units that do not face a CO<sub>2</sub> compliance cost. If such a shift results in an increase in CO<sub>2</sub> emissions from electric generation as a whole, such an increase is referred to as emissions leakage.

<sup>45</sup> The nine-state 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<sub>2</sub> emissions) from: (a) in-region non-RGGI units (i.e., fossil fuel-fired units in the nine-state RGGI region with a capacity less than 25 MWe, which are not subject to RGGI); (b) electric generation outside the nine-state 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.”