



STATE OF NEW JERSEY  
**DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**2015 Statewide Greenhouse Gas  
Emissions Inventory**

December 2017

# **2015 Update to New Jersey's Statewide Greenhouse Gas (GHG) Emissions Inventory**

## **Introduction**

The previous GHG Emissions Inventory update, completed in September 2014, was issued for the years 2010 to 2012. This update provides estimates for 2013, 2014, and 2015 Statewide GHG emissions, and highlights features relevant for the assessment of progress in satisfying the GHG emissions limits set by the State's 2007 Global Warming Response Act (GWRA) for the years 2020 and 2050.

Pursuant to the reporting obligation under the GWRA, the initial GHG Inventory for the State was published in November 2008.<sup>1</sup> The 2008 Inventory included the 1990 estimate that is required for establishing the baseline for the 2020 goal, estimated emissions for 2004, and projections up to year 2020. Four subsequent updates were completed and published in November 2009 (representing 2005 – 2007 emissions data), May 2011 (representing 2008 emissions data), November 2012 (representing 2009 emissions data), and September 2014 (representing emissions estimates for 2010, 2011, and 2012). The emissions estimates for the subsequent years until 2015 constitute the fifth Inventory update.<sup>2</sup>

## **Methods and Data**

In line with previous Statewide inventory updates, the 2015 GHG Inventory update is mainly based on emissions data from the NJDEP emission statement database<sup>3</sup> and on fuel use data from the Energy Information Administration (EIA) of the U.S. Department of Energy.<sup>4,5</sup> Methods used to derive the emissions estimates from the data are detailed in the report "New Jersey Greenhouse Gas Inventory and Reference Case Projections 1990 – 2020" (Inventory and Projections), published November 2008. Modifications and refinements in methods were introduced and described in the first, second, and third updates, mentioned above. A few minor changes in methodology have been made for the 2015 GHG Inventory update, discussed briefly in the appendix to this report.

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<sup>1</sup> New Jersey Greenhouse Gas Inventory and Reference Case Projections 1990 – 2020, *New Jersey Department of Environmental Protection*, November 2008.

<sup>2</sup> Inventories are subject to availability of information from the United States Energy Information Administration (EIA), which has a lag time of 2 years for collection and publication of data.

<sup>3</sup> NJDEP, *Bureau of Air Quality Planning, Division of Air Quality*. (Data provided through Danny Wong, Research Scientist, July 5, 2016)

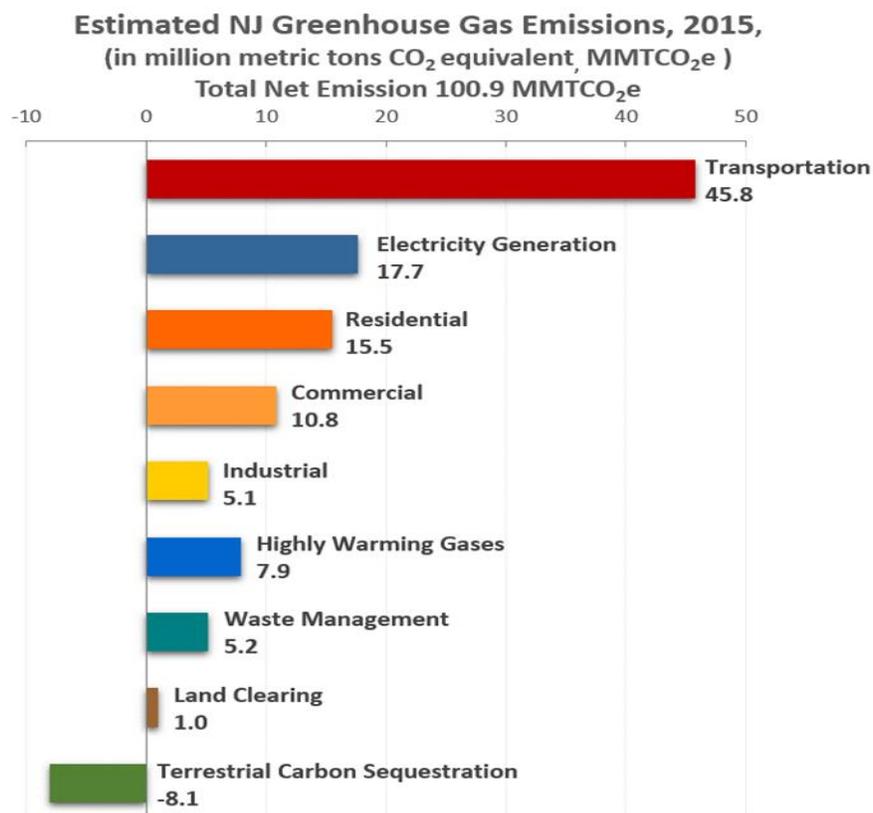
<sup>4</sup> <http://www.eia.doe.gov/oiaf/1605/coefficients.html> (accessed, July 30, 2016)

<sup>5</sup> <http://www.eia.gov/state/seds> (accessed, July 8, 2016)

## New Jersey GHG Emissions Updates for 2013, 2014, and 2015

Estimated net greenhouse gas emissions<sup>6</sup> are as follows: **105.3** million metric tons of carbon dioxide equivalent<sup>7</sup> (*MMT<sub>CO<sub>2</sub>e</sub>*) in 2013; **111.8** *MMT<sub>CO<sub>2</sub>e</sub>* in 2014<sup>8</sup>; **100.9** *MMT<sub>CO<sub>2</sub>e</sub>* in 2015. The sectoral distribution of the greenhouse gas emissions for 2015 is shown in Figure 1 below.

Figure 1



<sup>6</sup> **Net GHG emissions** is the difference between the addition of greenhouse gases into the atmosphere through *emissions*, primarily carbon dioxide, and the removal of carbon dioxide from the atmosphere through *sequestration* via plant growth and land use (acting as natural carbon sinks). **Gross emissions** represent the total of all emissions, including carbon release from land clearing.

<sup>7</sup> "Carbon dioxide equivalent" represents the conversion of all emitted compounds, including methane and other GHG gases, to the equivalent quantity of carbon dioxide using global warming potential (GWP) values, as discussed in the periodic reports of the Intergovernmental Panel on Climate Change (IPCC). See IPCC AR5, 2013, Climate Change 2013: Working Group I: The Physical Science Basis [www.ipcc.ch/report/ar5/wg1/](http://www.ipcc.ch/report/ar5/wg1/) (accessed 7/15/2014).

<sup>8</sup> The relatively higher amount of GHG emissions in 2014 was driven by substantial increases in residential, commercial, and in-state electricity generation sector emissions. During that year the residential sector experienced greater demand for heating due to weather factors such as the polar vortex. In the commercial sector, increased economic activity contributed to higher energy usage. Nuclear power plants had several outages in 2014 related to maintenance and other issues.

The three leading sources of GHG emissions in 2015 are transportation, electricity generation, and residential, commercial and industrial (RCI) sectors fossil fuels use. Transportation remains the largest source at 45.8 MMTCO<sub>2</sub>e, which is 42% of the gross Statewide GHG emissions. Electricity generation follows as the next largest source at 17.7 MMTCO<sub>2</sub>e, which is 16% of Statewide GHG emissions. Close at third is the residential sector with 15.5 MMTCO<sub>2</sub>e, 14% of Statewide GHG emissions. The combined contribution of the residential, commercial and industrial sectors is 31.4 MMTCO<sub>2</sub>e, which is 29% of the gross emissions, of which residential space heating/cooling is a significant portion. On the other hand, carbon captured by the State's natural sinks (growth of forests and other vegetation plus soils left undisturbed) amounted to 8.1 MMTCO<sub>2</sub>e in 2015, "offsetting" 7% of the gross Statewide GHG emissions.

**Table 1: Estimated NJ Statewide Greenhouse Gas Emissions**

| Sector                                                                                                                                                                                                | 1990         | 2005         | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         | 2012         | 2013         | 2014         | 2015         | Notes |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------|
| Commercial                                                                                                                                                                                            | 10.7         | 10.8         | 9.2          | 10.6         | 10.2         | 10.8         | 10.6         | 11.3         | 10.1         | 10.6         | 12.3         | 10.8         |       |
| Industrial                                                                                                                                                                                            | 19.8         | 17.3         | 16.3         | 15.9         | 13.9         | 10.6         | 9.1          | 10.3         | 10.3         | 9.7          | 9.7          | 5.1          |       |
| Residential                                                                                                                                                                                           | 15.2         | 16.3         | 13.7         | 15.6         | 14.9         | 15.2         | 14.2         | 13.6         | 12.1         | 14.7         | 16.1         | 15.5         |       |
| Transportation                                                                                                                                                                                        |              |              |              |              |              |              |              |              |              |              |              |              |       |
| on-road gasoline                                                                                                                                                                                      | 28.9         | 38.0         | 38.1         | 39.0         | 38.2         | 37.3         | 36.8         | 36.1         | 35.3         | 34.3         | 34.7         | 34.8         |       |
| distillate (primarily on-road)                                                                                                                                                                        | 5.6          | 10.8         | 10.8         | 11.4         | 9.9          | 7.9          | 8.9          | 10.2         | 8.7          | 8.8          | 9.3          | 8.8          |       |
| jet fuel                                                                                                                                                                                              | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | *1    |
| residual (primarily marine)                                                                                                                                                                           | 1.0          | 0.9          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | 0.8          | *2    |
| other                                                                                                                                                                                                 | 0.4          | 0.3          | 0.3          | 0.3          | 0.3          | 0.3          | 0.5          | 0.5          | 0.4          | 0.4          | 0.4          | 0.4          |       |
| Electricity                                                                                                                                                                                           |              |              |              |              |              |              |              |              |              |              |              |              |       |
| In-state electric                                                                                                                                                                                     | 12.4         | 19.8         | 18.5         | 22.7         | 19.1         | 15.0         | 17.7         | 15.7         | 15.1         | 14.0         | 18.0         | 16.9         |       |
| Imported electric                                                                                                                                                                                     | 14.1         | 13.1         | 11.7         | 11.9         | 10.0         | 7.7          | 7.7          | 6.8          | 5.2          | 4.9          | 2.9          |              | *3    |
| MSW incineration                                                                                                                                                                                      | na           | 0.8          | 0.8          | 1.0          | 0.8          | 0.8          | 0.7          | 0.7          | 0.6          | 0.8          | 0.8          | 0.8          | *3a   |
| Halogenated gases (ex. SF6)                                                                                                                                                                           | 0.0          | 3.0          | 3.2          | 3.2          | 3.3          | 3.4          | 3.9          | 4.0          | 4.1          | 4.6          | 4.8          | 5.0          | *4a   |
| SF6                                                                                                                                                                                                   | 1.0          | 0.4          | 0.3          | 0.3          | 0.3          | 0.3          | 0.2          | 0.2          | 0.1          | 0.2          | 0.2          | 0.1          | *4a   |
| Industrial non-fuel related                                                                                                                                                                           | 0.3          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.3          | 0.3          | 0.3          | *4    |
| Agriculture                                                                                                                                                                                           | 0.6          | 0.5          | 0.5          | 0.5          | 0.5          | 0.5          | 0.4          | 0.4          | 0.4          | 0.4          | 0.3          | 0.3          | *4    |
| Natural gas T&D                                                                                                                                                                                       | 2.5          | 2.4          | 2.6          | 2.6          | 2.6          | 2.5          | 2.5          | 2.5          | 2.5          | 2.3          | 2.3          | 2.2          | *4b   |
| Landfills, in-state                                                                                                                                                                                   | 11.7         | 3.6          | 3.5          | 3.5          | 3.4          | 3.3          | 3.3          | 3.2          | 3.2          | 3.0          | 3.3          | 3.6          |       |
| out-of-state                                                                                                                                                                                          | 2.6          | 1.0          | 1.0          | 1.1          | 1.1          | 1.1          | 1.1          | 1.1          | 1.1          | 1.1          | 1.2          | 1.3          | *5    |
| industrial                                                                                                                                                                                            | 1.1          | 0.3          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.1          | 0.1          | 0.1          |       |
| POTWs                                                                                                                                                                                                 | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.2          | 0.4          | 0.4          | 0.2          | *6    |
| Released thru land clearing                                                                                                                                                                           | 0.6          | 1.8          | 1.8          | 0.3          | 0.3          | 0.3          | 0.3          | 0.3          | 0.3          | 1.0          | 1.0          | 1.0          | *7    |
| Total gross emissions, MMT                                                                                                                                                                            | 129.6        | 142.3        | 134.6        | 142.2        | 131.1        | 119.3        | 120.1        | 119.2        | 112.0        | 113.4        | 119.9        | 109.0        |       |
| Sequestered by forests                                                                                                                                                                                | -4.0         | -6.0         | -6.0         | -7.6         | -7.6         | -7.6         | -7.6         | -7.6         | -7.6         | -8.1         | -8.1         | -8.1         | *7    |
| <b>Total net emissions MMT</b>                                                                                                                                                                        | <b>125.6</b> | <b>136.3</b> | <b>128.6</b> | <b>134.6</b> | <b>123.5</b> | <b>111.7</b> | <b>112.5</b> | <b>111.6</b> | <b>104.4</b> | <b>105.3</b> | <b>111.8</b> | <b>100.9</b> |       |
| <b>All numbers are estimates; uncertainty of totals is likely in range of plus or minus 5 percent</b>                                                                                                 |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *1 set equal to 1 MMT in effort to account for in-state only                                                                                                                                          |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *2 estimated to represent in-state only per methods of NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008, assumed same 2005 thru 2012                                         |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *3 2015 value negligible as in-state generation approximately equaled retail electricity purchased by NJ .                                                                                            |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *3a 1990 value from NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008, includes MSW incineration.                                                                             |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *4 2005 value from NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008; 2006 thru 2009 assumed equal to 2005. 2010 to 2015 Agr. from NJDEP                                      |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *4a based on U.S. data from EPA, apportioned to NJ based on population for HFCs, based on elec. use for SF6                                                                                           |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *4b Through 2009, based on pipeline data from US DOT. 2010 through 2012 assumed the same as 2009. Values for 2013-2015 estimated using EPA State GHG Inventory Tool (SGIT).                           |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *5 values from 2009 - 2012 assumed equal to 2008 and 2007. Out-of-state landfill estimated as fraction of in-state total based on American Society of Civil Engineers (ASCE) scorecard report for NJ. |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *6 earlier values have been adjusted; assumed equal to newly-calculated value for 2008 & 2009; 2010 thru 2015 from NJDEP                                                                              |              |              |              |              |              |              |              |              |              |              |              |              |       |
| *7 all values updated per NJDEP calculations.                                                                                                                                                         |              |              |              |              |              |              |              |              |              |              |              |              |       |
| MSW - municipal solid waste                                                                                                                                                                           |              |              |              |              |              |              |              |              |              |              |              |              |       |
| SF6 - sulfur hexafluoride                                                                                                                                                                             |              |              |              |              |              |              |              |              |              |              |              |              |       |
| T&D - transmission and distribution                                                                                                                                                                   |              |              |              |              |              |              |              |              |              |              |              |              |       |
| MMT - million metric tons                                                                                                                                                                             |              |              |              |              |              |              |              |              |              |              |              |              |       |
| POTW - Publicly Owned Treatment Works                                                                                                                                                                 |              |              |              |              |              |              |              |              |              |              |              |              |       |
| CO <sub>2</sub> e - carbon dioxide equivalent                                                                                                                                                         |              |              |              |              |              |              |              |              |              |              |              |              |       |

## Review of the 2015 Update Results

This section briefly reviews the updated inventory information shown in Table 1, identifying apparent trends and key data for certain sectors. This analysis also identifies implications for the GWRA 2020 and 2050 Statewide greenhouse gas limits.

### *New Jersey's Greenhouse Gas Emissions Profile Relative to GWRA Targets*

The GWRA establishes the 1990 Statewide GHG emissions of 125.6 MMTCO<sub>2</sub>e as the target limit for 2020. Table 1 shows the Statewide GHG emissions for 1990, 2005, and for each year from 2006 through 2015. Since 2008, the Statewide GHG emissions have been under the 2020 target limit.

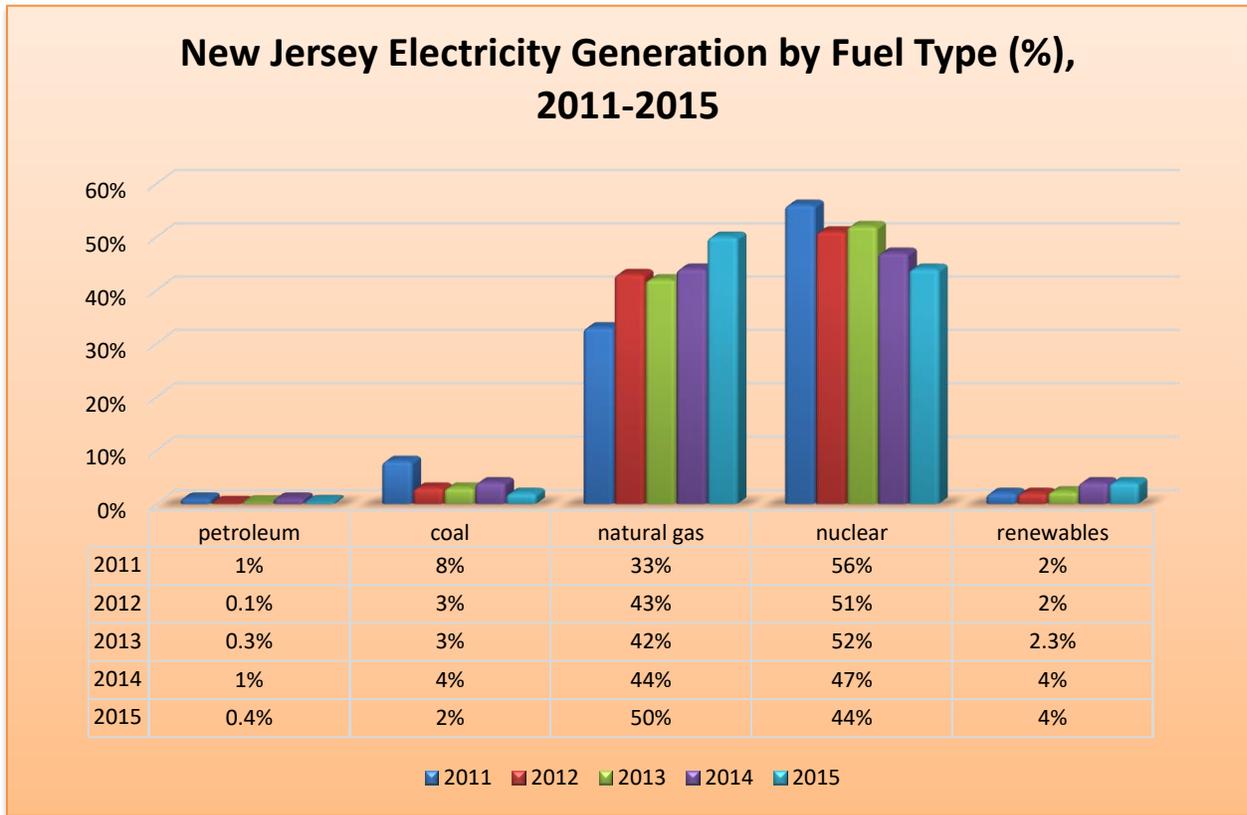
For the year 2050, the GWRA target limit is estimated to be 25.7 MMTCO<sub>2</sub>e representing 80% reduction from the GHG emissions for 2006. The estimate for 2015, which is **100.9** MMTCO<sub>2</sub>e (net GHG emissions) currently exceeds the 2050 limit by 75.2 MMTCO<sub>2</sub>e. Thus, substantial reductions in Statewide GHG emissions would be needed over the next three decades to meet the 2050 target limit.

The average gross Statewide GHG emissions for 2012, 2013 and 2014 is 107.2 MMTCO<sub>2</sub>e. The estimate of emissions for 2015 is approximately 6% below the average of the prior three years, representing a significant reduction. The likely explanations for this reduction are outlined below as follows:

#### *Electricity Generation*

The electricity generation sector contributed a comparatively smaller and declining share of the overall gross GHG emissions in 2015, relative to the transportation sector. Within the electricity generation sector, the switch in fuel use from coal to natural gas accounted for most of the GHG emissions reduction. In addition, declines in overall electricity consumption and decreases in imported electricity also contributed to these reductions in GHG emissions. Figure 2 shows the shift in the electricity generation fuel sources from 2011 to 2015.

Figure 2



Source of Basic Data: U.S. Energy Information Administration (EIA)

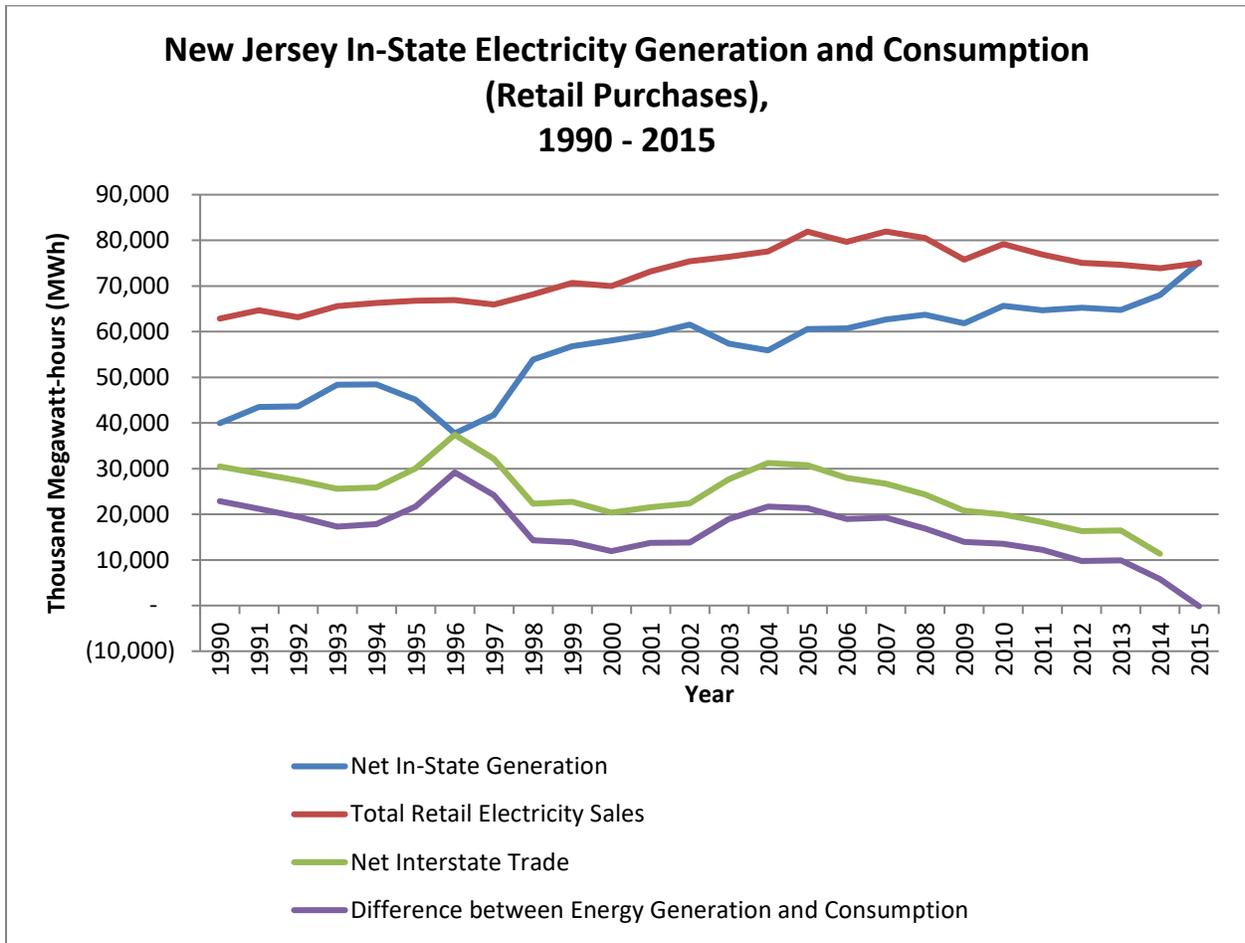
The consumption of coal for electricity generation drastically dropped to 22.9 trillion BTUs in 2015, from 49.6 trillion BTUs in 2011. During the same period (2011 – 2015), the consumption of natural gas for electricity production increased from 205.0 trillion BTUs to 295.0 trillion BTUs.<sup>9</sup> Between 2011 and 2015, coal in-State generation declined by 75%; renewables increased by 50%; natural gas generation increased by over 50%; and while nuclear generation in terms of MWh remained fairly constant, it has declined to 44% of total generation as natural gas generation has significantly increased.

Another contributing factor to the reductions in GHG emissions is the decreasing trend in imported electricity starting in 2008, with in-state generation totals for the first time exceeding in-state retail sales. With natural gas prices remaining low, NJ’s electricity demand has been met by relatively cleaner, in-State, combined cycle natural gas generation (NGCC). Figure 3

<sup>9</sup> U.S. Energy Information Administration (EIA), **Electric power sector consumption estimates, 1960 – 2015, New Jersey** [https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep\\_use/eu/use\\_eu\\_NJ.html&sid=NJ](https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_use/eu/use_eu_NJ.html&sid=NJ) (accessed 7/27/2017)

depicts this significant trend. It should be noted that in the 13-States PJM electric transmission region, New Jersey’s power sector has, by far, the lowest carbon dioxide emissions rate.

Figure 3



Source of Basic Data: U.S. Energy Information Administration (EIA)

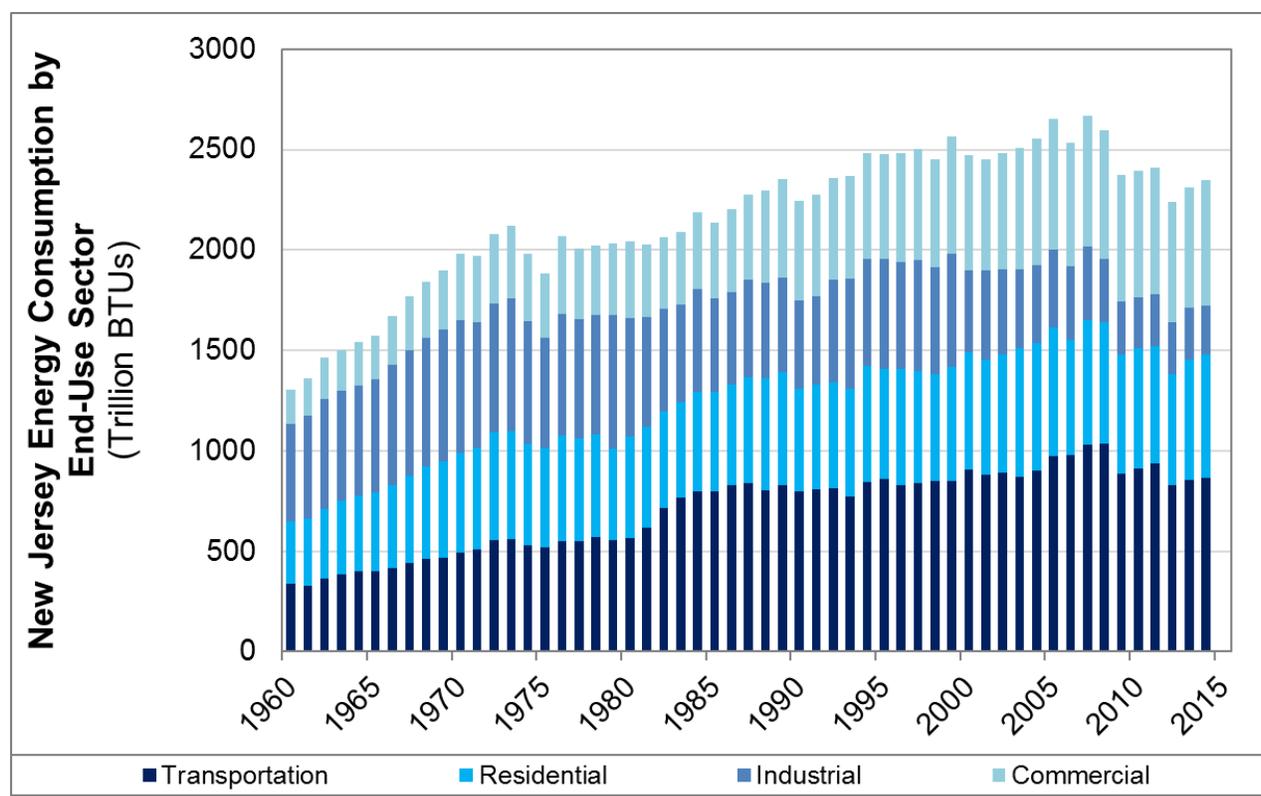
**Net Interstate Trade** (defined by EIA): Total supply – (total electric industry retail sales + direct use + estimated losses + total international exports if applicable)

## Transportation

The transportation sector continues to be the largest contributor to Statewide GHG emissions; emitting 45.8 MMTCO<sub>2</sub>e in 2015, which is more than 40% of New Jersey's total estimated GHG emissions for that year. This tracks directly with the sector's share of energy consumption in the State's total energy profile. Figure 4 shows the relative share of transportation among the major end-use sectors that consume energy.

Within this sector, there was a slight reduction in on-road gasoline, from 2012 to 2015. These reductions occurred despite the rebound in vehicle miles traveled (VMT) from a decline in previous years (e.g., during the 2008-2009 economic recession). The emissions from the other sectors remained virtually flat. Long-term reductions in emissions will require significant improvements in fuel efficiency and replacement of most combustion engines with electric motors.

**Figure 4**



Source: NJDEP/Division of Science, Research, and Environmental Health. Environmental Trends Report

## *Commercial, Industrial, and Residential*

These three sectors collectively comprise a large source of GHG emissions. Of the three, only the industrial sector showed significant decreases in GHG emissions from 2012 to 2015 with emission declines of 50%. This could be attributed to a combination of factors: decreased share of the industry sector in the State's economy, decreased energy usage (see Figure 4), and improvements in energy efficiency measures.

On the other hand, GHG emissions from the residential sector have increased by 28% from 2012 to 2015. Weather factors particularly the polar vortex<sup>10</sup> in 2014 played a role in driving this surge in emissions due to increased energy usage to meet greater demand for heating.

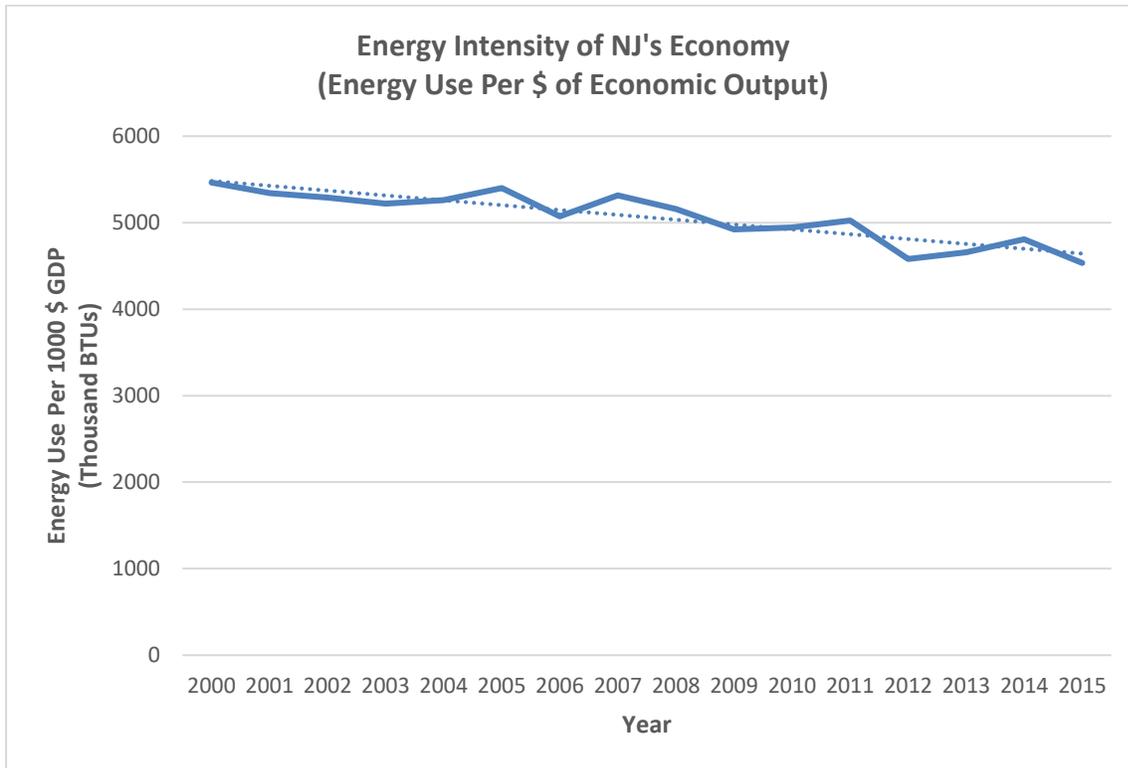
The emissions from the commercial sector remained practically the same during the period of 2012 to 2015. This is a growing segment of the State's economy that has kept its emissions relatively constant. There is a perceptible decline in energy intensity of the State's economy over the last decade and a half (2000 – 2015), and this is reflected in the GHG emissions pattern of the commercial and industrial sectors. Figure 5 depicts this trend in New Jersey's *energy intensity*, which tracks energy consumed per unit of economic output (gross domestic product or GDP).<sup>11</sup>

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<sup>10</sup> See <https://scijinks.gov/polar-vortex/>

<sup>11</sup> **Energy Intensity:** A ratio of energy consumption to another metric, typically national gross domestic product, in the case of a country's energy intensity. Sector-specific intensities may refer to energy consumption per household, per unit of commercial floor space, per dollar value of industrial shipment, or another metric indicative of a sector. Improvements in energy intensity include energy efficiency and conservation as well as structural factors not related to technology or behavior.

Figure 5



Source of Basic Data: U.S. Bureau of Economic Analysis (BEA) for GDP data and Energy Information Administration (EIA) for energy consumption data. <https://www.eia.gov/state/seds/seds-data-complete.php?sid=NJ#Consumption> (06/30/2016)

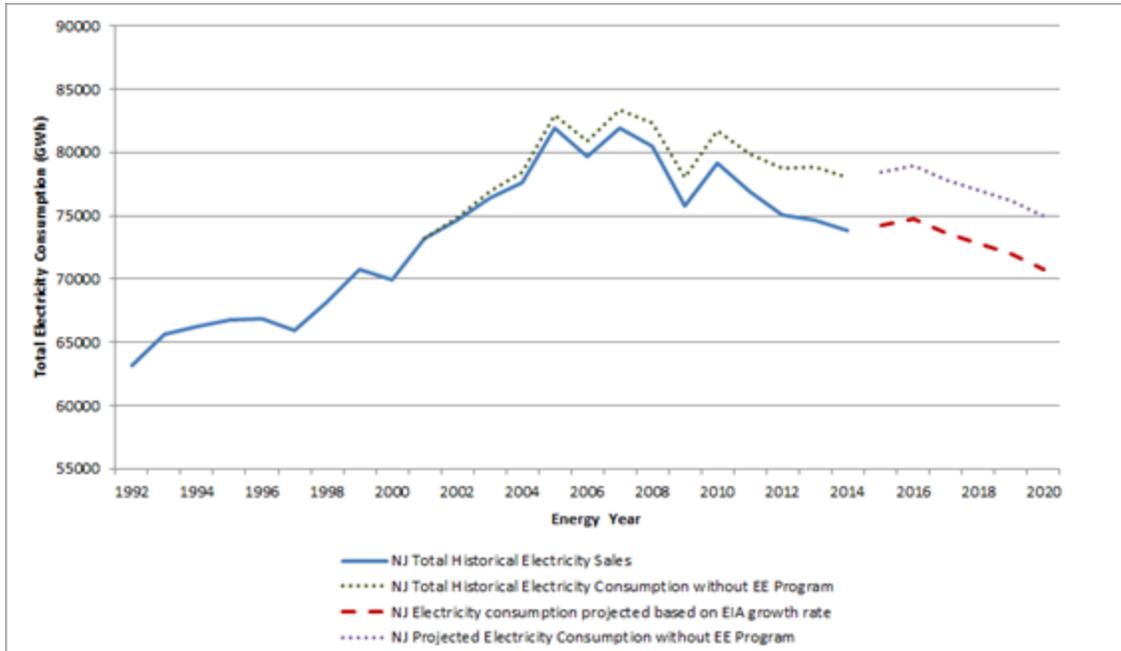
Energy intensity has decreased 17% in New Jersey over the period 2000 to 2015. The State's average energy intensity in recent years has been 41% below the corresponding national average, indicating that New Jersey's energy usage relative to productivity outperforms the national average (average of all States).<sup>12</sup>

New Jersey has implemented a variety of energy efficiency (EE) and conservation programs, including combined heat and power (CHP) initiatives, to improve energy efficiency, conserve energy and reduce peak demand. The State's broad range of conservation, EE, and CHP initiatives were designed to be a cost-effective way to lessen energy and capacity costs, and reduce emissions. Figure 6 below illustrates the impact of energy efficiency measures on

<sup>12</sup> U.S. Energy Information Administration (EIA). **Energy Intensity by State** (2000 – 2014) <http://www.eia.gov/environment/state/analysis/pdf/table6.pdf> (accessed 8/28/2016)

electricity use in the State, showing both the actual usage and what the expected usage would have been absent any energy efficiency programs.

Figure 6



Source: New Jersey Energy Master Plan Update (2015) [http://nj.gov/emp/docs/pdf/New\\_Jersey\\_Energy\\_Master\\_Plan\\_Update.pdf](http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf)

## Appendix: Changes in Greenhouse Gas Emissions Inventory Data and Methods in 2015

### *In-State Electricity Generation and MSW incineration*

The methodology used in previous inventories was applied to generate the 2015 Inventory update. The 2008 Inventory documentation details the methodology employed. Results were compared with data from the U.S. Environmental Protection Agency (EPA) GHG Emissions Reporting Program for consistency.

### *Out-of-State Landfills*

Values from 2013 to 2015 estimated as fraction of the in-State total based on data cited in latest *Infrastructure Report Card for New Jersey* (waste management) by the American Society of Civil Engineers (ASCE). <https://www.infrastructurereportcard.org/state-item/new-jersey/> (accessed 4/11/2017)

### *Publicly-Owned Treatment Works (POTWs)*

Values were revised, in part, based upon EPA's State Greenhouse Gas Inventory Tool (SIT), which was used for estimating 2013 through 2015 emissions.

### *Carbon Sequestered by Forests and Other Land-Uses and Released Through Land Clearing*

Carbon uptake (removal from the atmosphere) by forests and other land-uses was recalculated based on 2012 NJDEP Land Use/Land Cover (LULC) data<sup>13</sup>; the latest data available from which projections beyond 2012 were based. The change in carbon released from clearing of vegetative cover due to land conversions has also been recalculated based on the updated and projected land-use data. For consistency, comparative reference was made to (a) the draft update of the Land Use and Land Cover section of the *NJDEP Environmental Trends Report*; and (b) the latest analysis of the NJDEP LULC data made by Rutgers and Rowan Universities (Lathrop, Bognar and Hasse. December 2016. **Changing Landscapes in the Garden State: Land Use Change in NJ 1986 thru 2012**).

[http://crssa.rutgers.edu/projects/lc/download/reports/NJ\\_Urb\\_Growth\\_III\\_executive\\_summary\\_2012\\_LathropHasse.pdf](http://crssa.rutgers.edu/projects/lc/download/reports/NJ_Urb_Growth_III_executive_summary_2012_LathropHasse.pdf) (accessed 5/12/2017)

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<sup>13</sup> LULC data for this update provided by the NJDEP, Office of Information Resource Management, Bureau of Geographic Information Systems and Ambient Data (through John Tyrawski, Research Scientist, August 2016).