



STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

**2012 Statewide Greenhouse Gas
Emissions Inventory**

September 2014

2012 Update to New Jersey’s Statewide Greenhouse Gas (GHG) Emissions Inventory

Background

The previous GHG Emissions Inventory update was issued for the year 2009, and published in November 2012. This new Inventory provides estimates for 2010, 2011, and 2012, and highlights features relevant for the assessment of progress in meeting the GHG emission limits set by the State’s 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 2008.¹ 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. Three subsequent updates were completed in November 2009 (presenting 2005 – 2007 data), May 2011 (presenting 2008 data), and November 2012 (presenting 2009 data). This 2012 Inventory report constitutes the fourth update.²

Data and Methods

Consistent with previous statewide inventories, the 2012 Inventory is primarily based on emissions data from the NJDEP emission statement database³ and on fuel use data from the Energy Information Administration (EIA) of the U.S. Department of Energy.^{4,5} 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 and second updates, mentioned above. A few minor changes in methodology have been made for the 2012 Inventory, discussed briefly in the appendix to this report.

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

² 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.

³ NJDEP, *Bureau of Air Quality Planning, Division of Air Quality*. (Data provided through Danny Wong, Research Scientist, July 15, 2014)

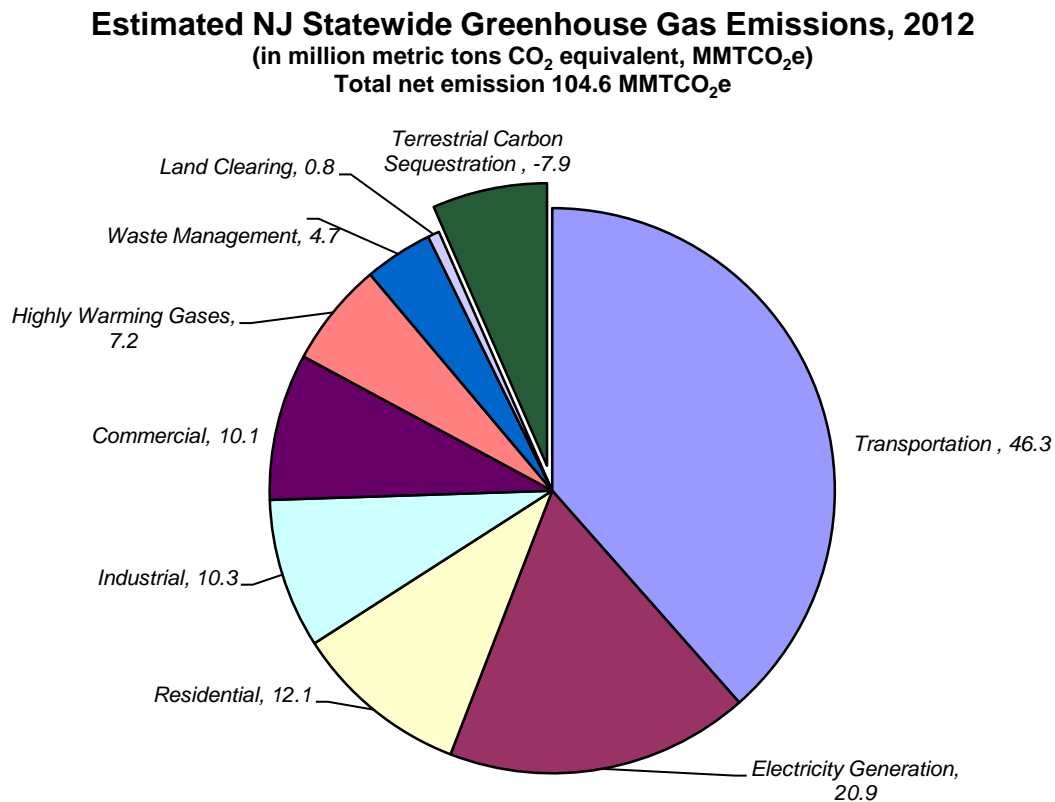
⁴ <http://www.eia.doe.gov/oiaf/1605/coefficients.html> (accessed, June 30, 2010)

⁵ <http://www.eia.gov/state/seds> (accessed, July 10, 2014)

New Jersey GHG Emissions for 2010, 2011, and 2012

Estimated net greenhouse gas emissions⁶ are as follows: **112.7** million metric tons of carbon dioxide equivalent (*MMT_{CO₂e}*) in 2010; **111.7** *MMT_{CO₂e}* in 2011; 104.6 *MMT_{CO₂e}* in 2012.⁷ The sectoral distribution of the greenhouse gas emissions for 2012 is shown in Fig. 1 below.

Figure 1



The three leading sectors of GHG emissions in 2012 are transportation, electricity generation, and residential, commercial and industrial fossil fuel use. Transportation remains as the largest

⁶ **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 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.

⁷ "Carbon dioxide equivalent" represents the conversion of all emitted compounds, which include methane and other gases, to the equivalent quantity of carbon dioxide using global warming potentials (GWP), 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/ (accessed 7/15/2014). The Technical Summary is available at www.climatechange2013.org/image/report/WGIAR5_TS_FINAL.pdf (accessed 7/15/2014).

source at 46.3 MMTCO₂e, which is 41% of the gross statewide emissions. Electricity generation follows as the next largest source at 20.9 MMTCO₂e, which is 19% of statewide emissions. The combined contribution of the residential, commercial and industrial sectors (primarily for heating) is 32.5 MMTCO₂e, which is 29% of the gross emissions, of which residential heating is the most significant portion at 12.5 MMTCO₂e, which is 11% of the gross emissions. Carbon captured by the state's natural sinks (growth of forests and other vegetation plus soils left undisturbed) amounted to 7.9 MMTCO₂e in 2012, "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	Notes
Commercial	10.7	10.8	9.2	10.6	10.2	10.8	10.6	11.3	10.1	
Industrial	19.8	17.3	16.3	15.9	13.9	10.6	9.1	10.3	10.3	
Residential	15.2	16.3	13.7	15.6	14.9	15.2	14.2	13.6	12.1	
Transportation										
on-road gasoline	28.9	38.0	38.1	39.0	38.2	37.3	36.8	36.1	35.3	
distillate (primarily on-road diesel)	5.6	10.8	10.8	11.4	9.9	7.9	8.9	10.2	8.7	
jet fuel	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	*2
other	0.4	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.4	
Electricity										
In-state electric	12.4	19.8	18.5	22.7	19.1	15.0	17.7	15.7	15.1	*3
Imported electric	14.1	13.1	11.7	11.9	10.0	7.7	7.7	6.8	5.2	
MSW incineration	na	0.8	0.8	1.0	0.8	0.8	0.7	0.7	0.6	
Halogenated gases (ex. SF6)										
SF6	1.0	0.4	0.3	0.3	0.3	0.3	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	*4
Agriculture	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	*4
Natural gas T&D	2.5	2.4	2.6	2.6	2.6	2.5	2.5	2.5	2.5	*4b
Landfills, in-state										
out-of-state	2.6	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	*5
industrial	1.1	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
POTWs	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	*6
Released thru land clearing	0.6	1.7	1.7	0.8	0.8	0.8	0.8	0.8	0.8	
Total gross emissions, MMT	129.6	142.2	134.6	142.6	131.6	119.8	120.6	119.7	112.5	
Sequestered by forests	-4.0	-7.6	-7.6	-7.9	-7.9	-7.9	-7.9	-7.9	-7.9	*7
Total net emissions MMT CO2eq	125.6	134.6	127.0	134.7	123.7	111.9	112.7	111.7	104.6	
All numbers are estimates; uncertainty of totals is likely in range of plus or minus 5 percent										
*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 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, 2011, and 2012 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.										
*5 values from 2009 on are assumed equal to 2008 and 2007.										
*6 earlier values have been adjusted; assumed equal to newly-calculated value for 2008 & 2009; 2010 thru 2012 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										
CO2e - carbon dioxide equivalent										

Analysis of the 2012 Update Results

This section presents a brief analysis of the updated inventory information shown in Table 1, identifying trends and highlighting 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 MMTCO₂e as the target limit for 2020. Table 1 shows the statewide GHG emissions for 1990, 2005, and for each year from 2006 through 2012. Since 2008, the statewide GHG emissions have been under the 2020 target limit.

For the year 2050, the GWRA target limit is an 80% reduction from the GHG emissions for 2006, which is estimated at 25.4 MMTCO₂e. The estimate for 2012, which is **104.6** MMTCO₂e (net GHG emissions), exceeds the 2050 limit by 79.2 MMTCO₂e. 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 2009, 2010 and 2011 is 120 MMTCO₂e. The estimate of emissions for 2012 is approximately 7% below that average, representing a significant reduction. There are a number of plausible explanations for this reduction.

Weather data from the *Office of the NJ State Climatologist* show that the temperatures in 2012 were unusually warm in the winter and unusually cool in the summer. Mild weather conditions result in reduced fuel and electricity consumption, for both heating and cooling, by the residential, commercial and industrial sectors. The heating and cooling degree days for 2012 are shown in Figures 2 and 3, which serve to define 2012 as a period of mild winter and cool summer temperatures.⁸

⁸ **Heating Degree Days (HDD):** A measure of how cold a location is over a period of time relative to a base temperature, most commonly specified as 65 degrees Fahrenheit. The measure is computed for each day by subtracting the average of the day's high and low temperatures from the base temperature (65 degrees), with negative values set equal to zero. Each day's heating degree days are summed to create a heating degree day measure for a specified reference period. Heating degree days are used in energy analysis as an indicator of space heating energy requirements or use.

Cooling Degree Days (CDD): A measure of how warm a location is over a period of time relative to a base temperature, most commonly specified as 65 degrees Fahrenheit. The measure is computed for each day by subtracting the base temperature (65 degrees) from the average of the day's high and low temperatures, with negative values set equal to zero. Each day's cooling degree days are summed to create a cooling degree day measure for a specified reference period. Cooling degree days are used in energy analysis as an indicator of air conditioning energy requirements or use.

Figure 2

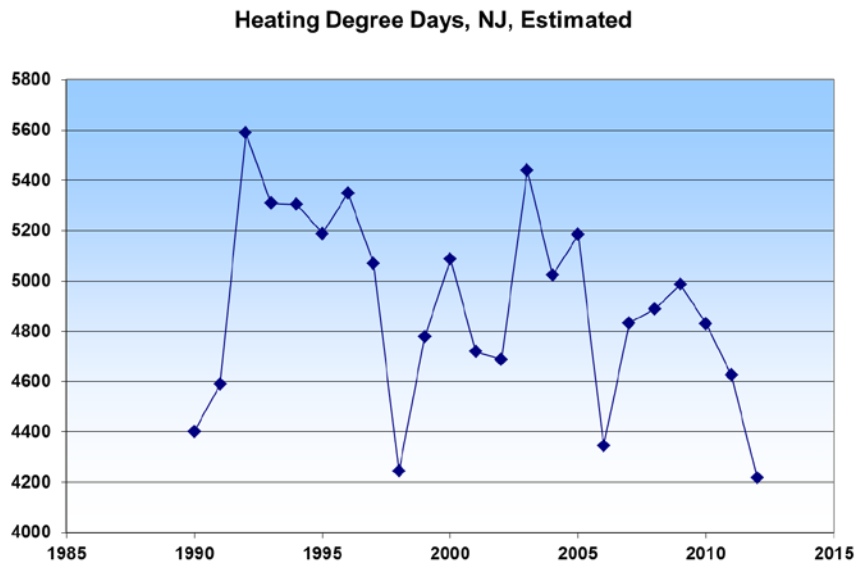
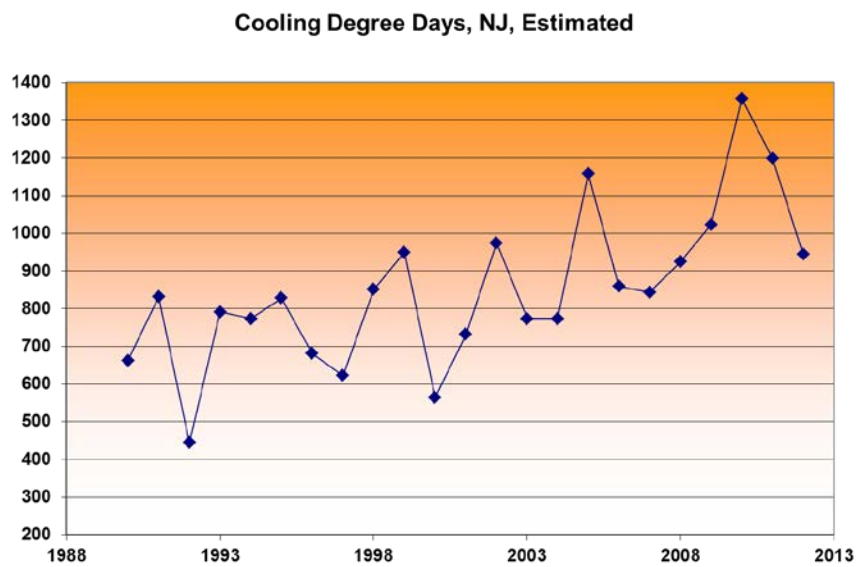


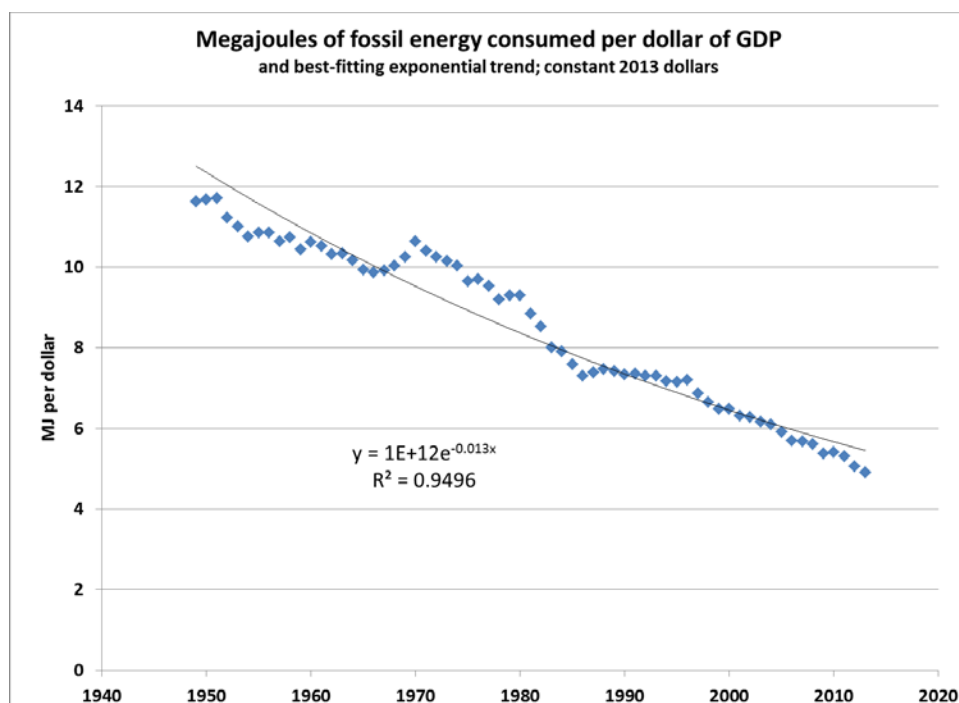
Figure 3



Emissions reductions in 2012 can also be attributed to the sharp reduction in the use of coal for electricity generation, and its replacement by natural gas. The consumption of coal for the production of electricity drastically dropped to 25.6 trillion BTUs in 2012, from 72.0 trillion BTUs in 2010. During the same period (2010 – 2012), the consumption of natural gas for electricity production increased from 204.2 trillion BTUs to 233.5 trillion BTUs.⁹

Increased energy efficiency (EE) in the residential, commercial and industrial sectors is another reason for GHG emissions reduction. This comports with the national trend. Figure 4 depicts this national trend in terms of *energy intensity*, which tracks energy consumed per unit of economic output (gross domestic product or GDP).¹⁰

Figure 4



⁹ U.S. Energy Information Administration (EIA), **Electric power sector consumption estimates, 1960 – 2012, New Jersey** http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_use/eu/use_eu_NJ.html&sid=NJ (accessed 8/28/2014)

¹⁰ **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.

At the state level, energy intensity has decreased 8.2% in New Jersey over the period 2000 to 2011. The state's average energy intensity in recent years has been 31% below the corresponding national average, indicating that New Jersey's energy usage relative to productivity outperforms the national average (all states).¹¹

New Jersey has adopted the 2009 *International Energy Conservation Code* or equivalent. New Jersey is among 25 states adopting the code for residential buildings, and among 30 states adopting the code for commercial buildings.¹² In addition, New Jersey is among only 14 states in the country which have appliance efficiency standards that are more stringent than federal requirements.¹³

Continuation of these favorable trends would help sustain or improve upon emissions reduction in the years ahead. The magnitude of reductions required by the 2050 limit, however, present significant challenges to achieve with existing technologies for each of the major GHG emission sectors and would likely require extreme changes in energy usage patterns.

Transportation

The transportation sector continues to be the largest contributor to statewide GHG emissions. Transportation as a source was 46.3 MMTCO₂e in 2012, which is more than 40% of New Jersey's total GHG emissions. Within this sector, however, there was a moderate reduction in certain sub-sectors, particularly in on-road gasoline and on-road diesel, from 2011 to 2012. These reductions occurred despite the rebound in vehicle miles traveled (VMT) from an earlier decline during the 2008-2009 economic recession. Further emission reductions in this sector are expected as new federal mileage standards for motor vehicles (mpg) take effect. Additional measures will be needed to yield substantial declines from this dominating GHG emission sector.

Electricity Generation

The electricity generation sector contributed a comparatively smaller and declining share of the overall gross GHG emissions in 2012, relative to the transportation sector. The switch in fuel from coal to natural gas accounted for most of this decrease. In addition, declines in overall

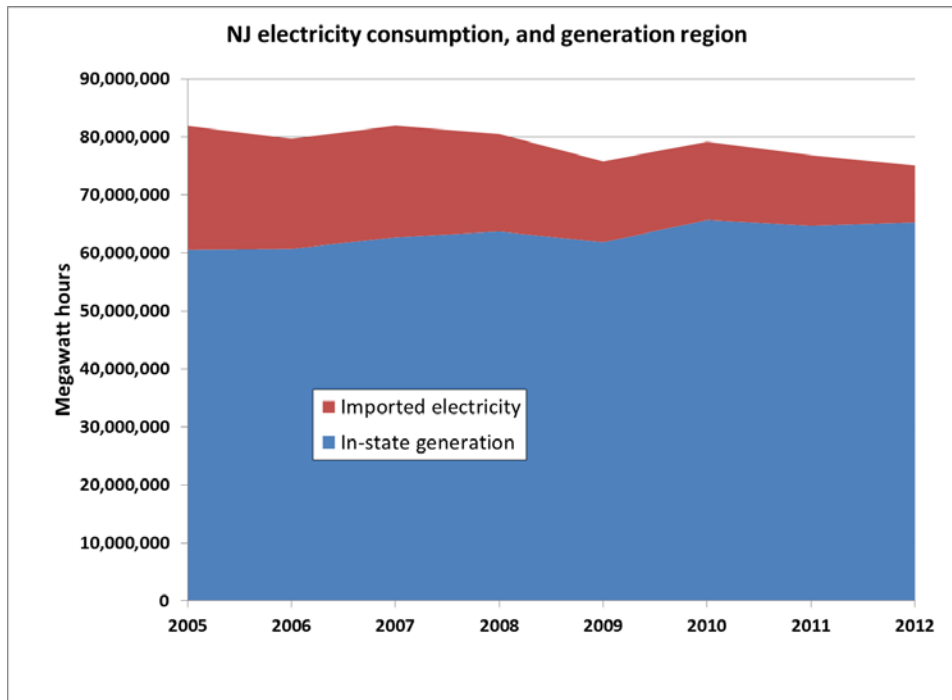
¹¹ U.S. Energy Information Administration (EIA). **Energy intensity by state** (2000 – 2011) <http://www.eia.gov/environment/state/analysis/pdf/table6.pdf> (accessed 8/28/2014)

¹² **Residential and Commercial Building Energy Codes** establish a minimum level of energy efficiency for residential and commercial buildings. Generally, codes specify requirements for "thermal resistance" of the building shell and windows, and minimum heating and cooling equipment efficiencies. The NJ Department of Community Affairs is adopting the 2015 IECC code and 2013 ASHRAE 90.1 standard, effective July 1, 2015.

¹³ States can set minimum energy efficiency standards for products not covered by mandatory federal standards. The U.S. Department of Energy can also grant a waiver to allow them to set stronger standards for products covered by existing federal standards.

electricity consumption and decreases in imported electricity also contributed to these reductions in GHG emissions. Figure 5 depicts this recent trend.

Figure 5



Reduction in electricity usage from 2008 to 2009 is attributed to the recession in economic activity. New Jersey's gross domestic product (GDP) increased by 2010,¹⁴ and the decline in GHG emissions is most likely attributable to other factors, such as increased energy efficiency and the lower demand for heating and cooling due to mild weather conditions.

Another reason for emissions reductions is the increase in electricity produced by solar photovoltaic (PV) systems, although this impact is small relative to the total electric generation sector. New Jersey is amongst the three states that lead the nation in installed solar PV capacity, with New Jersey second in the nation for installed solar net-metered capacity. In 2012, solar PV systems in New Jersey were producing approximately 1.2 million MWh of electricity, based upon year-end figures of 956 MW of solar capacity¹⁵ at a capacity factor of 14.5 percent. Relative to average GHG emissions from in-state and out-of-state electric generation (and solar energy comprising approximately 1.6% of the total), New Jersey's solar generation reduces GHG

¹⁴ http://www.eia.gov/state/seds/sep_use/notes/use_gdp.pdf (accessed 8/13/14)

¹⁵ By February 2013, the state had surpassed 1000 MW of installed solar capacity.

emissions by approximately 0.3-0.6 MMTCO₂e, compared to the Electricity Generation sector's emissions of 20.9 MMTCO₂e in 2012.

Residential and Commercial

From 2011 to 2012, residential GHG emissions from fuel use decreased approximately 16 percent, while the commercial sector's emissions declined by 7 percent. Weather factors and improvements in energy efficiency may account for these reductions.

Industrial

For the years 2009 to 2012, the industrial sector's GHG emissions remained relatively flat, with minor fluctuations. Industrial, non-fuel related GHG emissions have been constant throughout the same period.

Appendix A: Changes in Greenhouse Gas Emissions Inventory Data and Methods in 2012

In-State Electricity Generation and MSW incineration

The methodology used in previous inventories was applied to generate the 2012 Inventory update. The 2008 Inventory documentation details the methodology employed.

Out-of-State Landfills

The 2008 Inventory documentation details the methodology employed.

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 2010 through 2012 emissions.

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

Beginning with the 2009 inventory, carbon uptake (removal from the atmosphere) by forests and other land-uses has been re-estimated based on 2012 NJDEP Land Use/Land Cover data.¹⁶ The change in carbon released from clearing of vegetative cover due to land conversions has also been recalculated based on the updated land-use data.

Acknowledgement

The analytical framework and methodology for the New Jersey GHG Emissions Inventory program was developed by Dr. Michael Aucott, while serving as Research Scientist at the *Office of Science, NJDEP, through 2012*. Dr. Aucott undertook an inventory update for 2012 with Rutgers University, and collaborated with *the Office of Sustainability and Green Energy, NJDEP*, for the preparation of this 2012 Inventory. The technical assistance provided by Dr. Aucott in the data analysis that underlies this report is gratefully acknowledged.

¹⁶ 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, June 6, 2014).