State of New Jersey
Department of Environmental Protection

Statewide Greenhouse Gas Emission Inventory for 2008

Office of Climate and Energy

May 2011

2008 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory

Background

This report updates New Jersey's Statewide Greenhouse Gas Emission Inventory and presents statistics on greenhouse gas emissions for the biennial report pursuant to the Global Warming Response Act (N.J.S.A. 26:2C-43). It discusses greenhouse gas emissions estimates for the most current and complete data for New Jersey (2008), recent trends, and progress towards achieving the 2020 and 2050 limits. The last biennial report was completed in November 2009 and included estimated greenhouse gas emissions for 2005 through 2007.[1]

Methods

As with previous statewide inventories, the inventory for 2008 is largely based on fuel use data obtained from the Energy Information Administration (EIA).[2] Emission factors used to estimate greenhouse gas emissions from fuel use were also obtained from EIA[3] and the State Inventory Tool (SIT)[4] developed by the Environmental Protection Agency. Details on methods used to estimate releases from these data are discussed in the report "New Jersey Greenhouse Gas Inventory and Reference Case Projections 1990-2020" (Inventory and Projections) dated November 2008.[5]

The inventory for 2008 incorporates a few changes to the data and methods discussed in the November 2008 Inventory and Projections report. These changes are briefly discussed in Appendix A. Changes in data and methods, when applied to prior year releases in 1990 and 2006, resulted in minor adjustments to the baselines used to track progress towards the 2020 and 2050 Statewide greenhouse gas limits. The 1990 baseline was increased from 122.9 to 125.6 million metric tons of carbon dioxide equivalent emissions (MMTCO2e) and the 2006 baseline was decreased from 127.7 to 126.8 MMTCO2e. These baseline adjustments are documented in Appendix A.

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1 New Jersey Statewide Greenhouse Gas Emissions Inventory Update: 2005, 2006, and 2007 Estimates

http://www.nj.gov/dep/oce/inventory-05-06-07.pdf

[2] http://www.eia.doe.gov/emeu/states/state.html?q_state_a=nj&q_state=NEW%20JERSEY, downloaded on June 30, 2010.

[3] http://www.eia.doe.gov/oiaf/1605/coefficients.html

[4] http://securestaging.icfconsulting.com/sit/

[5] http://www.nj.gov/globalwarming/home/documents/pdf/20081031inventory-report.pdf

Statewide Greenhouse Gas Emissions for 2008

The most currently available statewide data covers emissions in 2008. In 2008, total Statewide greenhouse gas emissions were 124.9 MMTCO2e. Figure 1 below presents the greenhouse gas emissions for each sector.

The top three sectors for greenhouse gas emissions remain transportation, electricity generation and combined fossil fuel use in the residential, commercial and industrial sectors. Transportation remains the largest sector accounting for approximately 50 MMTCO2e, which is 40 percent of statewide greenhouse gas emissions. Electricity generation is second releasing approximately 30 MMTCO2e (~24 percent) of Statewide emissions. Fossil fuel used in residential, industrial and commercial sectors mainly for heating had combined releases of 39 MMTCO2e.

Figure 1: Statewide Greenhouse Gas Emissions, MMTCO2e (2008)

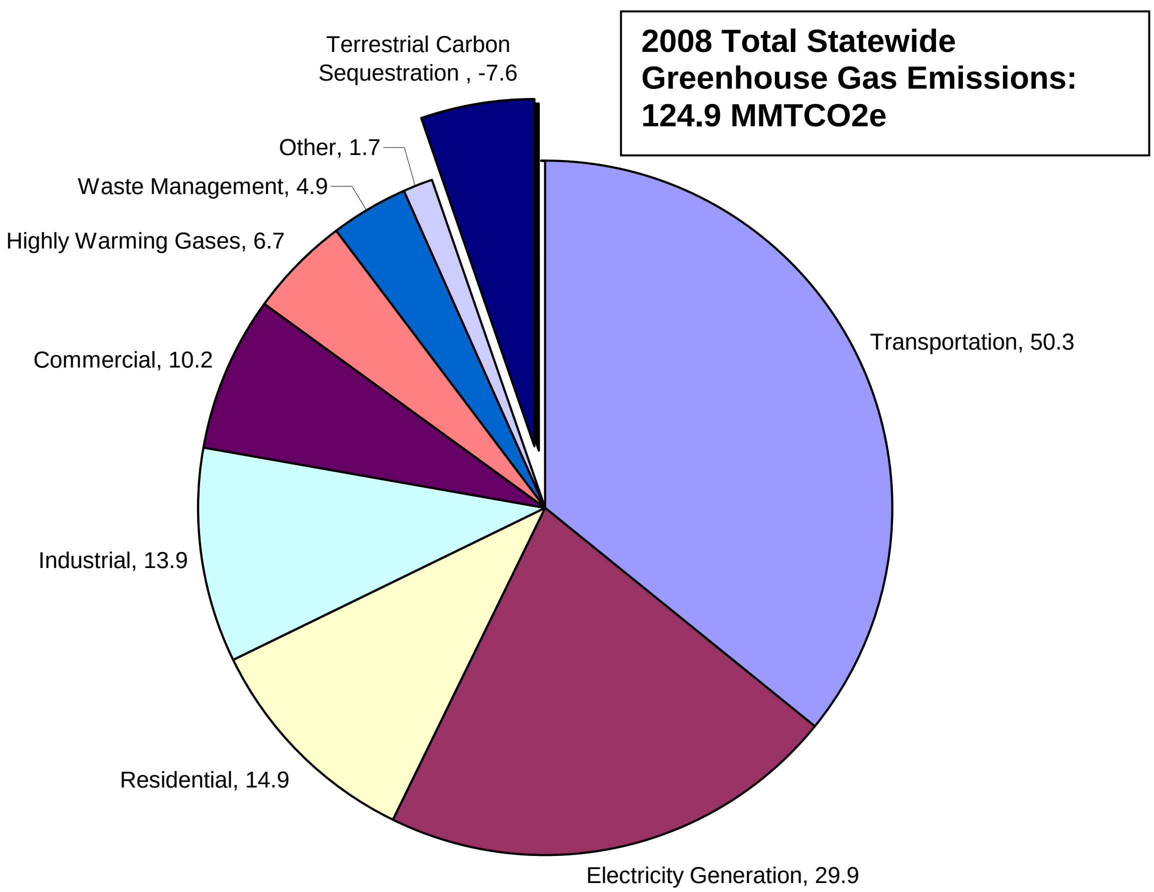

Table 1: Estimated New Jersey Statewide Greenhouse Gas Emission
Million Metric Tons Carbon Dioxide Equivalents

Sector	1990		2005	2006	2007	2008	Notes
Commercial	10.7		10.8	9.2	10.6	10.2	
Industrial	19.8		17.3	16.3	15.9	13.9	
Residential	15.2		16.3	13.7	15.6	14.9	
Transportation							
on-road gasoline	28.9		38.0	38.1	39.0	38.2	
distillate (primarily on-road diesel)	5.6		10.8	10.8	11.4	9.9	
jet fuel	1.0		1.0	1.0	1.0	1.0	**1*
residual (primarily marine)	1.0		0.9	0.8	0.8	0.8	**2*
other	0.4		0.3	0.3	0.3	0.3	
Electricity							
In-state electric	12.4		19.8	18.5	22.7	19.1	**3*
Imported electric	14.1		13.1	11.7	11.9	10.0	
MSW incineration	na		0.8	0.8	1.0	0.8	
Halogenated gases (ex. SF6)	0.0		2.9	3.0	3.1	3.2	
SF6	1.0		0.3	0.3	0.3	0.3	
Industrial non-fuel related	0.3		0.1	0.1	0.1	0.1	**4*
Agriculture	0.6		0.5	0.5	0.5	0.5	**4*
Natural gas T&D	2.5		2.4	2.6	2.6	2.6	
Landfills, in-state	11.7		3.6	3.5	3.5	3.4	
out-of-state	2.6		1.0	1.0	1.1	1.1	
industrial	1.1		0.3	0.2	0.2	0.2	
POTWs	0.2		0.2	0.2	0.2	0.2	**5*
Released thru land clearing	0.6		1.7	1.7	1.7	1.7	*5
Total gross emissions, MMT	**129.6**		**142.1**	**134.4**	**143.4**	**132.5**	
Sequestered by forests	-4.0		-7.6	-7.6	-7.6	-7.6	*5
Total net emissions MMT CO2eq	**125.6**		**134.5**	**126.8**	**135.9**	**124.9**	

Reference 1 is NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008

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 Ref. 1

*3 1990 value from Ref. 1, includes MSW incineration.

*4 2005 value from Ref. 1; 2006, 2007 & 2008 assumed equal to 2005

*5 earlier values have been adjusted; See Appendix A for Baseline Adjustments for 1990 and 2006

Trends and Progress Towards 2020 and 2050 Limits

This section briefly discusses recent trends in greenhouse gas emissions and progress toward achieving the 2020 and 2050 statewide greenhouse gas limits. Trends for specific sectors are discussed, including key related data for specific sectors, where appropriate.

Statewide Progress in meeting 2020 and 2050 limits

Table 1 above presents estimated statewide greenhouse gas emissions for 1990 (the 2020 limit) and 2005 through 2008. Statewide greenhouse gas emissions in 2008 decreased by approximately 11.0 MMTCO2e compared to 2007 emissions (a decrease of 8.1 percent). The U. S. Environmental Protection Agency also estimated a decrease at the national level of approximately 2.9 percent between 2007 and 2008.[6] In New Jersey the Electricity sector accounted for the biggest reductions at 5.6 MMTCO2e. Transportation sector releases were down 2.3 MMTCO2e. Potential reasons for these decreases are briefly discussed below in relevant sectors.

The Statewide greenhouse gas limit for 2020 is to stabilize emissions to levels seen in 1990, which is 125.6 MMTCO2eq. In 2008, Statewide greenhouse gas emissions were slightly under the 2020 limit, at 124.9 MMTCO2, approximately 0.7 MMTCO2 under the 2020 limit.

The Statewide greenhouse gas limit for 2050 is 80 percent less than the 2006 level of Statewide greenhouse gas emissions, or 25.4 MMTCO2e. To achieve this limit, greenhouse gas emissions must be reduced approximately 101.5 MMTCO2e compared to 2006 emissions. The 2008 releases are 124.9 MMTCO2e, approximately 99.5 MMTCO2e above the 2050 limit.

Transportation

Greenhouse gas releases from transportation remained the biggest contributor to Statewide greenhouse gas emissions; however, 2008 saw the biggest reduction in transportation emissions since 1992 as further supported by NJDOT data for Vehicle Miles Traveled (VMT) (Figures 2 and 3). Transportation releases decreased by approximately 2.3 MMTCO2e (4.4 percent) between 2007 and 2008. Releases from the use of diesel fuel had the biggest reductions on an absolute and percentage basis with a decrease of 1.5 MMTCO2e (12 percent), while motor gasoline had reductions of 0.8 MMTCO2e (2.1 percent).

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[6] http://epa.gov/climatechange/emissions/usinventoryreport.html

Figure 2: Estimated Transportation Sector Greenhouse Gas Releases 1990 – 2008 (MMTCO2e)[7]

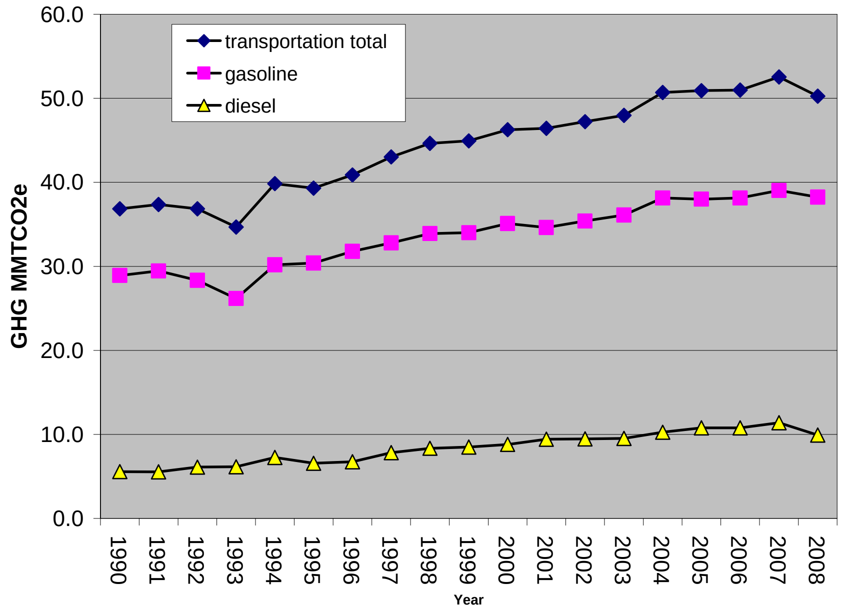
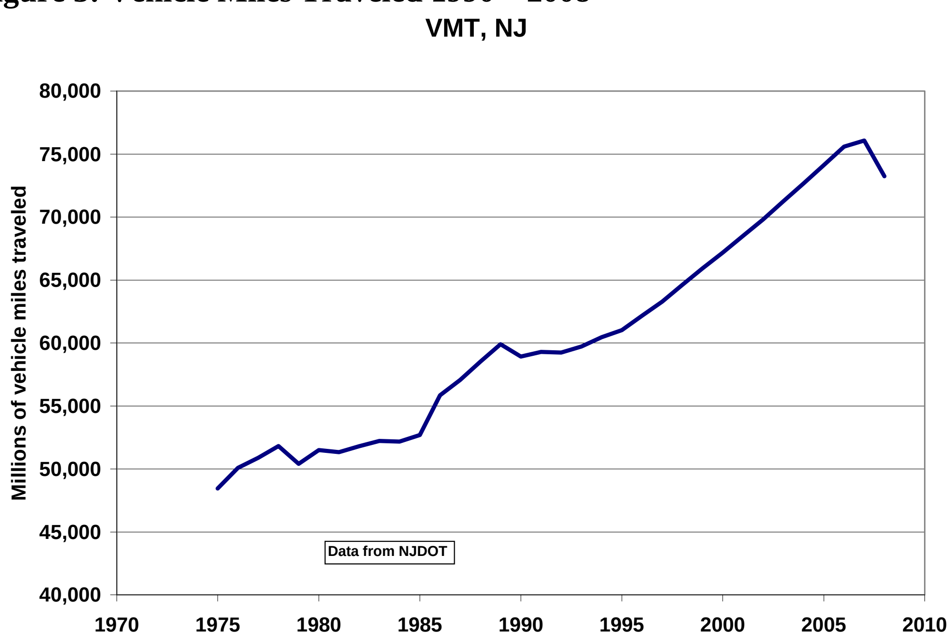


Figure 3: Vehicle Miles Traveled 1990 – 2008[8]



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[7] Estimated by NJDEP using data from EIA State Energy Data System (SEDS)

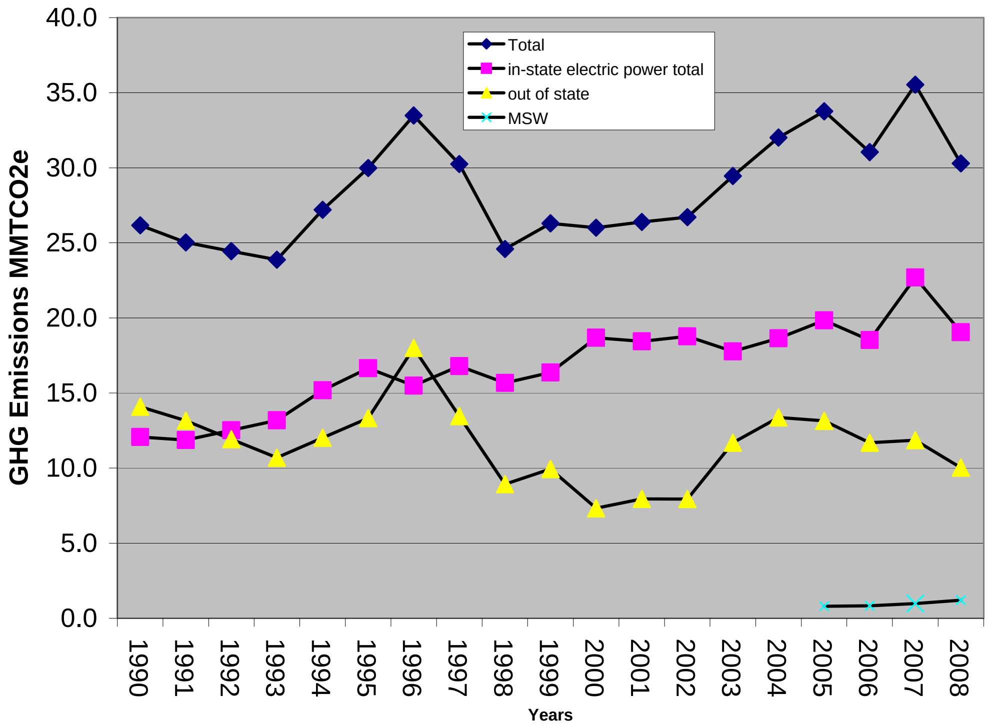
[8] http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2008/prmvmt_08.pdf

Electricity Generation

Electricity generation had the biggest reduction for any sector with a decrease of 5.6 MMTCO2e (15.9 percent) between 2007 and 2008. Both in-state generation and out-of-state generation saw similar reductions on a percentage basis (Figure 4). Total retail sales of electricity in New Jersey decreased by approximately 2 percent (Figure 5), which does not account for all the reduction. Other factors likely include changes in the mix of fuels used to generate electricity. On a BTU basis, the use of coal decreased by 12 percent, while the use of natural gas increased approximately 8 percent (Figure 6). The switch from coal to natural gas occurred even as the price of natural gas in the EGU sector increased from 8.17 $/thousand cubic feet to 10.78 $/thousand cubic feet (31%) percent from 2007 to 2008 (Figure 7).

Reductions in greenhouse gas releases from electricity generation were seen even as the need for air conditioning in the residential sector, as measured by cooling degree days, increased by approximately 10 percent (Figure 8).

Figure 4: Estimated Greenhouse Gas Emissions from Electric Power Generation[9]



[9] Estimated by NJDEP using data from EIA State Energy Data System (SEDS)

Figure 5: Total Retail Sales of Electricity in New Jersey[10]

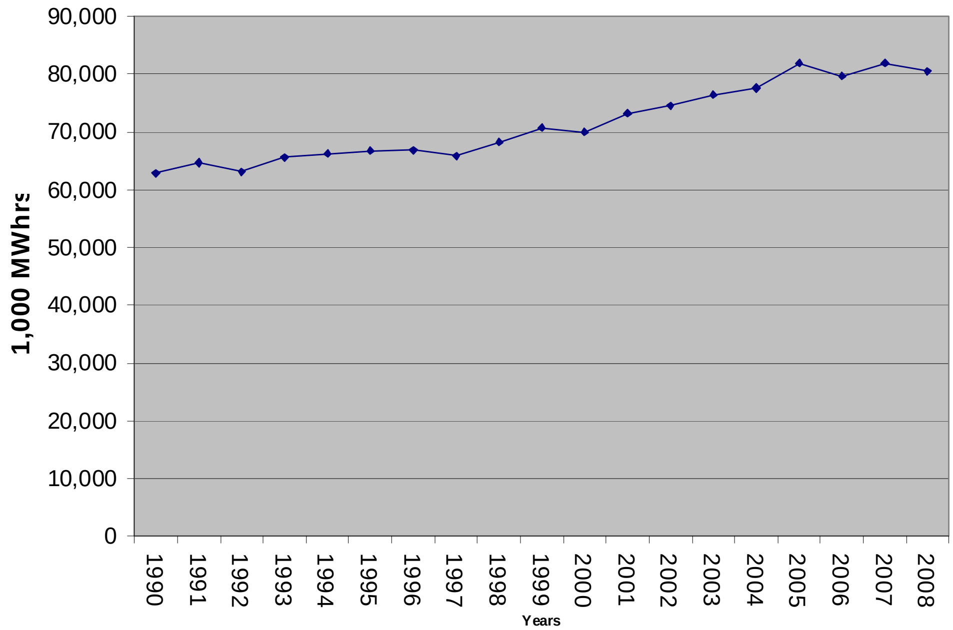
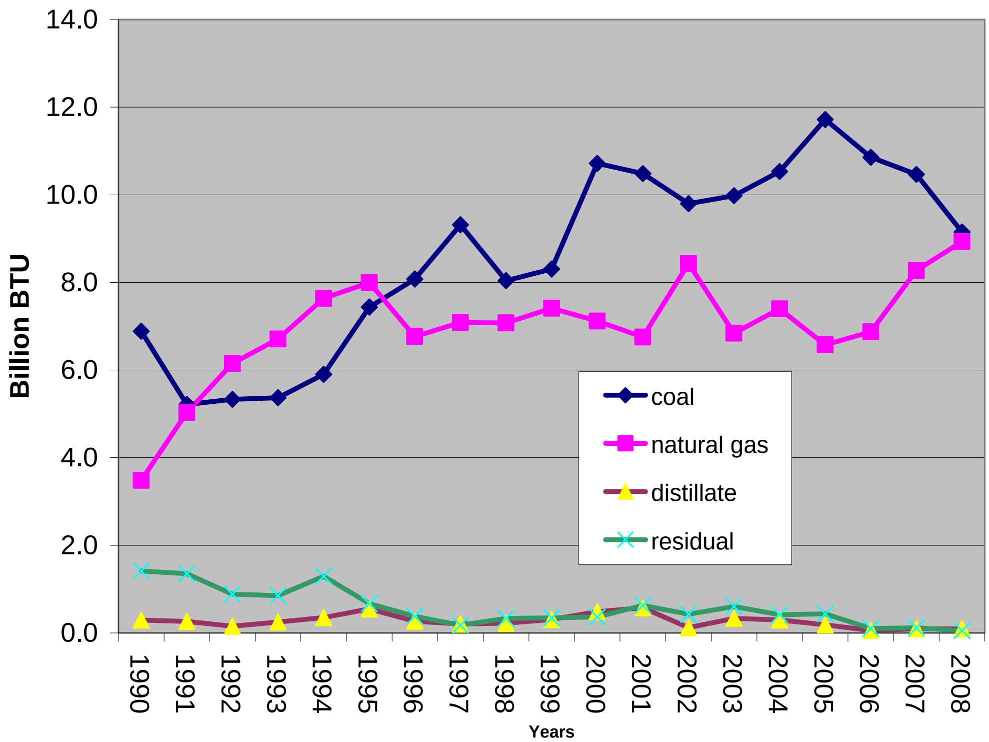
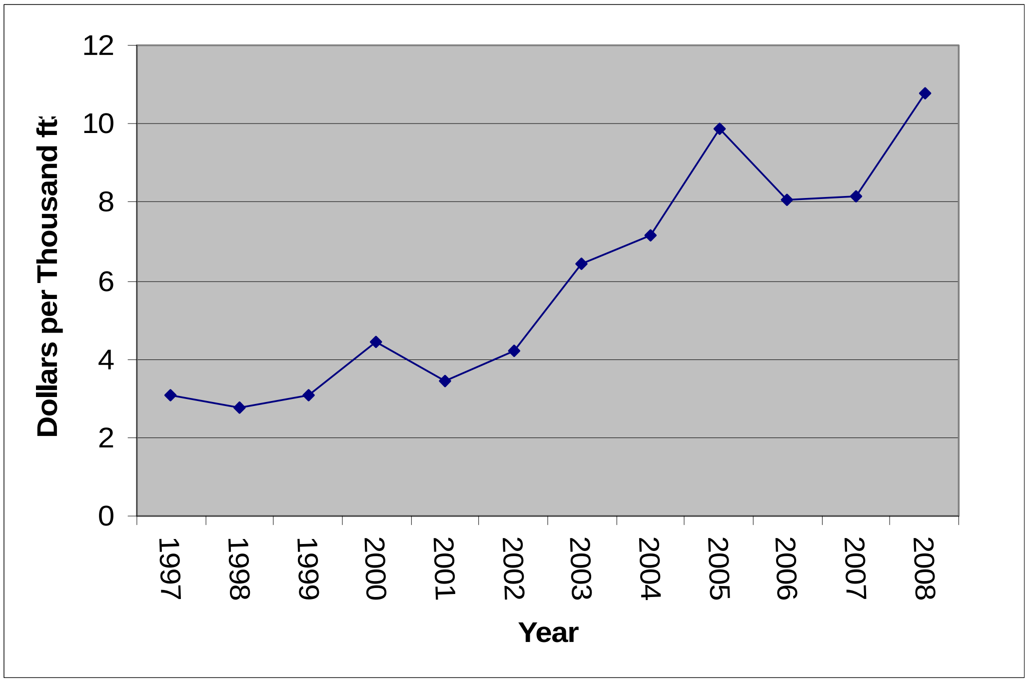


Figure 6: Fossil Fuel Use in Electric Power Generation



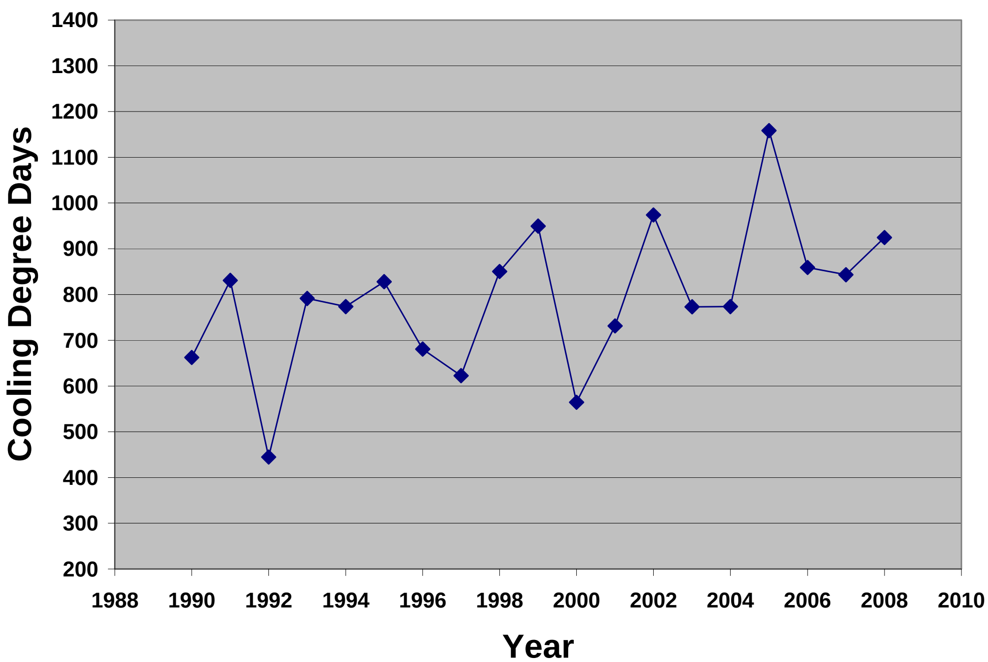
[10] http://www.eia.doe.gov/cneaf/electricity/st_profiles/sept08nj.xls

Figure 7: Natural Gas Price for Electric Power Generation[11]



Residential and Commercial

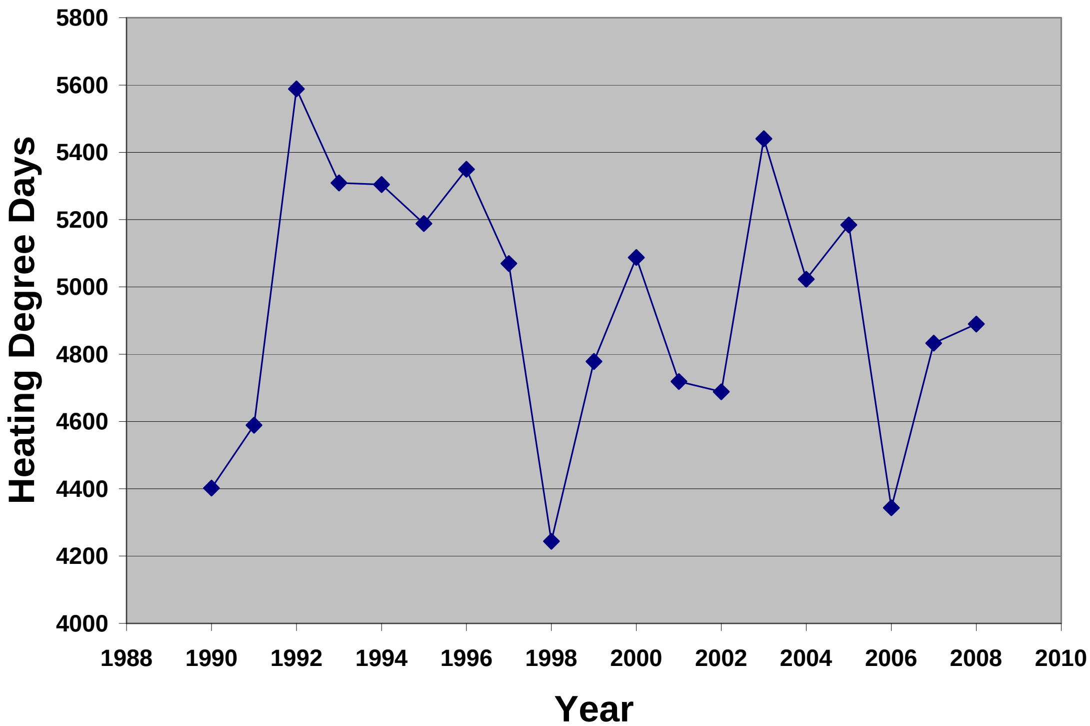
Figure 8: Cooling Degree Days, Estimated[12]



[11] http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_snj_a.htm

[12] Calculated by NJDEP from NJ monthly mean temp. from NJ State Climatologist web site

Figure 9: Heating Degree Days, Estimated[13]



Greenhouse gas releases from fuel use in the residential and commercial sectors combined decreased by approximately 1.0 MMTCO2e (4.1%) between 2007 and 2008. In the commercial sector, reductions are due primarily to decreases in the use of distillate fuels, with the use of natural gas remaining relatively constant. In the residential sector percent reductions from 2007 to 2008 were generally the same for distillate fuels and natural gas. These reductions were seen even though the trend for heating degree days remained relatively stable with an increase of one percent. In 2004 through 2007, changes in greenhouse gas emissions were more closely linked to heating degree days in these sectors (Figure 9).

Industrial

Greenhouse gas releases from the industrial sector decreased by approximately 2.0 MMTCO2e (12.8%). Reductions in fuels associated with the petroleum refining sector (still gas and other petroleum feedstocks) accounted for over half of the decrease (1.1 MMTCO2e). A review of fuel use data reported by the refineries to the Department's emission statement program also indicates a reduction of approximately 10% for petroleum refinery gases. Reductions in natural gas accounted for much of the remaining decrease.

[13] Calculated by NJDEP from NJ monthly mean temp. from NJ State Climatologist web site

Appendix A: Changes in Greenhouse Gas Inventory Data and Methods in 2008

In-State Electricity Generation and MSW incineration

Greenhouse gas releases from in-state electricity generation and incineration of municipal solid waste are taken from the Department's Emission Statement database. Data were downloaded from the Department's database through WebIntelligence on May 19, 2010. Facilities with NAICS code 221112, Fossil Fuel Electric Power Generation, or with NAICS code 221119, Other Electric Power Generation, or which are otherwise known to be electric power generation facilities are included in this sector.

For MSW, the portion of CO2 emitted from biogenic sources (e.g. paper) was excluded in the inventory, as is consistent with other national and international inventories, with the assumption that wood and other biomass is grown in a sustainable manner and so the quantity of carbon released from combustion of these materials will be removed from the atmosphere soon by growth of new trees and biomass. The biogenic portion was estimated to be 59 percent based on a new method, ASTM D6866, that measures the portion of carbon emissions that is the isotope C14. This isotope is present in biologically-derived material that is relatively recent, such as wood and paper, but is not present in fossil fuels. The 59 percent biogenic portion is the mean value of four reported values, as discussed in the last biennial report released in May 2007.

Out-of-State Landfills

Emissions from out-of-state landfills were estimated based on new data provided by the DEP's Division of Solid and Hazardous Waste. Prior year estimates for 2006 and 2007 were based on data for 2005. Using new data for 2005 through 2008 we applied the existing method to estimate emissions from these landfills. This method assumed that emissions from out-of-state landfills are proportional to the portion of solid waste disposed at these facilities vs. the proportion of solid waste disposed at in-state landfills. In-state landfill emissions were estimated using EPA's first-order decay formula as were estimates for previous years. This formula uses quantities of waste in place, age of the waste, and quantities of waste added each year to generate an estimate of CH_4 emissions. Such emissions from the landfills that are currently receiving waste in the State were estimated. Over the years 2005 through 2008, out-of-state landfills received an average of approximately 4.3 million short tons of NJ solid waste, while active in-state landfills received an average of approximately 3.7 million short tons of NJ solid waste. The emissions from the out-of-state landfills were assumed to be proportional (i.e. approximately 4.3/3.7 times as much) to the emissions from the active in-state landfills during this period.

POTWs

The method to estimate emissions of nitrous oxide (N_2O) from wastewater treatment plants has been revised. The new method used data on the presence or absence of specific processes to remove nitrates from effluent at each of the approximately 100 largest wastewater treatment plants in the State which was collected by the DEP through a survey. The new method also used information and emission factors for plants both with and without specific nitrate removal process from a study of N_2O emissions from wastewater plants as reported by Ahn, et al.[i] Plants using nitrification processes for treatment emitted approximately 0.3025 % of the Total Kjeldahl Nitrogen (TKN), while plants without nitrification emitted approximately 0.18 %. These data permitted the estimation of N_2O emitted directly from each of these plants, which represent over 95% of the wastewater flow in the State. This quantity was augmented with an estimate of the amount of N_2O emitted into the environment downstream from the plant due to the presence of nitrogen-containing compounds that remained in the effluent; this quantity was estimated using EPA's State Inventory Tool. The estimated quantity was augmented further to account for emissions from on-site septic systems, using the assumption that these systems released N_2O at the same rate as wastewater plants, but proportional to the percentage of the State's population served by such systems, estimated as 15%.

Sequestered by Forests and Other Land-Uses

The new estimates of carbon sequestration by forests and other land-uses were calculated based on updated information made available recently. Two specific sets of new information were drawn upon to estimate the annual change in biomass and soil carbon densities during the period 2002 to 2007 and re-calculate the previous estimates for the two earlier periods: 1995 to 2001 and 1986 to 1995. Firstly, the NJ Department of Environmental Protection (NJDEP) released on July 19, 2010 the NJDEP 2007 Land Use/Land Cover (LU/LC) Update (Please see http://www.nj.gov/dep/gis/lulc07cshp.html). This update indicates significant loss in forest area. Secondly, Rutgers University completed, also in July 2010, an NJDEP-assisted project on "Assessing the Potential for New Jersey Forests to Sequester Carbon and Contribute to Greenhouse Gas Emissions Avoidance." The new LU/LC data provided the new area parameters while the Rutgers study validated the forest biomass density factors and supported the assumption that soil carbon is 40% of the total carbon in forests. The new biomass density factors are 49 metric tons C/acre for 2002-2007, 39 metric tons C/acre for 1995-2001, and 25 metric tons C/acre for 1986-1995, respectively. Combining the new forest area (less area due to land-use change) with the new forest carbon density estimate (much higher due to substantial forest biomass growth in 2002-2007) yields a net increase in forest carbon sequestered. Prior estimates for 2006 forest sequestration were 6.7 MMTCO2e. Using the new methods and data, 2006 forest sequestration estimates increase to 7.6 MMTCO2.

In the previous estimation procedure, a uniform carbon density factor of 39 metric tons C/acre was applied across all periods. With the new carbon density factors forest sequestration estimates for the earlier periods (1986-95 and 1995-2001) were also recalculated. For these earlier time periods, forest sequestration estimates decreased. Prior estimates for 1990 sequestration were 7.5 MMTCO2e. Using the new methods and data, 1990 forest sequestration estimates decrease to 4.0 MMTCO2e. In the absence of new data for the other biomass quantity and rate of change factors (i.e., for grassland, bareland, cropland, and wetland), the values and assumptions used in the previous inventory are retained. These default values are from Appendix H of the report "New Jersey Greenhouse Gas Inventory and Reference Case Projections, 1900-2020" issued in November 2008, as adapted from IPCC and other sources. Further, in this referenced report, the working assumption is that 50% of forest removal is converted to wood products (which retain carbon if they remain in use).

Land Clearing

The new estimate for GHG emissions due to land clearing is also based on the 2007 LU/LC Update taking account of the new forest carbon density factors and the conversions to urban/developed land from major land-uses (forest, agriculture, wetland, and barren) for 1986-1995, 1995-2001, and 2002-2007. The updated data enables calculation of the biomass and soil carbon losses due to land use changes during these three time periods. The updated estimate of carbon loss due to land clearing is computed as the summation of the respective products of forest land loss and the new forest carbon density factor (biomass and soil); agricultural land loss and the default carbon density factor for cropland; wetland loss and assumed carbon density value (assumed as 50% forest + 50% bare land); and bare land loss and default carbon density factor for barren land. The overall result is converted to carbon dioxide (CO_2) emission using the factor 3.67.

The earlier estimates for 1990 land clearing decreased from 1.1 to 0.6 MMTCO2e. This is primarily the result of using the lower carbon density (25 instead of 39 metric tons C/acre). Since the forest contained less carbon than previously estimated, clearing resulted in lower emissions. Estimates in 2006 show the opposite impact, with increasing impacts from land clearing. The carbon density factor increased from 39 to 49 metric tons C/acre resulting in increased releases from 1.1 to 1.7 MMTCO2e.

Summary of Baseline Adjustments

Changes in methods to estimate greenhouse gas releases discussed above resulted in minor adjustments to the baselines used to track progress towards the 2020 and 2050 Statewide greenhouse gas limits. Changes to the 1990 baseline are summarized in Table A1 below (all units are MMTCO2e).

1990 baseline in 2007 report	**122.9**				
			2007 report	2008 report	Difference
POTWs			0.5	0.2	**-0.3**
Released thru land clearing			1.1	0.6	**-0.5**
Sequestered by forests			-7.5	-4.0	**3.5**
TOTAL			-5.9	-3.2	**2.7**
1990 baseline in 2008 report	**125.6**				

Changes to the 2006 baseline are summarized in Table A2 below (all units MMTCO2e):

2006 baseline in 2007 report	**127.7**				
			2007 report	2008 report	Difference
Out-of-state			1.3	1.0	**-0.3**
POTWs			0.5	0.2	**-0.3**
Released through land clearing			1.1	1.7	**0.6**
Sequestered by forests			-6.7	-7.6	**-0.9**
TOTAL			-3.7	-4.6	**-0.9**
2006 baseline in 2008 report	**126.8**				

[i] Ahn, Joon Ho, Sungpyo Kim, Hongkeun Park, Brian Rahm, Krishna Pagilla, and Kartik Chandran, 2010, N_2O Emissions from Activated Sludge Processes, 2008-2009; Results of a National Monitoring Survey in the United States, Environ. Sci. Technol., 44, 4505-4511.