NEW YORK STATE Greenhouse Gas Emissions Inventory and Forecasts for the 2009 State Energy Plan

New York State Energy Research and Development Authority

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Sources and Methodologies

Emission sources were classified into two broad categories for the 2007 New York State Greenhouse Gas Emissions Inventory: "Fuel Combustion" and "Other Sources" (Table 1). The Fuel Combustion category was further broken down by end-use sector, which was generally unnecessary for the Other Sources category since each one represented only one end-use sector (e.g., aluminum production would represent a source in the industrial sector).

The greenhouse gases included in the inventory were carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6). Because each of these gases has a different global warming potential, emissions for gases other than carbon dioxide were converted into carbon dioxide equivalent units (CO2e) through multiplication with their appropriate Intergovernmental Panel on Climate Change (IPCC) global warming potential value[1] (see Appendix A). Linear interpolation was generally used to generate data for years with missing values prior to the current year. Derived growth rates were generally used to generate projections, based on modeling results or projections from the literature.

With the exception of on-highway diesel and gasoline fuel use, emissions from fuel combustion were calculated by multiplying fuel consumption values from the Department of Energy's Energy Information Administration (EIA)[2] by coefficients based on U.S. Environmental Protection Agency (EPA) emission factors for carbon dioxide, methane, and nitrous oxide[3] (see Appendix A). On-highway fuel use was estimated based on New York State vehicle miles of travel[4] along with historical[5] and EIA-projected[6] vehicle fuel economy.

Methane emissions from agricultural animals and manure management were derived by multiplying animal population data from the United Stated Department of Agriculture (USDA)[7] by EPA emissions factors.[8]

Emissions of nitrous oxide from agricultural soil management were derived by combining USDA nitrogen fertilizer application data[9] with EPA default values and

[1] IPCC, 1995. *Second Assessment: Climate Change 1995.* According to EPA guidance, this inventory uses potentials from the IPCC *Second Assessment* report, rather than values from the more current *Third Assessment: Climate Change 2001* report. Using the *Third Assessment Report* values would have resulted in emission estimates that were approximately 0.8% higher.
[2] EIA *Annual Energy Review*, multiple years.
[3] EPA, 2008. *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2006* (Annex 2).
[4] NYS Department of Transportation.
[5] Oak Ridge National Laboratory, *Transportation Energy Data Book*, edition 27.
[6] EIA, *Annual Energy Outlook*, multiple years.
[7] USDA *Census of Agriculture*, multiple years (1992, 1997, 2002)
[8] EPA, 2004. *EIIP Volume VIII, Chapter 7: Methods for Estimating Methane Emissions from Domesticated Animals*.
[9] USDA National Agricultural Statistics Service *Agricultural Chemical Usage* reports, multiple plants and years (field crops, vegetables, fruits; 1990-1992, 1995-1997, 2002-2004)

emissions factors.[10] Non-daily spread manure management emissions are accounted for under manure management.

Emissions of methane and nitrous oxide from crop waste combustion were derived by multiplying USDA crop yield data[1] by EPA default parameters and emissions factors.[11]

Emissions of carbon dioxide and PFCs from aluminum production and limestone use were derived by scaling EPA national emissions data to the state level using ratios derived from United State Geological Survey (USGS) Data.[12] U.S. and New York State production capacity values were used to scale the aluminum production data, while U.S. and New York State limestone consumption values were used to scale the limestone use data. (A CF_4/C_2F_6 ratio of 7:1 was assumed for the PFC data.)

Emissions of carbon dioxide, methane, and PFCs from cement production, chemical manufacturing, manufacturing of carbon dioxide, iron and steel manufacturing, and semiconductor manufacturing were derived by scaling EPA and EIA emissions data[13] by New York State's market share.[14,15] For manufacturing use of carbon dioxide, New York State's relative market share in chemical, food, soft drink and beer manufacturing was used.

Emissions of SF_6 from electricity distribution were derived by scaling a 2003 New York State-specific emissions estimate obtained by the New York State Department of Public Service[16] to EPA's overall U.S. growth rate in emissions from electricity transmission and distribution.

Emissions of methane from natural gas leakage were derived by scaling EIA data on U.S. emissions[17] by EIA data on New York State's relative use of natural gas[2]. Because the aggregate U.S. figure includes natural gas emissions from production and processing, total U.S. emissions were reduced by 37.48%, EIA's estimate for the share of production and processing in total emissions from natural gas systems.

Emissions of HFCs from refrigerant substitutes were derived by scaling EPA data on national emissions by EIA data on New York State's relative use of air conditioning, refrigerators and freezers.[18]

Emissions of carbon dioxide, methane, and nitrous oxide from municipal waste were derived from New York State Department of Environmental Conservation (NYSDEC) data on annual waste landfilled and waste-in-place as well as a detailed emissions

[10] EPA, 2004. *EIIP Volume VIII, Chapter 10: Methods for Estimating Greenhouse Gas Emissions from Agricultural Soil Management*.
[11] EPA, 2004. *EIIP Volume VIII, Chapter 11: Methods for Estimating Greenhouse Gas Emissions from Field Burning of Agricultural Residues* .
[12] USGS *Minerals Yearbook*, various years
[13] EIA, 2005. *Emissions of Greenhouse Gases in the United States 2004*.
[14] National Mining Association *State Profile: New York.*
[15] United States Census Bureau *Economic Census of the United States*, various years (1997, 2002)
[16] Personal communication with John d'Aloia, NYSDPS.
[17] EIA *Emissions of Greenhouse Gases in the United States*, various years (2004, 2005)
[18] EIA *2001 Household Electricity Reports* for New York State and the U.S.

estimate from NYSDEC for 2004, which was based on an EPA method described in EPA's 2004 publication *EIIP Volume VIII, Chapter 13: Methods for Estimating Greenhouse Gas Emissions from Municipal Solid Waste*. EPA default values for carbon dioxide and nitrous oxide emissions from municipal waste were also used.

Emissions of carbon dioxide, methane, and nitrous oxide from municipal wastewater and soda ash use were derived based on New York State population data.[19] EPA emissions factors and default parameters[20] were combined with the population data for the wastewater emissions, while EPA total emissions for soda ash were scaled by the population data for soda ash use (because soda ash has numerous end uses).

Emissions from net imports of electricity were based on output from ICF International's Integrated Planning Model® (IPM), an electricity sector modeling software used to support the development of New York's 2009 State Energy Plan.[21] For imports, the emission factor was estimated based on modeled emissions from neighboring electric service territories.

Table 1. Sources of Emissions for the New York State Greenhouse Gas Inventory and Forecast

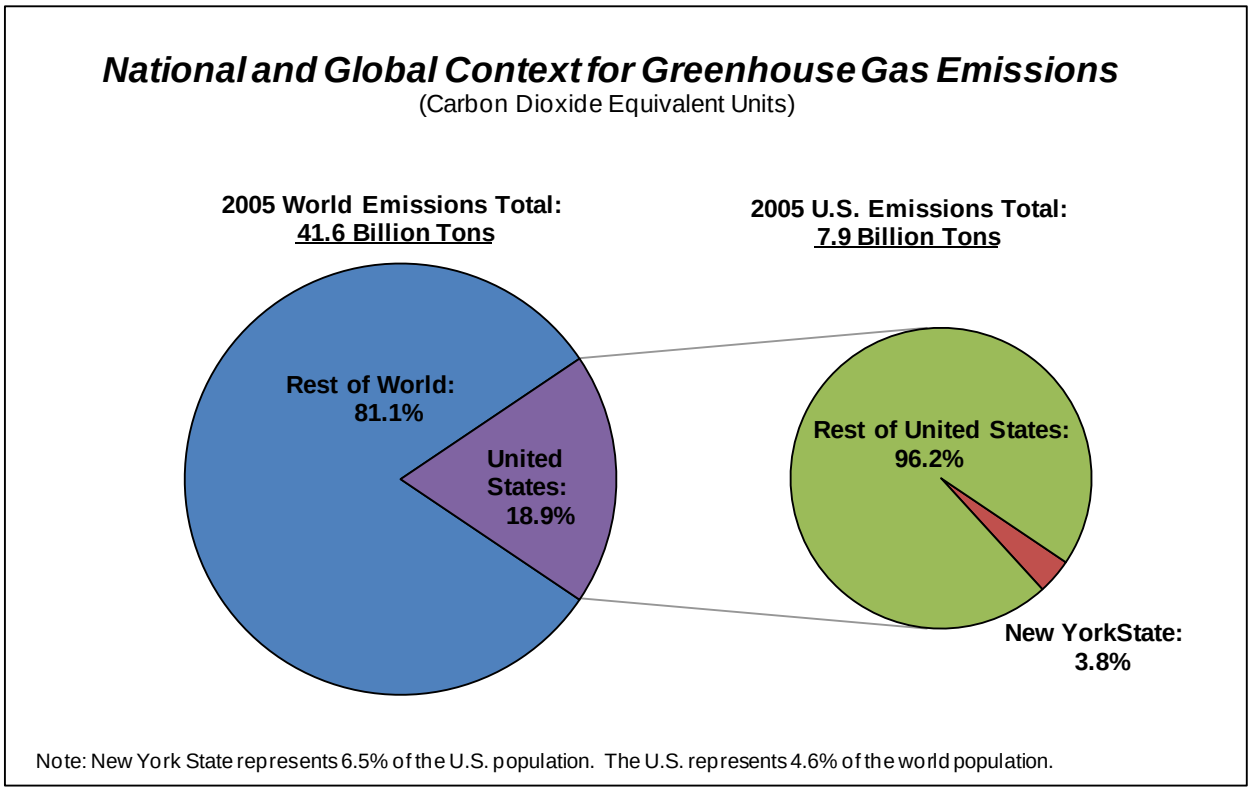
Fuel Combustion	Other Sources		
Electricity Generation	Agricultural Animals	Crop Waste Combustion	Municipal Wastewater
Net Imports of Electricity	Agricultural Soil Management	Electricity Distribution	Natural Gas Leakage
Transportation	Aluminum Production	Iron & Steel Manufacturing	Refrigerant Substitutes
Residential	Cement Production	Limestone Use	Semiconductor Manufacturing
Commercial	Chemical Manufacturing	Manure Management	Soda Ash Use
Industrial	Manufacturing Use of Carbon Dioxide	Municipal Waste	

[19] United States Census Bureau statistics.
[20] EPA, 2004. *EIIP Volume VIII, Chapter 14: Methods for Estimating Greenhouse Gas Emissions from Wastewater*.
[21] See the *Electricity Assessment* within the 2009 New York State Energy Plan for model results for the 'Starting Point' Reference Case.

New York State Emissions in National and Global Context

Greenhouse gas emissions for the State of New York totaled 298 million tons of carbon dioxide equivalent in 2005. This represents 3.8% of total emissions in the United States,[22] while New York accounts for 6.5% of the U.S. population.[23] New York's low relative emissions result from extensive use of public transportation in New York City, a State economy weighted towards services rather than industrials, and greater employment of hydroelectric, nuclear, and natural gas electricity generation than the national average.

Figure 1. National and Global Context for Greenhouse Gas Emissions[24,25]



[22] Based on the World Resource Institute's 2005 estimate for total United States greenhouse gas emissions, as reported by the Climate Analysis Indicators Tool.
[23] Based on U.S. Census Bureau National and State Population Estimates.
[24] World population data for Figure 1 were collected from the United Nation's 2008 Revision Population Database.
[25] Global greenhouse gas emissions data were collected from the World Resource Institute's Climate Analysis Indicators Tool.

New York State 2007 Greenhouse Gas Emissions

Greenhouse gas emissions for the State of New York totaled 284 million tons of carbon dioxide equivalent in 2007, 2.5% higher than 1990, but 6.9% lower than 2000 levels. Figure 2 shows the percentage of the carbon dioxide equivalent emitted in New York State that is attributed to each of the six greenhouse gases. Table 2 presents the complete 2007 greenhouse gas emissions inventory by gas and source category. The portion of emissions resulting from fuel combustion, as opposed to those coming from other sources, is presented separately to show how fuel combustion dominates the emission inventory. Other sources of emissions include cement production, limestone consumption, soda ash consumption, aluminum production, direct manufacturing use of carbon dioxide, agricultural soil management, and municipal solid waste combustion. Carbon dioxide comprised the vast majority of greenhouse gas emissions (88.5%), most of which resulted from fuel combustion (98.3%) (see Figure 3 for more detail). Methane had the second highest contribution (6.5%), most of which (93.9%) resulted from sources such as municipal waste and natural gas distribution leakage rather than fuel combustion. Nitrous oxide emissions made up only 2.3% of the total and were mostly attributable to automotive fuel combustion. Other gases made up the remaining 2.7% of emissions, the majority coming from hydrofluorocarbon refrigerant substitutes.

Figure 2. Total Greenhouse Gas Emissions in New York, 2007

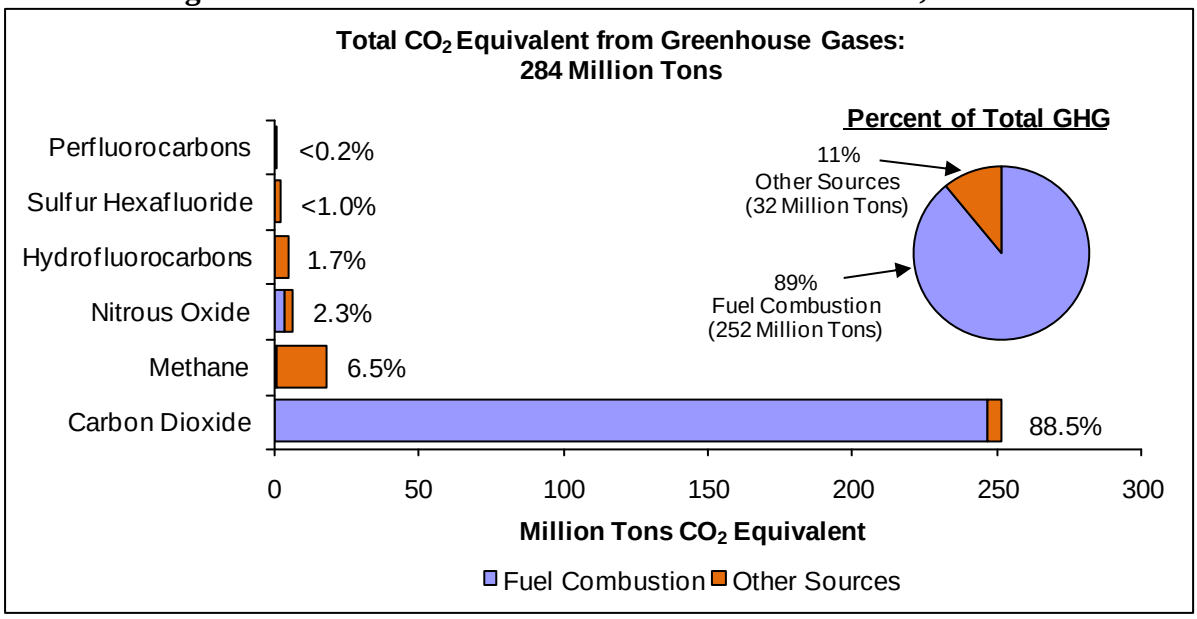


Table 2. New York State Greenhouse Gas Inventory 2007

Million tons of CO2 equivalent

	CO_2	CH_4	N_2O	PFC	HFC	SF_6	Total (inc. Net Imports of Electricity)	% of Total (inc. Net Imports of Electricity)
Fuel Combustion (inc. Net Imports of Electricity)	**247.20**	**1.12**	**4.11**	**-**	**-**	**-**	**252.43**	**88.85%**
Electric Generation	54.01	0.04	0.18	-	-	-	54.23	19.09%
Net Imports of Electricity	8.10	0.01	0.03	-	-	-	8.13	2.86%
Transportation	93.51	0.29	3.62	-	-	-	97.42	34.29%
Residential	40.69	0.60	0.16	-	-	-	41.45	14.59%
Commercial	29.83	0.16	0.06	-	-	-	30.05	10.58%
Industrial	21.07	0.02	0.05	-	-	-	21.15	7.44%
Other Sources	**4.28**	**17.27**	**2.49**	**0.39**	**4.89**	**2.38**	**31.68**	**11.15%**
Cement Production	1.29	-	-	-	-	-	1.29	0.45%
Limestone Use	0.76	-	-	-	-	-	0.76	0.27%
Soda Ash Use	0.04	-	-	-	-	-	0.04	0.02%
Aluminum Production	0.32	-	-	0.29	-	-	0.61	0.22%
Semiconductor Manufacturing	-	-	-	0.10	-	-	0.10	0.03%
Chemical Manufacturing	-	0.03	-	-	-	-	0.03	0.01%
Iron & Steel Manufacturing	-	0.01	-	-	-	-	0.01	0.00%
Electricity Transmission & Distribution	-	-	-	-	-	2.38	2.38	0.84%
CO_2 Manufacture	0.09	-	-	-	-	-	0.09	0.03%
Refrigerant Substitutes	-	-	-	-	4.89	-	4.89	1.72%
Natural Gas Systems	-	5.25	-	-	-	-	5.25	1.85%
Domesticated Animals	-	2.60	-	-	-	-	2.60	0.91%
Manure Management	-	0.37	0.28	-	-	-	0.65	0.23%
Agricultural Soil Management	0.00	-	0.93	-	-	-	0.93	0.33%
Agricultural Waste Combustion	-	0.002	0.001	-	-	-	0.003	0.00%
Municipal Waste Management	1.78	7.98	0.05	-	-	-	9.81	3.45%
Municipal Wastewater	-	1.03	1.22	-	-	-	2.25	0.79%
Total (inc. Net Imports of Electricity)	**251.48**	**18.39**	**6.60**	**0.39**	**4.89**	**2.38**	**284.11**	100%
% of Total (inc. Net Imports of Electricity)	**88.51%**	**6.47%**	**2.32%**	**0.14%**	**1.72%**	**0.84%**	**100%**	-
Total (exc. Net Imports of Electricity)	**243.38**	**18.38**	**6.57**	**0.39**	**4.89**	**2.38**	-	-

2007 Carbon Dioxide Emissions from Fuel Combustion by Fuel

Carbon dioxide emissions resulting from fossil fuel combustion totaled 247 million tons in 2007, which comprised 87.0% of all greenhouse gas emissions in New York State. Figure 3 shows this tonnage of carbon dioxide emissions broken down by end-use sector. On a percentage-wise basis, transportation and on-site fuel use had similar carbon dioxide contributions related fuel combustion.

Figure 3. CO_2 from Fuel Combustion by End Use Sector, 2007

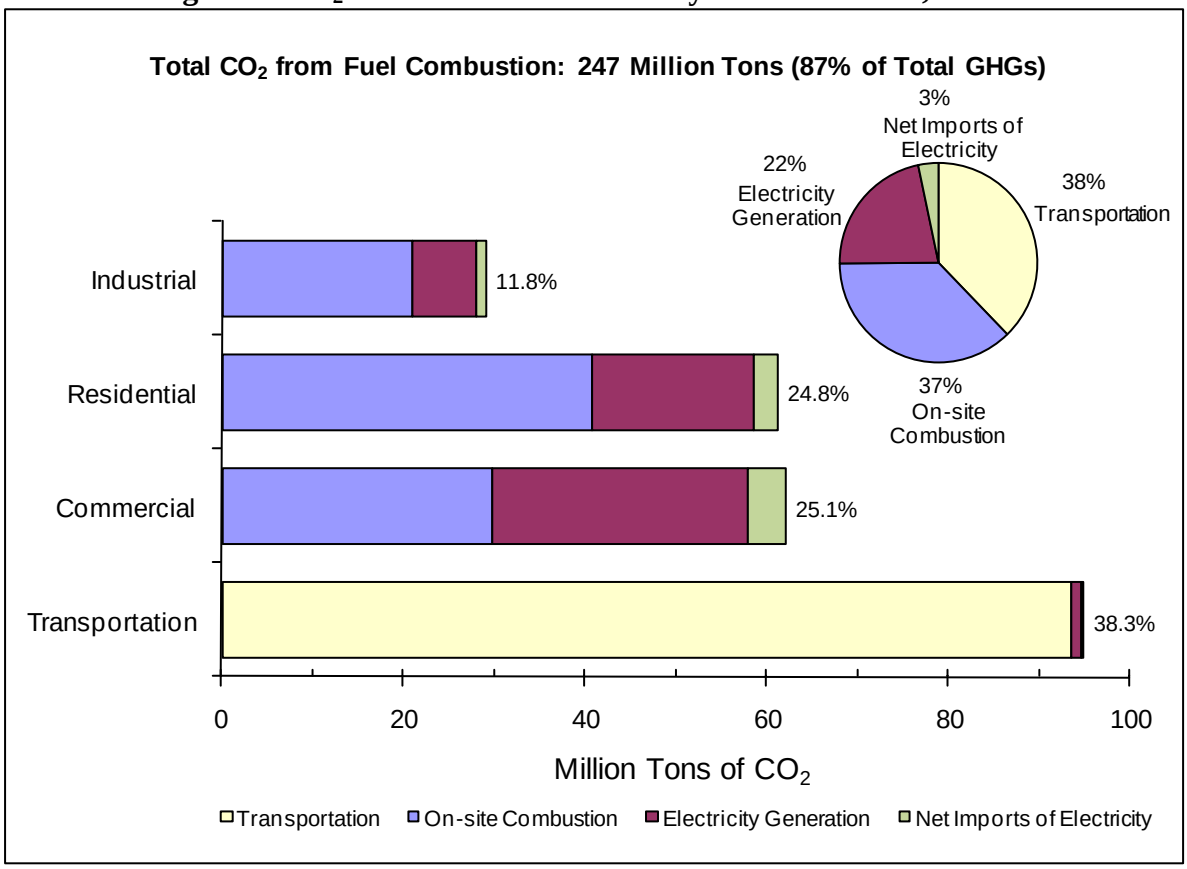
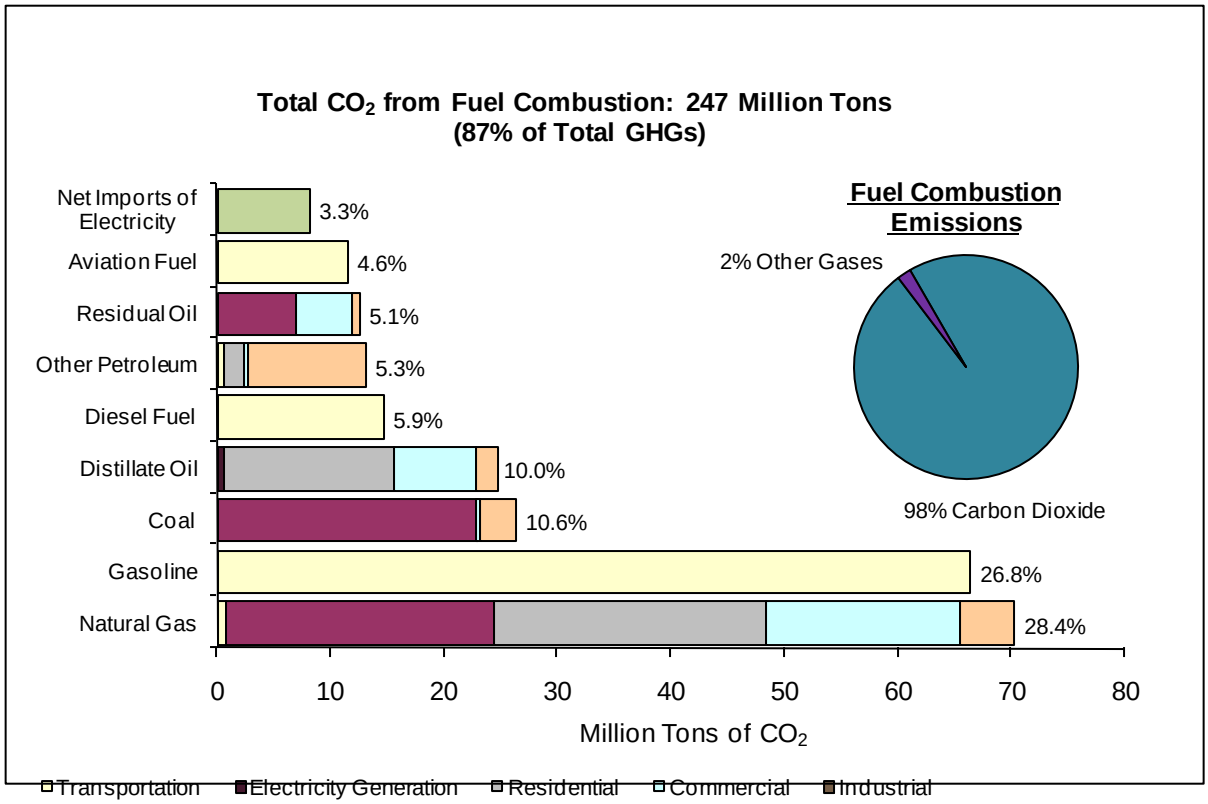


Figure 4 depicts the contribution of each different fuel type toward the tonnage of carbon dioxide emissions that resulted from fuel combustion, which made up 97.9% of the total emissions from fuel combustion in the State, with the remaining 2.1% attributed to methane and nitrous oxide. The figure also indicates the relative percentage of emissions contributed by the transportation, electricity generation, residential, commercial, and industrial sectors for each fuel type, as well as net imports of electricity. Natural gas, which ranked highest among the various fuels in terms of carbon dioxide emissions, had emissions stemming from each of the five sectors, with large contributions from the electricity generation, residential, and commercial sectors, and relatively small contributions from the transportation and industrial sectors. In contrast, carbon dioxide emissions from gasoline, which ranked second-highest among the fuel types, resulted from the transportation sector exclusively. Emissions from natural gas and gasoline made up over half of all emissions from fuel combustion.

Figure 4. CO_2 from Fuel Combustion by Fuel Type, 2007



Forecast of New York State Greenhouse Gas Emissions Through 2025

Greenhouse gas emissions for the State of New York are projected to decline between 2007 and 2010 and then increase to 293 million tons of carbon dioxide equivalent by 2025. This growth in emissions represents a 5.8% increase as compared to 1990, but a 4.0% decreased compared to 2000 levels. Figure 5 shows historical and projected greenhouse gas emissions for the Fuel Combustion and Other Sources categories, with the Fuel Combustion category broken down by sector. Net imports from electricity are also included. Table 3 shows the supporting data, with emissions broken down by gas and source category.

The transportation sector consistently made the largest contribution to greenhouse gases over time, with the electricity generation sector continuously ranking second in terms of greenhouse gas emissions. The residential sector was the third-highest contributor to greenhouse gases between 1990 and 2015, while the Other Sources category ranked third for 2020 through 2025. The industrial sector is projected to have the lowest greenhouse gas emissions by 2025.

Forecasts of petroleum and coal use for the residential, commercial, industrial and non-highway transportation sectors were based on the Energy Information Administration's forecasts for Mid-Atlantic fuel demand, while natural gas projections were provided by Energy and Environmental Analysis, Inc.[26] Forecasts for on-highway diesel and gasoline fuel use were based on forecasts of New York State vehicle miles of travel along with EIA-projected vehicle fuel economy. Forecasts for fuel use for the electricity sector and net imports of electricity were based on output from ICF International's Integrated Planning Model® (IPM), an electricity sector modeling software used to support the development of New York's 2009 State Energy Plan.[27] For imports, the emission factor was estimated based on modeled emissions from neighboring electric service territories.

Non-fuel combustion emission forecasts for the industrial sector were based on the projected growth of various New York industries. These forecasts were created using Policy Insight® version 8.0, a macroeconomic modeling software from Regional Economic Models Inc. Emissions from HFC refrigerant substitutes were estimated by scaling EPA's projection for national emissions by New York's relative use of air conditioners, refrigerators, and freezers. Emissions from electricity transmission and distribution were assumed to continue to decline following the long-term historical trend.

[26] For more details see the *Energy Demand and Price Forecast* within the 2009 New York State Energy Plan.

[27] See the *Electricity Assessment: Modeling* within the 2009 New York State Energy Plan for model results for the 'Starting Point' Reference Case.

Figure 5. Greenhouse Gas Emissions by Source Category, 1990 – 2025

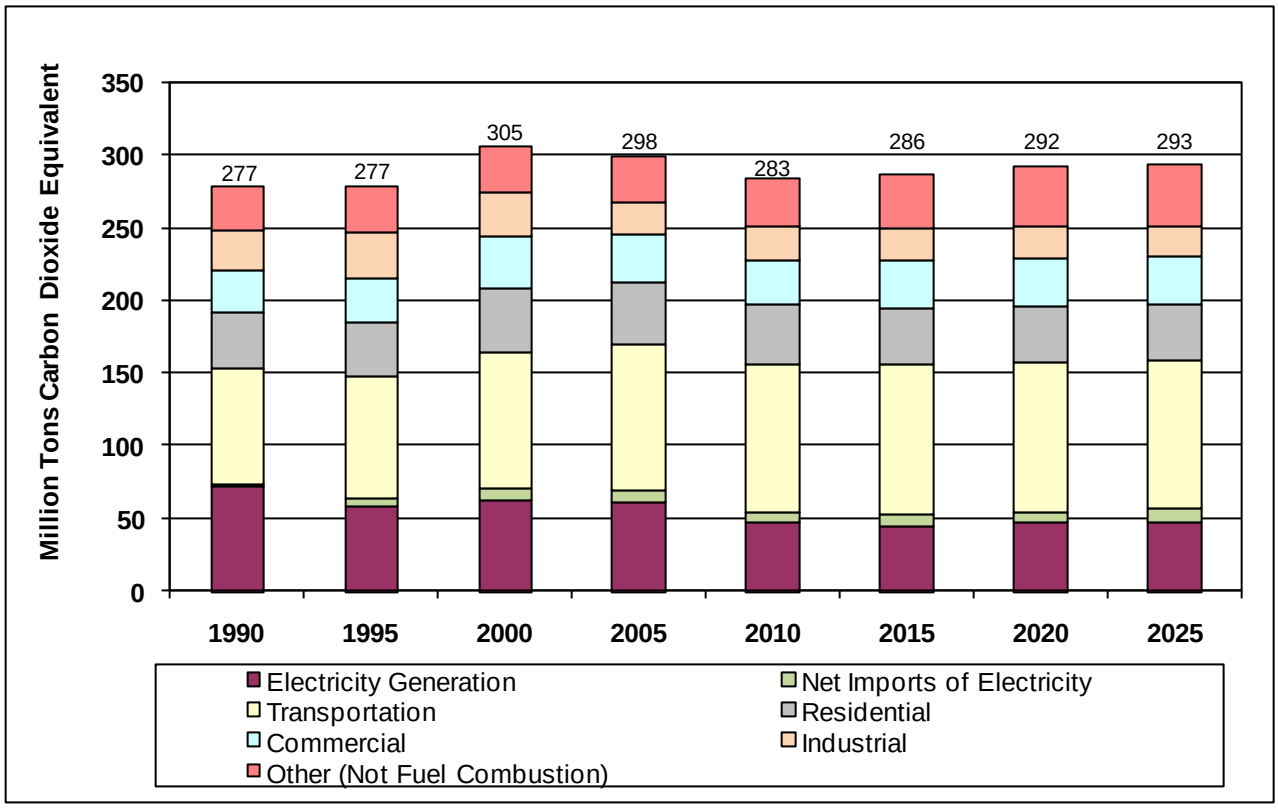


Table 3. New York State Greenhouse Gas Inventory and Forecast

Million tons of CO2 equivalent

Emissions by Gas and Source Category

	1990	1995	2000	2005	2010	2015	2020	2025
Carbon Dioxide (inc. Net Imported Electricity)	**247.79**	**246.51**	**273.08**	**266.25**	**249.17**	**248.44**	**249.77**	**250.85**
Carbon Dioxide (exc. Net Imported Electricity)	**245.95**	**240.97**	**266.07**	**258.21**	**243.01**	**241.15**	**241.98**	**242.47**
Fuel Combustion (inc. Net Imported Electricity)	*243.67*	*242.21*	*268.62*	*261.57*	*244.27*	*243.35*	*244.47*	*245.35*
Fuel Combustion (exc. Net Imported Electricity)	*241.82*	*236.68*	*261.61*	*253.54*	*238.11*	*236.06*	*236.69*	*236.96*
Electricity Generation	70.83	56.88	62.29	60.21	47.10	44.35	46.21	47.11
Net Imported Electricity	1.85	5.54	7.01	8.03	6.16	7.29	7.78	8.39
Transportation	77.16	80.53	89.88	95.99	97.85	98.99	98.49	98.86
Residential	37.10	37.79	43.33	43.12	39.81	38.74	38.02	37.57
Commercial	29.33	29.74	35.27	31.51	30.78	32.34	32.96	32.91
Industrial	27.39	31.74	30.84	22.70	22.57	21.63	21.01	20.52
Other	*4.13*	*4.29*	*4.45*	*4.68*	*4.90*	*5.09*	*5.30*	*5.50*
Cement Production	0.92	1.01	1.14	1.27	1.37	1.49	1.62	1.76
Limestone Use	0.70	0.73	0.70	0.75	0.79	0.84	0.88	0.92
Soda Ash Use	0.04	0.05	0.04	0.04	0.05	0.05	0.06	0.06
Aluminum Mfg.	0.41	0.38	0.36	0.28	0.34	0.35	0.37	0.39
CO_2 Use	0.04	0.05	0.07	0.09	0.09	0.10	0.11	0.11
Municipal Waste	2.02	2.08	2.14	2.26	2.26	2.26	2.26	2.26
Methane (inc. Net Imported Electricity)	**15.74**	**17.81**	**18.60**	**18.38**	**18.77**	**19.25**	**19.72**	**20.22**
Methane (exc. Net Imported Electricity)	**15.74**	**17.81**	**18.59**	**18.37**	**18.77**	**19.24**	**19.72**	**20.21**
Fuel Combustion (inc. Net Imported Electricity)	*0.82*	*0.97*	*1.32*	*1.15*	*1.08*	*1.08*	*1.08*	*1.07*
Fuel Combustion (exc. Net Imported Electricity)	*0.82*	*0.96*	*1.32*	*1.14*	*1.07*	*1.07*	*1.07*	*1.07*
Electricity Generation	0.05	0.04	0.05	0.05	0.03	0.03	0.03	0.03
Net Imported Electricity	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01
Transportation	0.24	0.25	0.28	0.30	0.31	0.31	0.31	0.31
Residential	0.38	0.48	0.73	0.59	0.54	0.54	0.54	0.53
Commercial	0.11	0.15	0.22	0.17	0.16	0.16	0.17	0.17
Industrial	0.05	0.04	0.05	0.03	0.03	0.03	0.03	0.03
Other	*14.92*	*16.85*	*17.27*	*17.23*	*17.70*	*18.17*	*18.65*	*19.14*
Chemical Mfg.	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04
Iron & Steel Mfg.	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
Natural Gas Leakage	4.03	5.38	5.55	5.20	5.42	5.64	5.88	6.12
Agricultural Animals	2.74	2.67	2.57	2.56	2.74	2.92	3.12	3.33
Manure Management	0.32	0.32	0.35	0.36	0.39	0.42	0.44	0.47
Crop Waste Comb.	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Municipal Waste	6.824	7.433	7.745	8.030	8.065	8.091	8.109	8.119
Municipal Wastewater	0.963	0.992	1.016	1.031	1.041	1.047	1.048	1.048

*1990-2005 values are based on historical data, 2010-2025 are forecasts.

	1990	1995	2000	2005	2010	2015	2020	2025
Nitrous Oxide (inc. Net Imported Electricity)	**5.95**	**6.13**	**6.60**	**6.72**	**6.88**	**7.00**	**7.04**	**7.11**
Nitrous Oxide (exc. Net Imported Electricity)	**5.94**	**6.11**	**6.57**	**6.69**	**6.86**	**6.97**	**7.01**	**7.08**
Fuel Combustion (inc. Net Imported Electricity)	*3.45*	*3.57*	*4.07*	*4.25*	*4.32*	*4.34*	*4.29*	*4.27*
Fuel Combustion (exc. Net Imported Electricity)	*3.45*	*3.55*	*4.05*	*4.22*	*4.30*	*4.32*	*4.26*	*4.24*
Electricity Generation	0.25	0.19	0.22	0.21	0.17	0.16	0.16	0.16
Net Imported Electricity	0.01	0.02	0.02	0.03	0.02	0.03	0.03	0.03
Transportation	2.92	3.08	3.46	3.73	3.87	3.90	3.84	3.82
Residential	0.11	0.13	0.19	0.16	0.14	0.14	0.14	0.14
Commercial	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.06
Industrial	0.10	0.08	0.10	0.06	0.06	0.06	0.06	0.06
Other	*2.49*	*2.56*	*2.52*	*2.47*	*2.56*	*2.65*	*2.75*	*2.85*
Manure Management	0.33	0.31	0.29	0.28	0.30	0.32	0.34	0.36
Soil Management	1.05	1.08	0.99	0.92	0.98	1.05	1.12	1.20
Crop Waste Comb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal Waste	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Municipal Wastewater	1.06	1.13	1.20	1.21	1.23	1.23	1.23	1.23
Perfluorocarbons	**1.24**	**0.94**	**0.71**	**0.28**	**0.46**	**0.54**	**0.60**	**0.67**
Aluminum Mfg.	1.19	0.85	0.58	0.20	0.30	0.32	0.34	0.36
Semiconductor Mfg.	0.05	0.08	0.13	0.08	0.16	0.22	0.26	0.32
Hydrofluorocarbons								
Refrigerant Subs.	1.27	2.14	3.66	4.65	6.03	9.38	13.82	13.82
Sulfur Hexafluoride								
Electricity Distribution	5.60	4.29	3.29	2.51	1.90	1.44	1.08	1.03
TOTAL (inc. Net Imported Electricity)	**277.60**	**277.82**	**305.93**	**298.78**	**283.21**	**286.04**	**292.04**	**293.71**
TOTAL (exc. Net Imported Electricity)	**275.74**	**272.26**	**298.89**	**290.72**	**277.03**	**278.72**	**284.22**	**285.28**

Emissions by Source Category (All Gases)

	1990	1995	2000	2005	2010	2015	2020	2025
Fuel Combustion (inc. Net Imported Electricity)	**247.95**	**246.75**	**274.02**	**266.96**	**249.67**	**248.77**	**249.84**	**250.69**
Fuel Combustion (exc. Net Imported Electricity)	**246.09**	**241.19**	**266.98**	**258.90**	**243.48**	**241.46**	**242.02**	**242.27**
Electricity Generation	71.14	57.11	62.56	60.47	47.30	44.55	46.41	47.31
Net Imported Electricity	1.86	5.56	7.04	8.07	6.18	7.32	7.82	8.42
Transportation	80.32	83.86	93.62	100.02	102.03	103.21	102.64	102.99
Residential	37.60	38.40	44.25	43.88	40.49	39.42	38.70	38.24
Commercial	29.50	29.96	35.56	31.75	31.00	32.57	33.19	33.13
Industrial	27.54	31.86	30.98	22.78	22.65	21.71	21.09	20.61
Other	**29.65**	**31.07**	**31.91**	**31.82**	**33.55**	**37.27**	**42.20**	**43.02**
TOTAL (inc. Net Imported Electricity)	**277.60**	**277.82**	**305.93**	**298.78**	**283.21**	**286.04**	**292.04**	**293.71**
TOTAL (exc. Net Imported Electricity)	**275.74**	**272.26**	**298.89**	**290.72**	**277.03**	**278.72**	**284.22**	**285.28**

Appendix A. Fuel Combustion Emission Factors and Global Warming Potentials

Fuel Combustion Emission Factors

(EPA *2006 Inventory of Greenhouse Gas Emissions & Sinks* , Annex 2)

	lb CO_2 / MMBtu
Asphalt	165.2
Aviation Fuel	154.8
Coal (Electricity Generation)	206.3
Coal (Industrial)	205.3
Coal (Residential & Commercial)	208.3
Distillate Fuel Oil	159.8
Gasoline	154.8
Kerosene	158.0
Liquefied Petroleum Gas	138.5
Lubricants	162.1
Metallurgical Coal	248.3
Natural Gas	116.5
Petrochemical Feedstocks	155.2
Residual Fuel Oil	172.1

Global Warming Potentials

(IPCC *Second Assessment Report*)

CO_2	1
CH_4	21
N_2O	310
HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
PFCs	6,500-9,200
SF_6	23,900