Chapter 3
Inventory and Forecast of New York State's Greenhouse Gas Emissions

Introduction

This chapter summarizes New York's greenhouse gas (GHG) emissions and sinks (carbon storage) from 1990 to 2030. The inventory and reference case forecasts were prepared to inform the climate action planning effort outlined in Chapter 1 by providing a comprehensive understanding of current and possible future GHG emissions. The information in this chapter reflects the information presented in the *New York Greenhouse Gas Emissions Inventory and Forecast* report (hereafter referred to as the Inventory and Forecast report).

Historical GHG emissions estimates (1990 through 2008)[1] were developed using a set of generally accepted principles and guidelines for state GHG emissions inventories, relying to the extent possible on New York-specific data and inputs. The reference case forecasts (2009- 2030) are based on a compilation of various existing forecasts of electricity generation, fuel use, and other GHG-emitting activities, along with a set of simple, transparent assumptions described in the final Inventory and Forecasts report.

Several demographic trends[2] that could affect future emissions are not fully captured in the current approach to developing New York's energy demand forecasts. Current patterns suggest per capita emissions could fall as the downstate population grows and as the population increases in age. Per capita emissions are generally lower downstate than upstate, and people over 65 generally live in smaller housing units and travel less than people under 65. However, total statewide emissions are expected to rise, driven by increased total population, growth in economic activity, aging housing stock and increased vehicle miles traveled.

The average age of housing stock could increase as the proportion replaced declines. However, new housing units that are built may be smaller on average than the current stock to accommodate increased numbers of smaller families and empty nesters. Given that relatively few new housing units are expected to be built in the next thirty years, opportunities to achieve emissions reductions through improved transportation and land use planning may be limited.

The Inventory and Forecast report covers the six types of gases included in the U.S. GHG inventory:[3] carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these GHGs are presented using a common metric, CO_2 equivalent (CO_2e), which indicates the relative

[1] The last year of available historical data for each sector varies between 2005 and 2008.

[2] See box, Demographic Trends, in Ch. 4.

[3] U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008*.April 2010. EPA430-R-08-006. Available at: http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

contribution of each gas, per unit mass, to global average radiative forcing on a global warming potential-weighted basis.[4]

It is important to note that the emissions estimates reflect the GHG emissions associated with the electricity sources used to meet New York's demands, corresponding to a consumption-based approach to emissions accounting that includes emissions from imported electricity. Another way to look at electricity emissions is to consider the GHG emissions produced by electricity generation facilities in the state, a production-based method. The study covers both methods of accounting for emissions, but for consistency, all total results are reported as consumption-based.

New York GHG Emissions: Sources and Trends

Figure 3-1 shows the relative apportionment of New York's GHG emissions in comparison with the rest of the U.S. as well as the world, all for 2005 (the latest year for which global emissions data were available). New York's share of emissions within the U.S. (3.8 percent) was smaller than its share of the U.S. population (6.5 percent). In contrast, the U.S. share of the world's GHG emissions in 2005 (18 percent) was much greater than its share of the 2005 population (4.6 percent). Nonetheless, New York's GHG emissions accounted for 0.7 percent of the world's GHG emissions in 2005.

[4] Changes in the atmospheric concentrations of GHGs can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth–atmosphere system. Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth). See: Boucher, O., et al. "Radiative Forcing of Climate Change." Chapter 6 in *Climate Change 2001: The Scientific Basis*. Contribution of Working Group 1 of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom. Available at: http://www.grida.no/climate/ipcc_tar/wg1/212.htm.

Figure 3-1. 2005 National and Global Context for Greenhouse Gas Emissions

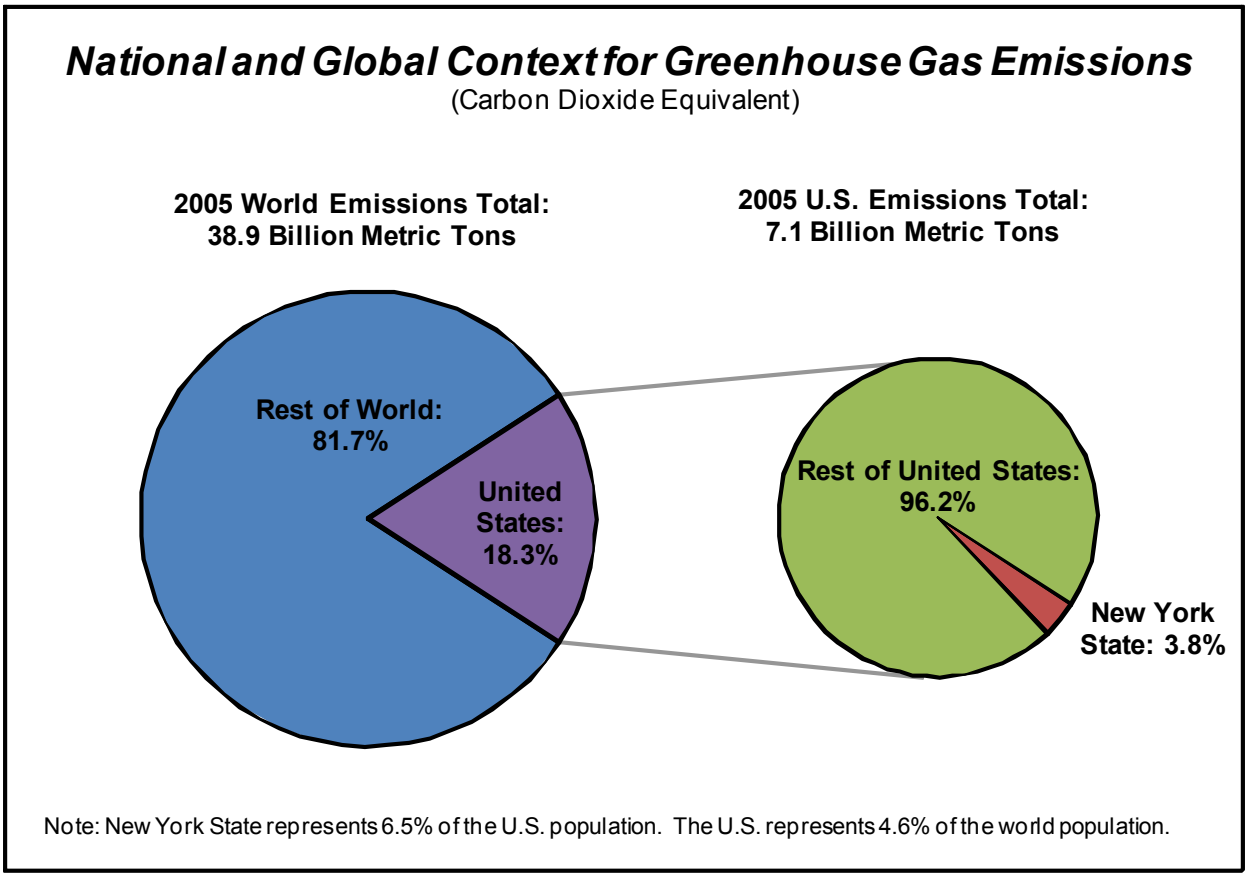


Table 3-1 provides a summary of GHG emissions estimated for New York by sector and gas in 2008, the most recent year for which historical data were available for most sectors. Since the six major greenhouse gases—CO_2, CH_4, N_2O, PFC, HFC, and SF_6—have different global warming potentials the emissions are stated in CO_2e to give a common frame of reference. The sections that follow discuss GHG emissions sources and sinks, trends, forecasts, and uncertainties.

Table 3-1. 2008 New York State Greenhouse Gas Inventory ($MMtCO_2e$)

Sources	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)	**212.81**	**0.73**	**2.39**	**-**	**-**	**-**	**215.94**	**85.16%**
Fuel Combustion (exc. Net Imports of Electricity)	**204.21**	**0.73**	**2.36**	**-**	**-**	**-**	**207.30**	**81.75%**
Electricity Generation	46.44	0.01	0.11	-	-	-	46.57	18.37%
Net Imports of Electricity	8.61	0.01	0.03	-	-	-	8.64	3.41%
Transportation	83.59	0.15	2.05	-	-	-	85.79	33.83%
Residential	34.20	0.42	0.11	-	-	-	34.74	13.70%
Commercial	25.27	0.12	0.05	-	-	-	25.43	10.03%
Industrial	14.70	0.02	0.04	-	-	-	14.77	5.82%
Other Sources	**11.32**	**14.68**	**3.24**	**0.36**	**7.51**	**0.53**	**37.64**	**14.84%**
Power Supply & Delivery	***2.42***	***-***	***0.06***	***-***	***-***	***0.53***	***3.00***	***1.18%***
Electricity Distribution	-	-	-	-	-	0.53	0.53	0.21%
Municipal Waste Combustion	2.42	-	0.06	-	-	-	2.48	0.98%
Agriculture, Forestry & Waste Management	***-***	***9.00***	***3.18***	***-***	***-***	***-***	***12.19***	***4.81%***
Agricultural Animals	-	2.70	-	-	-	-	2.70	1.06%
Agricultural Soil Management	-	-	1.80	-	-	-	1.80	0.71%
Landfills	-	4.46	-	-	-	-	4.46	1.76%
Manure Management	-	0.53	0.24	-	-	-	0.76	0.30%
Municipal Wastewater	-	1.33	1.15	-	-	-	2.47	0.98%
Industrial Processes & Manufacturing	***8.90***	***5.68***	***-***	***0.36***	***7.51***	***-***	***22.45***	***8.85%***
Aluminum Production	-	-	-	0.26	-	-	0.26	0.10%
Cement Production	7.91	-	-	-	-	-	7.91	3.12%
Iron & Steel Production	0.63	-	-	-	-	-	0.63	0.25%
Limestone Use	0.20	-	-	-	-	-	0.20	0.08%
Natural Gas Leakage	-	5.68	-	-	-	-	5.68	2.24%
Ozone-Depleting Substances Substitutes	-	-	-	-	7.51	-	7.51	2.96%
Semiconductor Manufacturing	-	-	-	0.10	-	-	0.10	0.04%
Soda Ash Use	0.16	-	-	-	-	-	0.16	0.06%
Total (inc. Net Imports of Electricity)	**224.14**	**15.41**	**5.63**	**0.36**	**7.51**	**0.53**	**253.58**	**100%**
% of Total (inc. Net Imports of Electricity)	88.39%	6.08%	2.22%	0.14%	2.96%	0.21%	100%	-
Total (exc. Net Imports of Electricity)	**215.53**	**15.41**	**5.60**	**0.36**	**7.51**	**0.53**	**244.94**	**-**

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; CH_4 = methane; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; PFC = perfluorocarbons; HFC = hydrofluorocarbons; SF_6 = sulfur hexafluoride

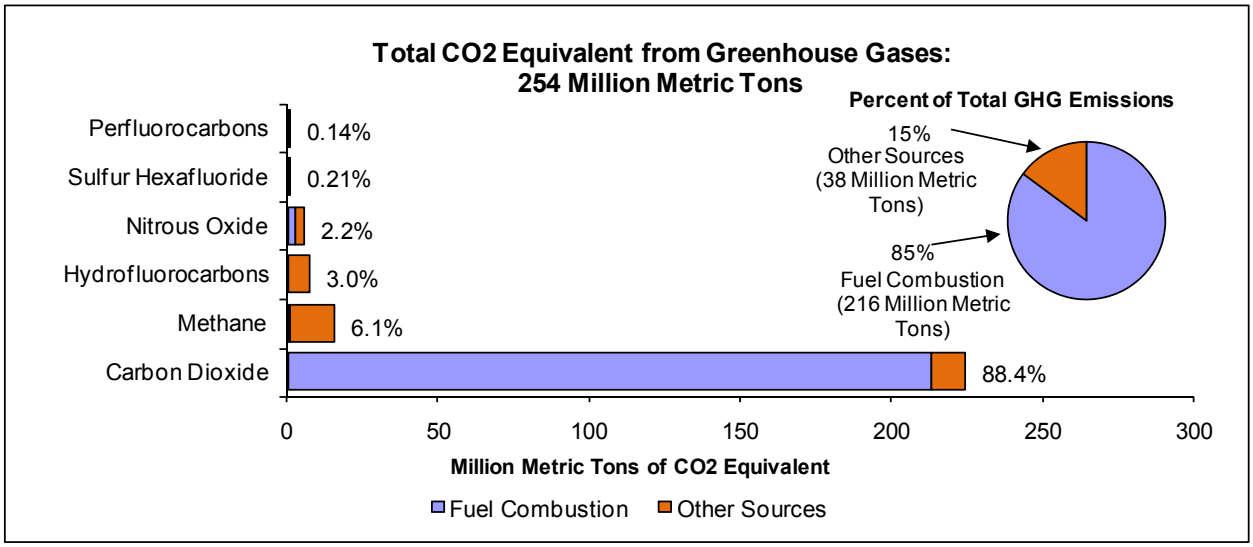
Historical Emissions

Overview—2008 Inventory

As shown in Table 3-1, on a gross emissions consumption basis (i.e., excluding carbon sinks), New York accounts for approximately 254 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) emissions in 2008, an amount equal to 3.7 percent of total U.S. gross GHG emissions.[5] This estimate includes emissions from net imports of electricity.

Figure 3-2 shows the breakdown of New York's 2008 gross GHG emissions by gas. This figure shows that 85 percent of the gross GHG emissions in 2008 are from fuel combustion, with most of these emissions coming from CO_2. The remaining 15 percent of the 2008 GHG emissions, the majority of which are CH_4, are from other non-fuel combustion sources.

Figure 3-2. 2008 Percentage of GHG Emissions by Gas and Source (Includes Net Imports of Electricity)

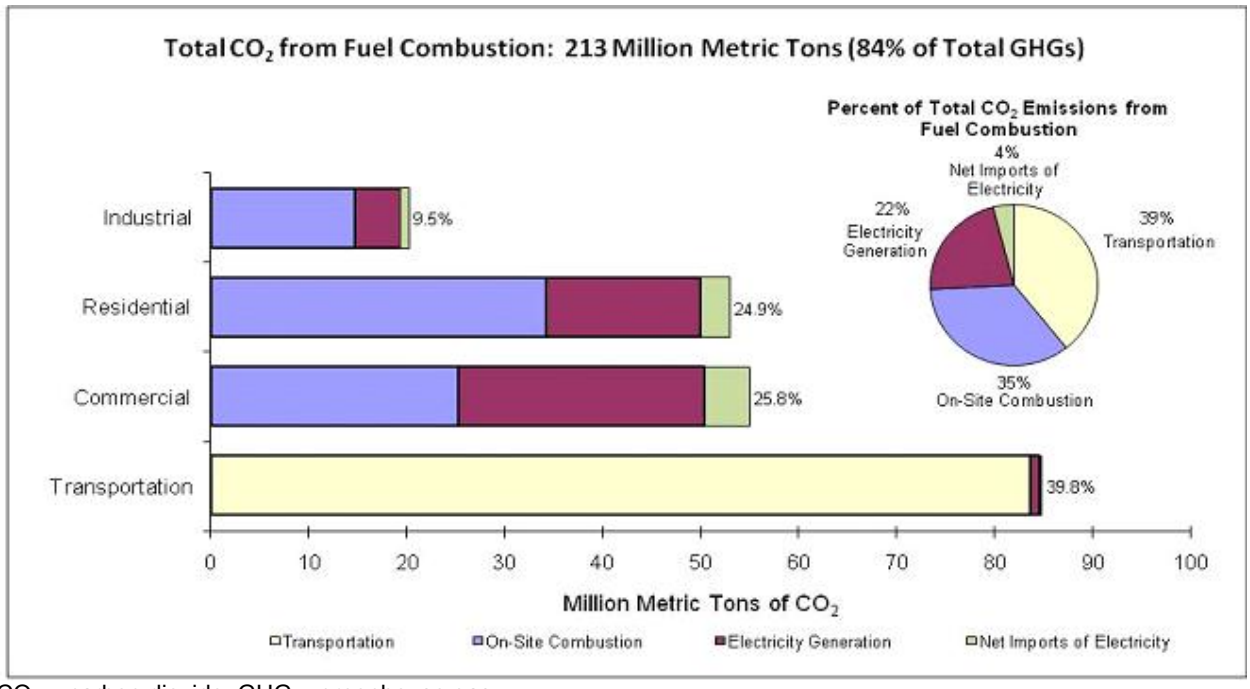


CO_2 = carbon dioxide; GHG = greenhouse gas.

Figure 3-3 provides a further breakdown of the CO_2 emissions from fuel combustion. As shown in this figure, the transportation sector accounts for approximately 40 percent of the CO_2 emissions from fuel combustion. The residential and commercial sectors are each responsible for roughly 25 percent of the CO_2 fuel combustion emissions, including emissions from the share of electricity generation required by each of these sectors. The residential sector shows greater emissions from fuel combustion on-site than from the emissions associated with electricity generation or imported electricity, while the commercial sector shows the reverse—emissions for this sector from electricity generation and imported electricity are higher than the emissions from on-site fuel combustion. The industrial sector contributes the lowest amount of CO_2 emissions from fuel combustion, accounting for approximately 10 percent of the CO_2 fuel combustion emissions in New York, with a majority of these emissions coming from on-site fuel combustion.

[5] The national emissions used for these comparisons are based on 2008 emissions from U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008*, April 2010, EPA430-R-08-006. Available at: http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

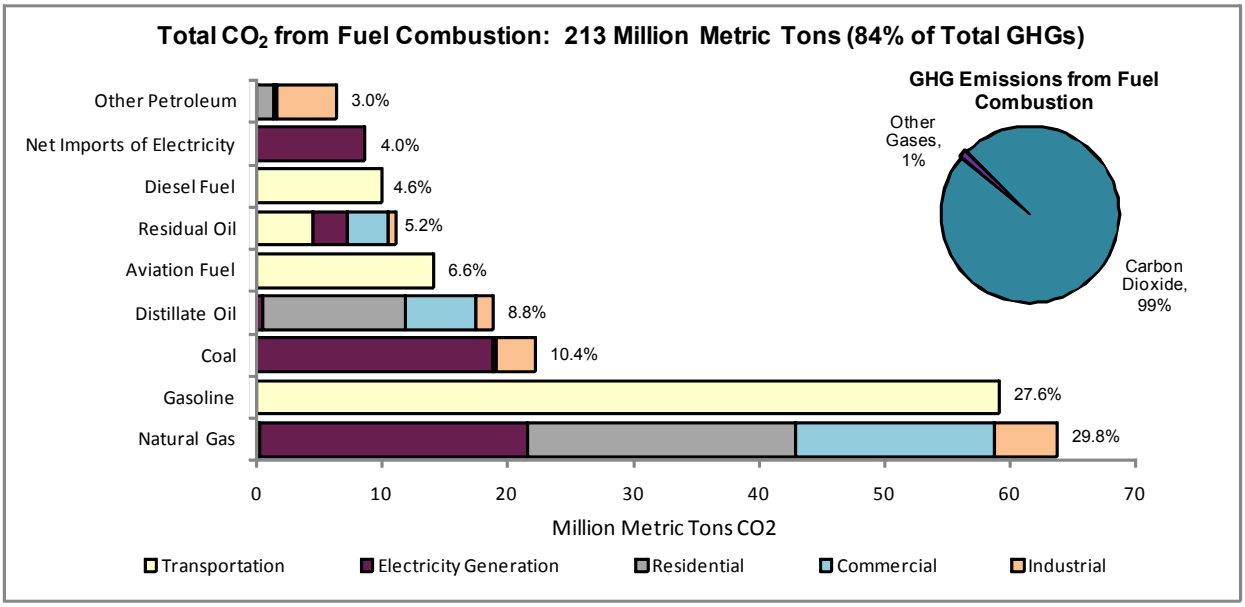
Figure 3-3. 2008 CO_2 Emissions from Fuel Combustion by End Use Sector (Includes Net Imports of Electricity)



CO_2 = carbon dioxide; GHG = greenhouse gas.

Figure 3-4 shows the fuels that contribute to the CO_2 fuel combustion emissions in 2008 in New York. This figure shows that natural gas accounts for the largest amount of CO_2 fuel combustion emissions, with emissions occurring in all five fuel combustion sectors (transportation, electricity generation, residential, commercial, and industrial). An additional 28 percent of the CO_2 fuel combustion emissions result from the burning of gasoline by the transportation sector. The remaining fuel combustion emissions result from the burning of coal, distillate oil, aviation fuel, residual oil, diesel, and other petroleum sources as well as imported electricity. In addition to releasing CO_2, these fuel combustion sources also emit a small amount of N_2O and CH_4, accounting for about 1 percent of the 2008 New York GHG emissions from fuel combustion.

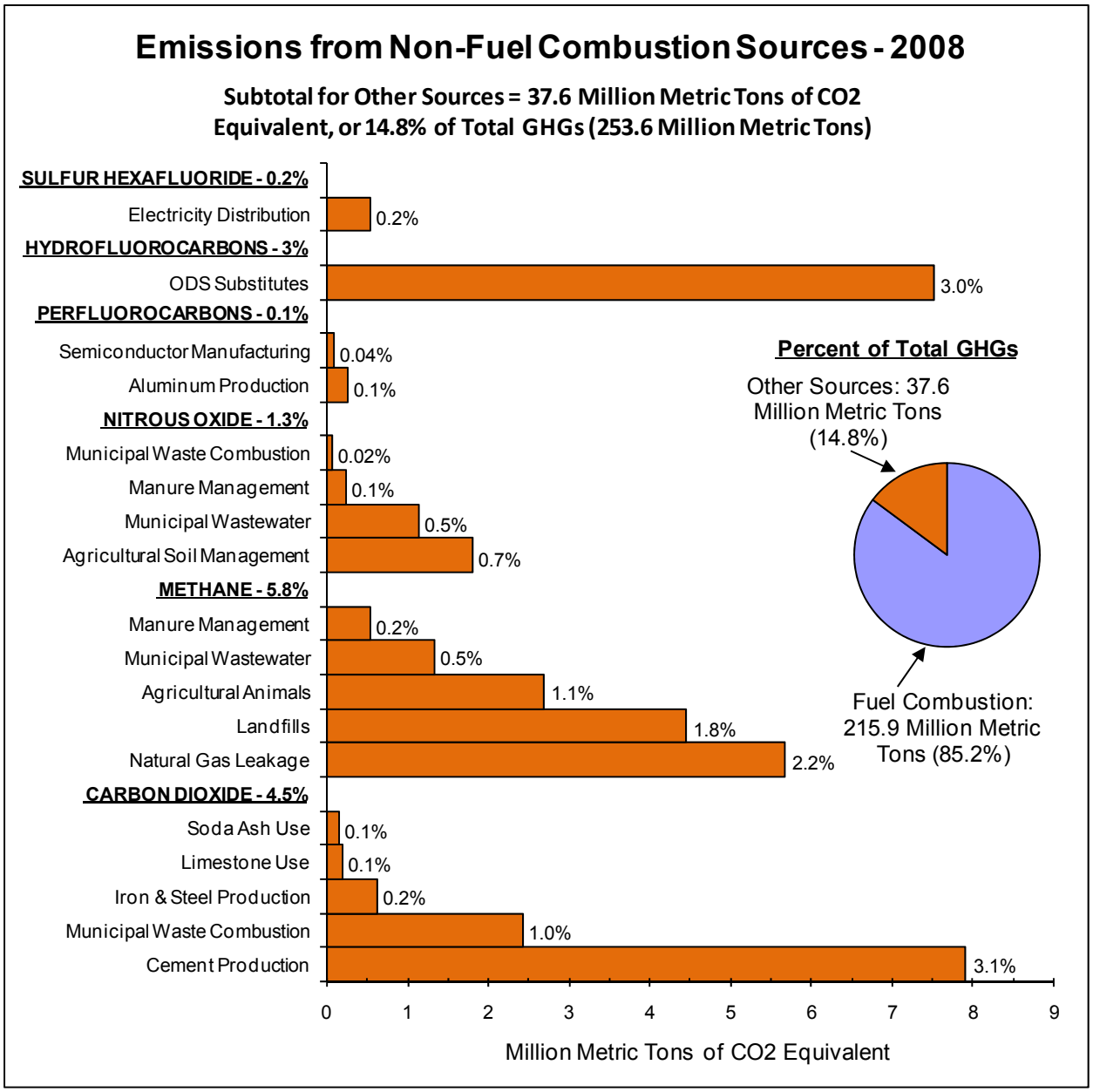
Figure 3-4. 2008 CO_2 Emissions from Fuel Combustion by Fuel Type (Includes Net Imports of Electricity)



CO_2 = carbon dioxide; GHG = greenhouse gas.

The origin of emissions from the non-fuel combustion or "other sources" category is shown in Figure 3-5. This figure includes emissions from all 6 of the GHG gases, with CH_4 accounting for the greatest portion of GHG emissions from these other sources at 5.8 percent of the gross GHG emissions in 2008. The major sources that emit CH_4 are natural gas leakage (at 2.2 percent of the 2008 gross GHG emissions) and landfills (at 1.8 percent of the 2008 gross GHG emissions). The sectors with the greatest non-fuel combustion emissions are cement production, which produces CO_2 emissions accounting for 3.1 percent of the total 2008 GHG emissions, and the use of ozone-depleting substance (ODS) substitutes, which contributes HFC emissions that account for 3.0 percent of the 2008 gross GHG emissions.

Figure 3-5. 2008 Emissions from Non-Fuel Combustion Sources (Total Emissions Include Net Imports of Electricity)



CO_2 = carbon dioxide; GHG = greenhouse gas; ODS = ozone-depleting substance.

Emissions Trends

Table 3-2 shows the trend in New York's historical GHG emissions in 5-year increments from 1990 to 2005, as well as for the reference case forecasts from 2015 to 2030. New York's gross GHG emissions, in total, increased by about 9 percent (or 23 $MMtCO_2e$) from 1990 to 2005, with a peak around 2000. This compares to a national increase in gross GHG emissions of 16 percent from 1990 to 2005.

The sectors that showed the greatest increase during this time period were the ODS substitutes category (more than 27 fold increase),[6] imported electricity (more than quadrupling), semiconductor manufacturing (more than doubling), and municipal waste combustion (nearly doubling).

In terms of the magnitude of emissions growth, the transportation sector showed by far the greatest growth, with emissions increasing by 17 $MMtCO_2e$ from 1990 to 2005. In contrast, emissions from electricity generated in-state decreased by about 10 $MMtCO_2e$ during this same period.

Table 3-2. New York Gross GHG Emissions, Historical and Reference Case Forecast ($MMtCO_2e$)*

Gas and Category	1990	1995	2000	2005	2015	2020	2025	2030
Carbon Dioxide	**224.73**	**223.99**	**248.23**	**241.45**	**223.47**	**225.27**	**226.92**	**231.67**
Fuel Combustion	***214.76***	***212.93***	***236.92***	***230.13***	***212.12***	***213.92***	***215.57***	***220.32***
Electricity Generation	64.01	51.39	55.99	54.19	39.83	41.51	42.91	46.34
Net Imports of Electricity	1.63	4.24	5.66	6.52	6.61	7.06	7.61	7.61
Transportation	68.11	72.17	83.05	85.89	85.18	85.05	85.25	86.85
Residential	33.65	34.29	39.30	39.10	35.14	34.50	34.10	33.92
Commercial	26.61	26.99	31.99	28.57	29.34	29.90	29.85	29.83
Industrial	20.75	23.85	20.93	15.86	16.01	15.89	15.86	15.78
Other Sources	***9.97***	***11.06***	***11.31***	***11.32***	***11.35***	***11.35***	***11.35***	***11.35***
Municipal Waste Combustion	1.26	1.54	1.87	2.37	2.41	2.41	2.41	2.41
Cement Production	6.68	7.63	7.98	7.94	7.91	7.91	7.91	7.91
Iron and Steel Production	1.65	1.55	1.07	0.63	0.65	0.65	0.65	0.65
Limestone Use	0.17	0.16	0.21	0.21	0.21	0.21	0.21	0.21
Soda Ash Use	0.20	0.19	0.18	0.17	0.16	0.16	0.16	0.16
Methane	**14.22**	**15.91**	**16.44**	**15.22**	**15.00**	**15.10**	**14.76**	**14.63**
Fuel Combustion	***0.84***	***0.90***	***1.10***	***0.75***	***0.70***	***0.71***	***0.72***	***0.74***
Electricity Generation	0.03	0.02	0.02	0.03	0.01	0.01	0.01	0.02
Net Imports of Electricity	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Transportation	0.36	0.33	0.26	0.18	0.13	0.14	0.16	0.17
Residential	0.31	0.40	0.60	0.39	0.40	0.40	0.39	0.39
Commercial	0.09	0.13	0.18	0.13	0.13	0.13	0.13	0.13
Industrial	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02
Other Sources	***13.38***	***15.01***	***15.34***	***14.46***	***14.30***	***14.39***	***14.04***	***13.89***
Agricultural Animals	2.83	2.69	2.67	2.65	2.54	2.45	2.35	2.27
Landfills	4.90	5.30	5.31	4.77	4.32	4.27	3.81	3.42
Manure Management	0.35	0.39	0.44	0.50	0.50	0.48	0.46	0.44
Municipal Wastewater	1.21	1.22	1.28	1.30	1.39	1.44	1.49	1.54
Natural Gas Leakage	4.08	5.41	5.66	5.23	5.55	5.76	5.93	6.22
Nitrous Oxide	**7.00**	**7.46**	**7.80**	**6.51**	**4.68**	**4.50**	**4.61**	**4.71**
Fuel Combustion	***3.74***	***4.38***	***4.61***	***3.21***	***1.39***	***1.17***	***1.23***	***1.29***
Electricity Generation	0.19	0.14	0.16	0.15	0.11	0.11	0.11	0.11
Net Imports of Electricity	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03
Transportation	3.31	4.01	4.14	2.82	1.05	0.82	0.89	0.95
Residential	0.09	0.11	0.16	0.12	0.11	0.11	0.10	0.10
Commercial	0.05	0.06	0.06	0.06	0.05	0.05	0.05	0.05
Industrial	0.09	0.06	0.07	0.05	0.05	0.05	0.05	0.05

[6] Emissions from ODS substitutes are expected to grow in line with national forecasts at over 5% a year.

Gas and Category	1990	1995	2000	2005	2015	2020	2025	2030
Other Sources	***3.26***	***3.08***	***3.19***	***3.29***	***3.29***	***3.33***	***3.38***	***3.42***
Agricultural Soil Management	1.93	1.74	1.78	1.88	1.81	1.82	1.83	1.84
Manure Management	0.30	0.27	0.26	0.24	0.22	0.21	0.21	0.20
Municipal Waste Combustion	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Municipal Wastewater	0.98	1.02	1.10	1.12	1.20	1.24	1.29	1.33
Perfluorocarbons	**0.43**	**0.39**	**0.44**	**0.36**	**0.36**	**0.36**	**0.36**	**0.36**
Aluminum Production	0.38	0.31	0.33	0.27	0.26	0.26	0.26	0.26
Semiconductor Manufacturing	0.04	0.07	0.11	0.09	0.10	0.10	0.10	0.10
Hydrofluorocarbons	**0.02**	**1.97**	**4.80**	**6.54**	**12.14**	**15.89**	**16.10**	**16.35**
ODS Substitutes	0.02	1.97	4.80	6.54	12.14	15.89	16.10	16.35
Sulfur Hexafluoride	**1.28**	**0.93**	**0.63**	**0.58**	**0.53**	**0.53**	**0.53**	**0.53**
Electricity Distribution	1.28	0.93	0.63	0.58	0.53	0.53	0.53	0.53
TOTAL	**247.68**	**250.65**	**278.34**	**270.65**	**256.19**	**261.65**	**263.28**	**268.25**
All Gases by Source Category								
Fuel Combustion	219.35	218.20	242.63	234.10	214.21	215.79	217.53	222.35
Electricity Generation	64.24	51.54	56.18	54.36	39.96	41.64	43.03	46.47
Net Imported Electricity	1.63	4.26	5.69	6.55	6.64	7.09	7.64	7.64
Transportation	71.78	76.50	87.44	88.89	86.36	86.02	86.30	87.96
Residential	34.06	34.80	40.05	39.61	35.64	35.00	34.60	34.42
Commercial	26.75	27.17	32.23	28.75	29.52	30.09	30.03	30.01
Industrial	20.88	23.93	21.04	15.93	16.09	15.96	15.93	15.85
Other Sources	28.34	32.44	35.71	36.55	41.97	45.85	45.75	45.90
TOTAL	**247.68**	**250.65**	**278.34**	**270.65**	**256.19**	**261.65**	**263.28**	**268.25**

NOTE: Values for 1990–2005 are based on historical data, while values for 2015–2030 are forecasted.

GHG = greenhouse gas; $MMTCO_2e$ = million metric tons of carbon dioxide equivalent.

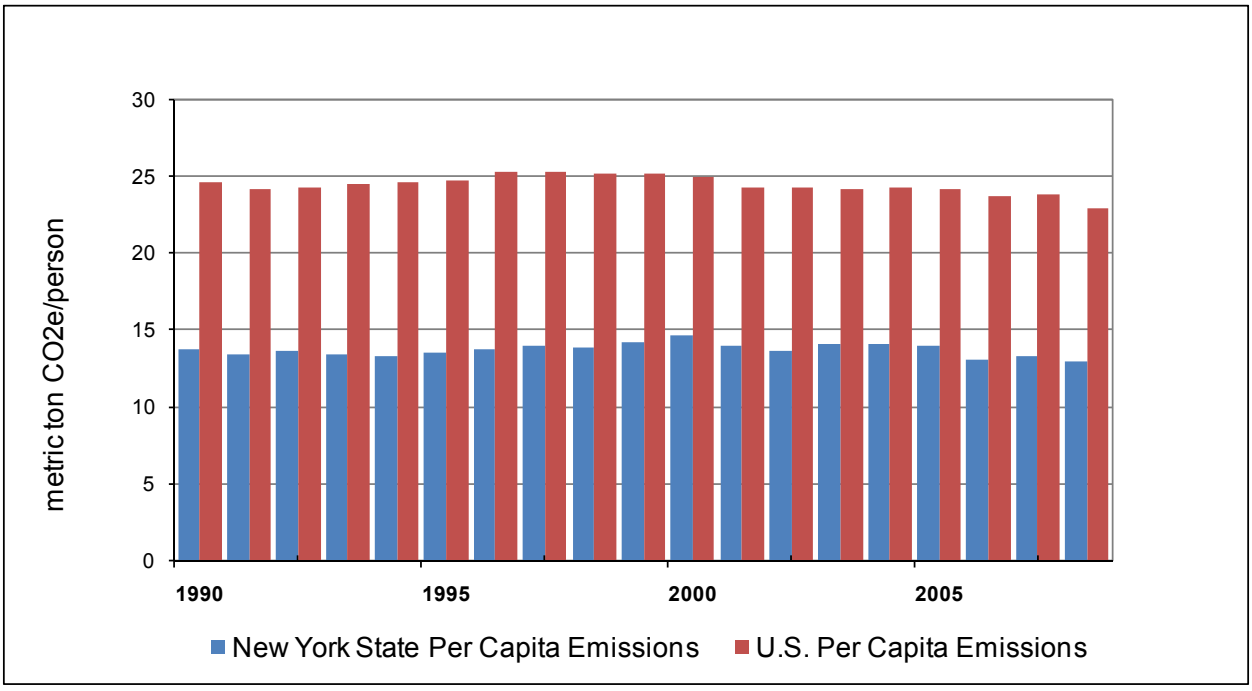
* Totals may not equal exact sum of subtotals shown in this table due to independent rounding.

As illustrated in Figure 3-6, on a per-capita basis, New York residents emitted about 13.7 metric tons (t) of gross CO_2e on average from 1990 to 2008, which is much lower than the national average of about 24.4 tCO_2e over the same time period. Both New York and national per-capita emissions remained relatively constant during this period. This indicates New York's population increase of about 8 percent from 1990 to 2008 resulted in a similar increase in overall gross GHG emissions during this time.

Figure 3-7 compares New York's emissions intensity with that of the United States from 1990 to 2008. This emissions intensity represents GHG emissions per unit of economic output—gross state product (GSP) for New York and gross domestic product (GDP) for the United States. As with emissions per capita, emissions per dollar GSP is much lower in New York than in the U.S. throughout this historical period, with an average of 0.09 kilograms (kg) CO_2e per dollar GSP in New York and 0.74 kg CO_2e per dollar GDP in the United States. In both New York and the nation as a whole, economic growth exceeded emissions growth throughout the 1990–2008

period. From 1990 to 2008, emissions per unit of gross product dropped by 31 percent nationally, and by 36 percent in New York.[7]

Figure 3-6. New York and U.S. Gross GHG Emissions per Capita



[7] Based on real gross domestic product (chained 2000 dollars) that excludes the effects of inflation. U.S. Department of Commerce, Bureau of Economic Analysis. "Gross Domestic Product by State." Available at: http://www.bea.gov/regional/gsp/.

Figure 3-7. New York and U.S. Emissions Intensity

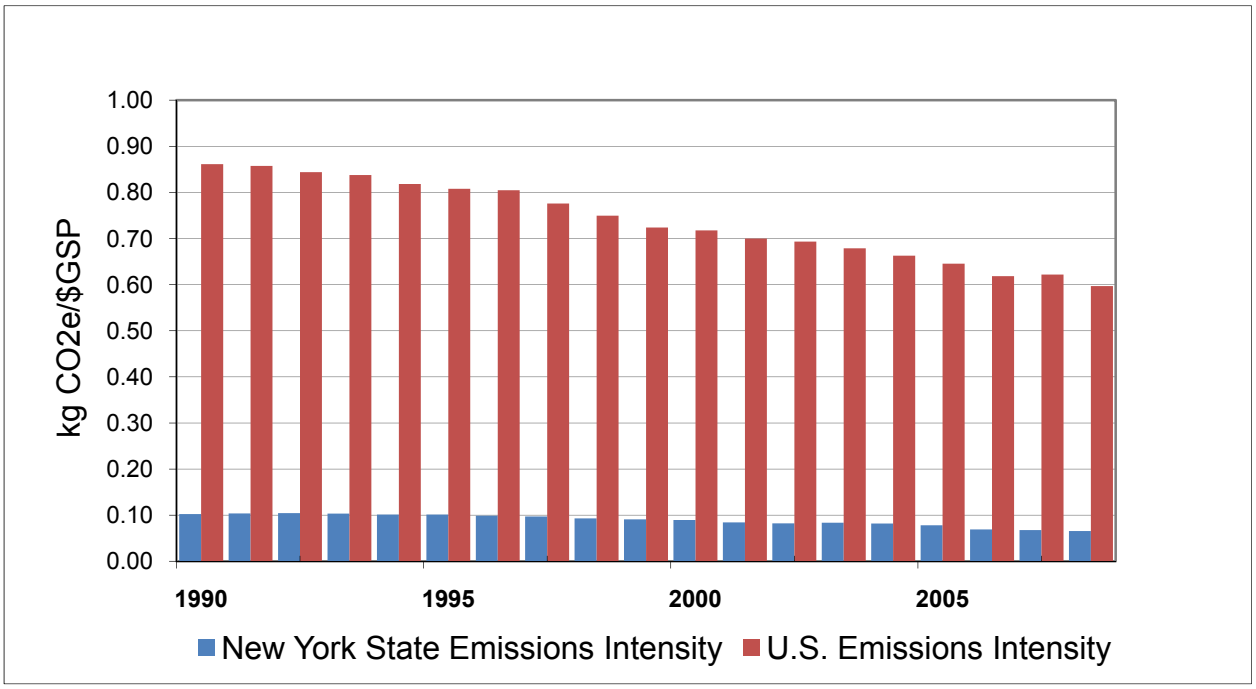
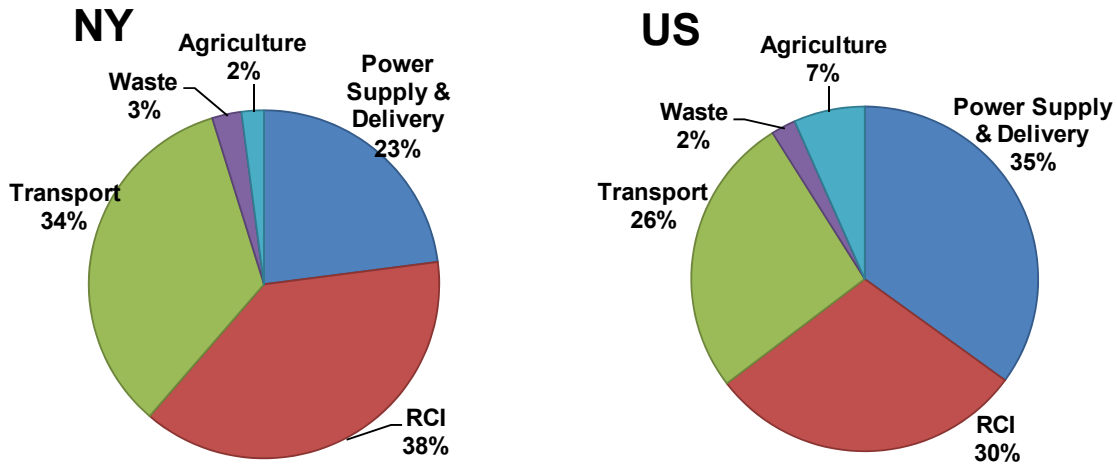


Figure 3-8 compares emissions by major sector in 2008 from New York and the United States. The principal sources of New York's GHG emissions in 2008 are the residential, commercial/institutional, and industrial sector; the transportation sector; and the power supply and delivery sector. These account for 38 percent, 34 percent, and 23 percent of New York's gross GHG emissions, respectively. These are also the three largest emitting sectors in the US, but in a different order, with the power supply and delivery sector at 35 percent, the RCI sector at 30 percent, and the transportation sector at 26 percent. In New York, emissions from waste and agriculture combine to account for the remaining 5 percent of gross GHG emissions in 2008, while these two sectors account for 9 percent of gross GHG emissions in the US.

Figure 3-8. 2008 Gross GHG Emissions by Sector: New York and U.S.



Notes: RCI = Residential, commercial/institutional, and industrial sector. Emissions for the residential, commercial, and industrial fuel use sectors are associated with the direct use of fuels (natural gas, petroleum, coal, and wood) to

provide space heating, water heating, process heating, cooking, and other energy end-uses in the residential, commercial/institutional, and industrial sectors. This sector also accounts for GHG emissions from non-fuel sources in the industrial sector, such as CO_2 emissions from cement production, as well as emissions from the fossil fuel industry (e.g., natural gas leakage). The transportation sector accounts for emissions associated with fuel consumption by all on-road and non-highway vehicles. Non-highway vehicles include jet aircraft, gasoline-fueled piston aircraft, railway locomotives, boats, and ships. Emissions from non-highway agricultural and construction equipment are included in the RCI sector. The power supply and delivery sector includes emissions associated with electricity generated within the state and electricity imported from outside of New York as well as the emissions associated with municipal waste combustion (waste-to-energy facilities) and electricity transmission and distribution. The waste category includes emissions from landfills and wastewater. The U.S. agriculture emissions also include CH_4 and N_2O emissions from forest fires.

Trends in Emissions Sinks

New York's forests serve as sinks of GHG emissions, as shown in Table 3-3. The forestry sector includes both forested lands as well as urban forestry. The largest sink is due to the net CO_2 flux[8] from forested lands in New York. In addition to the forestry sector, Table 3-3 shows that cultivation practices in the agriculture sector are also found to be sinks of CO_2e emissions in New York.

Table 3-3. New York GHG Emissions Sinks, Historical and Reference Case Forecast ($MMtCO_2e$)

Emissions Sinks	1990	1995	2000	2005	2015	2020	2025	2030
Soil Carbon (Cultivation Practices)	–1.20	–1.20	–1.36	–1.36	–1.36	–1.36	–1.36	–1.36
Compost	–0.11	–0.11	–0.11	–0.11	–0.11	–0.11	–0.11	–0.11
Forest Carbon Flux	–19.61	–23.60	–23.60	–23.60	–23.60	–23.60	–23.60	–23.60
Urban Trees	–1.97	–2.09	–2.21	–2.33	–2.38	–2.38	–2.38	–2.38
Landfilled Yard Trimmings and Food Scraps	–1.66	–0.92	–0.72	–0.61	–0.51	–0.51	–0.51	–0.51
TOTAL	**-24.55**	**-27.92**	**-28.00**	**-28.01**	**-27.96**	**-27.96**	**-27.96**	**-27.96**

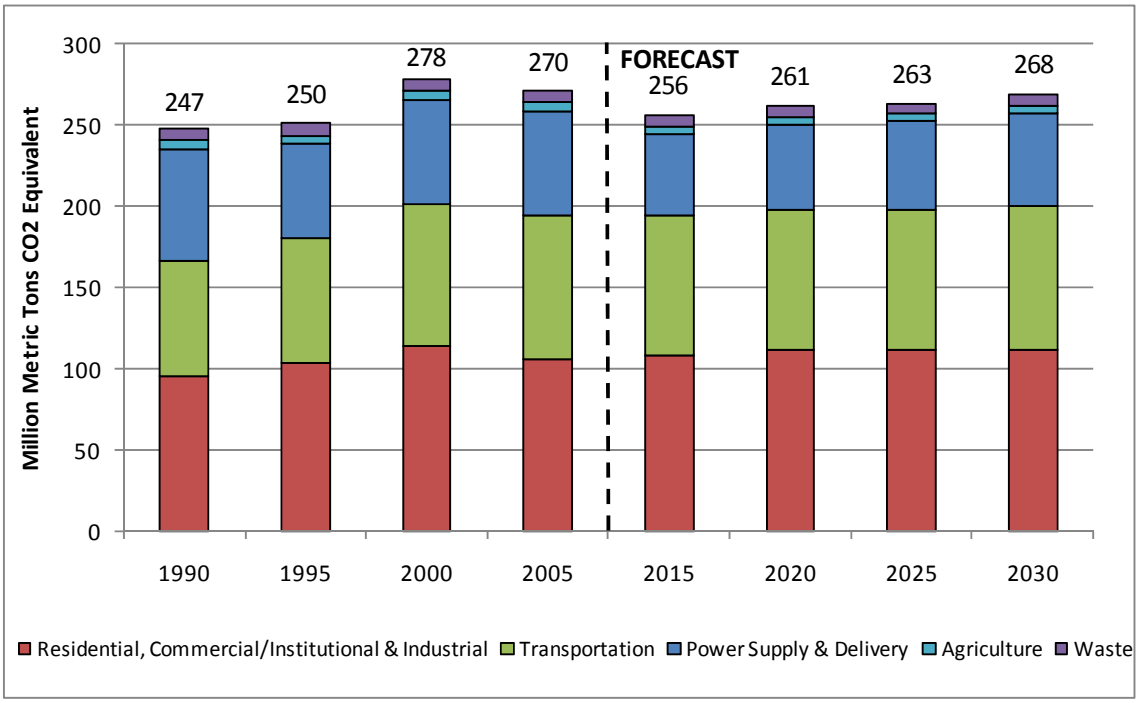
GHG = greenhouse gas; $MMTCO_2e$ = million metric tons of carbon dioxide equivalent; N_2O = nitrous oxide.

Reference Case Forecasts

Relying on a variety of sources for forecasts, a simple reference case forecast of GHG emissions through 2030 was developed. As illustrated in Figure 3-9 and shown numerically in Tables 3-1 and 3-2, under the reference case forecasts, New York's gross GHG emissions increase by about 12 $MMtCO_2e$ from 2008 over the forecast period to reach about 268 $MMtCO_2e$ by 2030, or 8 percent above 1990 levels. This equates to a 0.2 percent annual rate of growth from 1990 to 2030. Relative to 2008, the share of emissions associated with the transportation, RCI, and power supply and delivery sectors are still forecasted to be the highest, in the same order.

[8] "Flux" refers to both emissions of CO_2 to the atmosphere and removal (sinks) of CO_2 from the atmosphere.

Figure 3-9. Greenhouse Gas Emissions by Source Category, 1990–2030



A Closer Look at the Major Source of Emissions: Fuel Combustion

The transportation sector accounts for the largest share of GHG emissions in New York, at 34 percent of New York's gross GHG emissions in 2008. Emissions from this sector rose at an average annual growth rate of 1.0 percent from 1990 to 2008. In 2008, motor gasoline, used by on-road vehicles and recreational marine vehicles, accounts for the majority of transportation GHG emissions; jet fuel contributes the second-highest transportation GHG emissions; and diesel fuel, used by on-road vehicles, commercial marine vehicles, and locomotives, ranks third among fuels contributing to transportation emissions. Residual fuel, liquefied petroleum gas, and other transportation fuels account for the remaining transportation GHG emissions in 2008. Emissions from the transportation sector are forecasted to increase at an average annual growth rate of 0.1 percent from 2008 to 2030, growing from 86 MMtCO2e to 88 MMtCO2e during that time. The mix of GHG-emitting transportation fuels in 2030 is expected to be relatively similar to the 2008 mix.

Activities in the RCI[9] fuel combustion sector produce GHG emissions when fuels are combusted to provide space heating, process heating, and other applications. Fuel combustion within the RCI sector accounts for 30 percent of New York's gross GHG emissions in 2008. From 1990 to 2008, emissions from RCI fuel combustion decreased at an annual rate of 0.5 percent. In 2008, the residential sector's contribution toward the total RCI emissions from direct fuel use was 46 percent (35 $MMtCO_2e$), while the commercial/institutional sector accounted for 34 percent (25 $MMtCO_2e$) and the industrial sector accounted for 20 percent (15 $MMtCO_2e$). Overall, emissions

[9] The industrial sector includes emissions associated with agricultural energy use and fuel used by the fossil fuel production industry.

from fuel combustion within the RCI sector are expected to increase by 0.3 percent annually between 2008 and 2030. Fuel combustion emissions from the commercial/institutional and industrial sectors are forecasted to annually increase by 0.75 percent and 0.32 percent between 2008 to 2030,respectively. In contrast, fuel combustion emissions from the residential sector are forecasted to decrease by 0.04 percent annually during that time. Total GHG emissions from fuel combustion in the RCI sector are expected to be 80 $MMtCO_2e$ in 2030.

In 2008, emissions from fuel combustion associated with New York's electricity consumption (55 $MMtCO_2e$) are 8 $MMtCO_2e$ higher than those associated with in-state electricity production (47 $MMtCO_2e$). The higher level for consumption-based emissions reflects GHG emissions associated with net imports of electricity from other states to meet electricity demand.[10] Electricity generation in New York is dominated by natural gas and nuclear-powered units, with coal, oil, and hydro also important sources of historical generation in New York.

Forecasts of electricity sales for 2008–2030 indicate that New York will remain a net importer of electricity. Emissions from electricity imports are forecasted to decrease slightly (by approximately 1 $MMtCO_2e$) from 2008 to 2030. In contrast, the reference case forecast indicates that production-based emissions (associated with electricity generated in-state) in 2030 will be approximately the same as those in 2008. Given these trends, it is anticipated that consumption-based emissions (associated with electricity consumed in-state) will only decrease slightly during that time period, from 55 $MMtCO_2e$ in 2008 to 54 $MMtCO_2e$ in 2030.

Key Uncertainties

Some data gaps exist in this inventory, particularly in the reference case forecasts. Key tasks for future refinement of this inventory and forecast include review and revision of key drivers, such as the transportation, RCI fuel use, and electricity demand growth rates that will be major determinants of New York's future GHG emissions. These growth rates are driven by uncertain economic, demographic, and land-use trends (including growth patterns and transportation system impacts), all of which deserve closer review and discussion.

[10] Estimating the emissions associated with electricity use requires an understanding of the electricity sources (both in-state and out-of-state) used by utilities to meet consumer demand. The current estimate reflects some very simple assumptions, as described in Appendix A of the Inventory and Forecast report.