PlaNYC

INVENTORY OF NEW YORK CITY GREENHOUSE GAS EMISSIONS

SEPTEMBER 17, 2008

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A GREENER, GREATER NEW YORK

The City of New York
Mayor Michael R. Bloomberg

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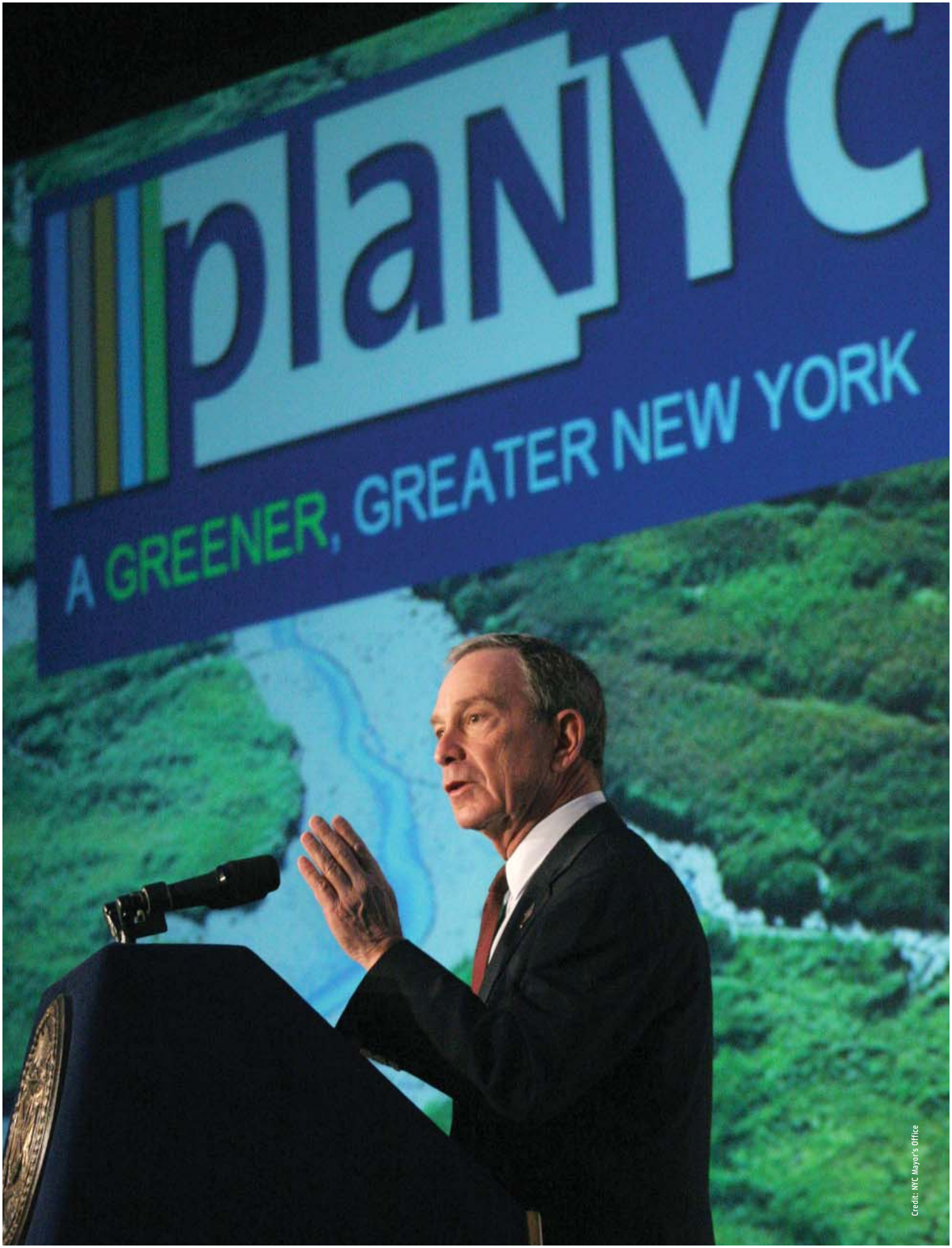
A GREENER, GREATER NEW YORK

Updated February 24, 2009 to address a calculation error discovered after the September 17, 2008 original publication of this report. This correction results in a 0.02 percent reduction in the 2005 citywide base year emissions level, the results of which are reflected in several charts and tables in this version.



Credit: NYC Mayor's Office

Foreword by Michael R. Bloomberg, Mayor of New York City

New York City recognizes the value of leading by example on the issue of climate change. The international community now agrees that climate change presents a significant threat which requires immediate, collaborative action. New York City, as we have done on matters of public health and safety, is in a position to help set the standard for responsible and innovative leadership. We are working to do just that, and our efforts began with data collection.

During my time in both the private and public sectors, the words, "If you can't measure it, you can't manage it," have always served me well. Now, as we face the daunting challenge of confronting global climate change, a data-driven approach to problem-solving is more important than ever.

Last year, the City released its first-ever comprehensive greenhouse gas inventory, detailing the sources and levels of emissions from both City government operations and the city as a whole. The 2007 inventory provided the benchmarks from which the City's carbon reduction targets are based: a 30 percent reduction from City government by 2017 and a 30 percent reduction citywide by 2030. What also became clear from our analysis was that one strategy alone would not get us to our ambitious goals.

That is why we released PlaNYC, the City's 127-point sustainability plan that will allow the city to meet these goals through decreases in energy demand, improvements to our power supply, and reductions in transportation emissions. We also developed a long-term energy conservation action plan for City government buildings and operations. The action plan is a comprehensive guide to reducing City government's carbon footprint, through making City buildings more efficient, improving preventive maintenance, capturing energy potential at wastewater treatment plants, and more.

This updated greenhouse gas inventory provides complete, transparent disclosure of citywide and City government greenhouse gas emissions. To further understand the sources and levels of these emissions, we have committed to completing regular inventory updates. This monitoring and reporting allows us to closely track the impact of our carbon emission mitigation efforts, and it allows citizens to hold us accountable for achieving results. Together, and with the best data, we can make the decisions necessary to combat climate change.

Credit: NYC Economic Development Corporation

Executive Summary

In April 2007, the City of New York (the City) released its first-ever comprehensive greenhouse gas inventory. The *Inventory of New York City Greenhouse Gas Emissions* actually included two emissions inventories: one for citywide emissions based on 2005 emissions data, and one for City government operations based on fiscal year 2006 (July 2005 to June 2006) data. These two base year inventories provided the benchmarks from which the City's greenhouse gas emissions reduction targets are based.

Since the April 2007 release, the City applied various changes to the City's base year inventories based on revised calculation protocols and methodologies as well as increased data availability. These adjustments resulted in an increase in both citywide and City government base year inventories.

The citywide 2007 and City government fiscal year 2007 inventories reflect changes that have occurred in building energy consumption, the make-up of New York City's energy supply mix, vehicle miles traveled, and emissions from our landfills and wastewater treatment plants since the base year inventories. Although the citywide and City government inventory methodologies are analogous, the results cannot be directly compared. The time periods included in the respective analyses are slightly offset – 2007 calendar year for citywide and fiscal year 2007 (July 2006 to June 2007) for City government. Because of the difference in the timeframes of data collection, variations in emissions from heating and cooling due to weather conditions prevent direct comparison.

The citywide 2007 inventory shows that CO_2e emissions in New York City decreased by 2.5 percent compared to the adjusted 2005 base year. Several factors contributed to this reduction, including two new efficient power plants opened in 2006 and milder winter and summer weather conditions in 2007. With this decrease in emissions citywide, New York City is on target to achieve the 30 percent reduction by 2030 goal. The fact that citywide emissions decreased despite a growing population and an increase in energy use per capita highlights the impact of cleaner energy sources on emissions levels. Following the recommendations of *PlaNYC*, the City will continue to pursue opportunities to further increase capacity of clean energy sources to displace inefficient and more carbon-intensive sources. At the same time, the City will move forward to aggressively improve the energy efficiency of our buildings and continue to enhance sustainable modes of transportation.

For City government operations, emissions increased by 5.6 percent between fiscal years 2006 and 2007. This increase is primarily attributed to an increase in electricity and heating fuel consumption in City buildings and the leakage of methane gas from wastewater treatment plants experiencing mechanical problems. In fiscal year 2008, the City made a major commitment to stemming future increases in greenhouse gas emissions by investing $80 million in energy efficiency. This major investment has already begun to improve the energy efficiency of City government buildings. In addition, the City is implementing the *Long-Term Plan to Reduce Energy Consumption and Greenhouse Gas Emissions of Municipal Buildings and Operations*, which the Energy Conservation Steering Committee released in July 2008. The plan includes strategies to significantly reduce energy consumption through aggressive building retrofits and by addressing methane emissions, among other strategies.

Annual inventory updates can provide valuable information on emission trends in New York City as well as the impacts that weather, population, infrastructure investments, policy decisions and consumer behavior have on greenhouse gas emission levels. The City looks forward to incorporating the effects of implementation of PlaNYC, the City's long-term sustainability plan, in future inventory updates. PlaNYC includes 127 initiatives, many of which reduce greenhouse gas emissions.

Overview

New York City is on target to achieve 30% reduction in greenhouse gas emissions by 2030

In April 2007, the City of New York (the City) released its first-ever comprehensive greenhouse gas (GHG) inventory, which detailed the sources and levels of GHG emissions from both citywide activities and from New York City government operations. Using 2005 data for the citywide base year and fiscal year 2006 (July 1, 2005 – June 30, 2006) for City government operations, the *Inventory of New York City Greenhouse Gas Emissions*[1] provided the baseline from which the city's GHG emissions reduction targets are based.

On Earth Day 2007, Mayor Bloomberg released *PlaNYC*,[2] New York City's comprehensive sustainability plan to accommodate a population increase of almost one million people by 2030 while improving the quality of the environment and mitigating the impacts of climate change. Most of *PlaNYC's* 127 separate initiatives contribute directly to achieving the city's GHG reduction goals—to reduce citywide GHG emissions by 30 percent by 2030 and to reduce City government GHG emissions by 30 percent by 2017.

Following PlaNYC, Mayor Bloomberg signed Executive Order 109 in October 2007. This mandated the reduction in greenhouse gas emissions by City agencies. City Council then codified both City government and citywide greenhouse gas reduction targets into law with the passing of Local Law 22 in early 2008. This law requires the City to complete annual updates to its GHG inventories and to achieve the GHG reductions embodied in *PlaNYC*. This report is completed in accordance with this law and reflects the updates to the citywide and City government GHG emissions inventories.

After the base year adjustments made due to protocol changes and increased data availability, the City's 2008 GHG emissions analysis shows a reduction of 1.6 million metric tons of carbon dioxide equivalent ($MMTCO_2e$)[3], or 2.5 percent, in citywide carbon dioxide equivalent (CO_2e) emissions between the 2005 adjusted baseline and 2007. From the adjusted fiscal year 2006 emission levels, the analysis shows an increase in City government emissions of 0.23 MMT, or 5.6 percent to 4.3 MMT of CO_2e. The changes in emissions reflect the addition of new efficient in-city power plants, the effect of weather and population growth on fuel and electricity use, and the impact of increased methane (CH_4) emissions at wastewater treatment plants due to the repair of methane flare equipment and the increase in anaerobic digester gas production.

The calculation of GHG inventories is an evolving science. Therefore, any emissions assessment must be considered an estimate derived using the best information and tools available at that time. Since the release in 2007 of the City's first, or base year, GHG inventory, numerous efforts have been underway to harmonize the different methodologies used by cities and other organizations worldwide to calculate their GHG emissions. These new protocols, now in draft form, will provide unified guidance to municipalities and others completing inventories, allowing for more comparability of results. Accordingly, the City has followed these draft protocols and has included updated data where there have been improvements in available data and modeling.

Following the new protocols, the City has now categorized its emissions into scopes based on the World Resources Institute/World Business Council for Sustainable Development's *Greenhouse Gas Protocol*,[4] and has revised its methodology for calculating emissions from solid waste. Due to improvements in available data, the City has also updated its emissions coefficients for electricity and steam and its base year

New York City's carbon footprint declined 2.5% between 2005 and 2007, due to more efficient power plants and milder weather offsetting increased energy consumption and driving

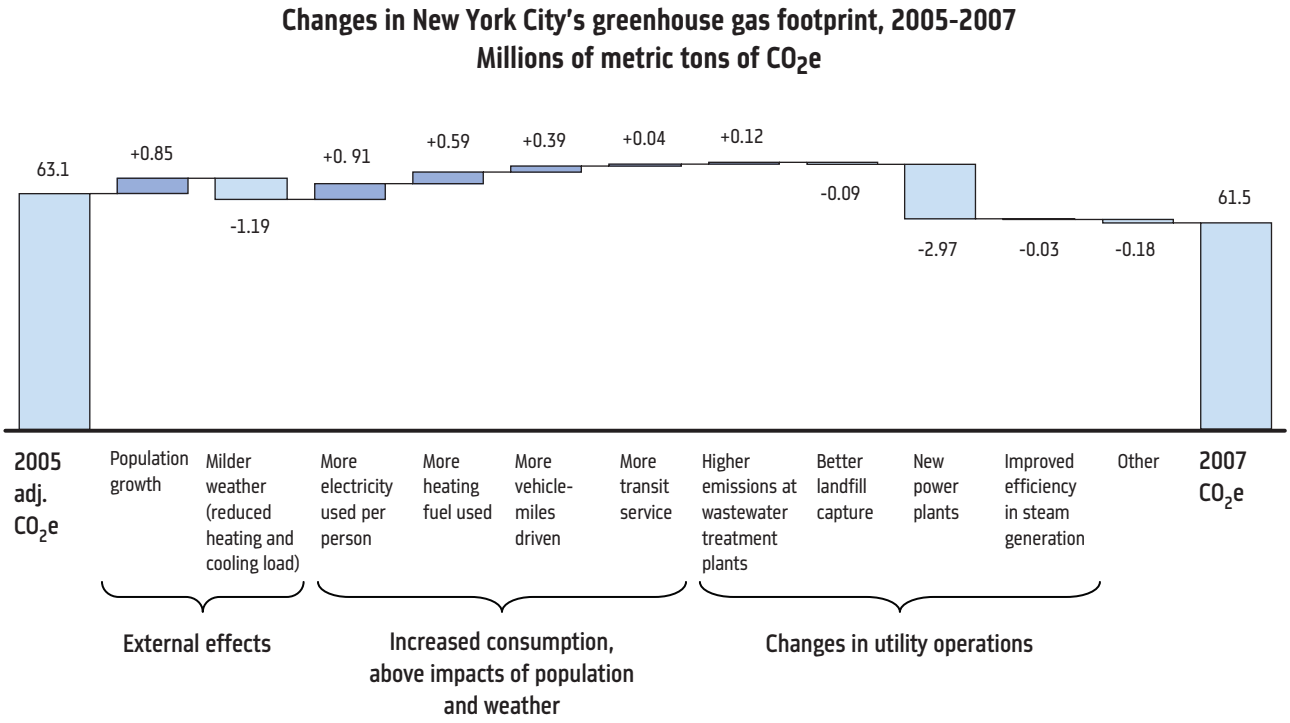


Figure 1

for on-road transportation emissions. The various changes have been applied to the City's base year GHG inventories, resulting in adjusted base year figures for both 2005 citywide and fiscal year 2006 analyses. All references to base years in this report refer to adjusted base years, unless otherwise noted.

As a result of the adjustments, both citywide and City government base year inventories have increased, with the citywide 2005 base year emissions level increasing 8.1 percent from 58.3 $MMTCO_2e$ to 63.1 $MMTCO_2e$, a 4.8 MMT increase. The City government fiscal year 2006 GHG base year inventory increased 5.9 percent from 3.8 $MMTCO_2e$ to 4.1 $MMTCO_2e$, rising 0.23 MMT.

Protocol changes

To accurately quantify GHG emissions levels, the City revised portions of its analysis methodologies from those used in the base year inventories. In revising its methodologies, the City followed the guidance of the draft *International Local Government GHG Emissions Analysis Protocol*, being developed by Local Governments for Sustainability (ICLEI), and the draft *Local Government Operations Protocol*, being developed by ICLEI, the California Air Resources Board, and the California Climate Action Registry, in collaboration with The Climate Registry.[5]

Revised Methodology

The guidance in these protocols resulted in two major changes in the City's methodology: CO_2e emissions from solid waste exported from the city were considered Scope 3 emissions (not included in total levels) and fugitive methane emissions from in-city landfills were added to both the citywide and City government analyses. In addition, the

BREAKDOWN OF CITYWIDE CO2e EMISSIONS CHANGES, 2005 BASE TO 2005 ADJUSTED		
	CO_2e (metric tons)	Change as % 2005 base
2005 base total	**58,317,711**	
Reason for change		
More accurate electricity consumption data	653,008	1.12%
More accurate natural gas consumption data	(273,256)	-0.47%
More accurate traffic model	(722,151)	-1.24%
More accurate reporting of transit consumption	122,048	0.21%
Revised ICLEI standard for landfill emissions	1,773,677	3.04%
Revision of inaccurate use of 2006 powerplant efficiency	1,742,192	2.99%
Improved accuracy of steam generation efficiency factors	1,415,049	2.43%
Other	23,906	0.04%
2005 citywide adjusted total	**63,052,184**	**8.12%**

Table 1

BREAKDOWN OF GOVERNMENT CO2e EMISSIONS CHANGES, FY 2006 BASE TO FY 2006 ADJUSTED		
	CO_2e (metric tons)	Change as % of FY 2006 base
FY 2006 base total	**3,840,470**	
Reason for change		
Changes in data and coefficient		
Electricity consumption	39,328	1.02%
Steam calculation	57,819	1.51%
WPCP calculation	(122,579)	-3.19%
WPCP methane	18,693	0.49%
Changes due to ICLEI standards		
Exclusion of school buses	(30,893)	0.80%
Landfills	235,073	6.12%
Other	29,311	-0.85%
2006 adjusted total	**4,067,222**	**5.90%**

Table 2

2005 STEAM COEFFICIENT			
Steam Coefficient per MMBtu Delivered to Buildings			
CO_2 (lbs per MMBTU)	CH_4 (lbs/MMBtu)	N_2O (lbs/MMBtu)	CO_2e (lbs/MMBtu)
147.82910	0.00484	0.00086	**148.1979**
2006 STEAM COEFFICIENT			
Steam Coefficient per MMBtu Delivered to Buildings			
CO_2 (lbs per MMBTU)	CH_4 (lbs/MMBtu)	N_2O (lbs/MMBtu)	CO_2e (lbs/MMBtu)
145.12993	0.00462	0.00081	**145.4770**
2007 STEAM COEFFICIENT			
Steam Coefficient per MMBtu Delivered to Buildings			
CO_2 (lbs per MMBTU)	CH_4 (lbs/MMBtu)	N_2O (lbs/MMBtu)	CO_2e (lbs/MMBtu)
145.30148	0.00464	0.00081	**145.6509**

Table 3

NEW YORK CITY CO2e COEFFICIENT FOR ELECTRICITY, 2005 BASE TO 2007						
2005 base	CO_2/MWh	CH_4/MWh	N_2O/MWh	CO_2e/MWh		
	lbs	lbs	lbs	lbs		
	1,037.53	-	-	**1,037.525**		
2005 adj.					% change in CO_2e coefficient	
					change from '05 base	
	1120.0070	0.0252	0.0062	**1,122.470**	**8.19%**	
2006					% change in CO_2e coefficient	
					change from '05 adj.	change from '05 base
	1033.1344	0.0211	0.0055	**1,035.294**	**-7.77%**	**-0.22%**
2007					% change in CO_2e coefficient	
					change from '06	change from '05 adj.
	983.1307	0.0199	0.0047	**985.020**	**-4.86%**	**-12.25%**

Table 4

greenhouse gas emissions from school buses[6] were excluded from the City government's inventory. Fugitive methane emissions from incomplete combustion of wastewater treatment plants' anaerobic digester gas flares and from digester gas used as fuel to heat digesters were included in the analyses.

Increased data availability

An emissions coefficient is the factor used to calculate the mass of CO_2e generated through either the combustion of fossil fuels or the decomposition of organic matter in wastewater treatment or solid waste management facilities. The City revised the emissions coefficients based on more accurate data on the composition of the power plant fleet in New York City in 2005. This change led to an increase in 2005 citywide emissions by1.9 MMT due to the revised electricity coefficient and a 1.4 MMT due to a revised steam coefficient. Similarly, the adjustment increased City government emissions by 0.4 MMT and by 0.6 MMT from steam. Tables 3 and 4 detail the changes made to the coefficients.

Other data improvements

Since the completion of the City's base year inventories, improvements in the modeling of on-road vehicle miles traveled (VMT) for 2005 resulted in a 3.3 percent reduction in the baseline VMT, resulting in a 1.2 percent adjustment in GHG emissions. Transit related emissions were also adjusted by 4.7 percent to reflect new electricity data from commuter rail stations that were not available in 2005, raising the citywide base year inventory by 0.2 percent.

The City was able to access better consumption data with the help of Consolidated Edison (ConEd), the city's local electric utility and a natural gas and steam utility, and National Grid, a natural gas utility. In 2005, the data for electricity and natural gas consumption was based on citywide aggregated data. For this revision, the utilities derived consumption levels from customer-level billing records, allowing the City to better estimate emissions. As a result, electricity consumption used to calculate CO_2e increased by approximately 2.7 percent, while natural gas consumption levels increased by approximately 0.7 percent. The City government base year inventory was also adjusted downward by 0.12 MMT to more precisely reflect the emissions from residual fuel oil consumed by the City's Department of Environmental Protection (DEP). (See Base Year Changes section of this document for more information.)

Citywide inventory results

Energy used in buildings and for transportation as well as methane from our in-city landfills and wastewater treatment plants all contribute to citywide CO_2e emissions levels. Based on the adjusted 2005 base year inventory, citywide CO_2e emissions decreased from 63.1 MMT to 61.5 MMT in 2007, a 2.5 percent reduction. (See Table 5) Many different factors contributed to this level of reduction, including the start of operation of two new efficient power plants in 2006 and milder winter and summer weather conditions in 2007. These reductions allow New York City to continue to report CO_2e emission reductions, despite increases in population, per capita electricity consumption, per capita natural gas and heating oil consumption, and VMT.

BREAKDOWN OF CITYWIDE CO_2e EMISSIONS CHANGES, 2005 ADJUSTED TO 2007		
	CO_2e (metric tons)	Change as % of 2005
2005 citywide adjusted total	**63,052,184**	
Reason for change		
Population	845,430	1.34%
Milder weather in 2007 than 2005	(1,190,062)	-1.89%
Per capita electricity consumption (eg, electronics)	912,500	1.45%
Per capita natural gas/heating oil consumption	592,603	0.94%
Per capita VMT growth	392,921	0.62%
Per capita transit consumption	40,975	0.06%
Wastewater treatment plants	117,278	0.19%
Improved landfill capture	(98,445)	-0.16%
New, more efficient electricity plants	(2,975,746)	-4.72%
Improved efficiency in steam generation	(39,623)	-0.06%
Other	(185,617)	-0.29%
2007 citywide total	**61,464,398**	**-2.52%**

Table 5

BREAKDOWN OF GOVERNMENT CO_2e EMISSIONS CHANGES, FY 2006 TO FY 2007		
	CO_2e (metric tons)	Change as % of FY 2006
FY 2006 total	**4,067,222**	
Reason for change		
Externalities		
Weather	(26,077)	-0.64%
Powerplants	(70,586)	-1.74%
Consumption		
Electricity	105,894	2.60%
Heating fuels	78,020	1.92%
Transportation	31,182	0.77%
Landfills	(10,626)	-0.26%
WPCP operations	(9,988)	-0.25%
WPCP methane leaks	118,789	2.92%
Other	9,238	0.23%
FY 2007 total	**4,293,069**	**5.55%**

Table 6

The most significant contribution to the net decrease in emissions is the addition of two new state-of-the-art power plants in the city in 2006: New York Power Authority's (NYPA) Astoria Combined Cycle Power Plant, in operation starting January 2006, and SUEZ Astoria Energy (formerly Astoria Energy LLC) plant, in operation starting May 2006. Together, these power plants added 1000 megawatts (MW) of clean energy capacity to the New York City electricity grid, displacing electricity generated from less efficient plants with higher CO_2e coefficients. This change alone accounted for a 5.0 percent reduction, or approximately 3.2 MMT, in CO_2e emissions from 2005 to 2007. (See Table 5)

Milder weather, an annually variable yet significant factor, also played a role in reducing CO_2e emission citywide. A warmer winter and cooler summer in 2007 compared to in 2005 resulted in 1.2 fewer MMT of CO_2e emissions from decreased demand for heating and cooling New York City buildings. Heating degree days (HDD) and cooling degree days (CDD), which reflect the demand for energy needed to heat or cool a home or business, decreased by 0.6 percent and 17.7 percent respectively from 2005 to 2007.[7] Figure 1 summarizes the changes in citywide CO_2e emissions levels between 2005 and 2007.

City government operations inventory results

The operation of New York City municipal government's facilities and provision of services to the city's residents, commuters, and visitors requires the consumption of a significant amount of energy. Between fiscal years 2006 and 2007, the emissions associated with City government operations increased by 5.6 percent to 4.3 MMT of CO_2e. (See Table 6) This increase is primarily attributed to an increase in electricity and heating fuel consumption in City buildings and the leakage of methane gas from wastewater treatment plants' methane flare equipment undergoing emergency maintenance. However, improvements in the efficiency of citywide power supply and milder weather helped to mitigate the growth in City government emissions.

The majority of the increase is due to a 2.6 percent increase in electricity consumption. Almost half of this growth reflects the operation of additional space as new City buildings came on line or additional ones were leased. Similar to the per capita increase in electricity consumption in citywide emissions, over one percent of electricity consumption can be attributed to more electricity used per employee. Finally, the City collected more accurate building data for fiscal year 2007 building electricity consumption data compared to 2006 as data collection and management processes continued to improve. For similar reasons as above, emissions from the consumption of natural gas and fuel oil for heating City buildings and creating hot water increased 1.9 percent. Data improvements also help the increase in emissions from the City's municipal vehicle fleet of 0.8 percent.

Methane leaks at wastewater treatment plants contributed to a 2.9 percent increase in City government GHG emissions. These leaks were due to both a change in how DEP quantifies methane and to methane flare equipment undergoing emergency maintenance. Table 6 details the source and principal causes of changes to the City government CO_2e levels between fiscal year 2006 and fiscal year 2007.

Base Year Changes

Base year results were revised due to protocol changes, revised methodology, and improved data availability

The calculation of greenhouse gas inventories is an evolving science. Therefore, any GHG emissions assessment must be considered an estimate derived using the best information and tools available at that time. Since the April 2007 *Inventory of New York City Greenhouse Gas Emissions*, there have been updates to protocols and methodologies to calculate greenhouse gas emissions levels as well as improvements in available information through access to better data. Accordingly, the City has adjusted the base year emission levels reported in this document. The City applied the revised methodologies and data reflected below to calculate City government fiscal year 2006 and citywide 2007 base year adjustments.

Protocol changes

This report categorizes direct and indirect GHG emissions into three scopes, as detailed below, following ICLEI's newest protocols and the World Resources Institute/World Business Council for Sustainable Development's (WRI/WBCSD) *Greenhouse Gas Protocol*. Categorizing GHG emissions into scopes allows separate accounting of direct and indirect emissions and improves transparency.[8] While the City followed the guidance of ICLEI in its original base year analyses issued last year, it did not fully adhere to the WRI/WBCSD scopes classification. In this update the City adhered strictly to WRI/WBCSD's scopes, which resulted in some changes to its base year calculations. The scope categories are as follows:

Scope 1: All direct GHG emissions (with the exception of direct CO2 emissions from biomass combustion).

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3: All other indirect emissions not covered in Scope 2, such as upstream and downstream emissions, emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, waste disposal, etc.[9]

Revised methodology

To accurately quantify GHG emissions levels, the City revised portions of its methodologies from those used in the April 2007 inventory. In revising its methodologies, the City followed the guidance of the draft *International Local Government GHG Emissions Analysis Protocol*,[10] being developed by Local Governments for Sustainability (ICLEI), and the draft *Local Government Operations Protocol* being developed by ICLEI, the California Air Resources Board, and the California Climate Action Registry, in collaboration with The Climate Registry.

The revised methodologies allow for more accurate calculation of the emissions coefficients. An emissions coefficient is the factor used to calculate the mass of CO_2e generated through either the combustion of fossil fuels or the decomposition of organic matter in wastewater treatment or solid waste management facilities. The development and application of accurate emissions coefficients are critical to ensuring correct measurement of CO_2e emissions. Therefore, following ICLEI's draft protocol, the City has updated its emissions coefficients for solid waste, electricity, and steam. Both the electricity and steam coefficients have been further updated to reflect improvements in data.

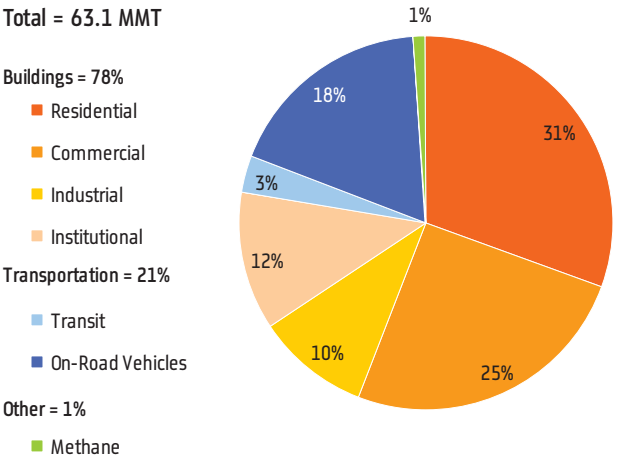


Figure 2

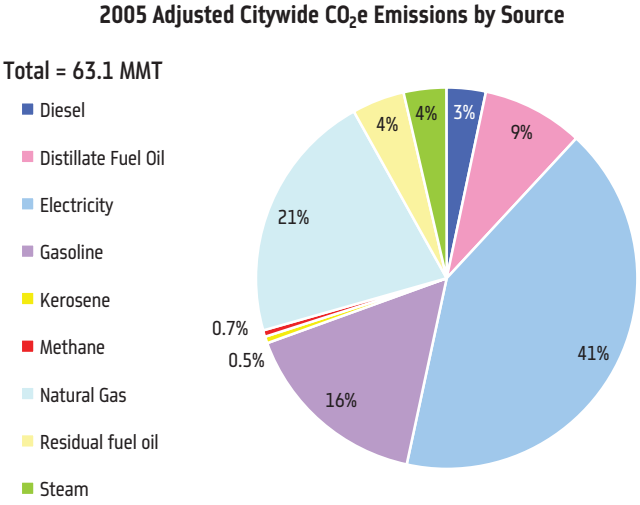


Figure 3

Solid waste coefficient

Following a change in calculation methodology in the revised protocol, the City adjusted its solid waste coefficient. In the original analysis, all CO_2e emissions generated from solid waste sent to in-city landfills were assumed to be emitted in the year of disposal—even though the actual emission of CO_2e may not occur for many years. Also, solid waste from organic matter was assumed to be sequestered in the landfill, resulting in a carbon sink. Following ICLEI's guidance, the City is now measuring the emissions from previously disposed solid waste in in-city landfills each year over the life of the gas.[11] Additionally, the waste coefficient was revised to exclude the sequestration of carbon for waste disposed of in out-of-city landfills (resulting in a positive CO_2e value for exported solid waste for both citywide and City government analyses). CO_2e emissions from in-city landfills are considered Scope 1 emissions, and counted toward the City's total inventories, while emissions from landfills outside the city that receive city solid waste were considered to be Scope 3 and are not include in the City's inventories.

Electricity emissions coefficient

Also following the revised ICLEI protocol, the City revised its electricity coefficient to include emissions of methane and nitrous oxide (N_2O) in addition to carbon dioxide (CO_2). In addition, the City made an even more significant adjustment to the coefficient to reflect more accurate data relating to the power plant fleet in New York City in 2005.

The electricity coefficient developed for the original base year analysis used New York State power plant data for the period of July 2005 to June 2006. However, using this time frame inaccurately reflects the efficiency and fuel mix of the plants in operation in 2005 because it includes two new power plants that went into operation during the first six months of 2006: New York Power Authority's (NYPA) Astoria Combined Cycle Power Plant, which began operation in January 2006, and SUEZ Astoria Energy (formerly Astoria Energy LLC) plant, which began operation in May 2006. Therefore, the original base year reported a fleet of power plants in New York with lower CO_2e emissions than actually existed at the time. Therefore, the City developed a customized electricity coefficient to more accurately reflect the fuel mix used by power plants to generate electricity consumed in New York City using 2005 power plant data.[12] The revised 2005 electricity coefficient was applied to the citywide base year inventory data, resulting in a 3.7 percent increase to citywide indirect emissions from electricity consumption in the 2005 base year. (See Table 4)

Following the guidance of the *Local Government Operations Protocol*, the City verified these coefficients with ConEd.

Steam emissions coefficient

The City also revised the emissions coefficient for steam with methane and nitrous oxide emissions data. This revision resulted in a reduction of the conversion rate from metric tons (Mlbs), the standard unit of measure for metered steam, to million British thermal units (MMBtu), used to calculate CO_2e. The coefficient was further adjusted based on updated steam production data from ConEd. This data included information on the fuel mix and efficiency of combined heat and power (CHP) plants. (See Table 3)

FY 2006 Government Adjusted CO_2e Emissions by Sector

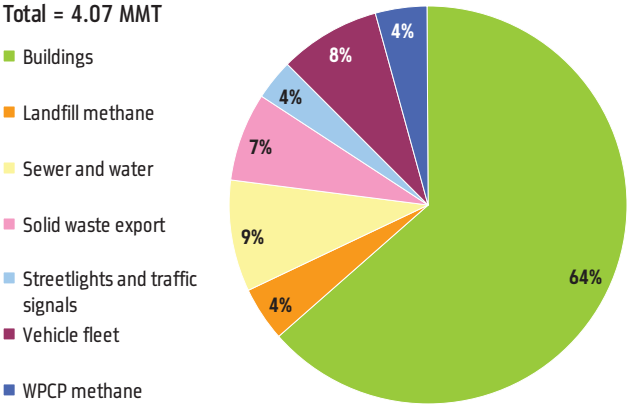


Figure 4

FY 2006 Government Adjusted CO_2e Emissions by Source

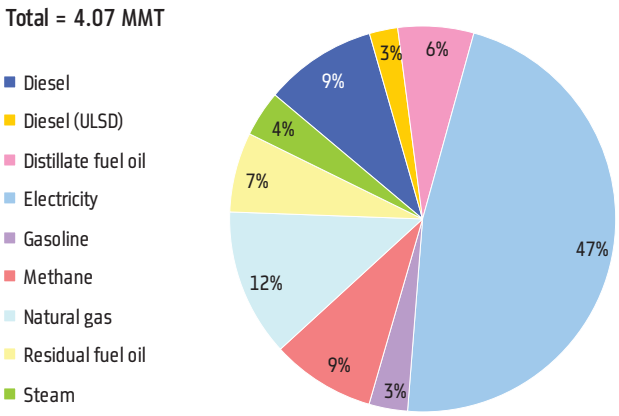


Figure 5

In the original base year analysis, all emissions from steam produced by combined heat and power (CHP) plants were assumed to be accounted for in the emissions from electricity generation. The revised protocol recommends accounting for 100% of emissions from steam generation, including CHP. To avoid double counting of CO_2e with emissions resulting from electricity generation, the City deducted the fuel attributable to electricity generation in CHP plants from the calculation of the electricity emissions coefficient. This revision to the steam emissions coefficient increases CO_2e emissions from steam by 2.4 percent for the citywide base year and by 1.5 percent for the City government base year.

Increased data availability

As the revisions to electricity and steam emissions coefficients demonstrate, adjustments to the base year inventory are also a result of access to better information. For the most part, the information improvements are due to improved modeling and access to more refined data.

On-road transportation Vehicle Miles Traveled (VMT)

Following the inventory protocols, the City used transportation data that was modeled to calculate CO_2e emissions from on-road transportation sources. Since the 2007 inventory report, the New York City Department of Transportation (DOT) improved the modeling of on-road VMT for 2007. Based on growth rates established by New York Metropolitan Transportation Council (NYMTC), the City determined this update's VMT by backcasting the revised 2007 VMT data. The resulting revised 2007 VMT values were applied to the base year emissions inventory and resulted in a 1.2 percent decrease in citywide CO_2e emissions from all on-road transportation sources other than buses operated by the Metropolitan Transportation Authority (MTA).

Electricity and natural gas data

Access to more granular data allowed the City to improve its calculations of emissions from natural gas and electricity consumption. Previous natural gas data had been based on forecasted data. Electricity consumption had been derived from the estimated proportion of electricity consumed in ConEd's territory attributable to New York City customers.[13] For this update, however, both ConEd and National Grid used customer billing records to derive precise consumption data for all years analyzed, instead of providing forecasted estimates. This change resulted in a 0.7 percent increase in reported natural gas consumption and a 2.7 percent increase in reported electricity consumption used for the citywide base year analyses.

Monthly energy data

ConEd and National Grid also provided the City with monthly energy consumption data, which allowed the City to better understand the effect weather played on GHG emissions. However, the monthly information did not result in any changes to base year calculations.

Summary of base year adjustments

The City adjusted the base CO_2e emissions levels to reflect the changes described above. As such, all references to the City's base year CO_2e emissions levels as reported in the *Inventory of New York City Greenhouse Gas Emissions*, including reduction targets based on these levels, should now be considered to be in relation to the updated values in this report. Tables 5 and 6 detail the adjusted citywide and City government base year inventories and the reasons for these changes.

NEW YORK CITY CITYWIDE BASE YEAR CO_2e EMISSIONS (METRIC TONS PER YEAR)				
Sector	**2005 original**	**2005 adjusted**	**change**	**% change**
Residential buildings	18,301,184	19,273,305	972,121	5.3%
Commercial buildings	14,638,335	15,875,854	1,237,519	8.5%
Institutional buildings	7,146,257	7,506,849	360,592	5.0%
Industrial buildings	5,667,545	6,228,463	560,918	9.9%
On-road vehicles	12,222,748	11,500,592	(722,156)	-5.9%
Transit	1,700,012	2,070,742	370,730	21.8%
WPCP methane	149,901	168,595	18,694	12.5%
Landfill methane	(1,508,270)	265,407	1,773,677	117.6%
Streetlights/traffic signals*	-	162,377	162,377	100.0%
Total	**58,317,711**	**63,052,184**	**4,734,473**	**8.1%**

*incorporated in industrial buildings in original base

Table 7

CITY GOVERNMENT BASE YEAR CO_2e EMISSIONS BY SECTOR (METRIC TONS PER YEAR)				
Sector	**FY '06 original**	**FY '06 adjusted**	**change**	**% change**
Municipal buildings	2,443,555	2,573,212	129,657	5.3%
Municipal vehicle fleet	335,381	335,382	1	0.0%
School buses	30,893	-	(30,893)	-100.0%
Solid waste export	286,527	286,527	-	0.0%
Streetlights/traffic signals	144,189	143,812	(377)	-0.3%
Sewer and water operations	505,129	379,727	(125,402)	-24.8%
WPCP methane	149,902	168,595	18,693	12.5%
Landfill methane	(55,106)	179,967	235,073	426.6%
Total	**3,840,470**	**4,067,222**	**227,752**	**5.9%**

Table 8

Adjustments to citywide base year inventory

As reported in Table 7, the citywide base year inventory was adjusted upward by approximately 4.8 MMT CO_2e, an 8.1 percent increase. The principal changes result from a revised electricity coefficient (3.3 percent), a revised steam coefficient (2.4 percent), and revised methodology and characterization of emissions from solid waste (3.0 percent). Additionally, improved electricity, natural gas, and steam energy data provided by ConEd and National Grid was updated slightly to reflect improved data, citywide VMT was reduced due to improved modeling, and new transportation emissions sources were added due to new data availability.[14] Streetlights and traffic signals, which had been incorporated into the institutional buildings' electricity calculation in the original base year analysis, were broken out and reported separately in the adjusted base year analysis.

Adjustments to City government base year inventory

The City government base year inventory was adjusted upward by 0.23 MMT of CO_2e, a 5.9 percent increase. Approximately 8.2 percent of this increase is the result of increased fugitive methane emissions from the wastewater treatment plants, the reported value of which was increased to reflect the new protocol's calculation for fugitive methane emissions from incomplete combustion of digester gas flares and from anaerobic digester gas used as fuel to heat digesters. Other adjustments include assignment of emissions from waste presently disposed of in landfills as Scope 3 emissions and inclusion of fugitive methane emissions from the City landfills in the base year inventory. The adjustments to the FY 2006 City government base year inventory are summarized in Table 8.

Inventory Results

Secular and operational factors affected 2007 greenhouse gas emissions

Between 2005 and 2007, New York City's population grew by almost 70,000 people and square footage of buildings in New York City expanded by roughly 2 percent. These trends, along with upgrades to the local energy supply mix, increased use of consumer electronics and weather fluctuations, have impacted New York City's citywide and government emission levels. The analysis below describes the City's citywide 2007 and City government's fiscal year 2007 emission levels and how they differ from the adjusted base year inventories.

Citywide inventory results

Based on the adjusted 2005 base year inventory, citywide CO_2e emissions decreased from 63.1 MMT to 61.5 MMT in 2007, a 2.5 percent reduction. (See Table 9) Many different factors contributed to this level of reduction, including two new efficient power plants in 2006 and milder winter and summer weather conditions in 2007. These reductions allow New York City to continue to report CO_2e emission reductions despite increases in population, per capita electricity consumption, per capita natural gas and heating oil consumption, and VMT.

Reasons for changes in citywide emissions from 2005 to 2007

The most significant contribution to the net decrease in emissions is the addition of 1000 megawatts (MW) of clean energy capacity from two new state-of-the-art power plants in 2006. The two plants New York Power Authority's (NYPA) Astoria Combined Cycle Power Plant and SUEZ Astoria Energy (formerly Astoria Energy LLC) plant began operating in January and May 2006, respectively. They are over 40 percent more efficient than the average power plant in New York City. Therefore, the electricity generated at these newer plants displaces the less efficient, more expensive peaker plants. The addition of these two plants to the city's energy supply mix alone accounts for a 5.1 percent reduction, or approximately 3.2 MMT, in CO_2e emissions compared to 2005.

Milder weather also played a significant role in reducing annual CO_2e emissions citywide. A warmer winter and cooler summer in 2007 compared to in 2005 reduced demand for heating and cooling in New York City buildings, resulting in a decrease of 1.2 MMT CO_2e emissions. Heating degree days (HDD) and cooling degree days (CDD), which reflect the demand for energy needed to heat or cool a home or business, decreased by 0.6 percent and 17.7 percent respectively from 2005 to 2007.[15] (See the Weather Impacts section of this document.)

Many factors influence changes to CO_2e emissions levels, including population, weather, and secular changes to energy demand. The impact of these factors is distributed among the various sectors of the city. The table and charts below summarize citywide CO_2e emissions levels for 2005 and 2007 by sector. In addition, the 0.8 percent increase from population growth contributed to CO_2e increases from all sources. Seventy-five percent of the heating degree days correlate with an increase in natural gas and fuel oil use. Twenty-five percent of cooling degree days correlate with an increase in electricity consumption.

Figure 6 illustrates the breakdown of 2007 citywide CO_2e emissions by sector, while Figure 7 illustrates the breakdown by source. In comparison to the breakdowns from the base year, these charts illustrate the proportional reduction in energy use from buildings attributable to a revised electricity coefficient and milder weather. Methane emissions

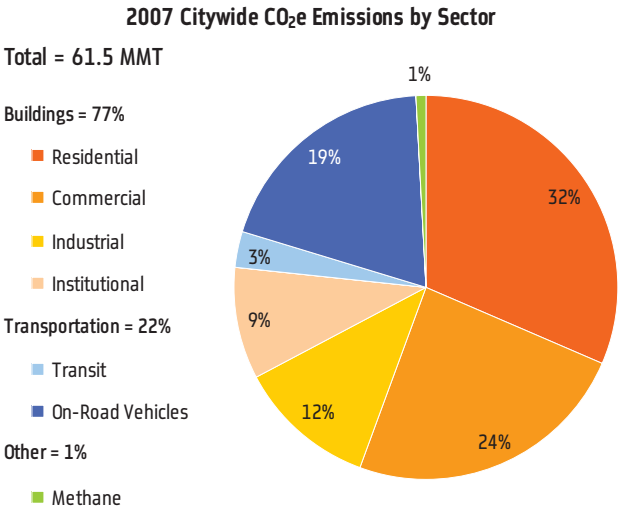


Figure 6

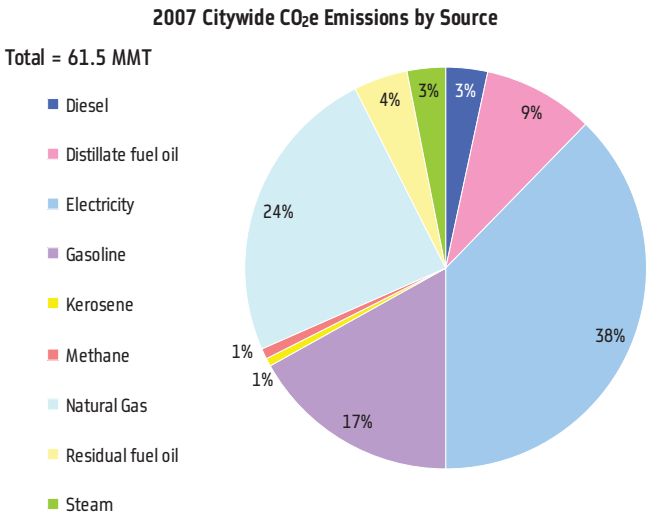


Figure 7

from wastewater treatment plants and landfills account for approximately one percent of CO_2e emissions. An increase in the percentage of on-road transportation emissions reflects the increase in citywide VMT.

City government inventory results

The operation of New York City municipal government's facilities and provision of services to the city's residents, commuters, and visitors requires the consumption of a significant amount of energy, emitting 4.3 MMT of CO_2e in FY 2007. Approximately 63 percent of these emissions result from the operation of city government buildings, and 8 percent stem from the City's municipal vehicle fleet. Other sources include the operation of the City's water supply and treatment system, the operation of streetlights and traffic signals, the exportation of solid waste, and fugitive methane from the City's landfills and wastewater treatment plants. (See Table 10)

Between fiscal years 2006 and 2007, the emissions associated with City government operations increased by 5.6 percent to 4.3 MMT of CO_2e. This increase is primarily attributed to greater electricity and heating fuel consumption in City buildings and the leakage of methane gas from wastewater treatment plants while methane flare equipment was undergoing emergency maintenance. However, improvements in the efficiency of citywide power supply and milder weather helped to mitigate the growth in City government emissions.

Figure 8 shows the breakdown of City government emissions by sector, while Figure 9 shows emissions by source. Table 10 lists the emissions levels in relation to the 2006 base year.

As shown in the figures and table, while the total emissions attributable to the operation of City government buildings increased by 4.6 percent between FY 2006 and 2007, the proportion of total emissions from buildings decreased due to the significant increase in methane emissions from wastewater treatment plants.

City government employs more than 300,000 people and consists of more than 50 City agencies. Depending on their mission, some agencies consume more energy than others, such as the Department of Education (DOE), Department of Environmental Protection (DEP), and Department of Sanitation (DSNY). To complete the government inventory, the City compiled energy consumption and methane emission data from all City agencies, as well as from other public and private entities. These include public hospitals, cultural institutions, libraries and others for which the City pays all or part of the energy costs. Agencies whose operations account for the majority of CO_2e emissions are identified in Figures 10 and 11. Numerous agencies that emitted smaller quantities of CO_2e are aggregated and reported here as "other." Care should be exercised in interpreting these data, which are not reflective of any particular entities' energy efficiency, but rather only of their total CO_2e emissions.

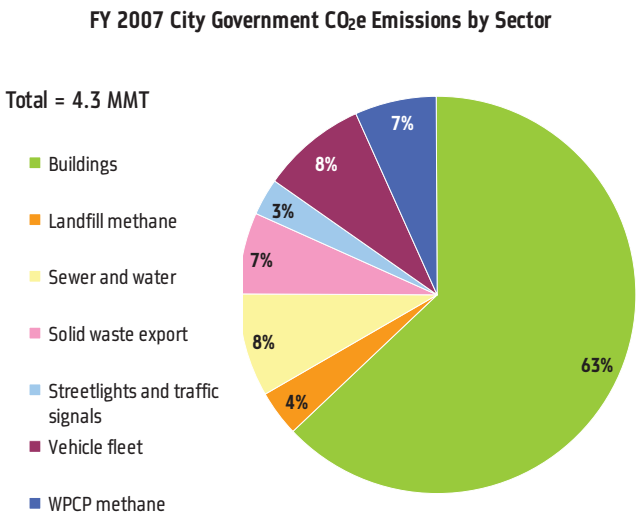


Figure 8

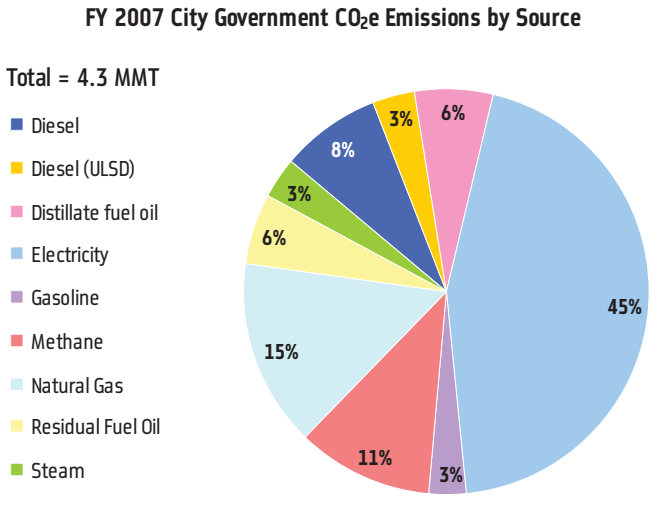


Figure 9

Reasons for changes in City government emissions from fiscal yar 2006 to fiscal year 2007

The primary reason for the increase in City government operation emissions is the 2.6 percent increase in electricity consumption. Almost a quarter of this growth reflects the operation of additional space as new City buildings came on line or additional ones were leased. Similar to the per capita increase in electricity consumption in citywide emissions, over one percent of electricity consumption can be attributed to more electricity used per employee. Finally, the City collected more accurate building data for fiscal year 2007 building electricity consumption data compared to fiscal year 2006 as data collection and management processes continued to improve. Also due to improved data, emissions from the consumption of natural gas and fuel oil for heating City buildings and creating hot water increased 1.9 percent. Data improvements also help explain a 0.8 percent increase of emissions from the City's municipal vehicle fleet.

A significant increase in methane emissions was reported at three of the city's 14 wastewater treatment plants from 2005 to 2007, resulting in an approximately 71 percent increase in this emission source. The cause of this increase is due to both a change in how DEP quantifies methane and to methane flare equipment undergoing emergency maintenance. Previously, DEP had reported methane based on a combination of metering and modeling. Between 2005 and 2007, the agency started modeling all methane emissions to ensure consistency across all 14 wastewater treatment plants, which led to an increase in the volume reported. Nonetheless, the fact that only a small number of fugitive methane sources are responsible for such a large percentage of the increase in City government CO_2e emissions highlights the importance of addressing this issue.

The other reason for the change in the City government emissions is a 8.4 percent increase in emissions from the City's municipal vehicle fleet. For the fiscal year 2006 base year inventory, vehicle fuel use for all agencies was obtained from the City's Office of Management and Budget (OMB). Agencies self-report their vehicle fuel consumption to OMB for budgeting purposes. To calculate fiscal year 2007 emissions, the City collected vehicles fuel use from each agency through surveys to improve completeness and accuracy of data. Since the base year and 2007 data were collected from different sources, the City has a lower degree of confidence in the accuracy represented by the increase in these emissions between the two years. However, this new method of data acquisition ensures that future analyses will accurately reflect changes in the City's vehicle fleet fuel consumption. Table 6 details the source and principal causes of changes in the City government CO_2e levels between FY 2006 and FY 2007.

FY 2007 City Government CO_2e Emissions by Agency or Building*

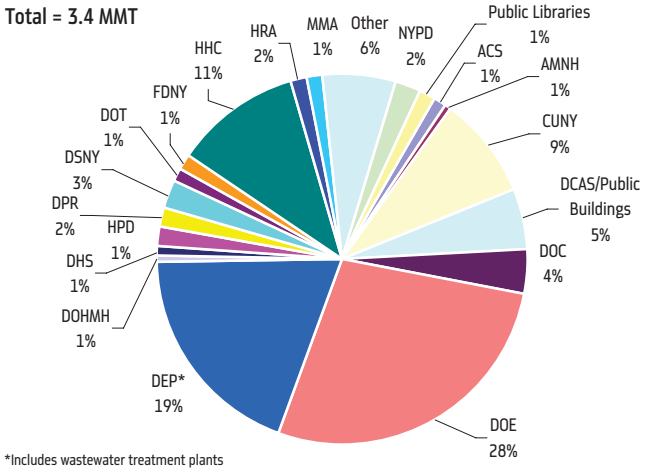


Figure 10

FY 2007 City Government Vehicle CO_2e Emissions by Agency

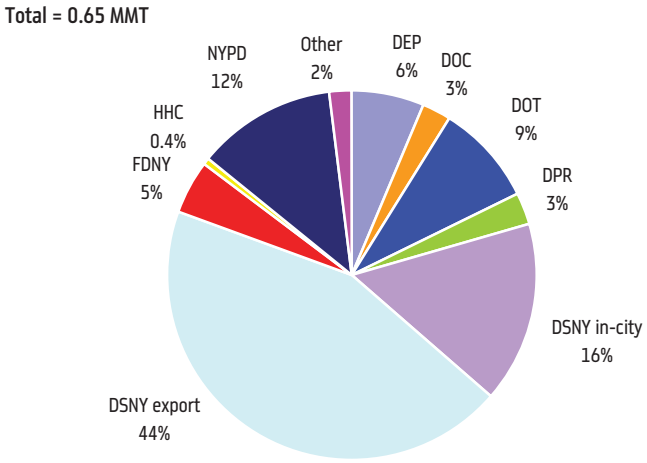


Figure 11

2005 AND 2007 NEW YORK CITY CO_2e EMISSIONS (METRIC TONS PER YEAR)				
Sector	**2005 adjusted**	**2007**	**change, 2005-2007**	**% change, '05-'07**
Residential buildings	19,273,305	19,284,241	10,936	0.1%
Commercial buildings	15,875,854	14,824,825	(1,051,029)	-6.6%
Institutional buildings	7,506,849	7,111,314	(395,535)	-5.3%
Industrial buildings	6,228,463	5,776,417	(452,046)	-7.3%
On-road vehicles	11,500,592	11,913,542	412,950	3.6%
Transit	2,070,742	1,955,937	(114,805)	-5.5%
WPCP methane	168,595	287,384	118,789	70.5%
Landfill methane	265,407	169,341	(96,066)	-36.2%
Streetlights/traffic signals	162,377	141,397	(20,980)	-12.9%
Total	**63,052,184**	**61,464,398**	**(1,587,786)**	**-2.5%**

Table 9

NEW YORK CITY GOVERNMENT CO_2e EMISSIONS, FY '06 AND FY '07 (METRIC TONS PER YEAR)				
Sector	**FY 2006**	**FY 2007**	**change**	**% change**
Municipal buildings	2,573,212	2,690,852	117,640	4.6%
Municipal vehicle fleet	335,382	363,577	28,195	8.4%
Solid waste export	286,527	286,528	1	0.0%
Streetlights/traffic signals	143,812	136,621	(7,191)	-5.0%
Sewer and water operations	379,727	358,766	(20,961)	-5.5%
WPCP methane	168,595	287,384	118,789	70.5%
Landfill methane	179,967	169,341	(10,626)	-5.9%
Total	**4,067,222**	**4,293,069**	**225,847**	**5.6%**

Table 10

Conclusion

This updated greenhouse gas inventory gives the City a better understanding of emission sources and trends in New York City. It also highlights the impacts that weather, population, infrastructure investments, policy decisions, and consumer behavior have on emission levels. Since PlaNYC was released in April 2007, this report does not yet reflect the plan's impact on GHG emissions. However, with improved calculation methodologies and access to data, this inventory also sets the foundation to monitor and assess the effectiveness of PlaNYC implementation and other carbon reduction efforts. Future assessments will highlight the progress the City is making toward achieving its reduction goals. These assessments will also monitor the impact of factors such as weather that are outside the control of City investment and policy.

With a decrease of 2.5 percent from 2005 to 2007, New York City is on target to achieve the 30 percent reduction citywide by 2030. The decrease in citywide emissions despite a population increase highlights the impact of cleaner energy sources and the City's need to continue to pursue opportunities to further increase capacity of clean energy sources to displace inefficient and more carbon-intensive sources, as suggested in PlaNYC. However, with only one new in-city power plant confirmed to come on line in the next three years and with energy consumption per capita still rising, the analysis proves that there is an even greater imperative to take action to mitigate growing energy consumption in the city's 950,000 buildings and to support the development of other clean sources of energy, including clean, distributed generation technologies and renewable energy installations.

The inventory analysis for City government operations shows an increase in GHG emissions. This is primarily due to growth and an increase in building electricity and heating fuel consumption, controlled for weather, and methane leaks associated with equipment under repair. This confirms the importance of continued investment to maintain the City's infrastructure and retrofit its buildings as outlined in PlaNYC and *The Long-Term Plan to Reduce Energy Consumption and Greenhouse Gas Emissions of Municipal Buildings and Operations*[16] released by the City's Energy Conservation Steering Committee in July 2008. The Steering Committee report verifies the GHG emissions reduction and energy production opportunities associated with reducing methane leaks, accounting for 17 percent of the City government's strategy to reduce emissions 30 percent by 2017.

In addition to these analyses, improvements to calculation methodologies, protocols, and data are an important step in improving our inventory calculations. GHG measurement and assessment will continue to evolve, as evidenced by the development of new, coordinated protocols by ICLEI. Regular review and application of the most recent approaches will ensure as accurate an assessment as possible and will allow for comparability of results with other cities.

Many additional opportunities exist to augment the analyses presented in this report. The City will complete a full assessment of citywide GHG emissions based on geography, and will release individual inventories for all five city boroughs in the near future. Building on this approach, additional analyses may involve analyzing GHG emissions on an even finer geographic scale by incorporating energy consumption data into a geographic information system (GIS) platform. Energy data is not yet available to facilitate this analysis, but the City intends to explore these opportunities and others for next year's inventory update.

The City also looks forward to incorporating the citywide effects of implementation of *PlaNYC* and *The Long-Term Plan to Reduce Energy Consumption and Greenhouse Gas Emissions of Municipal Buildings and Operations* in future inventory updates.

Credit: NYC Economic Development Corporation

APPENDICES

Endnotes

1 Available at http://www.nyc.gov/html/planyc2030/downloads/pdf/emissions_inventory.pdf

2 Available at http://www.nyc.gov/planyc2030

3 Carbon dioxide equivalent is the standard measure for greenhouse gas emissions, allowing greenhouse gases of different strengths to be combined and reported as a common unit. Per the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (1996), methane (CH_4) is considered to have 21 times the impact on global warming (global warming potential) as carbon dioxide (CO_2), and nitrous oxide (N_2O) has a global warming potential of 310. To convert units of carbon dioxide to units of carbon, divide by 44/12.

4 Available at http://www.ghgprotocol.org

5 Both documents available at http://www.iclei-usa/org/programs/climate/ghg-protocol

6 This is because the City itself does not own the school buses, but rather contracts with private school bus companies for bussing services.

7 The number of heating degrees in a day is defined as the difference between a reference value of 65°F (18°C) and the average outside temperature for that day.

8 Direct CO_2e emissions come from stationary combustion of fossil fuels in buildings, mobile combustion of fossil fuel in vehicles, and the escape of fugitive emissions from landfills and water pollution control plants. Indirect CO_2e emissions result from purchased electricity and steam.

9 ICLEI guidance allows flexibility in the assignment of CO_2e emissions into scopes. New York City chose for CO_2e from long-haul export of municipal solid waste to remain Scope 1 emissions to allow the significant expected reduction in CO_2e from implementation of the City's Solid Waste Management Plan (SWMP) to be reflected as a reduction below the base year inventory.

10 Available at http://www.iclei-usa.org/programs/climate/ghg-protocol

11 New York's landfills no longer accept the disposal of solid waste. These landfills are managed by two City agencies: the Department of Sanitation (DSNY) manages the Fresh Kills and Edgemere landfills; the Department of Environmental Protection (DEP) manages the Brookfield Avenue, Fountain Avenue, Pelham Bay, and Pennsylvania Avenue landfills.

12 Power plant data source: Ventyx, Velocity Suite

13 The ConEd electricity service area includes Westchester County

14 MTA Bus Company diesel buses; MTA New York City Transit bus compressed natural gas; Long Island Rail Road station electricity; Metro North Railroad rail station electricity; Port Authority Trans-Hudson (PATH) rail station electricity; and New Jersey Transit (NJIT) traction electricity

15 The number of heating degrees in a day is defined as the difference between a reference value of 65°F (18°C) and the average outside temperature for that day.

16 Available at http://www.nyc.gov/html/om/pdf/2008/pr264-08_plan.pdf

Acronym Definitions

New York City Agencies:

ACS - New York City Administration for Children's Services
DCAS - New York City Department of Citywide Administrative Services
DEP - New York City Department of Environmental Protection
DDC - New York City Department of Design and Construction
DHS - New York City Department of Homeless Services
DJJ - New York City Department of Juvenile Justice
DOB - New York City Department of Buildings
DOHMH - New York City Department of Health and Mental Hygiene
DOT - New York City Department of Transportation
DPR - New York City Department of Parks and Recreation
DOC - New York City Department of Correction
DOE - New York City Department of Education
DSNY - New York City Department of Sanitation
FDNY - New York City Fire Department
HPD - New York City Department of Housing Preservation and Development
HRA - New York City Human Resources Administration
NYPD - New York City Police Department
OMB - New York City Office of Management and Budget

Other Entities:

AMNH - American Museum of Natural History
ConEd - Consolidated Edison
CUNY - City University of New York
EDC - New York City Economic Development Corporation
FHWA - Federal Highway Administration
HHC - New York City Health and Hospitals Corporation
ICLEI - ICLEI-Local Governments for Sustainability
LIPA - Long Island Power Authority
LIRR - Long Island Railroad
MMA - Metropolitan Museum of Art
MTA - Metropolitan Transportation Authority
MNR - Metro North Rail Road
NYDEC - New York State Department of Environmental Conservation
NYMTC - New York Metropolitan Transportation Council
NYPA - New York Power Authority
PATH - Port Authority Trans-Hudson Corporation
SCA - New York City School Construction Authority
USDOT - United States Department of Transportation
USEPA - United States Environmental Protection Agency
WBCSD - World Business Council for Sustainable Development
WRI - World Resources Institute

The following acronyms are used throughout this report:

Btu - British thermal units
CDD - cooling degree days
CH_4 - methane
CHP - combined heat and power
CO_2e - carbon dioxide equivalent
FY - fiscal year
GHG - greenhouse gas
GIS - geographic information systems
HDD - heating degree days
MMBtu - million British thermal units
$MMTCO_2e$ - million metric tons of carbon dioxide equivalent
MT - metric ton
$MTCO_2e$ - metric tons of carbon dioxide equivalent
MW - megawatts
N_2O - nitrous oxide
VMT - vehicle miles traveled
WPCP - water pollution control plant, i.e. wastewater treatment plant

Weather Impacts

Figures 12 illustrates the impact weather plays on energy use and CO_2e emissions. As shown, natural gas consumption is directly related to the number of Heating Degree Days (HDD). This relationship is important to consider when interpreting GHG inventory results. While City government CO_2e emissions increased by 5.6 percent from 2006-2007, half of this increase was due to increased heating fuel use, as heating degree days increased by 5 percent between fiscal years 2006 and 2007.

Energy use and subsequent CO_2e emissions are also closely aligned with cooling degree days. Figure 13 shows City government electricity use for FY 2006-2007 and cooling degree days. As shown, the summer of 2006 brought on a sharp increase in electricity consumption, which declined as soon as the weather cooled off in the fall.

New York City Natural Gas Use and Heating Degree Days, 2006-2007

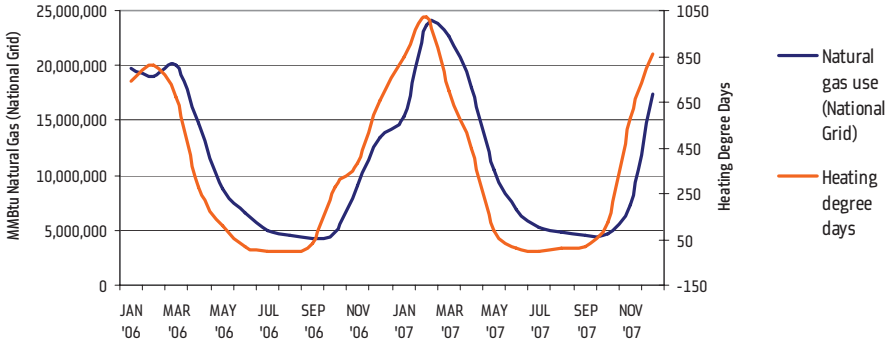


Figure 12

City Government Electricity Use and Cooling Degree Days, FY 2006-2007

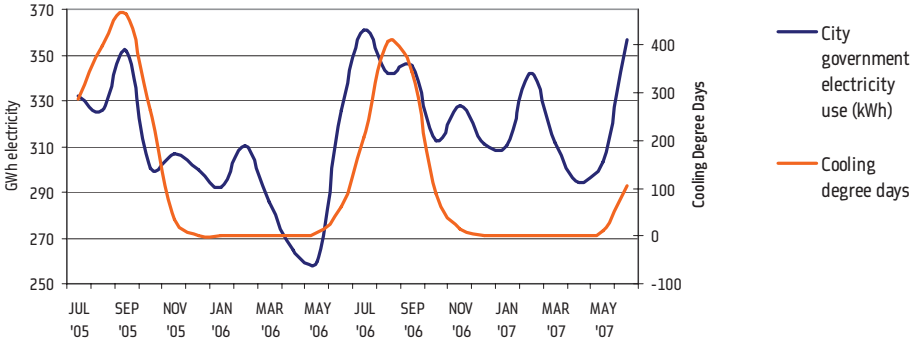


Figure 13

Steam Coefficients

2005 STEAM COEFFICIENT											
								Steam coefficient per MMBtu delivered to buildings			
To convert metered lbs of steam to Btu		Steam fuel breakdown and emission coefficients						divided by fuel mix percentage			
Lbs of steam generated per lb of steam delivered (1/0.85)	1.1718		CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N_2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)	% of mix	CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)
Steam generation efficiency	103.5%	Residual Fuel Oil	173.91	0.0070	0.0014	174.4850	54.09%	94.07073	0.00377	0.00075	94.38394883
Difference between delivery and generation	113.2%	Natural Gas	117.08	0.0023	0.0002	117.2009	45.88%	53.71971	0.00107	0.00011	53.7751937
Steam Btu/lb at generation	1193	Kerosene	159.54	0.0070	0.0014	160.1140	0.02%	0.03865	0.00000	0.00000	0.038792265
Water Btu	18							147.82910	0.00484	0.00086	**148.1979**
Net Btu/lb	1175							Steam coefficient per Mlb delivered to buildings			
Total Btu input /lb steam	**1330.15**							CO_2 (lbs/Mlb)	CH_4 (lbs/Mlb)	N_2O (lbs/Mlb)	CO_2e (lbs/Mlb)
								196.6349078	0.006441056	0.001146287	**197.1255**

2006 STEAM COEFFICIENT											
								Steam coefficient per MMBtu delivered to buildings			
To convert metered lbs of steam to Btu		Steam fuel breakdown and emission coefficients						divided by fuel mix percentage			
Lbs of steam generated per lb of steam delivered (1/0.85)	1.1718		CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N_2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)	% of mix	CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)
Steam generation efficiency	124.6%	Residual Fuel Oil	173.91	0.0070	0.0014	174.4850	49.33%	85.78490	0.00344	0.00069	86.07052415
Difference between delivery and generation	94.0%	Natural Gas	117.08	0.0023	0.0002	117.2009	50.63%	59.27505	0.00118	0.00012	59.33626976
Steam Btu/lb at generation	1193	Kerosene	159.54	0.0070	0.0014	160.1140	0.04%	0.06999	0.00000	0.00000	0.070239909
Water Btu	18							145.12993	0.00462	0.00081	**145.4770**
Net Btu/lb	1175							Steam coefficient per Mlb delivered to buildings			
Total Btu input /lb steam	**1104.83**							CO_2 (lbs/Mlb)	CH_4 (lbs/Mlb)	N_2O (lbs/Mlb)	CO_2e (lbs/Mlb)
								160.34366	0.005106155	0.000891158	**160.7271**

2007 STEAM COEFFICIENT											
								Steam coefficient per MMBtu delivered to buildings			
To convert metered lbs of steam to Btu		Steam fuel breakdown and emission coefficients						divided by fuel mix percentage			
Lbs of steam generated per lb of steam delivered (1/0.85)	1.1718		CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N_2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)	% of mix	CO_2 (lbs/ MMBtu)	CH_4 (lbs/ MMBtu)	N2O (lbs/ MMBtu)	CO_2e (lbs/ MMBtu)
Steam generation efficiency	120.3%	Residual Fuel Oil	173.91	0.0070	0.0014	174.4850	49.05%	85.30732	0.00342	0.00068	85.59135938
Difference between delivery and generation	97.4%	Natural Gas	117.08	0.0023	0.0002	117.2009	50.13%	58.69312	0.00117	0.00012	58.75373655
Steam Btu/lb at generation	1193	Kerosene	159.54	0.0070	0.0014	160.1140	0.82%	1.30105	0.00006	0.00001	1.30576724
Water Btu	18							145.30148	0.00464	0.00081	**145.6509**
Net Btu/lb	1175							Steam coefficient per Mlb delivered to buildings			
Total Btu input /lb steam	**1144.24**							CO_2 (lbs/Mlb)	CH_4 (lbs/Mlb)	N_2O (lbs/Mlb)	CO_2e (lbs/Mlb)
								166.2602499	0.005314769	0.000929563	**166.6600**

Electricity Coefficients

NEW YORK CITY CO2e COEFFICIENT FOR ELECTRICITY, 2005 BASE TO 2007												
2005 base	Generation	CO_2	CO_2/MWh	CH_4	CH_4/MWh	N_2O	N_2O/MWh	CO_2e	CO_2e/MWh	Rest of state (ROS)		
	GWh	tons	lbs	tons	lbs	tons	lbs	tons	lbs	generation - 8%	CO_2 emissions	CO_2e emissions
In-city	29,900	20,171,470	1,349.28						1,349.279	MWh	tons	
Contract	16,804	1,884,703	224.31						224.315	44,122,942	40,087,670	
ROS imported	5,572	5,062,667	1,817.09						1,817.090			
Total 2005 NYC consumption	52,276	27,118,841	1,037.53						**1,037.525**			
2005 adjusted	Generation	CO_2	CO_2/MWh	CH_4	CH_4/MWh	N_2O	N_2O/MWh	CO_2e	CO_2e/MWh	Rest of state (ROS)		
	GWh	tons	lbs	tons	lbs	tons	lbs	tons	lbs	generation	CO_2 emissions	CO_2e emissions
In-city	25,452	16,584,670	1303.21	386.9	0.0304	49.9	0.0039	16,608,265	1,305.061	MWh	tons	tons
Contract	16,744	2,352,852	281.04	46.7	0.0056	4.7	0.0006	2,355,283	281.332	45,585,315	37,456,551	37,599,239
ROS imported	11,811	9,704,939	1643.36	211.4	0.0358	104.9	0.0178	9,741,909	1,649.621			
Total	54,007	56,394,073	1060.69		0.0239		0.0059	28,705,457	1,063.027			
Total 2005 NYC consumption	50,987										% change in CO_2e coefficient	
Transmission and generation loss rate	5.59%								**CO_2e coefficient (lbs/MWh)**		change from 2005 base	
Emissions with transmission and distribution losses			**1120.0070**		**0.0252**		**0.0062**		**1,122.470**		**8.19%**	
2006	Generation	CO_2	CO_2/MWh	CH_4	CH_4/MWh	N_2O	N_2O/MWh	CO_2e	CO_2e/MWh	Rest of state (ROS)		
	GWh	tons	lbs	tons	lbs	tons	lbs	tons	lbs	generation	CO_2 emissions	CO_2e emissions
In-city	27,293	15,662,420	1147.74	332.0	0.0243	37.3	0.0027	15,680,953	1,149.102	MWh	tons	tons
Contract	15,051	1,590,260	211.31	31.6	0.0042	3.2	0.0004	1,591,902	211.530	41,527,556	33,627,669	33,759,297
ROS imported	10,752	8,706,761	1619.54	166.3	0.0309	98.7	0.0184	8,740,841	1,625.874			
Total	53,096		977.83		0.0200		0.0052	26,013,696	979.874			
total 2006 NYC consumption	50,093										% change in CO_2e coefficient	
Transmission and generation loss rate	5.66%								**CO_2e coefficient (lbs/MWh)**		change from 2005 adjusted	change from 2005 base
Emissions with transmission and distribution losses			**1033.1344**		**0.0211**		**0.0055**		**1,035.294**		**-7.77%**	**-0.22%**
2007	Generation	CO_2	CO_2/MWh	CH_4	CH_4/MWh	N_2O	N_2O/MWh	CO_2e	CO_2e/MWh	Rest of state (ROS)		
	GWh	tons	lbs	tons	lbs	tons	lbs	tons	lbs	generation	CO_2 emissions	CO_2e emissions
In-city	29,460	16,289,071	1105.83	338.1	0.0230	36.6	0.0025	16,307,530	1,107.084	MWh	tons	tons
Contract	15,841	1,775,702	224.19	35.3	0.0045	3.5	0.0004	1,777,536	224.422	45,189,448	35,878,863	36,016,771
ROS imported	9,449	7,501,878	1587.93	143.7	0.0304	83.3	0.0176	7,530,713	1,594.035			
Total	54,750		933.94		0.0189		0.0045	25,615,779	935.736			
total 2007 NYC consumption	51,866										% change in CO_2e coefficient	
Transmission and generation loss rate	5.27%								**CO_2e coefficient (lbs/MWh)**		change from 2006	change from 2005 adj.
Emissions with transmission and distribution losses			**983.1307**		**0.0199**		**0.0047**		**985.020**		**-4.86%**	**-12.25%**

All calculations presented in this report are based on data submitted to the New York City Mayor's Office. While every effort has been made to ensure these data's accuracy, the possibility for errors exists. This report is not intended to be a flawless accounting of New York City's carbon emissions, but is rather intended to provide guidance from which policy decisions may be based. The City of New York does not accept responsibility for the completeness or accuracy of this report, and it shall not be held liable for any damage or loss that may result, either directly or indirectly, as a result of its use.

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