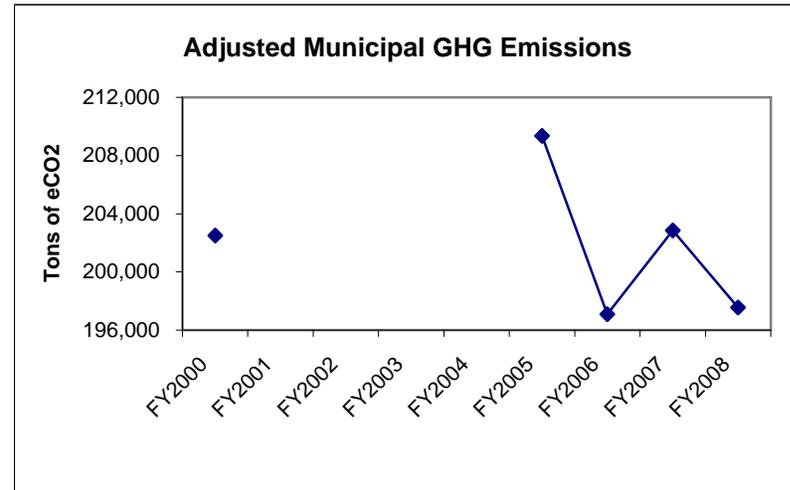
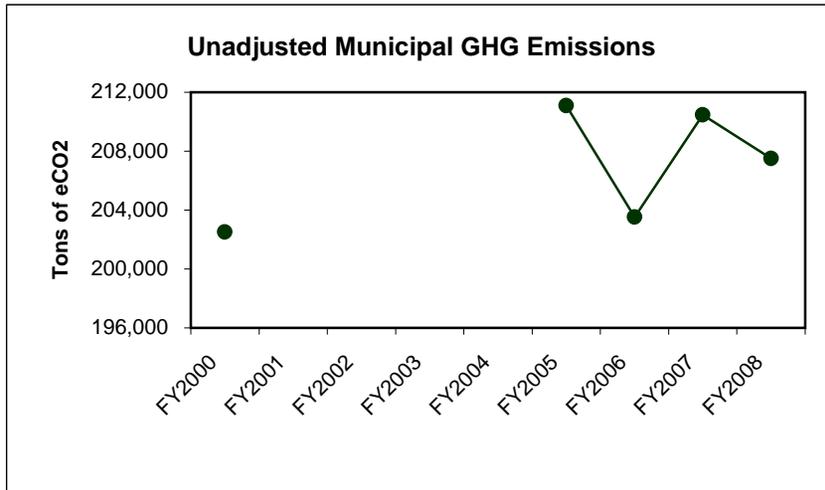


## **Boston Municipal Greenhouse Gas Inventories**

1. Summary of GHG Emissions
2. Revised FY2005 City of Boston Municipal GHG Emissions
3. Revised FY2006 City of Boston Municipal GHG Emissions
4. FY2007 City of Boston Municipal GHG Emissions
5. FY2008 City of Boston Municipal GHG Emissions
6. Notes

## City of Boston Municipal Greenhouse Gas Emissions Summary (CO2 tons equivalent)

	<b>FY2000</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
<b>Electricity</b>	85,754	98,947	93,388	96,137	94,699
<b>Natural gas</b>	40,732	61,828	59,976	63,597	62,156
<b>Diesel</b>	19,562	20,213	19,935	21,412	21,669
<b>Gasoline</b>	18,084	16,645	17,204	17,823	18,443
<b>Light fuel oil</b>	30,586	7,505	7,372	5,965	5,426
<b>Steam</b>	7,636	5,651	5,421	5,318	4,923
<b>Propane</b>	146	307	229	210	181
<b>Unadjusted Emissions</b>	202,500	211,096	203,525	210,462	207,497
<b>Adjustments</b>		1,753	6,438	7,606	9,947
<b>Adjusted Emissions</b>	202,500	209,343	197,087	202,856	197,550



# FY2005 City of Boston Municipal GHG Emissions - in Equivalent CO<sub>2</sub> tons

Revised: 12/2/2009

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	38,572		366	14,416	30,825		84,179	40%
Center for Youth and Families	3,031				1,530		4,561	2%
Emergency Medical Services	258				169		427	0%
Fire	2,715	603	920	2,111	2,443		8,792	4%
Graphic Arts	261				85		346	0%
Inspectional Services					243		243	0%
Library	958	202			8,187	3,776	13,123	6%
Neighborhood Development					127		127	0%
Parks and Recreation	644	220	226	546	1,545		3,181	2%
Police	2,957	610	9,004	1	5,061		17,633	8%
Property Management	523	511			7,986	1,875	10,895	5%
Public Works	2,515	158	5,279	2,356	1,703		12,011	6%
Public Works Streetlights	5,116				32,149		37,265	18%
Transportation	228	45			345		618	0%
Public Health Commission	3,177	5,373			3,825		12,375	6%
Water and Sewer Commission	873	90	850	783	2,724		5,320	3%
	61,828	7,812	16,645	20,213	98,947	5,651	211,096	100%

## ADJUSTMENTS and TOTALS

Scope 1 total	106,498
Scope 1 adjustments	
<b>Scope 1 adjusted total</b>	<b>106,498</b>
Scope 2 total	104,598
Scope 2 adjustments	1,753
<b>Scope 2 adjusted total</b>	<b>102,845</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>209,343</b>

GHGs by Sector*	eCO <sub>2</sub>	%
Buildings	136,973	65%
Transportation	36,858	17%
Streetlights	37,265	18%

\*unadjusted

GHGs by Fuel*	eCO <sub>2</sub>	%
Electricity	98,947	47%
Natural gas	61,828	29%
Diesel	20,213	10%
Gasoline	16,645	8%
Light fuel oil	7,505	4%
Steam	5,651	3%
Propane	307	0%

\*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	47,097	6,705	420	22	31,625	696	86,565
Redevelopment Authority	1,980	64	850	783	156		3,833
MWRA (Boston share)	849	9,227	378	245	24,595		35,294

# FY2006 City of Boston Municipal GHG Emissions - in Equivalent CO<sub>2</sub> tons

Revised: 12/2/2009

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	37,532		354	14,436	24,770		77,092	38%
Center for Youth and Families	3,024				1,682		4,706	2%
Emergency Medical Services	248				145		393	0%
Fire	3,146	239	919	2,240	2,420		8,964	4%
Graphic Arts	197				89		286	0%
Inspectional Services					238		238	0%
Library	918	239			8,797	3,991	13,945	7%
Neighborhood Development					52		52	0%
Parks and Recreation	490	226	146	530	1,620		3,012	1%
Police	2,396	476	9,269	2	5,455		17,598	9%
Property & Construction Mgmt	589	457			8,265	1,430	10,741	5%
Public Works	2,061	156	5,673	2,006	1,696		11,592	6%
Public Works Streetlights	5,116				31,621		36,737	18%
Transportation	177	92			287		556	0%
Public Health Commission	3,395	5,663			3,705		12,763	6%
Water and Sewer Commission	687	53	843	721	2,546		4,850	2%
	59,976	7,601	17,204	19,935	93,388	5,421	203,525	100%

## ADJUSTMENTS and TOTALS

Scope 1 total	104,716
Scope 1 adjustments	31
<b>Scope 1 adjusted total</b>	<b>104,685</b>
Scope 2 total	98,809
Scope 2 adjustments	6,407
<b>Scope 2 adjusted total</b>	<b>92,402</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>197,087</b>

GHGs by Sector*	eCO <sub>2</sub>	%
Buildings	129,649	64%
Transportation	37,139	18%
Streetlights	36,737	18%

\*unadjusted

GHGs by Fuel*	eCO <sub>2</sub>	%
Electricity	93,388	46%
Natural gas	59,976	29%
Diesel	19,935	10%
Gasoline	17,204	8%
Light fuel oil	7,372	4%
Steam	5,421	3%
Propane	229	0%

\*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	65,363	10,110			38,747		114,220
Redevelopment Authority	1,648	77			146		1,871
MWRA (Boston share)	895	9,261	359	68	25,396		35,979

# FY2007 City of Boston Municipal GHG Emissions - in Equivalent CO<sub>2</sub> tons

12/2/2009

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events					216		216	0%
Boston Public Schools	41,013		358	15,245	27,794		84,410	40%
Center for Youth and Families	2,629				1,636		4,265	2%
Emergency Medical Services	258				219		477	0%
Fire	3,137	218	963	2,597	2,568		9,483	5%
Graphic Arts	219				90		309	0%
Inspectional Services					181		181	0%
Library	1,013	234			8,451	3,822	13,520	6%
Neighborhood Development					57		57	0%
Parks and Recreation	717	191	458	496	1,952		3,814	2%
Police	2,286	423	9,533		4,980		17,222	8%
Property & Construction Mgmt	680	450			7,876	1,496	10,502	5%
Public Works	2,282	144	5,617	2,225	2,064		12,332	6%
Public Works - Streetlights	5,116				31,559		36,675	17%
Transportation	196	72			274		542	0%
Public Health Commission	3,292	4,395			3,909		11,596	6%
Water and Sewer Commission	759	48	894	849	2,311		4,861	2%
	63,597	6,175	17,823	21,412	96,137	5,318	210,462	100%

Scope 1 total	109,007
Scope 1 adjustments	116
<b>Scope 1 adjusted total</b>	<b>108,891</b>
Scope 2 total	101,455
Scope 2 adjustments	7,490
<b>Scope 2 adjusted total</b>	<b>93,965</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>202,856</b>

GHGs by Sector*	eCO <sub>2</sub>	%
Buildings	134,552	64%
Transportation	39,235	19%
Streetlights	36,675	17%

\*unadjusted

GHGs by Fuel*	eCO <sub>2</sub>	%
Electricity	96,137	46%
Natural gas	63,597	30%
Diesel	21,412	10%
Gasoline	17,823	8%
Light fuel oil	5,965	3%
Steam	5,318	3%
Propane	210	0%

\*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	61,780	9,739			44,505		116,024
MWRA (Boston share)	5,880	1,048	342	42	26,431		33,743

## FY2008 City of Boston Municipal GHG Emissions - in Equivalent CO<sub>2</sub> tons

12/2/2009

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events					143		143	0%
Boston Public Schools	38,930		404	15,357	27,206		81,897	39%
Center for Youth and Families	2,996				1,760		4,756	2%
Emergency Medical Services	292				231		523	0%
Fire	3,236	235	933	2,587	2,558		9,549	5%
Graphic Arts	247				92		339	0%
Inspectional Services					277		277	0%
Library	1,058	202			8,290	3,255	12,805	6%
Neighborhood Development					78		78	0%
Parks and Recreation	421	220	457	622	1,832		3,552	2%
Police	2,582	610	10,206	3	5,146		18,547	9%
Property & Construction Mgmt	789	511			7,963	1,668	10,931	5%
Public Works	2,283	158	5,584	2,260	1,910		12,195	6%
Public Works - Streetlights	5,116				31,018		36,134	17%
Transportation	191	45			300		536	0%
Public Health Commission	3,263	3,626			3,721		10,610	5%
Water and Sewer Commission	752		859	840	2,174		4,625	2%
<b>Subtotal</b>	<b>62,156</b>	<b>5,607</b>	<b>18,443</b>	<b>21,669</b>	<b>94,699</b>	<b>4,923</b>	<b>207,497</b>	<b>100%</b>

Scope 1 total	107,875
Scope 1 adjustments	121
<b>Scope 1 adjusted total</b>	<b>107,754</b>
Scope 2 total	99,622
Scope 2 adjustments	9,826
<b>Scope 2 adjusted total</b>	<b>89,796</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>197,550</b>

GHGs by Sector*	eCO <sub>2</sub>	%
Buildings	131,251	63%
Transportation	40,112	19%
Streetlights	36,134	17%

\*unadjusted

GHGs by Fuel*	eCO <sub>2</sub>	%
Electricity	94,699	46%
Natural gas	62,156	30%
Diesel	21,669	10%
Gasoline	18,443	9%
Light Fuel Oil	5,426	3%
Steam	4,923	2%
Propane	181	0%

\*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	65,056	10,144			43,807		119,007

# Notes on the City of Boston Municipal Greenhouse Gas Inventories FY2005 to FY 2008

In his April 2007 [Executive Order Relative to Climate Action](#), Mayor Thomas Menino directed that the City report annually on its greenhouse gas (GHG) emissions. On January 10, 2008, the City released 2005 GHG emission inventories both for municipal operations and for the Boston community as a whole. In December 2008, the City released the fiscal year (FY) 2006 municipal inventory and a revision for FY05. This report contains the GHG inventories for municipal operations in FY07 and FY08 as well as revisions for FY05 and FY06.

1. *For more information.* Boston GHG inventories are overseen by staff of the Boston [Air Pollution Control Commission](#) (APCC). Please direct any comments or questions about the inventories to Carl Spector, Executive Director, Air Pollution Control Commission, [carl.spector@cityofboston.gov](mailto:carl.spector@cityofboston.gov).
2. *New inventory protocol.* The overall methodology for calculating GHG emissions relies on the [Clean Air and Climate Protection \(CACP\) software](#) developed by [ICLEI](#) and the [National Association of Clean Air Agencies](#) (the City of Boston is a member of both organizations). Over a two-year period, ICLEI worked with the California Air Resources Board, the California Climate Action Registry, and The Climate Registry to develop a new [Local Government Operation Protocol](#) for conducting inventories of GHG emissions. The protocol was adopted by ICLEI, the California Climate Action Registry Board, and the California Air Resources Board in 2008, and by The Climate Registry in 2009.

The City of Boston intends to conduct its inventory in accordance with the new protocol, although it may take several years to put all the necessary data collection and management systems into place. As a first step, the City is following the protocol's guidance concerning (a) direct and indirect emissions and (b) organizational and operational boundaries (see chapters 3 and 4 of the protocol).

*a. Direct and indirect emissions.* The protocol's division of direct (Scope 1) and indirect (Scope 2) emissions is straightforward. Direct emissions come from the burning of natural gas, fuel oil, gasoline, diesel fuel, and other fuels in the City's facilities, vehicles, and other equipment. Indirect emissions come from the burning of fuels in facilities owned and operated by others to produce electricity and steam that the City uses.

*b. Organizational and operational boundaries.* The new protocol's more involved questions surround Scope 3, "additional emission sources of potential policy relevance," which pertain to the decision of where to place the emissions of the independent and quasi-independent governmental authorities associated with the City of Boston, in particular, the [Boston Housing Authority](#), the [Massachusetts Water Resources Authority](#), the [Boston Public Health Commission](#), the [Boston Redevelopment Authority](#), and the [Boston Water and Sewer Commission](#), all of which were included in the original FY00 and FY05 inventories.

Concerning "autonomous departments," the protocol states:

It is often the case that autonomous departments like municipal utilities, ports and airports are managed by their own board of commissioners or executives. If this board is appointed by local government officials (e.g. appointed by the Mayor and confirmed by the City Council) and the local government officials have some level of oversight of the board (e.g. the local government can help guide policy

decisions of the department, the actions of the Board can be reviewed and overturned by the City Council, etc.), then the local government is considered to have operational control over the department and should report the emissions associated with the municipal utility/port/airport as part of the local government's GHG inventory. (page 16)

This description applies to the Boston Public Health Commission and the Boston Water and Sewer Commission, whose members and directors are appointed by the mayor and which, therefore, are listed with other City departments. It does not apply to the Massachusetts Water Resources Authority (MWRA), where the City has three seats out of 11 on the MWRA's board of directors; MWRA emissions are listed in Scope 3.

*c. Leased property.* The new protocol states that a "lessor should not report emissions for assets leased under an operating lease if the lessor is using the operational control consolidation method." (page 19) Although the Boston Housing Authority (BHA) and the Boston Redevelopment Authority (BRA) come under the operational control of the City of Boston (see note 2.b), their emissions, when available, are listed under Scope 3, because the bulk of their emissions come from rental housing and leased industrial and commercial properties. As a practical matter, the BHA, the largest landlord in Boston, with 12,000 rental units, has a large number of [programs](#) to reduce energy use and greenhouse gas emissions at its properties. The apparent jump in BHA emissions from 2006 to 2007 is due primarily to improved data collection

3. *Time frame.* The municipal inventory is based on the City's fiscal year, July 1 to June 30, except for data from the Boston Water and Sewer Commission and the Boston Housing Authority, which are based on a calendar year.

4. *Electricity emission factor.* The municipal and community GHG inventories use the electricity emission factor based on the area served by [ISO-New England](#), the regional transmission organization. The ISO-NE electricity emission factor is about 7 percent lower than the factor used by the [Commonwealth of Massachusetts](#) for their statewide GHG emissions inventory released in July 2009. The Commonwealth's emission factor is based primarily on power plants located in Massachusetts.

5. *Adjustments.* The Adjustments section of the inventory reflects the City's purchases of a biodiesel blend for its diesel vehicles and of Renewable Energy Credits for electricity purchases. Because there remains considerable disagreement about the proper calculations for the GHG implications of these energy sources, the adjustments are made outside of the Scope 1 and 2 calculations.

*a. Biodiesel.* In FY06, the City started buying B5, a mixture with 95 percent ultra-low-sulfur diesel and 5 percent biodiesel, for use in many of its diesel vehicles. In the Scope 1 calculation, all the diesel and biodiesel fuels are subject to the same emission factor of 0.0106 tons (2.12 lb) eCO<sub>2</sub> per gallon. The Scope 1 adjustment assumes that B100 (one hundred percent biodiesel), on the basis of a life-cycle calculation that includes the capture of atmospheric CO<sub>2</sub> during plant growth, has net emissions of only 0.00636 tons (1.27 lb) eCO<sub>2</sub> per gallon, a 40 percent reduction. (See Hill et al., "Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels," <http://www.pnas.org/content/103/30/11206>, 2006). In FY08, the City purchased the equivalent of 28,552 gallons of B100.

*b. Renewable Energy Credits (RECs).* RECs represent the generation of electricity from renewable energy sources such as wind and biomass. The City started buying RECs in FY05. In FY05 through FY08, these RECs came from Midwestern wind farms. The Scope 2 adjustments assume that these

sources of electricity have zero GHG emissions and that the appropriate adjustment per megawatt-hour (MWh) is the same as the electricity emission factor. In FY05, the City purchased 3,787 MWh of RECs; in FY06, 15,860 MWh; in FY07, 16,390 MWh; in FY08, 21,530 MWh.

6. *Other FY05 and FY06 revisions.* There are adjustments to the Public Health Commission's light fuel oil, electricity, and natural gas usage. Electricity numbers for the Inspectional Service Department have been added, because it was discovered that their bills had been recorded in a different system than the one we originally used as data source. For the revision to the emissions from streetlights, see below.

7. *Data sources—City Hall departments.* Data on electricity and natural gas purchases by department come from the computer-based Major Vendor System maintained by the Office of Budget Management. The Major Vendor System compiles monthly bills submitted by the City's electricity and natural gas suppliers. Data on gasoline, diesel, and fuel oil come from the Purchasing Department's list of invoices received for deliveries, except for diesel used by the Boston Public Schools and gasoline used by the Police Department, the data for which come directly from the individual department. Trigen Energy supplied the data on the City's steam consumption. The GHGs were allocated to fiscal year by the date of delivery; except for GHGs from the schools' diesel fuel and the Police Department's gasoline, which are based on date of consumption. The annual inventories include some changes from year to year in department names and some consolidation of accounts. The municipal inventories do not include GHGs associated with official airplane travel nor with employee commuting.

8. *Data sources—authorities and commissions.* The five authorities and commissions maintain their own accounts of energy use. They transmitted their annual energy purchases to the APCC, which performed the GHG calculations.

9. *Streetlights.* Most of the City's natural gas streetlights and many of the electric streetlights are unmetered. The bills that the City receives for energy use are based on calculations by the utilities regarding size of pipe, number of hours of darkness, and so on. The GHG emissions for the gas streetlights are based on an average use of 69,000 therms per month.

10. *Boston Redevelopment Authority.* The BRA's FY07 and FY08 energy and emission data were not available as of the release date of this report. We hope to include them in later revisions.

11. *MWRA allocation.* The Massachusetts Water Resources Authority provides water and sewer services to 2.5 million people and more than 5,500 businesses in 61 communities in eastern and central Massachusetts. At our request, the MWRA allocated to Boston its pro rata share of the MRWA total annual energy used based on measurements of actual water and sewer flows. For FY05 through FY07, the Boston share was about 32 percent of the total.

12. *Verification.* The City of Boston municipal inventory has not received third-party verification. In general, existing verification frameworks require facility-specific data by calendar year. The City intends to develop the detail of its inventory to this level in the next several years and then obtain verification.

13. *Overall trends.* The City of Boston has now completed inventories of GHG emissions for five fiscal years (2000 and 2005–2008). The data suggest that municipal emissions may be on a downward

trend since 2005—and the City has been aggressively pursuing many energy-saving strategies in the past several years—but it is too soon to make a firm conclusion. In particular, a large part of the drop from FY05 to FY06 was due to the consequences of Hurricane Katrina, which led many electrical power plants to switch temporarily from oil to lower-GHG natural gas. Also, it does not take into account annual fluctuations of weather.

December 2, 2009