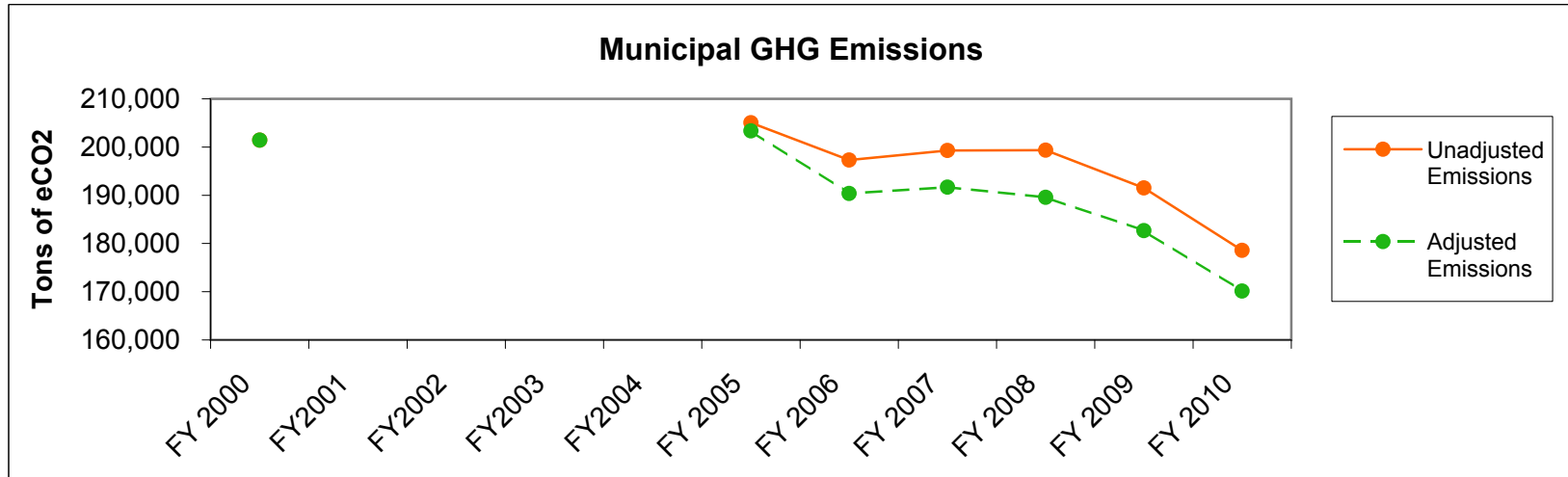


Boston Municipal Greenhouse Gas Inventories

1. Summary of GHG Emissions
2. Municipal GHG Emissions FY2005–FY2010
3. Notes

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

	FY 2000	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Electricity	86,986	97,526	92,052	90,491	93,302	85,981	80,656
Natural gas	38,456	58,685	56,924	60,097	59,012	59,059	54,430
Diesel	21,948	21,427	21,079	22,631	22,633	23,500	21,089
Gasoline	16,564	15,078	15,590	16,271	15,987	15,151	15,032
Light fuel oil	29,683	7,502	7,329	5,950	4,945	4,797	4,355
Steam	7,636	4,842	4,323	3,852	3,487	3,032	3,024
Propane	154	289	216	198	171	158	155
Unadjusted Emissions	201,427	205,060	197,297	199,292	199,366	191,520	178,586
Adjustments		1,708	6,916	7,613	9,803	8,843	8,445
Adjusted Emissions	201,427	203,352	190,381	191,679	189,563	182,677	170,141



FY2005 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	36,611		215	15,202	30,363		82,391	40%
Center for Youth and Families	2,877				1,507		4,384	2%
Fire	2,577	586	835	1,763	2,406		8,167	4%
Graphic Arts	247				84		331	0%
Inspectional Services					239		239	0%
Library	910	196	60		8,064	3,215	12,445	6%
Neighborhood Development					125		125	0%
Parks and Recreation	612	220	226	577	1,522		3,157	2%
Police	2,807	593	8,176	1	4,985		16,562	8%
Property Management	497	496			7,867	1,627	10,487	5%
Public Works	2,387	154	4,794	2,492	1,677		11,504	6%
Public Works Streetlights	4,855				31,667		36,522	18%
Transportation	216	44			339		599	0%
Emergency Medical Services	245			470	167		882	0%
Public Health Commission	3,015	5,213			3,768		11,996	6%
Water and Sewer Commission	829		772	922	2,746		5,269	3%
	58,685	7,502	15,078	21,427	97,526	4,842	205,060	100%

ADJUSTMENTS and TOTALS

Scope 1 total	102,692
Scope 1 adjustments	0
Scope 1 adjusted total	102,692
Scope 2 total	102,368
Scope 2 adjustments (note 4b)	1,708
Scope 2 adjusted total	100,660
Scope 1+2 ADJUSTED TOTAL	203,352

GHGs by Sector*	eCO ₂	%
Buildings	132,015	64%
Transportation	36,505	18%
Streetlights	36,522	18%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	97,526	48%
Natural gas	58,685	29%
Diesel	21,427	10%
Gasoline	15,078	7%
Light fuel oil	7,195	4%
Steam	4,842	2%
Propane	289	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)	806	8,969	343	307	24,025		34,450

FY2006 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Fiscal Year

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	35,623		215	15,224	26,189		77,251	39%
Center for Youth and Families	2,870				2,595		5,465	3%
Fire	2,986	232	836	1,739	2,294		8,087	4%
Graphic Arts	187				84		271	0%
Inspectional Services					226		226	0%
Library	871	232	59		8,338	3,215	12,715	6%
Neighborhood Development					49		49	0%
Parks and Recreation	466	220	132	559	1,514		2,891	1%
Police	2,274	463	8,425	2	5,170		16,334	8%
Property & Construction Mgmt	559	444			7,834	1,108	9,945	5%
Public Works	1,956	151	5,157	2,115	1,607		10,986	6%
Public Works Streetlights	4,855				29,972		34,827	18%
Transportation	168	89			272		529	0%
Emergency Medical Services	235			624	137		996	1%
Public Health Commission	3,222	5,498			3,512		12,232	6%
Water and Sewer Commission	652		766	816	2,259		4,493	2%
	56,924	7,329	15,590	21,079	92,052	4,323	197,297	100%
							197,297	

ADJUSTMENTS and TOTALS

Scope 1 total	100,922
Scope 1 adjustments	33
Scope 1 adjusted total	100,889
Scope 2 total	96,375
Scope 2 adjustments	6,883
Scope 2 adjusted total	89,492
Scope 1+2 ADJUSTED TOTAL	190,381

GHGs by Sector*	eCO ₂	%
Buildings	125,788	64%
Transportation	36,669	19%
Streetlights	34,827	18%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	92,052	47%
Natural gas	56,924	29%
Diesel	21,079	11%
Gasoline	15,590	8%
Light fuel oil	7,100	4%
Steam	4,323	2%
Propane	216	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)	865	9,002	326	316	24,807		35,316

FY2007 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Fiscal Year

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events					203		203	0%
Boston Public Schools	38,928		326	16,077	26,132		81,463	41%
Center for Youth and Families	2,495				1,538		4,033	2%
Fire	2,977	212	876	2,286	2,414		8,765	4%
Graphic Arts	208				84		292	0%
Inspectional Services					170		170	0%
Library	961	227	60		7,946	2,762	11,956	6%
Neighborhood Development					54		54	0%
Parks and Recreation	416	186	416	523	1,816		3,357	2%
Police	2,170	411	8,671		4,682		15,934	8%
Property & Construction Mgmt	645	438			7,405	1,090	9,578	5%
Public Works	2,166	140	4,792	2,046	1,940		11,084	6%
Public Works - Streetlights	4,855				29,673		34,528	17%
Transportation	186	70			258		514	0%
Emergency Medical Services	245		317	753	206		1,521	1%
Public Health Commission	3,125	4,266			3,675		11,066	6%
Water and Sewer Commission	720		813	946	2,295		4,774	2%
	60,097	5,950	16,271	22,631	90,491	3,852	199,292	100%

Scope 1 total	104,949
Scope 1 adjustments	123
Scope 1 adjusted total	104,826
Scope 2 total	94,343
Scope 2 adjustments	7,490
Scope 2 adjusted total	86,853
Scope 1+2 ADJUSTED TOTAL	191,679

GHGs by Sector*	eCO ₂	%
Buildings	125,862	63%
Transportation	38,902	20%
Streetlights	34,528	17%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	90,491	45%
Natural gas	60,097	30%
Diesel	22,631	11%
Gasoline	16,271	8%
Light fuel oil	5,740	3%
Steam	3,852	2%
Propane	198	0%

*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	60,547	9,656			41,898		112,101
MWRA (Boston share)	995	5,716	311	367	25,818		33,207

FY2008 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Fiscal Year

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events			4		141		145	0%
Boston Public Schools	36,950	48	368	16,244	26,861		80,471	40%
Center for Youth and Families	2,844		126	1	1,734		4,705	2%
Fire	3,089	228	849	2,154	2,528		8,848	4%
Graphic Arts	234		6		90		330	0%
Inspectional Services			170	11	272		453	0%
Library	1,005	197	56		8,166	2,328	11,752	6%
Neighborhood Development			33		43		76	0%
Parks and Recreation	400	250	549	618	1,807		3,624	2%
Police	2,451	383	9,284	54	5,069		17,241	9%
Property & Construction Mgmt	749	176	305	34	7,844	1,159	10,267	5%
Public Works	2,167	129	1,694	1,326	1,882		7,198	4%
Public Works - Streetlights	4,855				30,553		35,408	18%
Transportation	181	15	1,070	363	296		1,925	1%
Emergency Medical Services	277		385	809	227		1,698	1%
Public Health Commission	3,097	3,519	306	123	3,665		10,710	5%
Water and Sewer Commission	713		782	896	2,124		4,515	2%
Subtotal	59,012	4,945	15,987	22,633	93,302	3,487	199,366	100%

Scope 1 total	102,577
Scope 1 adjustments	128
Scope 1 adjusted total	102,449
Scope 2 total	96,789
Scope 2 adjustments	9,675
Scope 2 adjusted total	87,114
Scope 1+2 ADJUSTED TOTAL	189,563

GHGs by Sector*	eCO ₂	%
Buildings	125,338	63%
Transportation	38,620	19%
Streetlights	35,408	18%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	93,302	47%
Natural gas	59,012	30%
Diesel	22,633	11%
Gasoline	15,987	8%
Light Fuel Oil	4,774	2%
Steam	3,487	2%
Propane	171	0%

*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	59,093	9,561			43,377		112,031
MWRA (Boston share)	841	2,311	368	379	25,850		29,749

FY2009 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Fiscal Year

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	257		6		188		451	0%
Boston Public Schools	36,458	42	355	16,233	22,977		76,065	40%
Center for Youth and Families	2,860		113	4	1,751		4,728	2%
Fire	2,933	280	758	2,154	2,405		8,530	4%
Graphic Arts	213		6		79		298	0%
Inspectional Services			143	15	250		408	0%
Library	988	53	53		7,133	1,960	10,187	5%
Neighborhood Development			31		43		74	0%
Parks and Recreation	393	302	554	688	1,678		3,615	2%
Police	2,580	428	8,798	45	4,970		16,821	9%
Property & Construction Mgmt	769	258	270	42	7,226	1,072	9,637	5%
Public Works	2,104	157	1,581	2,020	1,748		7,610	4%
Public Works - Streetlights	4,855				29,319		34,174	18%
Transportation	209	14	1,090	368	231		1,912	1%
Emergency Medical Services	285		358	937	227		1,807	1%
Public Health Commission	3,177	3,263	289	98	3,475		10,302	5%
Water and Sewer Commission	978		746	896	2,281		4,901	3%
Subtotal	59,059	4,797	15,151	23,500	85,981	3,032	191,520	100.0%

Scope 1 total	102,507
Scope 1 adjustments	138
Scope 1 adjusted total	102,369
Scope 2 total	89,013
Scope 2 adjustments	8,705
Scope 2 adjusted total	80,308
Scope 1+2 ADJUSTED TOTAL	182,677

GHGs by Sector*	eCO ₂	%
Buildings	118,695	62%
Transportation	38,651	20%
Streetlights	34,174	18%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	85,981	45%
Natural gas	59,059	31%
Diesel	23,500	12%
Gasoline	15,151	8%
Light Fuel Oil	4,639	2%
Steam	3,032	2%
Propane	158	0%

*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	62,487	9,256			41,442		113,185
MWRA (Boston share)	1,005	3,569	372	386	22,691		28,023

FY2010 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Fiscal Year

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	240		5		196		441	0%
Boston Public Schools	34,119	43	355	14,886	20,068		69,471	39%
Center for Youth and Families	2,760		113	5	1,707		4,585	3%
Fire	2,035	212	705	2,191	2,380		7,523	4%
Graphic Arts	189				85		274	0%
Inspectional Services			264	12	246		522	0%
Library	1,045		31		6,309	2,124	9,509	5%
Neighborhood Development	140		30		63		233	0%
Parks and Recreation	356	261	522	754	1,753		3,646	2%
Police	2,378	369	8,586	43	4,959		16,335	9%
Property & Construction Mgmt	848	192	524	45	6,049	900	8,558	5%
Public Works	1,950	134	1,442	1,188	1,955		6,669	4%
Public Works - Streetlights	4,855				29,092		33,947	19%
Transportation	188	9	1,095	12	317		1,621	1%
Emergency Medical Services	257		239	1,055	228		1,779	1%
Public Health Commission	2,320	3,135	336	18	2,949		8,758	5%
Water and Sewer Commission	750		785	880	2,300		4,715	3%
Subtotal	54,430	4,355	15,032	21,089	80,656	3,024	178,586	100.0%

Scope 1 total	94,906
Scope 1 adjustments	54
Scope 1 adjusted total	94,852
Scope 2 total	83,680
Scope 2 adjustments	8,391
Scope 2 adjusted total	75,289
Scope 1+2 ADJUSTED TOTAL	170,141

GHGs by Sector*	eCO ₂	%
Buildings	108,518	60.77%
Transportation	36,121	20.23%
Streetlights	33,947	19.01%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	80,656	45%
Natural gas	54,430	30%
Diesel	21,089	12%
Gasoline	15,032	8%
Light Fuel Oil	4,187	2%
Steam	3,024	2%
Propane	155	0%

*unadjusted

Notes on the City of Boston Municipal Greenhouse Gas Inventories FY2005 to FY2010

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. In December 2009, the City released a report that included inventories for fiscal year 2000 and fiscal years 2005–2008. This report extends the annual inventories through fiscal year 2010 (FY10). It also includes adjustments to the earlier inventories based on revised data and emissions factors. Greenhouse gas emissions from the entire Boston community are described in a separate report.

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.

2. *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 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 (which includes Emergency Medical Services), 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 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 usually several percent lower than the factor used by the Commonwealth of Massachusetts for the statewide GHG emissions inventory, which is based primarily on power plants located in Massachusetts. Both factors can vary from year to year according to the actual fuel mix used to produce electricity.

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) eCO₂ 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 CO₂ during plant growth, has net emissions of only 0.00636 tons (1.27 lb) eCO₂ 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 30,797 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 FY10, 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; in FY09, 20,925; in FY10, 20,171.

6. *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. Starting in FY08, data on gasoline and diesel for the Fire and Parks and Recreation Department, and fuel oil for all departments come from the Purchasing Department's list of invoices received for deliveries. All other departmental fuel use data is based on consumption compiled by the Public Works Department, 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. Veolia Energy supplied the data on the City's steam consumption. The GHGs were allocated to fiscal year by the date of delivery for data from the Purchasing Department with all other fuel based GHGs 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.

7. *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.

8. *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.

9. *Boston Redevelopment Authority.* The BRA's FY07 to FY10 energy and emission data were not available as of the release date of this report. We hope to include them in later revisions.

10. *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 FY10, the Boston share averaged about 32 percent of the total.

11. *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.

12. *Overall trend.* Please see *A Climate of Progress: City of Boston Climate Action Plan Update 2011*, page 36, for a discussion.

April 20, 2011