Boston Municipal Greenhouse Gas Inventory Summary

From fiscal year FY 2005 to FY 2012, the City of Boston reduced its annual greenhouse gas emissions from municipal government operations by about 51,000 metric tonnes, or 27 percent. This reduction is equivalent to the reduction from taking over 10,000 cars off the road each year. The City will continue to lead by example in cutting its emissions in the years to come and is exploring new goals for 2020.
About two-thirds of the reduction of the City of Boston's carbon footprint came from five sources.

Department	Fuel type	Reduction of CO2e (metric tonnes)	Percentage of total reduction
Boston Public Schools	Electricity	-12,675	24.9%
Public Works (streetlights)	Electricity	-10,957	21.6%
Boston Public Libraries	Electricity	-2,760	5.4%
Boston Public Health Commission	Fuel Oil	-2,175	4.3%
All departments	Steam	-4,960	9.8%
Total		-33,527	66.1%

Greenhouse gas emissions related to electricity use fell throughout New England. The low price of natural gas led many electricity generators to use it in place of oil and coal, both of which produce more greenhouse gases per unit of energy. The City of Boston increased its purchase of renewable energy credits to offset municipal emissions from electricity. The City also took many steps to use electricity more efficiently, which produced additional greenhouse gas reductions.
This year, the City of Boston is implementing an Enterprise Energy Management System (EEMS) for managing and understanding energy use through all municipal properties. The EEMS will pinpoint energy use at a specific time, as well as track trends, giving the City a better understanding of the best opportunities for energy efficiency and saving taxpayer dollars.

Emission Source Reductions

Boston Public Schools Electricity

Boston Public Schools' (BPS) cuts in electricity use can be attributed, in large part, to investing in co-generation. Co-generation, also known as combined heat and power (CHP), uses the steam produced from a boiler to both generate electricity and heat the building, thus making more efficient use of fuel. BPS has deployed 29 state-of-the-art co-generation units on 19 school campuses.
BPS closed six facilities in 2012, which contributed to a decline in electricity use for that year. However, BPS opened ten schools for FY 2013, which is expected to increase BPS energy use.

Public Works' Streetlight Replacement Program

In 2010, the Department of Public Works began replacing old mercury-vapor and high-pressure-sodium streetlight fixtures with light-emitting diodes (LEDs), an energy-saving technology that also has a much longer lifespan and provides brighter and higher quality light. At the end of 2012, about 25,000 streetlights had been replaced. These actions are saving the City and taxpayers nearly $2.8 million a year in electricity costs.

Library Lighting and Efficiency Upgrades

The Boston Public Library replaced T12 fluorescent lighting fixtures with more efficient lighting fixtures. They also installed variable frequency drives, so that ventilation systems can run at slower rates, when appropriate. One of the largest reductions in energy use out of any individual building was achieved in the Boston Public Library's Copley Branch (see below).

Boston Public Health Commission Fuel Switching/HVAC Upgrade

The Boston Public Health Commission (BPHC) reduced emissions because of a major heat system retrofit at their Long Island facility. The Long Island facility switched from fuel oil to a high-efficiency natural gas system. BPHC is also monitoring outside temperatures to determine better times to switch heating systems on or off.

Steam Fuel Switching

Greenhouse gases from steam generation have dropped by about 55 percent. This drop is primarily because of fuel switching and co-generation. Many steam providers have switched from burning oil to burning natural gas to generate steam, which has resulted in a lower carbon footprint. Increased co-generation, as described above to generate both electricity and steam, is lowering the amount of greenhouse gases from the use of steam.

Energy Efficiency Projects

This year, the City of Boston began implementing an Enterprise Energy Management System (EEMS) for managing and understanding energy use through all municipal properties. The EEMS will allow the City to follow energy use and trends in detail, which will help identify the best opportunities for energy efficiency and saving taxpayer dollars. Some recent notable projects include:

Boston Public Library Copley

Boston Public Library installed a new Building Management System (BMS) to control the Library's air-conditioning system. This BMS is connected to an outdoor thermostat that determines the best time to turn the air-conditioning on and off. Previously, the facility always turned on at 6 AM regardless of the temperature outside. This energy conservation measure will save the City approximately 330,000-kilowatt hours and $50,000 in annual energy expenses.

The Library also installed automatic, motion-detecting light controls in its several floors of private books stacks, which have no natural lighting. Previously, these lights were often left on. This measure is saving the City approximately 136,000-kilowatt hours and $20,000 every year.

Boston City Hall

Property Management replaced old air conditioning motors at City Hall with energy efficient motors and installed variable frequency drives that control the fan speed based on air-flow and ventilation needs.

In 2009, Property Management also replaced City Hall's aging hot and cold-water circulation systems with a digitally controlled system. In addition, the controls for dampers that allow fresh air into the building and exhaust stale air out were replaced with a digitally controlled system. With digital controls, these systems can be optimized to turn on and off as necessary, as opposed to being on a fixed schedule. These combined measures are expected to save the City over 2,500,000 kilowatt-hours and $381,000 in annual energy expenses.

City Central Fleet Maintenance Garage at 400 Frontage Road

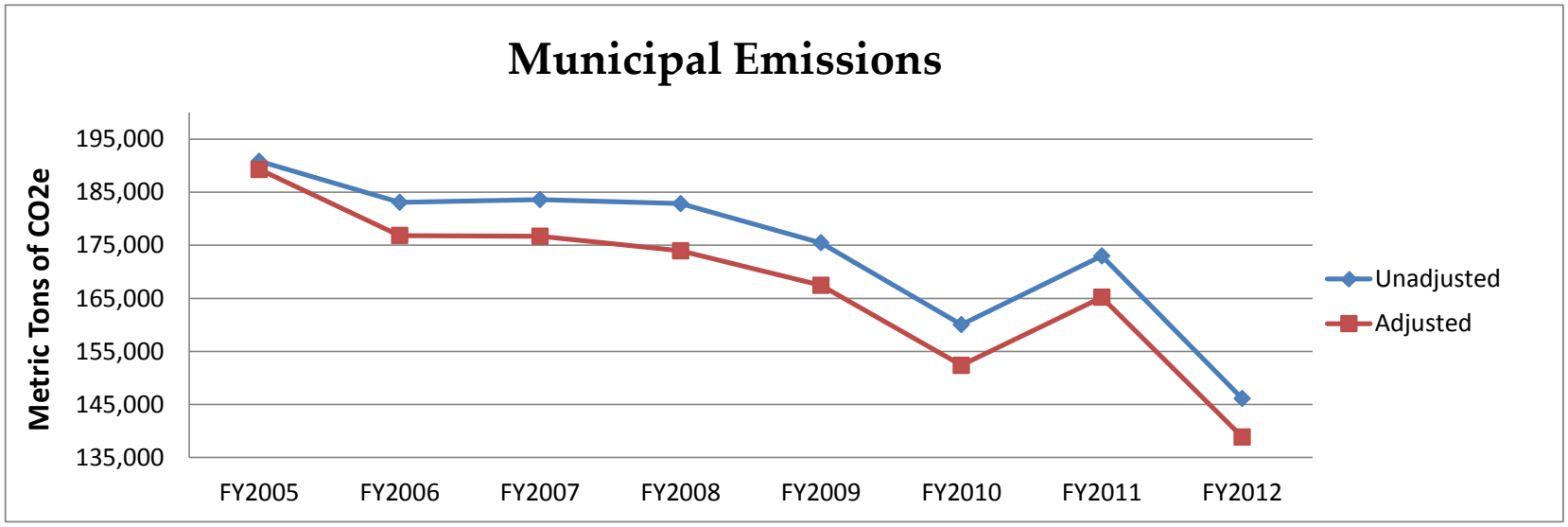
Public Works replaced an aging building management system (BMS) that controlled the HVAC system with a sophisticated, web-based system. This gives the facility manager remote access to observe the health and operation of the building's mechanical systems. Managers can now diagnose alerts and maintenance calls from any Internet connection before sending out maintenance personnel on potentially false calls.

Concurrent with new BMS implementation, three other energy conservation measures were also installed. Highly efficient recirculation hot water pumps and variable frequency drives were replaced on the building heating system. Twenty-four exhaust fans were rewired to operate in sequence with one another. Each new device was connected to the BMS, which will save the City approximately 350,000-kilowatt hours and 36,000 therms annually. The City will now save over $100,000 annually in energy expenses from these four energy conservation measures.

City of Boston Municipal Greenhouse Gas Emissions Summary

(Metric tons of CO2 equivalent)

	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
Electricity	88,476	83,510	82,093	84,644	78,002	70,346	67,609	56,884
Natural gas	53,239	51,641	54,520	53,536	53,578	49,155	63,562	48,727
Diesel	19,439	19,123	20,531	20,533	21,319	19,499	20,601	20,250
Gasoline	13,679	14,143	14,788	14,503	13,745	13,416	12,608	12,647
Light fuel oil	6,806	6,649	5,398	4,331	4,352	3,835	4,149	3,520
Steam	8,931	7,838	6,108	5,150	4,340	3,663	4,340	3,971
Propane	279	208	180	155	143	141	135	131
Unadjusted Emissions	190,847	183,112	183,617	182,852	175,479	160,054	173,006	146,130
Adjustments	1,549	6,273	6,906	8,893	8,022	7,666	7,804	7,290
Adjusted Emissions	189,298	176,839	176,711	173,959	167,457	152,388	165,202	138,841



FY2012 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

Scope 1 And 2 Departments	SCOPE 1 Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	SCOPE 2 Electricity	Steam	Total Dept. CO2e	% of Total	% change from last year
Arts, Tourism, & Events	185	-	4	-	209	-	398	0%	-15%
Boston Public Schools	31,302	48	333	14,349	14,870	-	60,902	41%	-15%
Center for Youth and Families	2,029	-	76	6	1,253	-	3,365	2%	-25%
Fire	1,750	210	195	2,013	1,936	-	6,104	4%	-17%
Inspectional Services	-	-	126	7	240	-	373	0%	8%
Library	621	-	43	4	4,556	2,973	8,198	6%	-7%
Neighborhood Development	164	12	18	-	57	-	251	0%	-41%
Parks and Recreation	311	239	597	661	1,236	-	3,044	2%	-5%
Police	2,200	230	7,906	48	4,081	-	14,465	10%	-3%
Property & Construction Mgmt	1,108	112	200	38	5,330	998	7,786	5%	-21%
Public Works	1,555	109	1,225	1,072	1,323	-	5,284	4%	-16%
Public Works - Streetlights	4,401	-	-	-	17,775	-	22,176	16%	-22%
Transportation	143	5	864	332	252	-	1,597	2%	-9%
Emergency Medical Services	197	-	198	1,086	174	-	1,656	1%	-3%
Public Health Commission	2,110	2,554	255	23	2,972	-	7,915	5%	-11%
Water and Sewer Commission	782	-	606	610	619	-	2,616	2%	-37%
Subtotal	48,858	3,520	12,647	20,250	56,884	3,971	146,130	100%	-16%

ADJUSTMENTS and TOTALS

Scope 1 Total	85,275
Scope 1 Adjustments	112
Scope 1 Adjusted Total	**85,163**
Scope 2 Total	60,855
Scope 2 Adjustments	7,177
Scope 2 Adjusted Total	**53,678**
Scope 1+2 ADJUSTED TOTAL	**138,841**

GHGs by Sector*	CO2e	%
Buildings	91,057	62%
Transportation	32,897	23%
Streetlights	22,176	15%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	56,884	39%
Natural gas	48,727	33%
Diesel	20,250	14%
Gasoline	12,647	9%
Light Fuel Oil	3,520	2%
Steam	3,971	3%
Propane	131	0%

*unadjusted

FY2011 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 and 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Arts, Tourism, & Events	265	-	6	-	198	-	469	0%
Boston Public Schools	40,628	70	309	14,502	16,466	-	71,974	42%
Center for Youth and Families	2,909	-	104	14	1,431	-	4,457	3%
Fire	2,604	227	316	2,079	2,155	-	7,382	4%
Graphic Arts	-	-	-	-	-	-	-	0%
Inspectional Services	-	-	131	5	210	-	345	0%
Library	980	-	38	-	4,892	2,885	8,795	5%
Neighborhood Development	237	82	29	-	76	-	423	0%
Parks and Recreation	393	287	477	626	1,430	-	3,212	2%
Police	2,763	287	7,532	35	4,245	-	14,862	9%
Property & Construction Mgmt	2,025	177	230	41	5,897	1,455	9,825	6%
Public Works	2,131	132	1,318	1,274	1,447	-	6,301	4%
Public Works - Streetlights	4,402	-	-	-	24,083	-	28,484	16%
Transportation	227	13	932	302	277	-	1,750	1%
Emergency Medical Services	272	-	219	1,057	163	-	1,711	1%
Public Health Commission	2,591	2,876	296	23	3,103	-	8,890	5%
Water and Sewer Commission	1,271	-	673	643	1,537	-	4,124	2%
Subtotal	63,698	4,149	12,608	20,601	67,609	4,340	173,006	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	101,057
Scope 1 Adjustments	102
Scope 1 Adjusted Total	**100,955**
Scope 2 Total	71,949
Scope 2 Adjustments	7,701
Scope 2 Adjusted Total	**64,248**
Scope 1+2 ADJUSTED TOTAL	**165,202**

GHGs by Sector*	**CO2e**	**%**
Buildings	111,311	64%
Transportation	33,210	19%
Streetlights	28,484	16%

*unadjusted

GHGs by Fuel*	**CO2e**	**% of Total**
Electricity	67,609	39%
Natural gas	63,562	37%
Diesel	20,601	12%
Gasoline	12,608	7%
Light Fuel Oil	4,149	2%
Steam	4,340	3%
Propane	135	0%

*unadjusted

FY2010 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Arts, Tourism, & Events	217	-	4	-	172	-	394	0%
Boston Public Schools	30,929	39	316	13,628	17,562	-	62,475	39%
Center for Youth and Families	2,502	-	103	4	1,494	-	4,104	3%
Fire	1,844	193	648	2,000	2,164	-	6,850	4%
Graphic Arts	172	-	-	-	74	-	246	0%
Inspectional Services	-	-	121	11	215	-	347	0%
Library	947	-	28	-	5,521	2,611	9,107	6%
Neighborhood Development	127	-	27	-	55	-	209	0%
Parks and Recreation	323	238	480	689	1,535	-	3,265	2%
Police	2,155	337	7,893	41	4,339	-	14,766	9%
Property & Construction Mgmt	597	175	241	41	5,295	1,052	7,402	5%
Public Works	1,772	122	1,319	1,085	1,711	-	6,009	4%
Public Works - Streetlights	4,401	-	-	-	25,459	-	29,861	19%
Transportation	170	8	1,006	287	277	-	1,749	1%
Emergency Medical Services	233	-	219	963	199	-	1,615	1%
Public Health Commission	2,244	2,721	309	16	2,581	-	7,871	5%
Water and Sewer Commission	662	-	700	734	1,690	-	3,785	2%
Subtotal	49,296	3,835	13,416	19,499	70,346	3,663	160,054	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	86,045
Scope 1 Adjustments	49
Scope 1 Adjusted Total	**85,996**
Scope 2 Total	74,009
Scope 2 Adjustments	7,617
Scope 2 Adjusted Total	**66,392**
Scope 1+2 ADJUSTED TOTAL	**152,388**

GHGs by Sector*	CO2e	%
Buildings	97,278	61%
Transportation	32,915	21%
Streetlights	29,861	19%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	70,346	44%
Natural gas	49,155	31%
Diesel	19,499	12%
Gasoline	13,416	8%
Light Fuel Oil	3,835	2%
Steam	3,663	2%
Propane	141	0%

*unadjusted

FY2009 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Arts, Tourism, & Events	233	-	5	-	170.5536	-	409	0%
Boston Public Schools	33,075	38	322	14,727	20,845	-	69,006	39%
Center for Youth and Families	2,595	-	103	4	1,589	-	4,289	2%
Fire	2,661	254	688	1,954	2,182	-	7,738	4%
Graphic Arts	193	-	5	-	72	-	270	0%
Inspectional Services	-	-	130	14	227	-	370	0%
Library	896	48	48	-	6,471	2,850	10,314	6%
Neighborhood Development	-	-	28	-	39	-	67	0%
Parks and Recreation	357	274	503	624	1,522	-	3,280	2%
Police	2,341	388	7,982	41	4,509	-	15,260	9%
Property & Construction Mgmt	698	234	245	38	6,555	1,490	9,260	5%
Public Works	1,909	142	1,434	1,833	1,586	-	6,904	4%
Public Works - Streetlights	4,404	-	-	-	26,598	-	31,003	18%
Transportation	190	13	989	334	210	-	1,735	1%
Emergency Medical Services	259	-	325	850	206	-	1,639	1%
Public Health Commission	3,026	2,960	262	89	3,153	-	9,489	5%
Water and Sewer Commission	887	-	677	813	2,069	-	4,446	3%
Subtotal	53,722	4,352	13,745	21,319	78,002	4,340	175,479	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	93,138
Scope 1 Adjustments	125
Scope 1 Adjusted Total	**93,013**
Scope 2 Total	82,342
Scope 2 Adjustments	7,897
Scope 2 Adjusted Total	**74,445**
Scope 1+2 ADJUSTED TOTAL	**167,457**

GHGs by Sector*	CO2e	%
Buildings	109,412	62%
Transportation	35,064	20%
Streetlights	31,003	18%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	78,002	44%
Natural gas	53,578	31%
Diesel	21,319	12%
Gasoline	13,745	8%
Light Fuel Oil	4,352	2%
Steam	4,340	2%
Propane	143	0%

*unadjusted

SCOPE 3	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Subtotal**
Boston Housing Authority	56,688	8,397	-	-	37,596	-	102,681
MWRA (Boston share)	912	3,238	337	350	20,585	-	25,422

FY2008 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Arts, Tourism, & Events	-	-	4	-	127.9152	-	132	0%
Boston Public Schools	33,521	44	334	14,737	24,368	-	73,003	40%
Center for Youth and Families	2,580	-	114	1	1,573	-	4,268	2%
Fire	2,802	207	770	1,954	2,293	-	8,027	4%
Graphic Arts	212	-	5	-	82	-	299	0%
Inspectional Services	-	-	154	10	247	-	411	0%
Library	912	179	51	-	7,408	3,400	11,950	7%
Neighborhood Development	-	-	30	-	39	-	69	0%
Parks and Recreation	363	227	498	561	1,639	-	3,288	2%
Police	2,224	347	8,422	49	4,599	-	15,641	9%
Property & Construction Mgmt	679	160	277	31	7,116	1,750	10,013	5%
Public Works	1,966	117	1,537	1,203	1,707	-	6,530	4%
Public Works - Streetlights	4,404	-	-	-	27,718	-	32,122	18%
Transportation	164	14	971	329	269	-	1,746	1%
Emergency Medical Services	251	-	349	734	206	-	1,540	1%
Public Health Commission	2,965	3,037	278	112	3,325	-	9,716	5%
Water and Sewer Commission	647	-	709	813	1,927	-	4,096	2%
Subtotal	53,691	4,331	14,503	20,533	84,644	5,150	182,852	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	93,058
Scope 1 Adjustments	116
Scope 1 Adjusted Total	**92,942**
Scope 2 Total	89,794
Scope 2 Adjustments	8,777
Scope 2 Adjusted Total	**81,017**
Scope 1+2 ADJUSTED TOTAL	**173,959**

GHGs by Sector*	CO2e	%
Buildings	115,694	63%
Transportation	35,036	19%
Streetlights	32,122	18%

*unadjusted

53535.69

GHGs by Fuel*	CO2e	% of Total
Electricity	84,644	46%
Natural gas	53,536	29%
Diesel	20,533	11%
Gasoline	14,503	8%
Light Fuel Oil	4,331	2%
Steam	5,150	3%
Propane	155	0%

*unadjusted

SCOPE 3	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Subtotal**
Boston Housing Authority	53,609	8,674	-	-	39,352	-	101,635
MWRA (Boston share)	763	2,097	334	344	23,451	-	26,988

FY2007 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Arts, Tourism, & Events	-	-	-	-	184	-	184	0%
Boston Public Schools	35,315	-	296	14,585	23,707	-	73,903	40%
Center for Youth and Families	2,263	-	-	-	1,395	-	3,659	2%
Fire	2,701	192	795	2,074	2,190	-	7,952	4%
Graphic Arts	189	-	-	-	76	-	265	0%
Inspectional Services	-	-	-	-	154	-	154	0%
Library	872	206	54	-	7,209	4,463	12,804	7%
Neighborhood Development	-	-	-	-	49	-	49	0%
Parks and Recreation	377	169	377	474	1,647	-	3,045	2%
Police	1,969	373	7,866	-	4,248	-	14,455	8%
Property & Construction Mgmt	585	397	-	-	6,718	1,645	9,345	5%
Public Works	1,965	127	4,374	1,856	1,760	-	10,082	5%
Public Works - Streetlights	4,404	-	-	-	26,919	-	31,324	17%
Transportation	169	64	-	-	234	-	466	0%
Emergency Medical Services	222	-	288	683	187	-	1,380	1%
Public Health Commission	3,015	3,870	-	-	3,334	-	10,219	6%
Water and Sewer Commission	653	-	738	858	2,082	-	4,331	2%
Subtotal	54,700	5,398	14,788	20,531	82,093	6,108	183,617	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	95,416
Scope 1 Adjustments	111
Scope 1 Adjusted Total	**95,305**
Scope 2 Total	88,201
Scope 2 Adjustments	6,795
Scope 2 Adjusted Total	**81,406**
Scope 1+2 ADJUSTED TOTAL	**176,711**

GHGs by Sector*	CO2e	%
Buildings	116,975	64%
Transportation	35,319	19%
Streetlights	31,324	17%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	82,093	45%
Natural gas	54,520	30%
Diesel	20,531	11%
Gasoline	14,788	8%
Light fuel oil	5,398	3%
Steam	6,108	3%
Propane	180	0%

*unadjusted

SCOPE 3	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Subtotal**
Boston Housing Authority	54,928	8,760	-	-	38,010	-	101,698
MWRA (Boston share)	903	5,186	282	333	23,422	-	30,125

FY2006 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Boston Public Schools	32,317	-	195	13,811	23,759	-	70,082	38%
Center for Youth and Families	2,604	-	-	-	2,354	-	4,958	3%
Fire	2,709	210	758	1,578	2,081	-	7,337	4%
Graphic Arts	170	-	-	-	76	-	246	0%
Inspectional Services	-	-	-	-	205	-	205	0%
Library	790	210	54	-	7,564	5,837	14,455	8%
Neighborhood Development	-	-	-	-	44	-	44	0%
Parks and Recreation	423	200	120	507	1,374	-	2,623	1%
Police	2,063	420	7,643	2	4,690	-	14,818	8%
Property & Construction Mgmt	507	403	-	-	7,107	2,001	10,018	5%
Public Works	1,774	137	4,678	1,919	1,458	-	9,966	5%
Public Works Streetlights	4,404	-	-	-	27,191	-	31,595	17%
Transportation	152	81	-	-	247	-	480	0%
Emergency Medical Services	213	-	-	566	124	-	904	0%
Public Health Commission	3,131	4,988	-	-	3,186	-	11,305	6%
Water and Sewer Commission	591	-	695	740	2,049	-	4,076	2%
Subtotal	51,849	6,649	14,143	19,123	83,510	7,838	183,112	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	91,764
Scope 1 Adjustments	28
Scope 1 Adjusted Total	**91,736**
Scope 2 Total	91,348
Scope 2 Adjustments	6,244
Scope 2 Adjusted Total	**85,103**
Scope 1+2 ADJUSTED TOTAL	**176,839**

GHGs by Sector*	CO2e	%
Buildings	118,251	65%
Transportation	33,266	18%
Streetlights	31,595	17%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	83,510	46%
Natural gas	51,641	28%
Diesel	19,123	10%
Gasoline	14,143	8%
Light fuel oil	6,649	4%
Steam	7,838	4%
Propane	208	0%

*unadjusted

SCOPE 3	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Subtotal**
Boston Housing Authority	59,297	9,172	0	0	35,151		103,620
Redevelopment Authority	1,495	70	0	0	132		1,697
MWRA (Boston share)	785	8,167	296	287	22,505		32,039

FY2005 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2			
Scope 1 And 2 Departments	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Total Dept. CO2e**	**% of Total**
Boston Public Schools	33,213	-	195	13,791	27,545	-	74,745	39%
Center for Youth and Families	2,610	-	-	-	1,367	-	3,977	2%
Fire	2,338	532	758	1,599	2,183	-	7,409	4%
Graphic Arts	224	-	-	-	76	-	300	0%
Inspectional Services	-	-	-	-	217	-	217	0%
Library	826	178	54	-	7,316	5,950	14,323	8%
Neighborhood Development	-	-	-	-	113	-	113	0%
Parks and Recreation	555	200	205	523	1,381	-	2,864	2%
Police	2,547	538	7,417	1	4,522	-	15,025	8%
Property & Construction Mgmt	451	450	-	-	7,137	2,981	11,019	6%
Public Works	2,165	140	4,349	2,261	1,521	-	10,436	5%
Public Works Streetlights	4,404	-	-	-	28,728	-	33,133	17%
Transportation	196	40	-	-	308	-	543	0%
Emergency Medical Services	222	-	-	426	152	-	800	0%
Public Health Commission	3,014	4,729	-	-	3,418	-	11,161	6%
Water and Sewer Commission	752	-	700	836	2,491	-	4,780	3%
Subtotal	53,518	6,806	13,679	19,439	88,476	8,931	190,847	100%

ADJUSTMENTS and TOTALS

Scope 1 Total	93,441
Scope 1 Adjustments	0
Scope 1 Adjusted Total	**93,441**
Scope 2 Total	97,407
Scope 2 Adjustments	1,549
Scope 2 Adjusted Total	**95,857**
Scope 1+2 ADJUSTED TOTAL	**189,298**

GHGs by Sector*	CO2e	%
Buildings	124,597	65%
Transportation	33,117	17%
Streetlights	33,133	17%

*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	88,476	46%
Natural gas	53,239	28%
Diesel	19,439	10%
Gasoline	13,679	7%
Light fuel oil	6,806	4%
Steam	8,931	5%
Propane	279	0%

*unadjusted

SCOPE 3	**Nat. Gas**	**Lt. Fuel Oil**	**Gasoline**	**Diesel**	**Electricity**	**Steam**	**Subtotal**
Boston Housing Authority	42,726	6,083	381	20	28,690	631	78,532
Redevelopment Authority	1,796	58	771	710	142	0	3,477
MWRA (Boston share)	731	8,137	311	279	21,795	0	31,253

Notes on
The City of Boston Municipal Greenhouse Gas Inventories
FY2005 to FY2012

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. The City released its first inventories in December 2009. The current report adds fiscal year 2012 (FY12) to the series for municipal operations. It also includes revisions to earlier inventories based on revised data and emission 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 the Office of Climate and Environmental Planning. Please direct any comments or questions about the inventories to Carl Spector, Director, 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 . A new Local Government Operations Protocol for conducting inventories of GHG emissions 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 latest update to the Protocol was in October, 2012. The City of Boston conducts its inventory in general accordance with this protocol, although not in all details. As part of the anticipated 2014 update of its Climate Action Plan, the City is re-evaluating its current inventory methods.

a. Direct and indirect emissions. The protocol categorizes emissions as direct (Scope 1) or indirect (Scope 2). 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 Scope 3, "additional emission sources of potential policy relevance," involves the decision of where to place the emissions of the independent and quasi-independent governmental authorities associated with the City of Boston. These include 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. ISO-NE usually publishes its emission factors about 16 months after the end of the calendar year, and we update already published inventories with the new factors when they are available. The ISO-NE factor only accounts for CO2, so the City adds four pounds of CO_2e/MWh to account for the presence of other greenhouse gases in fossil fuel emissions.

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 some 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 0.01022 metric tons (22.5 lbs) CO_2e 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_2 during plant growth, has net emissions of only 0.00603 metric tons (13.3 lbs) CO_2e per gallon, a 41 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).

b. Renewable Energy Credits (RECs). RECs represent the generation of electricity from renewable energy sources such as wind, solar, and biomass. The City started buying RECs, primarily from Midwestern wind farms, in FY05. 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 MWh; in FY10, 20,171 MWh; in FY11 21,000 MWh; in FY12 21,000 MWh.

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.

Data on fuel oil use for all departments come from the Purchasing Department's list of invoices received for deliveries or from the fuel vendors themselves. Depending on department, data on gasoline and diesel fuel for vehicles can come from the department itself, the Public Works Department, or the Purchasing Department. Veolia Energy supplies the data on the City's steam consumption as well as an annual emission factor, based on a changing mix of fuels and guidance from the U.S. Energy Information Administration. The annual inventories include some changes from year to year in department names and some consolidation of accounts. For example, starting in FY11, electricity usage by the Graphic Arts Department was counted under Property and Construction Management. The municipal inventories do not include GHGs associated with official airplane travel nor with employee commuting.

7. *Streetlights*. The City has over 66,000 streetlights including unmetered natural gas streetlights and both metered and unmetered electric streetlights. The bills that the City receives for energy use are based on either actual metered usage or on estimates by the utilities based on size of pipe, number of hours of darkness, and so on. The City has embarked on an LED electric streetlight replacement project that is greatly improving the energy efficiency of the streetlight system, and the unmetered electric streetlights have been prioritized. Based on the energy savings from the LED streetlights, the electricity usage for the unmetered lights is estimated to have been cut in half. The City is also piloting photo-sensitive controls on its natural gas streetlights.

8. *Boston Public Health Commission.* The BPHC uses propane at one of their facilities. Since 2005 the amount used has dropped steadily. This translates to around 135 metric tons of CO_2e. , Since this amount is so small and no other departments use propane, it is accounted for in the natural gas column of the inventory.

9. *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. Data from the BRA and the BHA are not available for all inventory years.

10. *Revisions.* ISO-NE released the electricity emission factor for 2011, so the FY11 inventory was updated to reflect the new factor.

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. *Baseline.* In previous years, the City used a rough average of emissions from FY00 and FY05-07, considered to be a very rough estimate of the City's FY1990 emissions, as the baseline against which to measure reductions. Starting with this inventory, we are now using FY05 alone as the baseline, for analytical and narrative simplicity. This is the same standard that we use for the Boston community inventory, which uses calendar year 2005 as the baseline. FY05 is the first year in our series of consecutive annual inventories. Because FY05 emissions are above the previously used average, its use as a baseline adds a couple of percent to the calculated reductions through FY12.

October 25, 2013