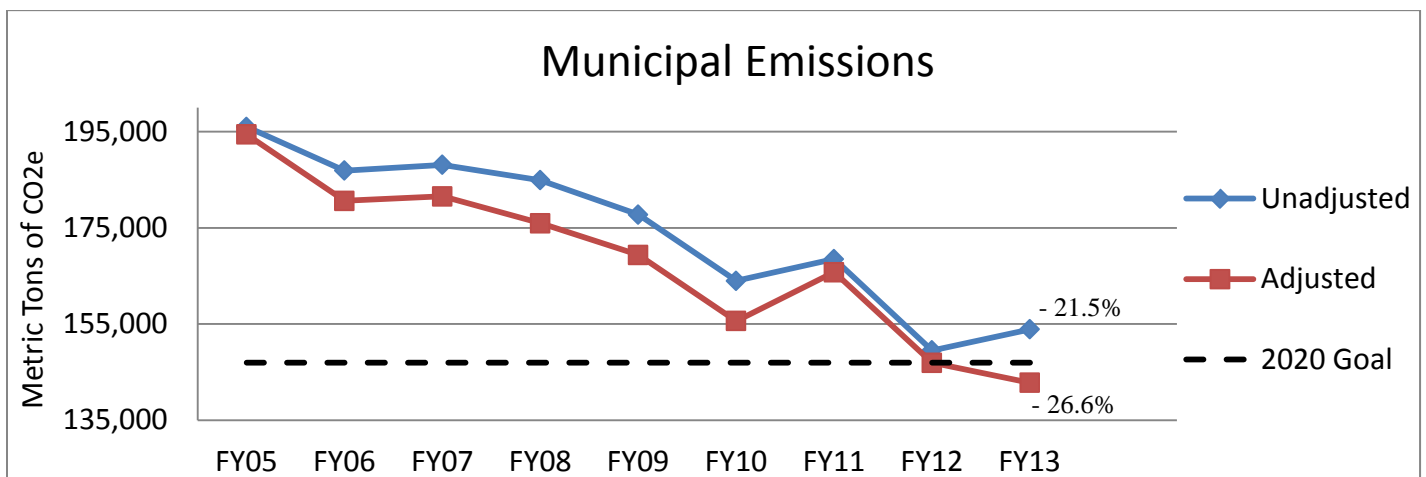


## City of Boston Municipal Greenhouse Gas Inventory Fiscal Years 2005-2013

### Overview

In fiscal year 2013 (FY13), the greenhouse gas (GHG) emissions from municipal facilities and operations of the City of Boston fell to 143 thousand metric tons. This represented an almost three-percent decline from FY12, a reduction of about four thousand metric tons, equivalent to the emissions from about 800 Boston homes.

This reduction brought the total reductions from the City's FY05 baseline to 26.6 percent. In 2011, then-Mayor Thomas M. Menino set a goal of reducing emissions from municipal operations 25 percent by 2020, which has now been achieved. The City has a long-term goal, reaffirmed by Mayor Martin J. Walsh, of reducing its own greenhouse gas emissions 80 percent by 2050.

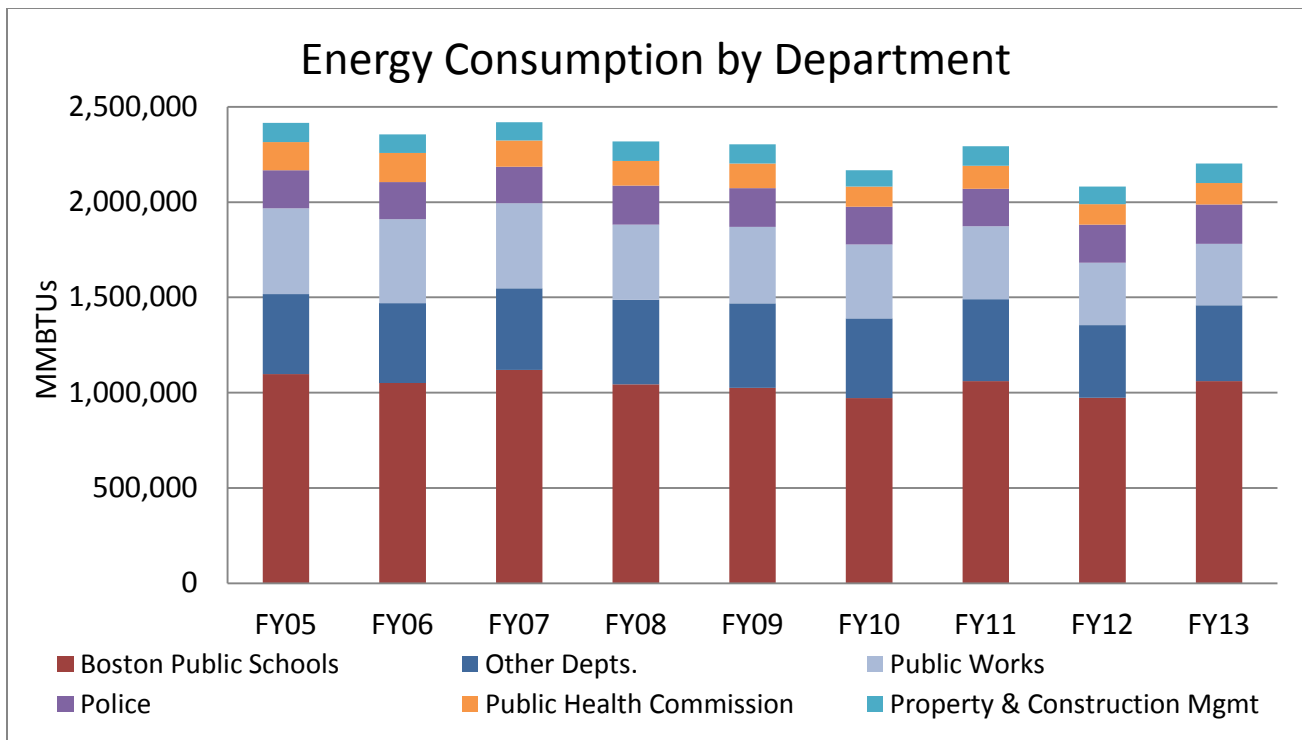


Note: Adjusted emissions include reductions for the purchase of biodiesel and Renewable Energy Credits. See Appendix 3.

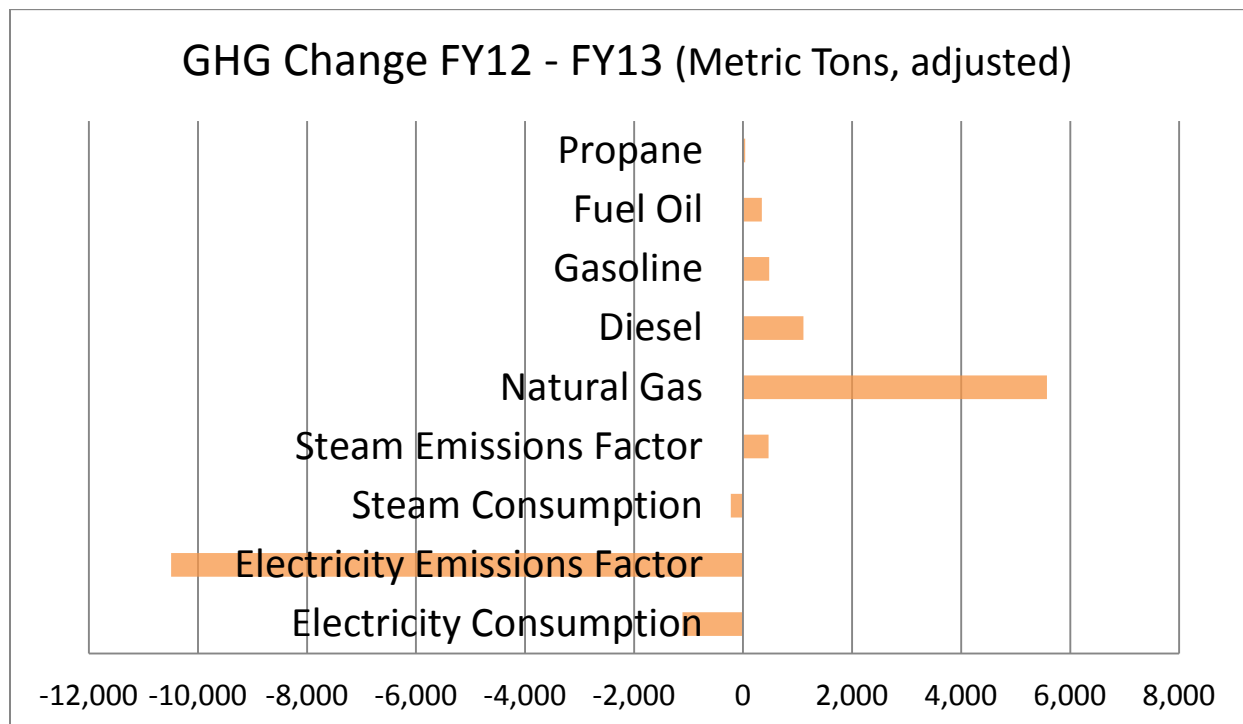
### Weather and Electricity

Two factors accounted for most of the change in GHG emissions from FY12 to FY13: a colder winter and a decrease in GHGs associated with the production of electricity.

The City of Boston used about 2.7 percent more total energy in FY13 than in FY12. As measured by the number of heating degree-days, the winter of 2012-2013 was about 20 percent colder than the unusually warm winter of 2011-2012. (However, the winter of 2012-2013 was still warmer than what is considered "normal" for Boston.) If not balanced by reductions elsewhere, the colder conditions would have caused a rise in energy use of about six percent and a similar rise in GHG emissions.

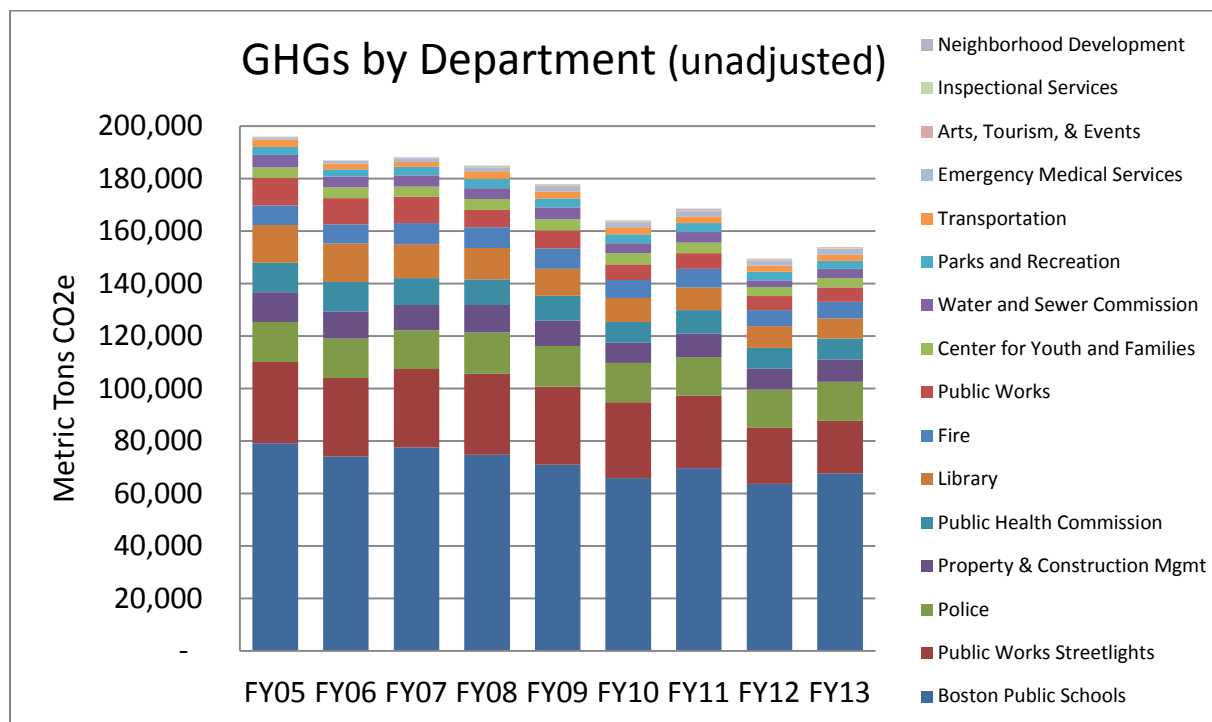


The rise in GHGs from energy use was more than compensated for by the decrease in GHGs associated with the production and use of electricity. The City's emissions from electricity decreased for two reasons. First, the amount of oil and coal used to produce electricity throughout New England continued to fall. Second, the City substantially increased its purchase of Renewable Energy Credits (RECs), which represent electricity produced with essentially zero GHG emissions. These two components combined (as in the bar labeled Electricity Emissions Factor in the figure below) to make the largest contribution in the FY12-FY13 change.



## GHGs by Department - Major Projects

GHG emissions vary enormously by department. Furthermore, weather can have substantially different effects on departmental operations. Boston Public Schools contributes about 44 percent of the City's total emissions, followed by the Streetlights Division of Public Works at 13 percent.



Notwithstanding the jump in energy use in FY13, the City continues to make significant progress in increasing the energy efficiency of its facilities and operations.

### Enterprise Energy Management System

The City began implementing an Enterprise Energy Management System (EEMS) during FY13. Now in operation, the EEMS will allow the City to monitor energy use in all of its assets—which include 321 buildings, 64,000 streetlights, 850 signalized intersections, 272 parks, playgrounds, athletic fields, pedestrian and traffic bridges, and its vehicle fleet—and identify the best opportunities for energy efficiency projects that reduce energy consumption and greenhouse gases, and also save taxpayer dollars.

### Boston Public Library

The Boston Public Library completed energy efficiency projects in 13 of its branches during FY13, including the installation of building management systems and efficient lighting. These projects are expected to save the Library Department approximately 650 Megawatt hours (MWh) of electricity annually, equivalent to about 230 metric tons CO<sub>2</sub>e.

### Department of Public Works

In 2010, the Department of Public Works began replacing the City's 64,000 mercury vapor and sodium vapor street lights with more efficient light-emitting diode (LED) fixtures. Public Works installed about 7,300 LED fixtures during FY13, reducing annual electricity use by about 5,400 MWh (1,771 metric tons CO<sub>2</sub>e in FY13). In FY14, the City installed approximately 8,750 LED fixtures. To date, more than 39,000 LED streetlights have been installed, including retrofits completed during the first quarter of FY15.

### Boston Public School Department

During FY13, the Boston Public Schools completed 15 energy efficiency projects in eight buildings. These ranged from the installation of efficient lighting and lighting controls to the installation of steam traps. Those projects will save 447 MWh and over 20,000 therms of natural gas annually (253 metric tons CO<sub>2</sub>e).

### Additional Energy Efficiency Projects

In addition to the projects described above, the Fire, Property Construction and Management, and Public Works Departments completed projects during FY13 in City Hall, the Central Maintenance Facility, the Strand Theater, and the Engine 7 fire house in the Back Bay. These projects yielded an additional 371 MWh in annual electricity savings (122 metric tons CO<sub>2</sub>e).

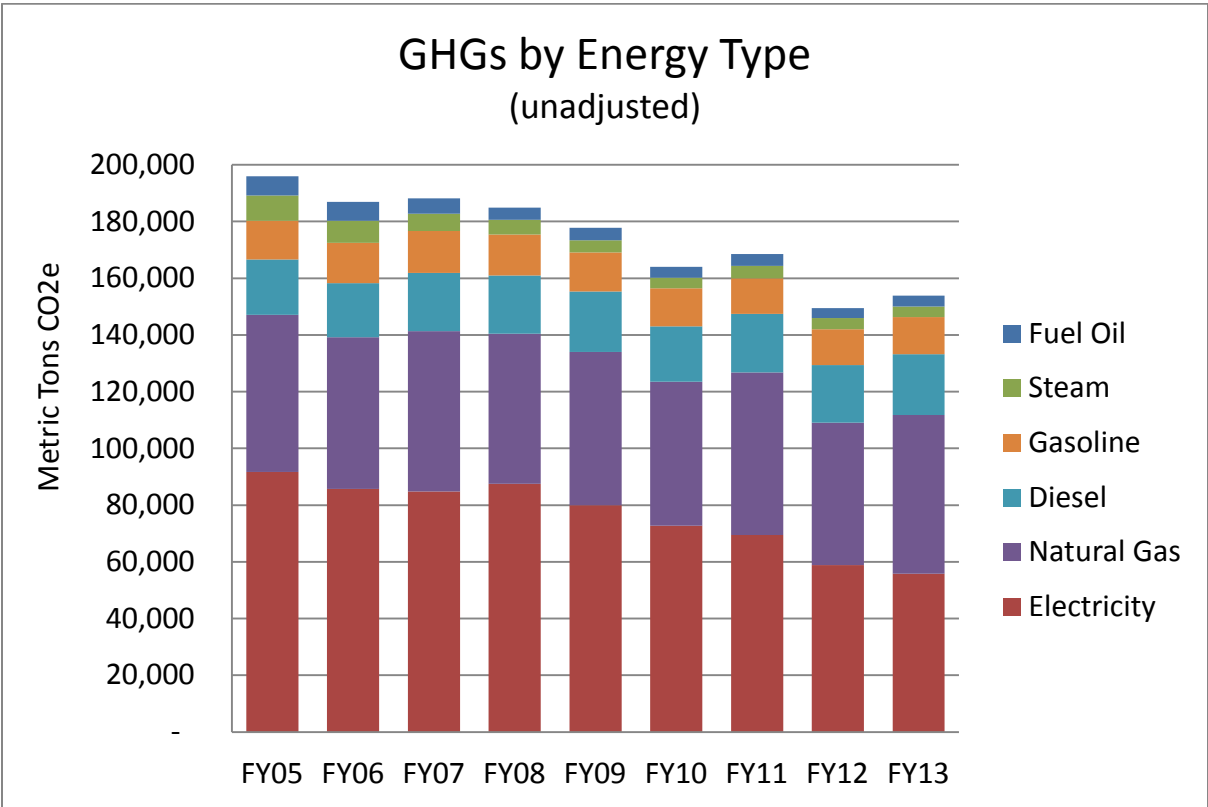
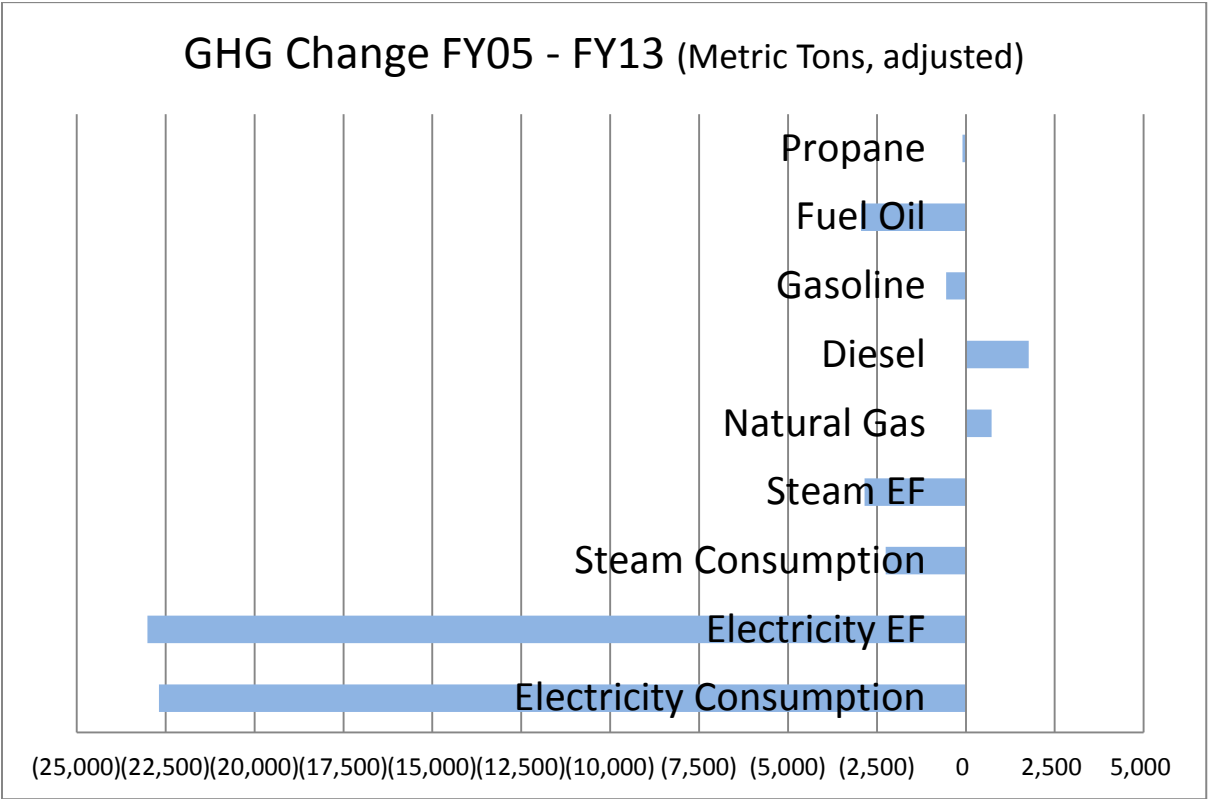
### Renewable Energy Projects and Renewable Energy Credits

During FY13, the City commissioned two large solar photovoltaic (PV) arrays on City facilities: the City Archives building in West Roxbury, and the Central Fleet Maintenance facility in South Boston. During FY13, they together produced about 139 MWh of electricity. The City also has six smaller PV arrays sited on City schools. The PV arrays reduce the City's GHG emissions in two ways. First, they reduce the amount of electricity that the City needs to buy from external, GHG-emitting sources. Second, because the solar renewable energy credits (SRECs) associated with this electricity are valuable in Massachusetts, the City sells some of its SRECs to buy a much larger amount of less expensive wind renewable energy credits (RECs) that are produced by facilities in other parts of the country.

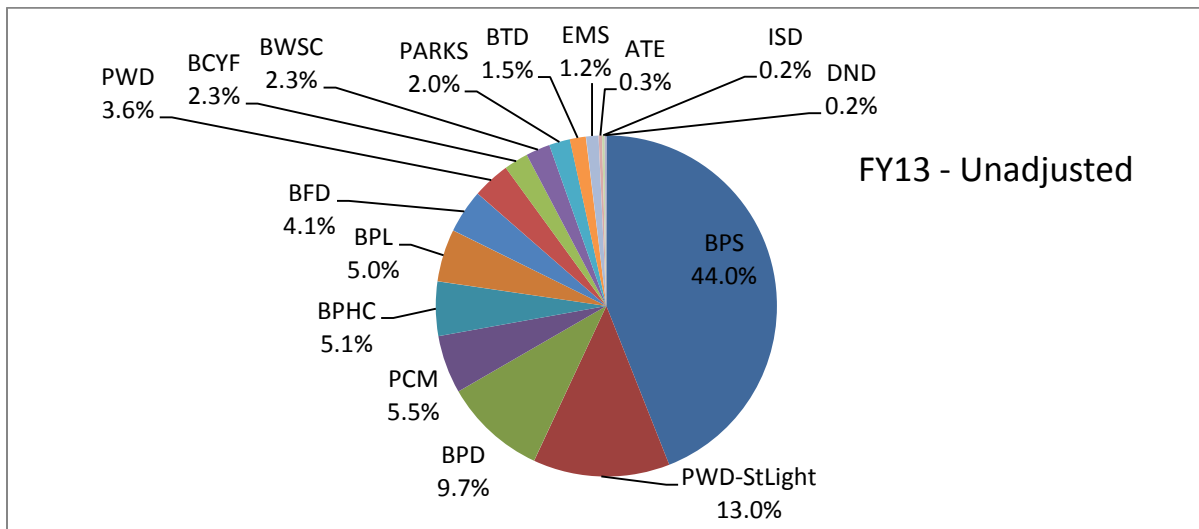
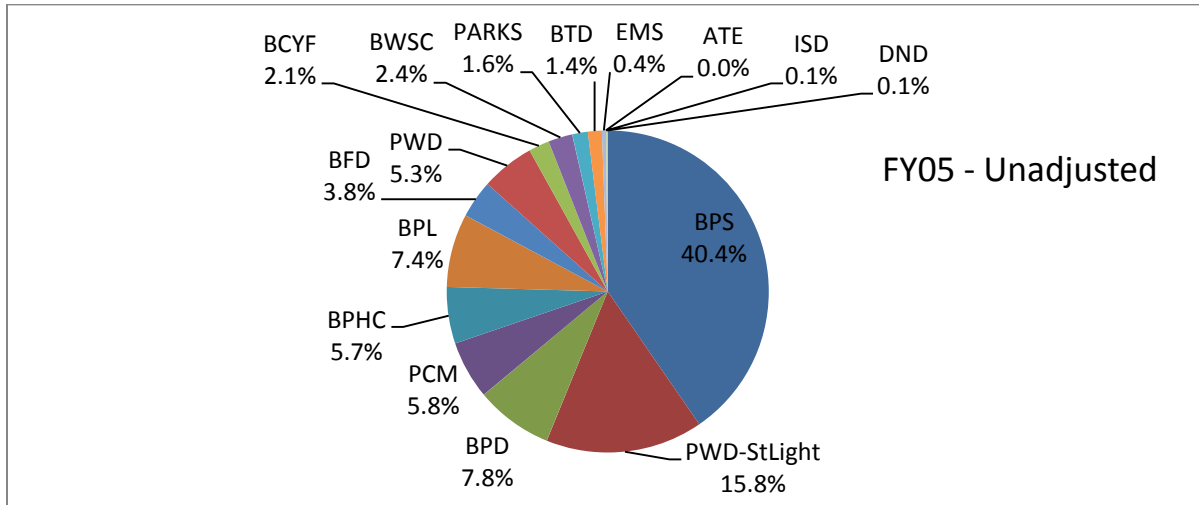
For more information:

- A report on energy use by individual municipal facilities, as required by the City's Building Energy Reporting and Disclosure Ordinance (BERDO), can be found at: <http://www.cityofboston.gov/eeos/reporting/default.asp>

Appendix 1: Supplemental Graphs



# Departmental Shares of Municipal Emissions



## Key:

Arts, Tourism and Events	ATE
Boston Public Schools	BPS
Center for Youth and Families	BCYF
Emergency Medical Services	EMS
Fire	BFD
Inspectional Services	ISD
Library	BPL
Neighborhood Development	DND
Parks and Recreation	PARKS

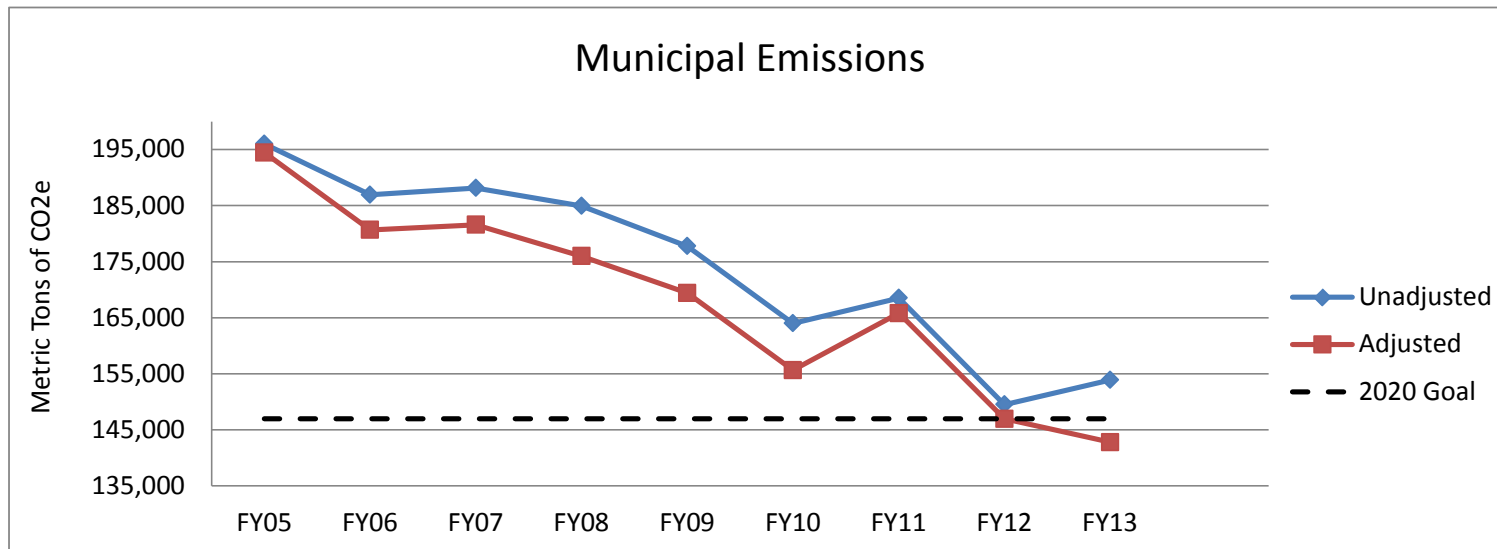
Police Department	BPD
Property & Construction Management	PCM
Public Health Commission	BPHC
Public Works	PWD
Public Works Streetlights	PWD StLight
Transportation	BTD
Water and Sewer Commission	BWSC

## City of Boston Municipal Greenhouse Gas Emissions Summary

(Metric tons of CO2 equivalent)

	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
<b>Electricity</b>	91,729	85,752	84,818	87,548	80,007	72,754	69,433	58,821	55,796
<b>Natural gas</b>	55,143	53,239	56,315	52,716	53,861	50,678	57,246	50,168	55,864
<b>Diesel</b>	19,438	19,123	20,531	20,533	21,319	19,499	20,602	20,250	21,344
<b>Gasoline</b>	13,679	14,143	14,788	14,503	13,744	13,416	12,608	12,647	13,128
<b>Light fuel oil</b>	6,806	6,649	5,398	4,331	4,352	3,835	4,149	3,520	3,862
<b>Steam</b>	8,931	7,838	6,108	5,151	4,340	3,663	4,340	3,971	3,732
<b>Propane</b>	279	191	175	151	140	138	135	131	179

<b>Unadjusted Emissions</b>	196,004	186,935	188,133	184,933	177,763	163,983	168,514	149,508	153,906
<b>Adjustments</b>	1,549	6,285	6,562	8,964	8,377	8,350	2,714	2,549	11,111
<b>Adjusted Emissions</b>	194,455	180,650	181,571	175,969	169,386	155,633	165,800	146,959	142,794



## FY2013 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

	SCOPE 1				SCOPE 2		Total Dept. CO2e	% of Total	% change from last year
<u>Scope 1 And 2 Departments</u>	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam			
Arts, Tourism, & Events	228	-	5	-	260		494	0%	24%
Boston Public Schools	36,710	56	276	14,948	15,713		67,703	44%	6%
Center for Youth and Families	2,129	-	66	11	1,345		3,551	2%	3%
Fire	2,082	246	182	1,997	1,846		6,353	4%	4%
Inspectional Services	-	-	134	11	231		376	0%	1%
Library	812	-	49	-	4,162	2,635	7,658	5%	-8%
Neighborhood Development	198	-	10	-	39		246	0%	-9%
Parks and Recreation	336	251	515	621	1,339		3,062	2%	-4%
Police	2,572	247	8,454	67	3,588		14,929	10%	2%
Property & Construction Mgmt	1,207	156	205	47	5,785	1,097	8,498	6%	8%
Public Works	1,451	130	1,290	1,451	1,148		5,470	4%	4%
Public Works - Streetlights	4,401	-	-	-	15,548		19,949	13%	-7%
Transportation	182	17	856	303	981		2,339	2%	-1%
Emergency Medical Services	226	-	215	1,219	178		1,838	1%	11%
Public Health Commission	2,501	2,759	275	19	2,364		7,918	5%	0%
Water and Sewer Commission	1,007	-	596	650	1,269		3,523	2%	35%
<b>Subtotal</b>	<b>56,043</b>	<b>3,862</b>	<b>13,128</b>	<b>21,344</b>	<b>55,796</b>	<b>3,732</b>	<b>153,906</b>	<b>100%</b>	<b>3%</b>

### ADJUSTMENTS and TOTALS

Scope 1 Total	94,378
Scope 1 Adjustments	144
<b>Scope 1 Adjusted Total</b>	<b>94,234</b>
Scope 2 Total	59,528
Scope 2 Adjustments	10,967
<b>Scope 2 Adjusted Total</b>	<b>48,560</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>142,794</b>

GHGs by Sector*	CO2e	%
Buildings	99,484	65%
Transportation	34,473	22%
Streetlights	19,949	13%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	55,796	36%
Natural gas	55,864	36%
Diesel	21,344	14%
Gasoline	13,128	9%
Light Fuel Oil	3,862	3%
Steam	3,732	2%
Propane	179	0%

\*unadjusted



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

<u>Scope 1 And 2 Departments</u>	SCOPE 1				SCOPE 2		Total Dept. CO2e	% of Total	% change from last year
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam			
Arts, Tourism, & Events	185	-	4		209		398	0%	-6%
Boston Public Schools	32,330	48	333	14,349	16,542		63,602	41%	-9%
Center for Youth and Families	2,099	-	76	6	1,253		3,435	2%	-13%
Fire	1,783	210	195	2,013	1,936		6,137	4%	-13%
Inspectional Services	-	-	126	7	240		373	0%	8%
Library	745	-	43	4	4,556	2,973	8,321	6%	-5%
Neighborhood Development	164	12	18	-	75		269	0%	-40%
Parks and Recreation	311	239	597	661	1,391		3,199	2%	-4%
Police	2,386	230	7,906	48	4,081		14,652	10%	0%
Property & Construction Mgmt	1,108	112	200	38	5,421	998	7,878	5%	-13%
Public Works	1,555	109	1,225	1,072	1,323		5,284	4%	-12%
Public Works - Streetlights	4,401	-	-	-	17,004		21,405	16%	-23%
Transportation	143	5	864	332	1,024		2,369	2%	-8%
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%
<b>Subtotal</b>	50,299	3,520	12,647	20,250	58,821	3,971	149,508	100%	-11%

### ADJUSTMENTS and TOTALS

Scope 1 Total	86,716
Scope 1 Adjustments	156
<b>Scope 1 Adjusted Total</b>	<b>86,560</b>
Scope 2 Total	62,792
Scope 2 Adjustments	2,392
<b>Scope 2 Adjusted Total</b>	<b>60,399</b>

GHGs by Sector*	CO2e	%
Buildings	95,206	64%
Transportation	32,897	22%
Streetlights	21,405	14%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	58,821	39%
Natural gas	50,168	34%
Diesel	20,250	14%
Gasoline	12,647	8%
Light Fuel Oil	3,520	2%
Steam	3,971	3%
Propane	131	0%

\*unadjusted

<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>146,959</b>
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## FY2011 City of Boston Municipal GHG Emissions - in Metric Tons CO2 Equivalent

### SCOPE 1

#### Scope 1 and 2 Departments

	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel
Arts, Tourism, & Events	220	-	6	-
Boston Public Schools	36,754	70	309	14,502
Center for Youth and Families	2,417	-	104	14
Fire	2,243	227	316	2,079
Inspectional Services	-	-	131	5
Library	900	-	38	-
Neighborhood Development	242	82	29	-
Parks and Recreation	350	287	477	626
Police	2,543	287	7,532	35
Property & Construction Mgmt	1,164	177	230	41
Public Works	1,824	132	1,318	1,274
Public Works - Streetlights	4,401	-	-	-
Transportation	190	13	932	302
Emergency Medical Services	272	-	219	1,057
Public Health Commission	2,592	2,876	296	23
Water and Sewer Commission	1,271	-	673	643
<b>Subtotal</b>	<b>57,382</b>	<b>4,149</b>	<b>12,608</b>	<b>20,602</b>

### SCOPE 2

Electricity	Steam	Total Dept. CO2e	% of Total
198	-	425	0%
18,006	-	69,640	41%
1,431	-	3,965	2%
2,155	-	7,021	4%
210	-	345	0%
4,892	2,885	8,715	5%
95	-	448	0%
1,596	-	3,335	2%
4,245	-	14,642	9%
5,995	1,455	9,062	5%
1,447	-	5,994	4%
23,222	-	27,623	16%
1,137	-	2,574	2%
163	-	1,711	1%
3,103	-	8,890	5%
1,537	-	4,124	2%
<b>69,433</b>	<b>4,340</b>	<b>168,514</b>	<b>100%</b>

#### ADJUSTMENTS and TOTALS

Scope 1 Total	94,741
Scope 1 Adjustments	147
<b>Scope 1 Adjusted Total</b>	<b>94,594</b>
Scope 2 Total	73,773
Scope 2 Adjustments	2,567
<b>Scope 2 Adjusted Total</b>	<b>71,205</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>165,800</b>

GHGs by Sector*	CO2e	%
Buildings	107,681	64%
Transportation	33,210	20%
Streetlights	27,623	16%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	69,433	41%
Natural gas	57,246	34%
Diesel	20,602	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		Total Dept. CO2e	% of Total
<u>Scope 1 And 2 Departments</u>	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	217	-	4	-	172	-	394	0%
Boston Public Schools	32,055	39	316	13,628	19,759	-	65,799	40%
Center for Youth and Families	2,567	-	103	4	1,494	-	4,169	3%
Fire	1,876	193	648	2,000	2,083	-	6,800	4%
Graphic Arts	172	-	-	-	74	-	246	0%
Inspectional Services	-	-	121	11	215	-	347	0%
Library	1,051	-	28	-	5,521	2,611	9,212	6%
Neighborhood Development	127	-	27	-	74	-	229	0%
Parks and Recreation	323	238	480	689	1,707	-	3,436	2%
Police	2,351	337	7,893	41	4,339	-	14,962	9%
Property & Construction Mgmt	597	175	241	41	5,397	1,052	7,503	5%
Public Works	1,772	122	1,319	1,085	1,711	-	6,009	4%
Public Works - Streetlights	4,401	-	-	-	24,544	-	28,946	18%
Transportation	170	8	1,006	287	1,193	-	2,664	2%
Emergency Medical Services	233	-	219	963	199	-	1,615	1%
Public Health Commission	2,241	2,721	309	16	2,581	-	7,868	5%
Water and Sewer Commission	662	-	700	734	1,690	-	3,785	2%
<b>Subtotal</b>	50,816	3,835	13,416	19,499	72,754	3,663	163,983	100%

### ADJUSTMENTS and TOTALS

Scope 1 Total	87,566
Scope 1 Adjustments	72
<b>Scope 1 Adjusted Total</b>	<b>87,493</b>
Scope 2 Total	76,417
Scope 2 Adjustments	8,278
<b>Scope 2 Adjusted Total</b>	<b>68,139</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>155,633</b>

GHGs by Sector*	CO2e	%
Buildings	102,122	62%
Transportation	32,915	20%
Streetlights	28,946	18%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	72,754	44%
Natural gas	50,678	31%
Diesel	19,499	12%
Gasoline	13,416	8%
Light Fuel Oil	3,835	2%
Steam	3,663	2%
Propane	138	0%

\*unadjusted

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

	SCOPE 1				SCOPE 2		Total Dept. CO2e % of Total	
<u>Scope 1 And 2 Departments</u>	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	233	-	5	-	165	-	402	0%
Boston Public Schools	33,060	38	322	14,727	22,800	-	70,947	40%
Center for Youth and Families	2,561	-	103	4	1,589	-	4,256	2%
Fire	2,690	254	688	1,954	2,182	-	7,768	4%
Graphic Arts	193	-	5	-	71	-	269	0%
Inspectional Services	-	-	130	14	226	-	370	0%
Library	882	48	48	-	6,471	2,850	10,299	6%
Neighborhood Development	103	-	28	-	59	-	189	0%
Parks and Recreation	376	274	503	624	1,700	-	3,477	2%
Police	2,542	388	7,982	41	4,509	-	15,462	9%
Property & Construction Mgmt	697	234	245	38	6,660	1,490	9,364	5%
Public Works	1,908	142	1,434	1,833	1,586	-	6,903	4%
Public Works - Streetlights	4,401	-	-	-	25,389	-	29,790	17%
Transportation	189	13	989	334	1,172	-	2,696	2%
Emergency Medical Services	259	-	325	850	206	-	1,639	1%
Public Health Commission	3,020	2,960	262	89	3,153	-	9,484	5%
Water and Sewer Commission	887	-	677	813	2,069	-	4,446	3%
<b>Subtotal</b>	<b>54,001</b>	<b>4,352</b>	<b>13,744</b>	<b>21,319</b>	<b>80,007</b>	<b>4,340</b>	<b>177,763</b>	<b>100%</b>

### ADJUSTMENTS and TOTALS

Scope 1 Total	93,416
Scope 1 Adjustments	186
<b>Scope 1 Adjusted Total</b>	<b>93,231</b>
Scope 2 Total	84,346
Scope 2 Adjustments	8,191
<b>Scope 2 Adjusted Total</b>	<b>76,155</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>169,386</b>

GHGs by Sector*	CO2e	%
Buildings	112,908	64%
Transportation	35,064	20%
Streetlights	29,790	17%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	80,007	45%
Natural gas	53,861	30%
Diesel	21,319	12%
Gasoline	13,744	8%
Light Fuel Oil	4,352	2%
Steam	4,340	2%
Propane	140	0%

\*unadjusted

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

	SCOPE 1				SCOPE 2		Total Dept. CO2e % of Total	
<u>Scope 1 And 2 Departments</u>	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	-	-	3	-	127,711	187	131	0%
Boston Public Schools	32,673	44	334	14,737	26,937	-	74,724	40%
Center for Youth and Families	2,540	-	114	1	1,573	-	4,228	2%
Fire	2,768	207	770	1,954	2,294	-	7,993	4%
Graphic Arts	212	-	6	-	82	-	300	0%
Inspectional Services	-	-	154	10	247	-	411	0%
Library	910	179	51	-	7,408	3,400	11,948	6%
Neighborhood Development	-	-	30	-	60	-	90	0%
Parks and Recreation	380	227	498	561	1,845	-	3,511	2%
Police	2,338	347	8,422	49	4,598	-	15,756	9%
Property & Construction Mgmt	668	160	277	31	7,225	1,750	10,111	5%
Public Works	1,956	117	1,537	1,203	1,707	-	6,520	4%
Public Works - Streetlights	4,401	-	-	-	26,514	-	30,915	17%
Transportation	163	14	971	329	1,471	-	2,948	2%
Emergency Medical Services	251	-	349	734	206	-	1,540	1%
Public Health Commission	2,959	3,037	278	112	3,325	-	9,711	5%
Water and Sewer Commission	647	-	709	813	1,927	-	4,096	2%
<b>Subtotal</b>	<b>52,867</b>	<b>4,331</b>	<b>14,503</b>	<b>20,533</b>	<b>87,548</b>	<b>5,151</b>	<b>184,933</b>	<b>100%</b>

### ADJUSTMENTS and TOTALS

Scope 1 Total	92,234
Scope 1 Adjustments	172
<b>Scope 1 Adjusted Total</b>	<b>92,062</b>
Scope 2 Total	92,698
Scope 2 Adjustments	8,792
<b>Scope 2 Adjusted Total</b>	<b>83,907</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>175,969</b>

GHGs by Sector*	CO2e	%
Buildings	118,981	64%
Transportation	35,036	19%
Streetlights	30,915	17%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	87,548	47%
Natural gas	52,716	29%
Diesel	20,533	11%
Gasoline	14,503	8%
Light Fuel Oil	4,331	2%
Steam	5,151	3%
Propane	151	0%

\*unadjusted

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

	SCOPE 1				SCOPE 2		Total Dept. CO2e % of Total	
<u>Scope 1 And 2 Departments</u>	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Arts, Tourism, & Events	-	-	-	-	184	-	184	0%
Boston Public Schools	36,595	-	296	14,585	26,114	-	77,590	41%
Center for Youth and Families	2,435	-	-	-	1,395	-	3,830	2%
Fire	2,727	192	795	2,074	2,190	-	7,978	4%
Graphic Arts	188	-	-	-	77	-	265	0%
Inspectional Services	-	-	-	-	154	-	154	0%
Library	1,002	206	54	-	7,208	4,463	12,933	7%
Neighborhood Development	-	-	-	-	69	-	69	0%
Parks and Recreation	377	169	377	474	1,842	-	3,239	2%
Police	2,165	373	7,866	-	4,247	-	14,652	8%
Property & Construction Mgmt	585	397	-	-	6,822	1,645	9,449	5%
Public Works	1,963	127	4,374	1,856	1,760	-	10,081	5%
Public Works - Streetlights	4,401	-	-	-	25,500	-	29,902	16%
Transportation	169	64	-	-	1,652	-	1,884	1%
Emergency Medical Services	222	-	288	683	187	-	1,380	1%
Public Health Commission	3,008	3,870	-	-	3,334	-	10,212	5%
Water and Sewer Commission	653	-	738	858	2,082	-	4,331	2%
<b>Subtotal</b>	56,490	5,398	14,788	20,531	84,818	6,108	188,133	100%

### ADJUSTMENTS and TOTALS

Scope 1 Total	97,207
Scope 1 Adjustments	165
<b>Scope 1 Adjusted Total</b>	<b>97,042</b>
Scope 2 Total	90,926
Scope 2 Adjustments	6,397
<b>Scope 2 Adjusted Total</b>	<b>84,529</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>181,571</b>

GHGs by Sector*	CO2e	%
Buildings	122,913	65%
Transportation	35,319	19%
Streetlights	29,902	16%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	84,818	45%
Natural gas	56,315	30%
Diesel	20,531	11%
Gasoline	14,788	8%
Light fuel oil	5,398	3%
Steam	6,108	3%
Propane	175	0%

\*unadjusted

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

### SCOPE 1

<u>Scope 1 And 2 Departments</u>	<u>Nat. Gas</u>	<u>Lt. Fuel Oil</u>	<u>Gasoline</u>	<u>Diesel</u>
Boston Public Schools	33,540	-	195	13,811
Center for Youth and Families	2,673	-	-	-
Fire	2,725	210	758	1,578
Graphic Arts	169	-	-	-
Inspectional Services	-	-	-	-
Library	920	210	54	-
Neighborhood Development	-	-	-	-
Parks and Recreation	422	200	120	507
Police	2,230	420	7,643	2
Property & Construction Mgmt	506	403	-	-
Public Works	1,773	137	4,678	1,919
Public Works Streetlights	4,401	-	-	-
Transportation	152	81	-	-
Emergency Medical Services	213	-	-	566
Public Health Commission	3,112	4,988	-	-
Water and Sewer Commission	591	-	695	740
<b>Subtotal</b>	<b>53,430</b>	<b>6,649</b>	<b>14,143</b>	<b>19,123</b>

### SCOPE 2

<u>Electricity</u>	<u>Steam</u>	<u>Total Dept. CO2e</u>	<u>% of Total</u>
26,586	-	74,132	40%
1,447	-	4,120	2%
2,081	-	7,353	4%
76	-	246	0%
205	-	205	0%
7,564	5,837	14,585	8%
65	-	65	0%
1,572	-	2,820	2%
4,690	-	14,986	8%
7,212	2,001	10,122	5%
1,458	-	9,965	5%
25,484	-	29,885	16%
1,954	-	2,187	1%
124	-	904	0%
3,186	-	11,286	6%
2,049	-	4,076	2%
<b>85,752</b>	<b>7,838</b>	<b>186,935</b>	<b>100%</b>

### ADJUSTMENTS and TOTALS

Scope 1 Total	93,345
Scope 1 Adjustments	44
<b>Scope 1 Adjusted Total</b>	<b>93,300</b>
Scope 2 Total	93,590
Scope 2 Adjustments	6,241
<b>Scope 2 Adjusted Total</b>	<b>87,350</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>180,650</b>

<u>GHGs by Sector*</u>	<u>CO2e</u>	<u>%</u>
Buildings	123,784	66%
Transportation	33,266	18%
Streetlights	29,885	16%

\*unadjusted

<u>GHGs by Fuel*</u>	<u>CO2e</u>	<u>% of Total</u>
Electricity	85,752	46%
Natural gas	53,239	28%
Diesel	19,123	10%
Gasoline	14,143	8%
Light fuel oil	6,649	4%
Steam	7,838	4%
Propane	191	0%

\*unadjusted

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

### SCOPE 1

#### Scope 1 And 2 Departments

	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel
Boston Public Schools	34,721	-	195	13,791
Center for Youth and Families	2,711	-	-	-
Fire	2,361	532	758	1,599
Graphic Arts	224	-	-	-
Inspectional Services	-	-	-	-
Library	955	178	54	-
Neighborhood Development	-	-	-	-
Parks and Recreation	554	200	205	523
Police	2,735	538	7,417	-
Property & Construction Mgmt	450	450	-	-
Public Works	2,164	140	4,349	2,261
Public Works Streetlights	4,401	-	-	-
Transportation	196	40	-	-
Emergency Medical Services	222	-	-	426
Public Health Commission	2,975	4,729	-	-
Water and Sewer Commission	752	-	700	836
<b>Subtotal</b>	<b>55,422</b>	<b>6,806</b>	<b>13,679</b>	<b>19,438</b>

### SCOPE 2

	Electricity	Steam	Total Dept. CO2e	% of Total
	30,483	-	79,190	40%
	1,367	-	4,078	2%
	2,183	-	7,433	4%
	76	-	300	0%
	217	-	217	0%
	7,316	5,950	14,453	7%
	135	-	135	0%
	1,566	-	3,049	2%
	4,522	-	15,212	8%
	7,246	2,981	11,127	6%
	1,522	-	10,435	5%
	26,525	-	30,927	16%
	2,510	-	2,746	1%
	151	-	800	0%
	3,418	-	11,122	6%
	2,491	-	4,780	2%
	<b>91,729</b>	<b>8,931</b>	<b>196,004</b>	<b>100%</b>

#### ADJUSTMENTS and TOTALS

Scope 1 Total	95,344
Scope 1 Adjustments	0
<b>Scope 1 Adjusted Total</b>	<b>95,344</b>
Scope 2 Total	100,660
Scope 2 Adjustments	1,549
<b>Scope 2 Adjusted Total</b>	<b>99,111</b>
<b>Scope 1+2 ADJUSTED TOTAL</b>	<b>194,455</b>

GHGs by Sector*	CO2e	%
Buildings	131,961	67%
Transportation	33,117	17%
Streetlights	30,927	16%

\*unadjusted

GHGs by Fuel*	CO2e	% of Total
Electricity	91,729	47%
Natural gas	55,143	28%
Diesel	19,438	10%
Gasoline	13,679	7%
Light fuel oil	6,806	3%
Steam	8,931	5%
Propane	279	0%

\*unadjusted



## Appendix 3

### Notes on The City of Boston Municipal Greenhouse Gas Inventories FY05 to FY13

The City of Boston reports annually on the greenhouse gas (GHG) emissions from municipal operations. The current report adds fiscal year 2013 (FY13) to the series that began with FY05. It also includes revisions to earlier inventories based on new and corrected data, as described in the notes below. GHG 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 Haidee Janak, Program Manager, [haidee.janak@boston.gov](mailto:haidee.janak@boston.gov).

2. *Inventory protocol.* The overall methodology for calculating GHG emissions is based on the ICLEI greenhouse gas reporting protocol for local government operations, developed by ICLEI and the National Association of Clean Air Agencies. This methodology is consistent with the requirements of the Carbon Disclosure Project (see note #11). 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. Under the protocol, emissions that are not under the operational control of the City government or involve leased properties are excluded. Emissions from the Boston Housing Authority, the Massachusetts Water Resources Authority (MWRA), and the Boston Redevelopment Authority (BRA) are not included in the inventory, although those from the Boston Public Health Commission (BPHC) and the Boston Water and Sewer Commission (BWSC) are.

3. *Units.* Greenhouse gases include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and fluorinated gases. Because some gases are more potent than others in increasing the Earth's retention of heat, emissions are measured in units of metric tons of CO<sub>2</sub> equivalent (CO<sub>2</sub>e), that include a conversion based on each gas's Global Warming Potential.

4. *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, which are based on the calendar year.

5. *Electricity emissions factor.* To calculate the GHG emissions associated with electricity use, the City of Boston uses the electricity emissions factor published by ISO-New England (ISO-NE), the regional transmission organization. The ISO-NE electricity emissions factor, based on all electricity-generating units in New England, 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 emissions 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 includes only CO<sub>2</sub>, so the City adds four pounds per MWh to account for the presence of other greenhouse gases in fossil fuel emissions (see note #3).

6. *Adjustments.* The Adjustments section of the inventory lowers the unadjusted total to reflect the City's purchases of a biodiesel blend for its diesel vehicles and of electricity Renewable Energy Credits.

a. *Biodiesel.* In FY06, the City started buying biodiesel, a diesel fuel made from renewable biological materials (for example, soybeans), to replace some of the petroleum-based diesel fuel needed to run its fleet. Initially, B5, a mixture of 95 percent ultra-low-sulfur diesel and 5 percent biodiesel, was used, and the proportion of biodiesel has since risen. In the initial Scope 1 calculation, all the diesel and biodiesel fuels are subject to the same emission factor of 0.01022 metric tons (22.531 lbs) CO<sub>2</sub>e 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 0.00603 metric tons (13.3 lbs) CO<sub>2</sub>e 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). As sources of and production methods for biodiesel change, the biodiesel adjustment factor may change.

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 in FY05, and the sources of those RECs have evolved with the renewable energy market. Because solar RECs produced in Massachusetts are particularly valuable (due to the Commonwealth's Renewable Energy Portfolio requirements), in FY13, the City created a revolving fund that receives the proceeds from selling RECs produced by the City's PV installations and provides those funds for the purchase of much cheaper RECs from other parts of the country. The City expects to expand this fund as it increases its PV installations and to maintain or increase the high level of REC purchases established in FY13.

The Scope 2 adjustments assume that these sources of electricity have zero GHG emissions and that the appropriate adjustment per megawatt-hour (MWh) is calculated the same as for electricity used for that time period. The new inventory includes significant changes to the adjustments for FY11 and FY12, because of an error that led to 21,000 total RECs being purchased for a multiyear contract instead of the desired 21,000 *annual* RECs. The numbers in the table below represent the difference between the number of solar RECs that the City sells and the number of RECs that the City buys.

Fiscal year	RECs (MWh)	Fiscal year	RECs (MWh)
FY05	3,787	FY10	21,921
FY06	15,860	FY11	7,000
FY07	16,390	FY12	7,000
FY08	21,500	FY13	33,250
FY09	20,925		

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 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, the fuel vendors or the Purchasing Department. Veolia Energy supplies the data on the City's steam consumption as well as an annual emissions factor, based on a changing mix of fuels and guidance from the U.S. Energy Information Administration, and the effect from their combined heat and power plant, that produces both steam and electricity. 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.

This year's report includes corrections in electricity and natural gas going back to FY05, and the discovery of two previously unidentified sources of energy consumption. First, it was discovered that natural gas supplied by NStar to municipal facilities in parts of Hyde Park had not previously been included. All other facilities are supplied by National Grid. Second, the review of energy accounts in preparation for implementing a new enterprise energy management system (EEMS) uncovered several accounts that also had not been included in previous totals. These corrections caused increases of no more than four percent in annual GHGs.

Starting in FY15, the City's energy data will be collected in the EEMS, which will ease the burden of data collection, make errors such as these less likely, and increase understanding of the City's energy use and opportunities for energy efficiency.

8. *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 is more than halfway through 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, 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.

9. *Boston Public Health Commission and Boston Water and Sewer Commission.* The BPHC and the BWSC maintain their own accounts of energy use. They transmitted their annual energy purchases to the Environment Department, which performed the GHG calculations. The BPHC uses propane at one of their facilities, and since 2005 the amount used has dropped steadily. This translates to around 135 metric tons of CO<sub>2</sub>e. Since this amount is so small and no other departments use propane, it is accounted for in the natural gas column of the inventory.

10. *Revisions.* For electricity emissions in the second half of FY13 (January-July 2013), calculations are based on a preliminary 2013 factor that was released by ISO-NE in November 2014. The final 2013 figure will probably be released in spring 2015.

11. *Verification and Public Reporting.* The City of Boston municipal inventory has not received third-party verification. In the spring of 2014, the City of Boston joined the C40 Climate Leadership Group, an international network of cities taking climate action. As part of its membership, the City reports its greenhouse gas inventories through the Carbon Disclosure Project, [www.cdp.net](http://www.cdp.net).

12. *Baseline.* For both municipal and community emissions, the City of Boston uses fiscal year 2005 and calendar year 2005, respectively, as the baselines for calculating changes in emissions. Based on historical analyses conducted by the Commonwealth of Massachusetts, we think that the FY05/CY05 levels of emissions are roughly similar to 1990 levels, which are cited as baselines in earlier reports and policy documents.

November 12, 2014