

City of Boston
Climate Action Plan
April 20, 2011

Boston Community Greenhouse Gas Inventories

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Boston Community Greenhouse Gas Inventory
tons eCO₂

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>
Residential	1,480,000	1,310,000	1,450,000	1,460,000	1,390,000
Commercial/Industrial	4,490,000	4,100,000	4,480,000	4,430,000	4,130,000
Transportation	2,340,000	2,330,000	2,370,000	2,380,000	2,360,000
Water and Sewer	35,000	36,000	34,000	30,000	28,000
Total Emissions	8,345,000	7,776,000	8,334,000	8,300,000	7,908,000
Emissions Per Capita	13.7	12.7	13.4	13.0	12.3

Boston Community Greenhouse Gas Inventory

In equivalent CO2 tons

20-Apr-11

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>	<u>2009</u> <u>Percentage</u>
Residential						
Electricity	600,259	506,433	569,010	557,123	510,285	
Natural Gas	325,203	330,647	414,320	448,704	429,312	
Fuel Oil	455,670	392,494	388,767	386,591	387,970	
Veolia Steam	43,529	31,432	28,306	26,373	24,399	
Waste	51,777	51,116	49,301	43,375	42,399	
Subtotal	1,480,000	1,310,000	1,450,000	1,460,000	1,390,000	18%
Commercial/ Industrial						
Electricity	2,488,095	2,204,086	2,518,306	2,472,410	2,253,882	
Natural Gas	1,125,159	1,128,495	1,224,072	1,243,047	1,199,429	
Fuel Oil	394,606	386,334	378,203	370,212	362,360	
Veolia Steam	352,192	254,317	229,024	213,378	178,927	
Waste	130,223	130,915	132,406	132,406	132,406	
Subtotal	4,490,000	4,100,000	4,480,000	4,430,000	4,130,000	52%
Transportation						
VMTs						
Gasoline	1,727,760	1,732,077	1,736,394	1,740,711	1,745,028	
Diesel	333,485	334,318	335,152	335,985	336,818	
MBTA						
Electricity	206,325	164,930	194,538	194,538	178,904	
Diesel	26,815	54,385	59,036	64,258	63,494	
CNG	37,065	37,065	37,065	37,065	31,513	
Gasoline	4,528	4,546	4,757	4,678	4,425	
Subtotal	2,340,000	2,330,000	2,370,000	2,380,000	2,360,000	30%
Water and Sewer						
Electricity	24,595	25,396	26,431	26,402	22,691	
Natural Gas	843	911	1,048	887	1,005	
Fuel Oil	9,227	9,226	5,880	2,377	3,569	
Gasoline	378	359	342	403	372	
Diesel	291	347	347	360	386	
CNG	6	4	4	0.4	0.1	
Subtotal	35,000	36,000	34,000	30,000	28,000	0.4%
Total Emissions	8,345,000	7,776,000	8,334,000	8,300,000	7,908,000	
Population	609,690	612,192	622,748	636,748	645,169	
Emissions Per Capita	13.7	12.7	13.4	13.0	12.3	

GHG Emissions by	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>	<u>2009%</u>
Electric	3,319,274	2,900,845	3,308,285	3,250,473	2,965,762	37%
Natural Gas	1,488,270	1,497,118	1,676,505	1,729,703	1,693,240	21%
Fuel Oil	859,503	788,054	772,850	759,180	785,412	10%
Steam	395,721	285,749	257,330	239,751	208,123	3%
Gasoline	1,732,666	1,736,982	1,741,493	1,745,792	1,749,825	22%
Diesel	360,591	389,050	394,535	400,603	400,698	5%
Waste	182,000	182,031	181,707	175,781	174,805	2%

Boston Community Energy Use

Calendar Year unless specified

20-Apr-11

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>
<u>Residential</u>					
Electricity (kWh)	1,300,668,524	1,247,372,559	1,251,947,232	1,246,359,067	1,226,647,553
Natural Gas (therms)	55,457,472	56,385,947	70,654,924	76,518,407	73,211,483
Fuel Oil (gals)	36,334,931	36,820,377	34,349,140	34,377,420	34,500,054
Steam (million BTU)	491,455	436,212	382,381	373,732	355,738
Waste (tons) - FY	253,129	249,897	236,364	221,215	216,239
<u>Commercial/ Industrial</u>					
Electricity (kWh)	5,391,322,420	5,428,782,998	5,540,827,008	5,531,118,810	5,417,986,149
Natural Gas (therms)	195,469,646	215,620,610	226,831,489	211,979,363	204,541,105
Fuel Oil (gals)	35,090,144	34,354,535	33,631,482	32,920,893	32,222,670
Steam (million BTU)	3,976,319	3,529,348	3,093,812	3,023,830	2,638,389
Waste (tons)	634,886	640,024	634,793	634,793	634,793
<u>Transportation</u>					
Vehicle Miles Traveled	3,067,029,330	3,074,692,556	3,082,355,782	3,090,019,008	3,097,682,234
<u>MBTA</u>					
Electricity (kWh)	447,075,000	406,231,550	428,025,310	435,207,000	430,057,000
Diesel (gals)	5,075,978	4,858,819	5,274,388	5,740,865	5,672,654
CNG (therm)	5,757,670	5,757,670	5,757,670	5,757,670	4,895,180
Gasoline (gals)	463,817	465,613	487,285	479,220	453,237
<u>Water and Sewer - FY</u>					
Electricity (kWh)	53,747,077	55,497,115	57,758,822	57,830,005	54,545,995
Natural Gas (therms)	137,409	147,511	169,605	143,441	171,314
Fuel Oil (gals)	797,533	800,528	508,250	205,474	317,363
Gasoline (gals)	35,175	33,433	31,870	37,680	38,078
Diesel (gals)	27,460	28,193	32,787	33,890	34,465
CNG (therms)	914	639	669	65	21

Notes for Boston Community Greenhouse Gas Inventories 2005 – 2009

1. In his April 2007 executive order on climate action, Mayor Thomas Menino directed that the City would report annually on its greenhouse gas (GHG) emissions. In December 2009, the City released a report that included the community inventories for 2005–2007. This report extends the annual inventories through 2009. It also includes adjustments to the earlier inventories based on revised data and emission factors. Greenhouse gas emissions specifically from municipal operations of the City of Boston are described in a separate report, though also included in community totals.
2. Boston GHG inventories are overseen by staff of the Boston Air Pollution Control Commission. However, these inventories could not have been completed nor achieved whatever level of accuracy they have without a large amount of work, cooperation, and guidance from colleagues in many City departments and independent authorities, several departments of the Commonwealth of Massachusetts, ICLEI, Boston's energy utilities, and a variety of local institutions.
3. Please direct comments or questions about the inventories to Carl Spector, Executive Director, Air Pollution Control Commission, carl.spector@cityofboston.gov. Suggestions for improving the accuracy or completeness of the inventory are welcome.
4. *Emission factors (energy to GHGs)*. 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. All other emissions factors come from GHG inventory tools released by ICLEI and the National Association of Clean Air Agencies.
5. *Time frame*. The municipal inventory is based on the City's fiscal year, July 1 to June 30. The community inventory is based on the calendar year, except for residential waste and water and sewer data, which are based on the fiscal year.
6. *Units*. The current inventories' unit of measurement is tons (short tons) of equivalent carbon dioxide (eCO₂). Many other reports use metric tons or tonnes: 1 short ton = 0.907 metric tonne.
7. *Approach*. The community inventory mixes top-down and bottom-up inventory methods and estimates based on models. It cannot have the same degree of precision as the municipal inventory, which is based on actual energy purchases. For this reason, the totals are rounded off,
8. *Scope*. The goal of the community inventory is to include GHG emissions associated with all activities—residential, commercial/industrial, institutional, transportation—within city boundaries. Most government activity is in the commercial/industrial category. The inventory does not currently include emissions from airplane travel at Logan Airport.
9. *Incomplete data*. In some cases, energy-use data for 2009 is still not available. In these cases, the reported data from 2008 or earlier has simply been repeated as a first-level estimate.

10. *Natural gas.* Data on natural gas consumption in Boston were provided by National Grid. National Grid reported natural gas sales in two categories according to account type—residential (types 3801–3832; 3901–3932) and commercial/industrial (types 3841–3853; 3941–3984). However, large residential sites—that is, those with more than four units that are not separately metered—are included in the commercial/industrial category. (This is true only for natural gas, not for electricity.) Natural gas used by the Veolia steam plant near South Station is subtracted from the National Grid data to prevent double counting.

11. *Electricity.* Data on electricity consumption in Boston was provided by NStar. For 2005 and 2006, NStar reported electricity sales according to rate type—residential (types R1–R4) and commercial/industrial (types G1–G3, T1–T2, and S1–S3; these last rates are for street lighting). For 2007–2009, NStar reported only the totals for residential and commercial/industrial, without a breakdown of the various rate types.

12. *Steam.* Boston’s largest steam plant is run by Veolia Energy, which provided data on actual fuel use and on steam supplied by category (residential, commercial, medical, and educational). The actual fuel used varies significantly due to variation in commodity prices (for example, in 2005, their fuel use was: 88% heavy fuel oil, 3% light fuel oil, and 9% natural gas; in 2009: 19% heavy fuel oil, 0.1% light fuel oil, and 81% natural gas). We used this data to calculate annual GHG emission factors specifically for this source.

13. *Residential fuel oil.* According to the Massachusetts Energy Consumers Alliance, the average Massachusetts household using fuel oil used 866.5 gallons in the 2004–2005 heating season and 742.7 gallons in 2005–2006. We averaged these to numbers to estimate 804.6 gallons per household for the 2005 calendar year. The U.S. Census Bureau estimates that 45,159 households in Boston used fuel oil as their primary heating source in 2005. Multiplication of these two numbers gives an estimate of 36,334,931 gallons of heating oil for the residential sector of the Boston community. We performed similar calculations based on census data and on average fuel oil use for subsequent years.

14. *Commercial/industrial fuel oil.* We estimated fuel oil use by multiplying together four factors from different sources: a) average fuel oil use per square foot, b) amount of commercial/industrial space, c) percentage of commercial structures using fuel oil, and d) a factor to account for the long-term decline of fuel oil use.

- a) According to the federal Energy Information Administration, buildings in the Northeast that used fuel oil used an average of 0.22 gallons per square foot for heating in 2003.
- b) A 2003 Department of Energy study found that about 52 percent of commercial structures used fuel oil.
- c) The City of Boston’s Assessing Department determined that, in 2005, there were 318.6 million and, in 2009, 330.5 million square feet of commercial/industrial building space in Boston. The total area of commercial space for 2006 through 2008 was interpolated from these two data points.
- d) In 2009, the Commonwealth of Massachusetts released its report *Statewide Greenhouse Gas Emissions Level* and support documents, which showed that statewide commercial fuel oil consumption dropped about five percent a year between 1990 and 2007. We applied a more conservative, three percent a year reduction factor to Boston fuel oil estimate.

15. *Transportation.* The Commonwealth’s Central Transportation Planning Staff (CTPS) has developed a computer model to estimate the number of miles traveled by all vehicles, except transit vehicles, on a high-traffic mid-week day in eastern Massachusetts in 2000 and 2010. At our request, CTPS used the same model to estimate daily vehicle miles traveled (VMTs) in Boston for 2000 and 2010. To calculate annual VMTs, CTPS advised us that a multiplier of 340 was appropriate, taking into account the weekend, holiday, and summer traffic patterns. We then used a linear interpolation between the 2000 and 2010

numbers to estimate VMTs for 2005–2009. The CACP software translated VMTs into GHG emissions by using the regional fleet mix to determine the distribution of vehicle types and assigning to these vehicle types a representative fuel mileage.

16. *MBTA fuel usage.* The MBTA provided data on its annual system-wide usage of gasoline, diesel fuel, electricity, and natural gas. Electricity includes usage for both transit vehicles and buildings. Starting in 2008, the MBTA was able to separate natural gas usage for vehicles and buildings. We used the 2008 natural gas usage by vehicles as an estimate of 2005 to 2007 vehicle usage. The MBTA’s natural gas use in buildings is included in the Commercial/Industrial sector.

17. *Waste.* The waste figure is an estimate of GHG emissions from the disposal of all non-hazardous, non-recycled waste—residential, commercial, industrial, and institutional—generated in Boston. According to the City’s Department of Public Works, total municipally controlled, non-diverted waste—that is residential waste and waste from municipal buildings—amounted to 216,000 tons in 2009. DPW has little control over waste disposal technology, but believes that most of Boston’s waste is incinerated. Commercial waste was calculated using the disposal rate per employee broken down by job sectors in the Massachusetts Department of Environmental Protection’s Commercial Waste Disposal Assessment Report and combined with yearly employment figures for Boston provided by the Massachusetts Executive Office of Labor and Workforce Development. With more recent data not yet available, the 2008 and 2009 inventories repeat the 2007 figure as a first-level estimate.

18. *Water and Sewer.* The Massachusetts Water Resources Authority and the Boston Water and Sewer Commission both provide service for Boston. The water and sewer category here includes only the MWRA; see the municipal inventory for BWSC emissions, which are incorporated into the commercial/industrial category. The MWRA 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 its total annual energy used based on measurements of actual water and sewer flows. For FY05 through FY09, the Boston share was about 32 percent of the total.

19. *Per capita emissions.* The residential population of Boston was 609,690 in 2005, 612,192 in 2006, 622,748 in 2007, 636,748 in 2008 and 645,169 in 2009 according to the Boston Redevelopment Authority. The daytime population on an average work day is about twice the residential population.

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