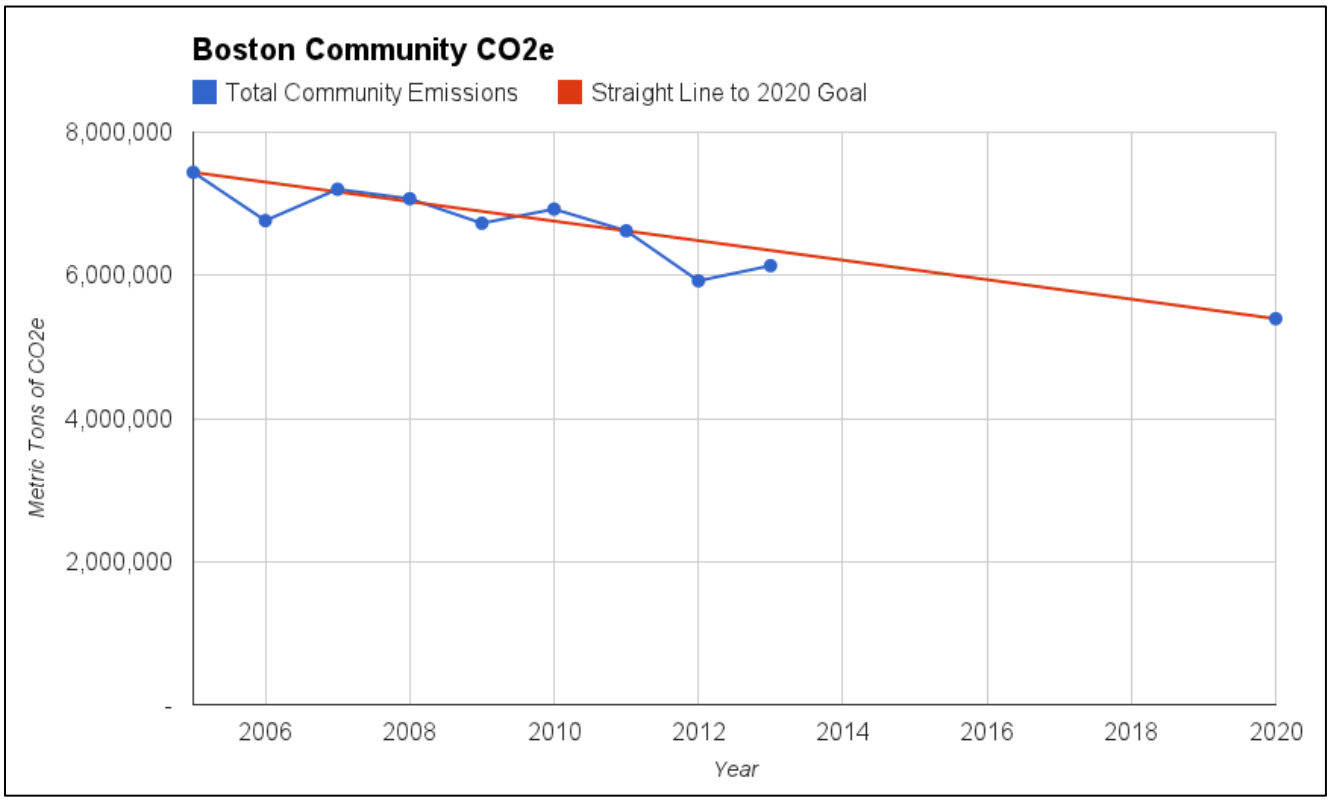
City of Boston
Community Greenhouse Gas Inventory
2005-2013

Overview

In 2013, the Boston community emitted 6.1 million metric tons of greenhouse gases (GHGs) from energy use in buildings and other facilities, and for transportation. This represented a four-percent increase from 2012, which had the lowest emissions in the nine years for which the City has conducted inventories. GHG levels reflect both the quantity of energy used and the source of that energy.

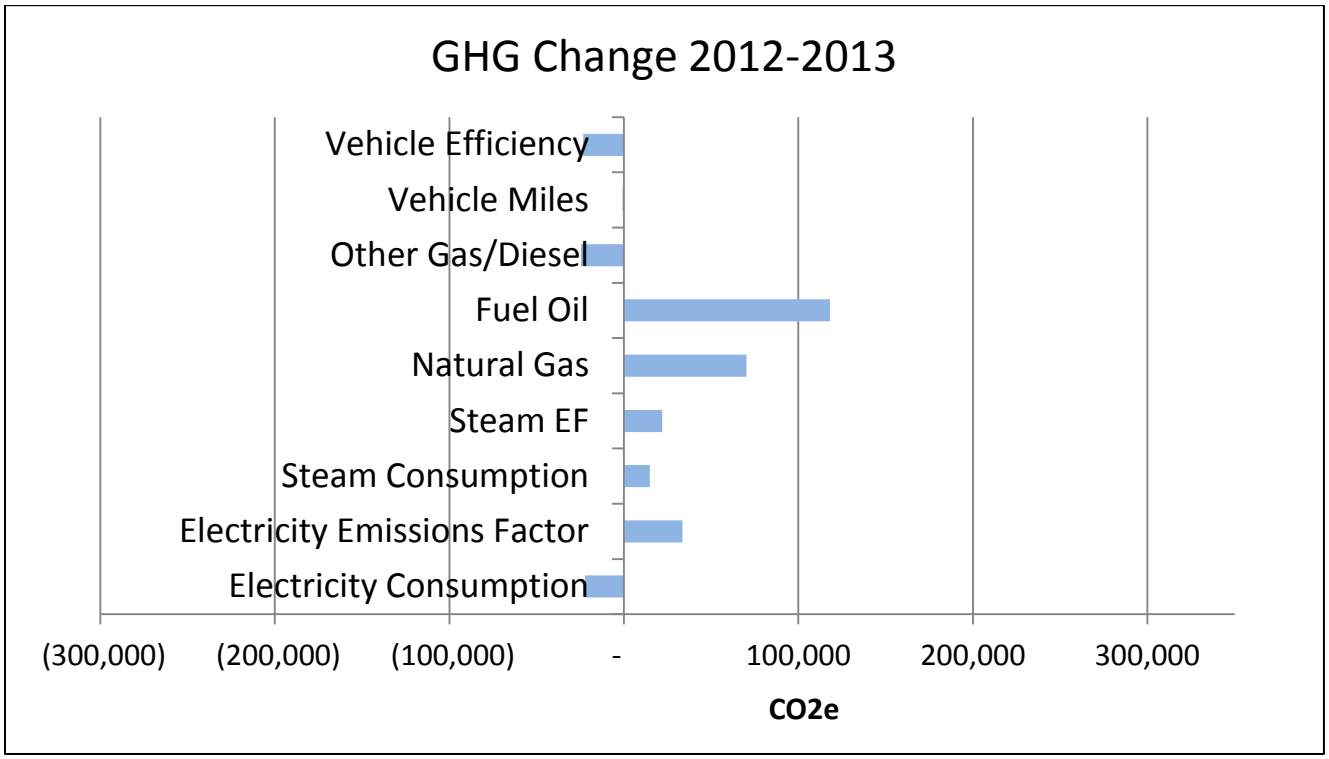
Despite the increase, the 2013 emissions were 18 percent lower than those in 2005, Boston's GHG baseline. This reduction has occurred at the same time that the population and the number of jobs in Boston have increased, both up about ten percent in the same time period. In 2011, then-Mayor Thomas M. Menino set a goal of reducing community-wide emissions 25 percent by 2020. Mayor Martin J. Walsh has reaffirmed this goal as well as the longer-term goal of reducing GHG emissions 80 percent by 2050. The *Greenovate Boston 2014 Climate Action Plan Update* details strategies and actions for reaching these goals (http://plan.greenovateboston.org/).

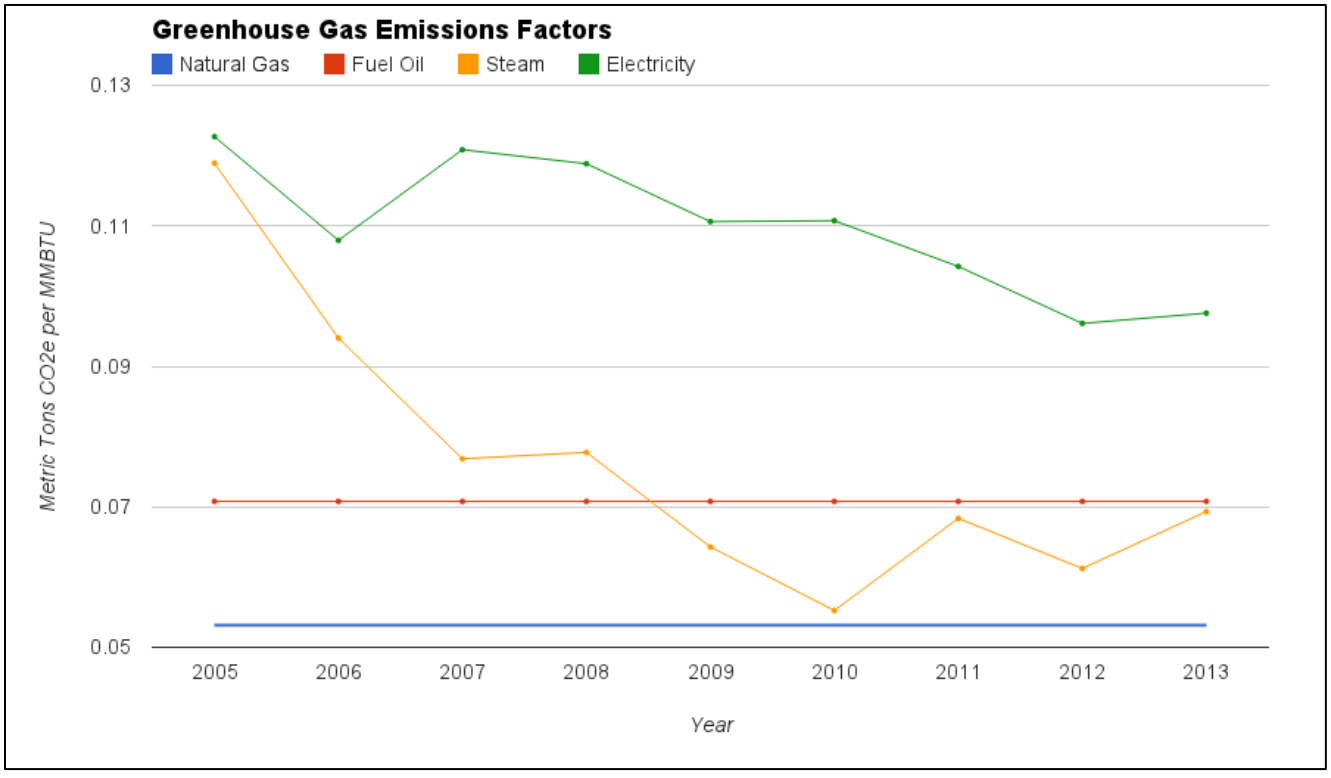
The annual GHG inventory is based on a combination of direct data and models for data that cannot be obtained directly. Following the summary, this report contains details of GHG emissions and energy use from 2005 to 2013 by energy source and sector as well as detailed notes on the inventory methodology.



Short-term changes

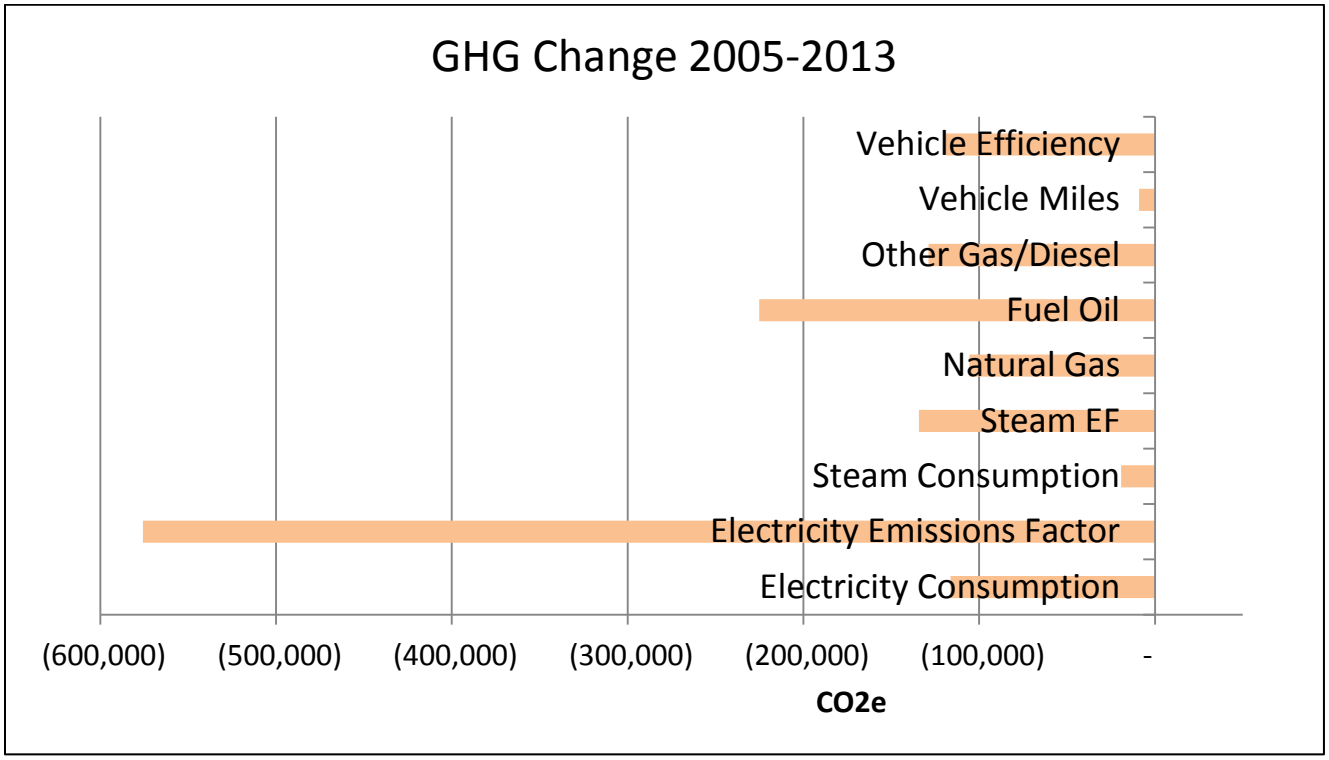
In 2013, the community's GHG emissions rose 3.5 percent (200 thousand metric tons) from the previous year. A major cause of the increase was the weather: 2012 was a warm year with 4,754 heating-degree days (HDD); 2013 had 5,521. This had two consequences. First, Bostonians consumed more heating fuels. Second, increased demand for natural gas caused the price to increase and reduced availability. This led some power plants producing electricity and steam to reverse a trend of the past several years and increase their use of oil and coal, both of which produce more GHGs per unit of energy than natural gas. This change is reflected in the higher emissions factors for steam and electricity.





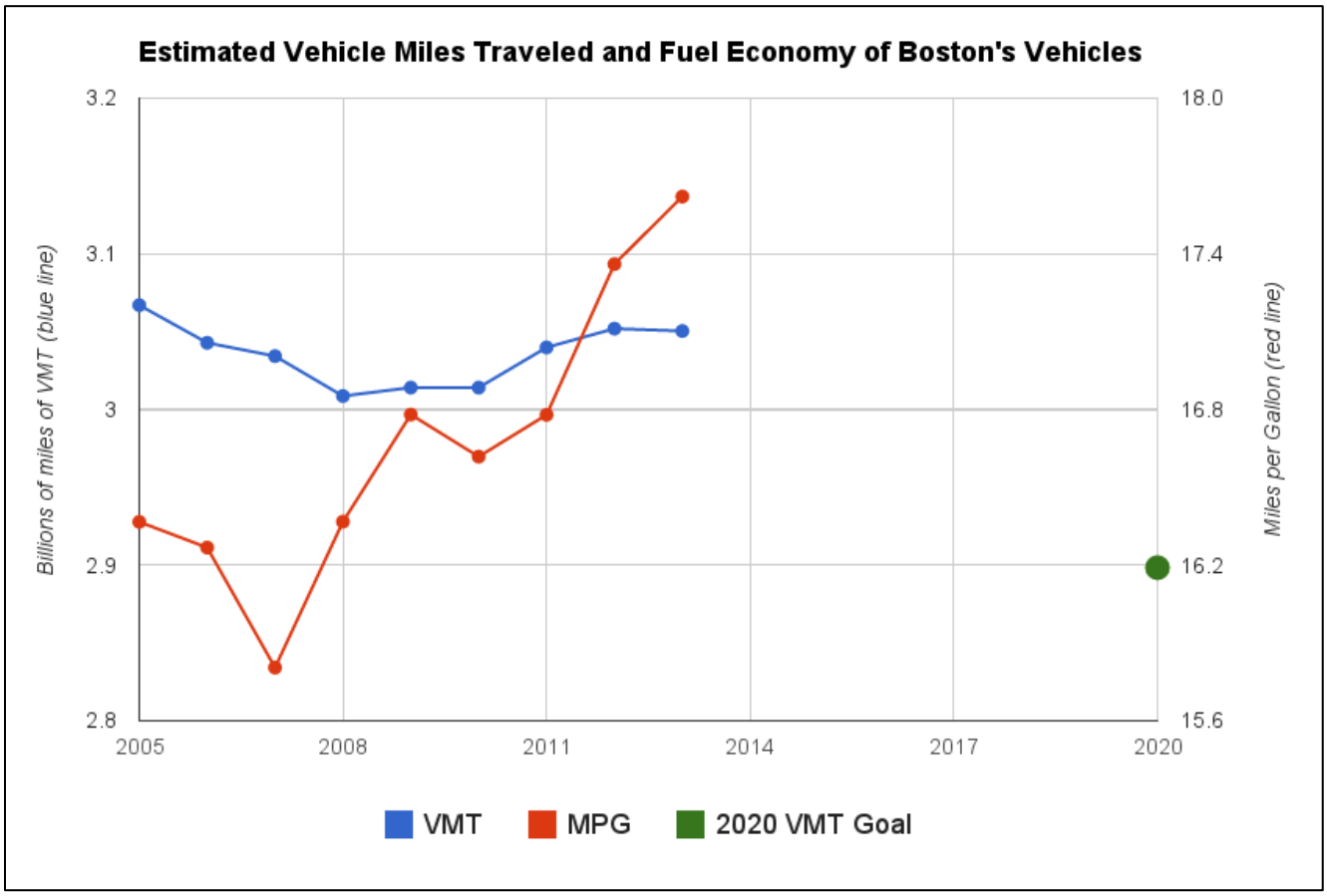
Long-term changes

Despite the 2012-2013 increase, GHG emissions from 2005 to 2013 have declined at an overall rate that would allow the Boston community to reach the 25-percent reduction goal by 2020. Approximately 40 percent of the reductions were the result of fuel-switching from oil and coal to natural gas, by both power plants and individual consumers, as reflected in the emissions factors and the consumption of fuel oil. Steam emissions reductions also include the effect of steam produced in the steam utility's co-generation plant, which began serving Boston in 2007. Energy-efficiency efforts—led by Renew Boston, the energy-efficiency programs of Boston's utilities, and many businesses, institutions, and residents—are contributing to reductions in emissions from electricity, steam, and natural gas consumption.

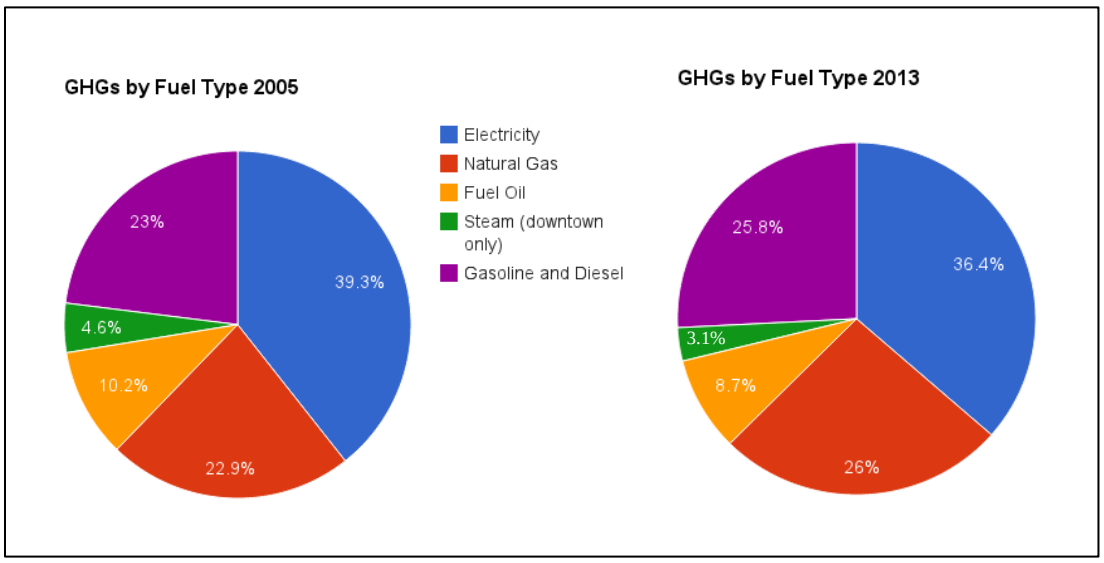


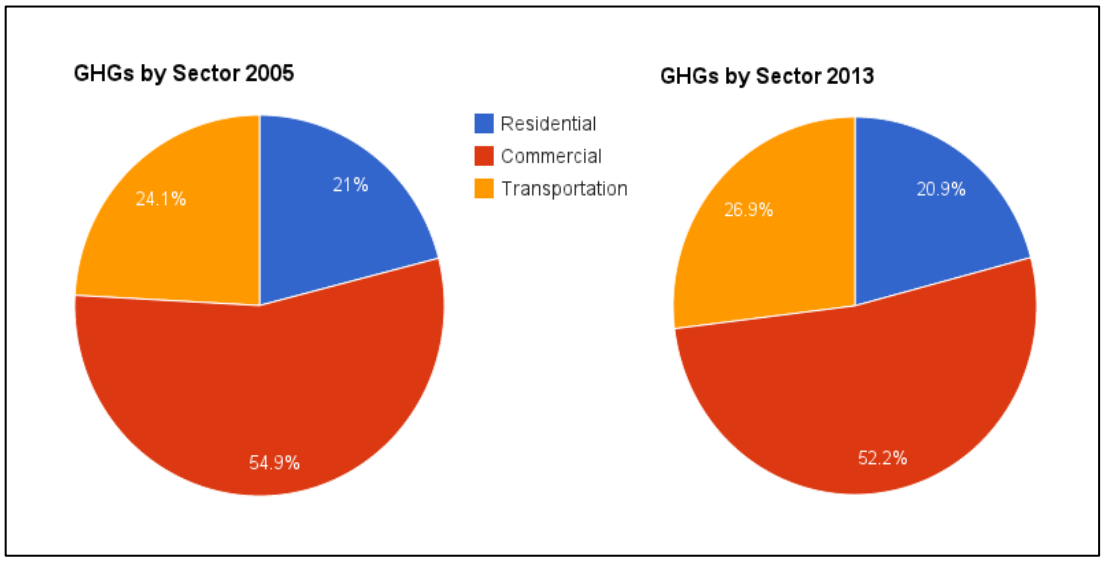
Vehicle miles traveled

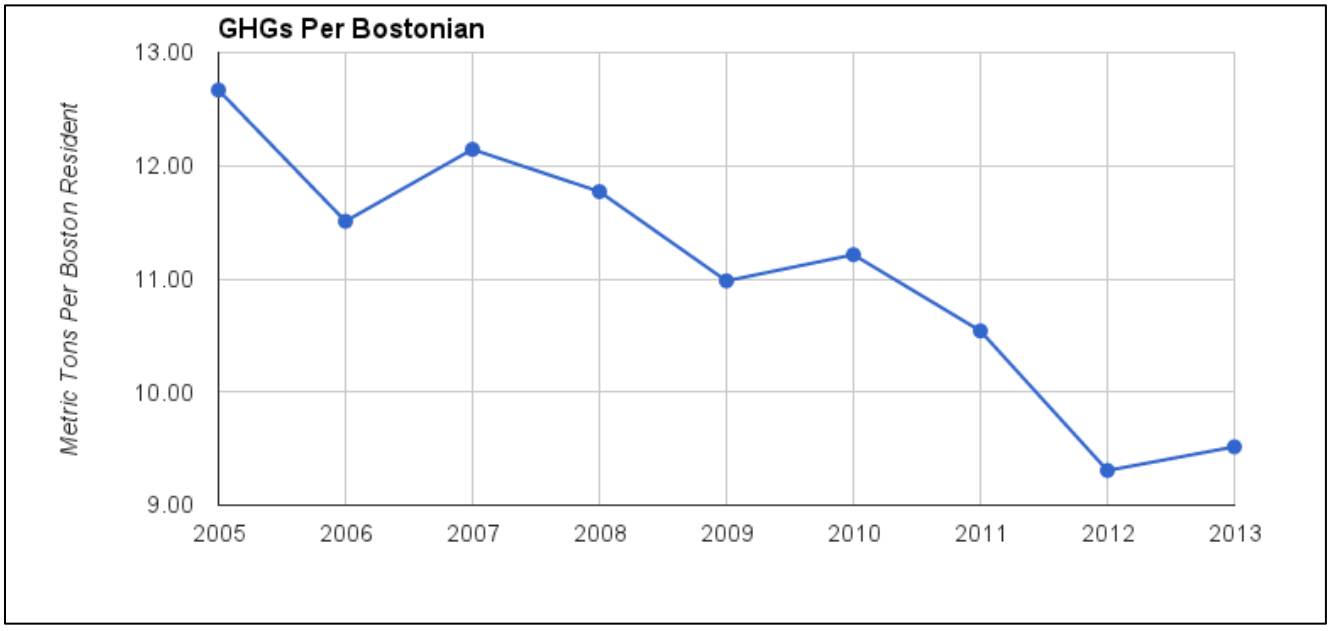
From 2005 to 2013, GHGs from private cars, trucks, and other vehicles decreased about eight percent. Although there was a dip in the amount of driving in Boston from 2008-2010, total miles traveled in 2012 and 2013 returned to close to 2005 levels. However, vehicle efficiency, as measured in average miles per gallon, increased enough to produce a significant reduction in vehicular GHGs. The increase in efficiency reflects better mileage for traditional vehicles as well as a slowly growing number of hybrid and all-electric vehicles.



Additional graphs



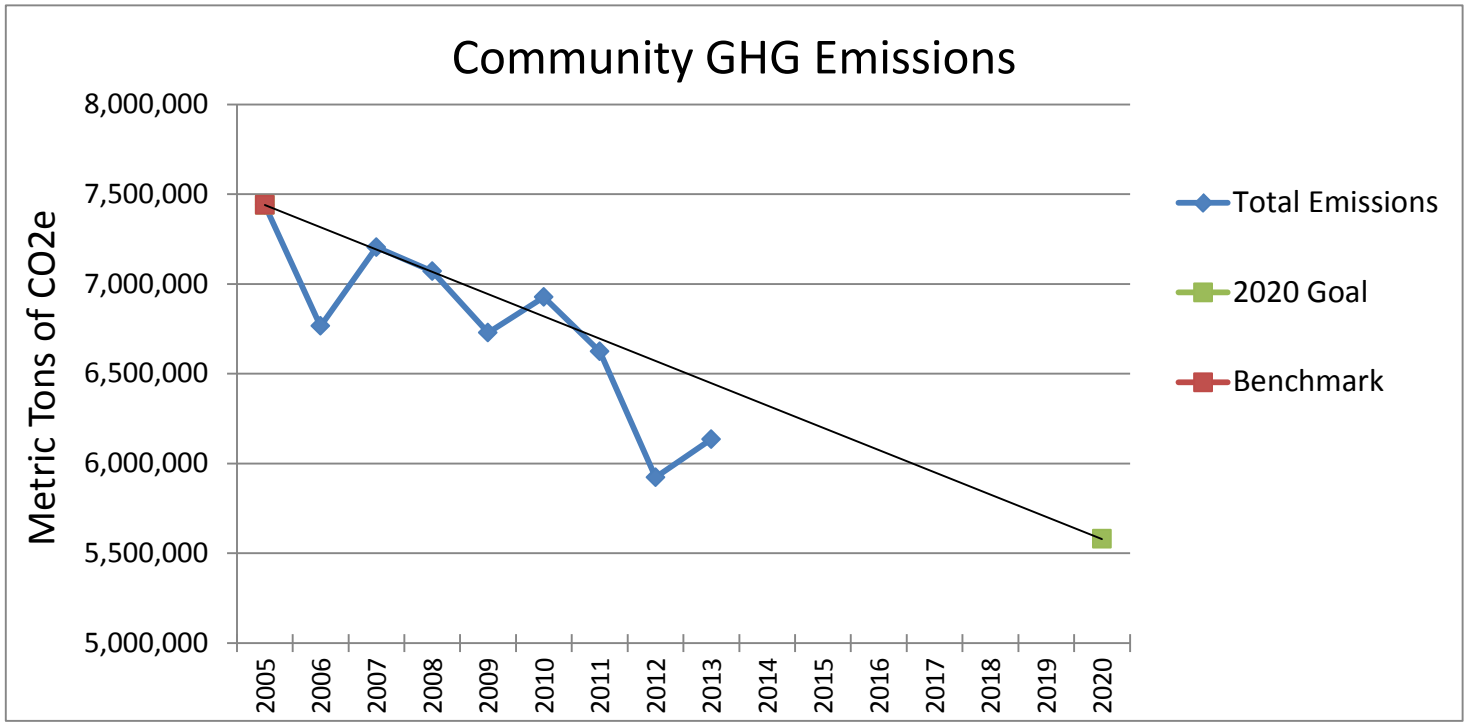




Boston Community Greenhouse Gas Inventory

In Metric Tons CO2 Equivalent

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Residential	1,563,000	1,413,000	1,476,000	1,475,000	1,434,000	1,430,000	1,339,000	1,189,000	1,282,000
Commercial/Industrial	4,049,000	3,549,000	3,868,000	3,809,000	3,555,000	3,738,000	3,534,000	3,039,000	3,179,000
Transportation	1,796,000	1,773,000	1,830,000	1,760,000	1,714,000	1,731,000	1,727,000	1,675,000	1,653,000
Water and Sewer	32,000	30,000	31,000	27,000	25,000	27,000	23,000	21,000	21,000
Total Emissions	**7,440,000**	**6,765,000**	**7,204,000**	**7,071,000**	**6,728,000**	**6,926,000**	**6,623,000**	**5,923,000**	**6,135,000**
Change from 2005	0%	-9%	-3%	-5%	-10%	-7%	-11%	-20%	-18%
Emissions per capita	12.7	11.5	12.1	11.8	11.0	11.2	10.5	9.3	9.5



Boston Community Greenhouse Gas Inventory

In Metric Tons CO2 Equivalent

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013 Percentage
Residential										
Electricity	544,545	459,429	516,197	505,413	462,923	495,959	467,618	428,819	440,285	
Natural Gas	588,787	528,224	572,302	574,014	573,310	557,250	577,356	505,380	586,836	
Fuel Oil	391,668	398,382	362,617	372,810	376,706	360,068	272,019	238,577	242,743	
Steam	37,554	27,096	24,417	22,733	21,030	16,346	22,088	16,609	11,716	
Subtotal	1,563,000	1,413,000	1,476,000	1,475,000	1,434,000	1,430,000	1,339,000	1,189,000	1,282,000	21%
Commercial / Industrial										
Electricity	2,292,076	1,999,513	2,284,569	2,242,933	2,044,688	2,072,768	1,944,361	1,727,028	1,724,219	
Natural Gas	1,097,216	1,083,346	1,139,573	1,197,957	1,116,915	1,121,490	1,156,461	1,005,972	994,767	
Fuel Oil	356,179	246,801	245,894	183,986	239,393	411,208	270,763	171,286	284,419	
Steam	303,843	219,235	197,557	183,929	154,217	132,256	161,975	134,386	176,063	
Subtotal	4,049,000	3,549,000	3,868,000	3,809,000	3,555,000	3,738,000	3,534,000	3,039,000	3,179,000	52%
Transportation										
Private Vehicles	1,684,384	1,676,350	1,720,937	1,648,906	1,610,721	1,626,703	1,624,860	1,576,721	1,552,644	
MBTA										
Electricity	68,478	54,739	64,566	64,566	59,377	59,414	56,000	52,382	54,958	
Diesel	25,106	24,032	26,087	28,394	28,057	30,138	29,877	28,569	27,984	
CNG	16,114	16,114	*16,114*	16,114	13,700	12,873	14,175	15,103	14,961	
Gasoline	2,018	2,020	2,114	2,080	1,967	1,895	1,962	1,974	2,032	
Subtotal	1,796,000	1,773,000	1,830,000	1,760,000	1,714,000	1,731,000	1,727,000	1,675,000	1,653,000	27%
MWRA										
Electricity	22,502	20,441	23,815	23,451	20,585	19,424	18,720	16,256	16,269	
Natural Gas	730	784	902	762	911	702	815	632	754	
Fuel Oil	8,190	8,221	5,219	2,110	3,259	6,389	2,898	2,924	3,666	
Gasoline	316	300	286	338	341	357	308	301	279	
Diesel	281	288	335	346	352	432	397	422	397	
CNG	5.29	3.70	3.87	0.38	0.12	0.00	1.20	1.38	0.00	
Subtotal	32,000	30,000	31,000	27,000	25,000	27,000	23,000	21,000	21,000	0.3%
Total Emissions	**7,440,000**	**6,765,000**	**7,204,000**	**7,071,000**	**6,728,000**	**6,926,000**	**6,623,000**	**5,923,000**	**6,135,000**	

GHG Emissions by Fuel	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013 Share
Electric	2,927,600	2,534,100	2,889,100	2,836,400	2,587,600	2,647,600	2,486,700	2,224,500	2,235,700	36%
Natural Gas (includes CNG)	1,702,900	1,628,500	1,728,900	1,788,800	1,704,800	1,692,300	1,748,800	1,527,100	1,597,300	26%
Fuel Oil	756,000	653,400	613,700	558,900	619,400	777,700	545,700	412,800	530,800	9%
Steam	341,400	246,300	222,000	206,700	175,200	148,600	184,100	151,000	187,800	3%
Vehicle Fuel	1,712,100	1,703,000	1,749,800	1,680,100	1,641,400	1,659,500	1,657,400	1,608,000	1,583,300	27%

Boston Community Energy Data

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Residential									
Electricity (kWh)	1,300,668,524	1,247,372,559	1,251,947,232	1,246,359,067	1,226,647,553	1,312,607,886	1,314,950,213	1,307,585,530	1,322,426,754
Natural Gas (therms)	110,764,799	99,371,575	107,663,537	107,985,766	107,853,226	104,831,923	108,614,469	95,074,004	110,397,850
Fuel Oil (gals)	38,141,291	38,795,057	35,312,200	36,304,875	36,684,276	35,064,043	26,489,637	23,233,029	23,638,676
Steam (klbs)	262,722	239,740	264,380	243,269	272,122	246,189	268,821	225,705	140,589
Commercial / Industrial									
Electricity (kWh)	5,474,714,628	5,428,782,998	5,540,827,008	5,531,118,810	5,417,986,149	5,485,799,351	5,467,579,949	5,266,175,760	5,178,818,239
Natural Gas (therms)	206,412,500	203,803,200	214,380,728	225,364,210	210,118,343	210,978,885	217,557,889	189,247,194	187,139,341
Fuel Oil (gals)	34,685,291	24,033,845	23,945,512	17,916,808	23,312,461	40,044,139	26,367,299	16,680,151	27,697,196
Steam (klbs)	2,125,663	1,939,713	2,139,074	1,968,264	1,995,564	1,991,896	1,971,350	1,826,160	2,112,730
Transportation									
Private Vehicles (fuel gals)	187,395,558	187,049,284	191,985,452	183,819,531	179,617,217	181,371,901	181,166,367	175,799,051	173,114,518
MBTA									
Electricity (kWh)	163,562,389	148,619,813	156,593,060	159,220,481	157,336,353	157,245,989	157,473,181	159,726,817	165,069,325
Diesel (gals)	2,456,574	2,351,478	2,552,597	2,778,353	2,745,342	2,948,933	2,923,428	2,795,442	2,738,207
CNG (therm)	2,786,486	2,786,486	2,786,486	2,786,486	2,369,075	2,226,132	2,451,140	2,611,617	2,587,053
Gasoline (gals)	224,469	225,338	235,827	231,924	219,349	211,286	218,783	220,059	226,612
Water and Sewer (Fiscal Yr)									
Electricity (kWh)	53,747,077	55,497,115	57,758,822	57,830,005	54,545,995	51,406,925	52,641,791	49,568,732	48,866,137
Natural Gas (therms)	137,409	147,511	169,605	143,441	171,314	132,043	153,401	118,842	141,820
Fuel Oil (gals)	797,533	800,528	508,250	205,474	317,363	622,135	282,229	284,748	356,956
Gasoline (gals)	35,175	33,433	31,870	37,680	38,078	39,839	34,339	33,593	31,104
Diesel (gals)	27,460	28,193	32,787	33,890	34,465	42,282	38,861	41,245	38,873
CNG (therms)	914	639	669	65	21	0	207	239	0

Notes

1. The City began issuing annual reports on Boston's greenhouse gas (GHG) emissions in 2007 (for the 2005 calendar year). This report extends these annual community inventories through 2013. Greenhouse gas emissions specifically from municipal operations of the City of Boston are described in a separate report, but are included in the community totals.

   As described in the items below, this report includes modifications to the methodology used in calculating GHGs from commercial/industrial fuel oil and transportation and removes waste-related GHGs from the inventory. Boston recently joined the C40 Cities Climate Leadership Group (C40), and we compared our inventory methodology with the C40 recommended methodology in order to ensure congruence. With the exception of accounting for transmission and distribution losses associated with grid-supplied energy, the City's methodology meets the C40 guidelines.

2. Boston GHG inventories are overseen by the Climate and Environmental Planning Division within the City of Boston Environment Department. However, these inventories could not have been completed 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. Please direct comments or questions about the inventories to Carl Spector, Director of Climate and Environmental Planning, or Haidee Janak, Climate Program Manager, at carl.spector@boston.gov and haidee.janak@boston.gov. Suggestions for improving the accuracy or completeness of the inventory are welcome.

3. *Scope*. The goal of the community inventory is to include GHG emissions associated with all activities—residential, commercial/industrial, institutional, transportation-related—within city boundaries. Most government activity is in the commercial/industrial category. The inventory does not currently include emissions from, among other things, airplane travel at Logan Airport, the complete life cycle of consumer products, or fugitive natural gas.

4. *Approach*. The community inventory mixes top-down and bottom-up inventory methods and includes estimates based on models. For this reason, no more than two significant digits should be used when citing these results.

5. *Time frame.* The community inventory is based on the calendar year. Data provided by the Massachusetts Water Resources Authority (MWRA) were based on the fiscal year through 2011, but calendar year data has been provided since 2012. The GHG inventory for Boston's municipal operations, released separately, is based on the City's fiscal year, July 1 to June 30.

6. *Units.* The inventory's unit of measurement is metric tons of carbon dioxide equivalent (CO2e). 1 short ton = 0.9072 metric tons.

7. *Emissions factors (energy to GHGs).* The municipal and community GHG inventories use the annual electricity emissions factors calculated by ISO-New England, the regional transmission organization. The ISO-NE electricity emissions 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 (see graph on page 2). All other emissions factors—

except steam's (see #11 below)—come from GHG inventory tools released by ICLEI - Local Governments for Sustainability and the National Association of Clean Air Agencies.

8. *Per capita emissions*. We calculated three types of per capita emissions using the most recent series of population and employment estimates by the U.S. Census Bureau, the Boston Redevelopment Authority, and the State's Executive Office of Labor and Workforce Development. Because of the results of the 2010 decennial census, there are some significant differences between the population numbers in this report and those of previous years. The per capita figures are derived by dividing the total GHG emissions from all counted sources by Boston's residential population. Because the large number of people who commute into Boston for work and school make Boston's typical weekday population about twice the residential population, we calculated a separate residential emissions per capita (total residential emissions divided by residential population) and C/I emissions per employee (total commercial/industrial emissions divided by number of Boston employees). Transportation and MWRA emissions are not part of the latter two calculations.

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Residential Population	587,260	587,816	593,136	600,685	612,669	617,594	628,335	636,479	644,710
Residential Emissions per Resident (metric tons CO2e)	2.7	2.4	2.5	2.5	2.3	2.3	2.1	1.9	2.0
Boston Employees	634,557	645,632	668,050	674,960	660,536	657,482	675,210	686,107	698,563
C/I Emissions per Employee (metric tons CO2e)	6.4	5.5	5.8	5.6	5.4	5.7	5.2	4.4	4.6

9. *Electricity.* Data on electricity consumption in Boston were provided by NStar and are reported by sector, residential and commercial/industrial.

10. *Natural gas.* Data on natural gas consumption in Boston were provided by National Grid and NStar. National Grid services most of the city while NStar services part of the Hyde Park neighborhood. The small section of the City served by NStar had been overlooked in past inventories. Data back to 2005 were obtained to update the entire inventory. National Grid reported natural gas sales in two categories according to account type—residential and commercial/industrial. National Grid charges large residential sites—that is, buildings with more than four units that are not separately metered—a commercial rate. Because these buildings are classified as commercial by the utility, there is no way to identify them as residential; consequently, they are included in the commercial/industrial category. (This is true only for natural gas, not for electricity). Natural gas used by Veolia steam plants is subtracted from the National Grid commercial sector data to prevent double counting. Inventory emissions related to natural gas do not currently include leaks from the natural gas distribution system in Boston, and we are continuing to study this issue.

11. *Steam.* Veolia Energy provided data on delivered steam by category (residential, commercial, medical, governmental, and educational). Veolia also provided an annual emissions factor that they calculated based on guidance from MassDEP and the federal Energy Information Administration (EIA). The EIA emissions factors (for natural gas and other fuels) used by Veolia vary slightly from the emissions factors used by the City. Previous to 2013, Veolia included mixed-use hotel/residential buildings

entirely in the residential category; starting in 2013, the hotel portion is included in the commercial category.

12. *Fuel oil.*

Residential

We estimated residential fuel oil use by multiplying the average fuel oil use per household by the number of households using fuel oil in Boston. The U.S. Census Bureau provides an estimate of the number of households that use heating oil in Boston through its annual American Community Survey. The household consumption data come from Mass Energy Consumers Alliance (Mass Energy), a non-profit energy organization with 15,000 residential customers in eastern Massachusetts, 3,000 of whom are in Boston. The Mass Energy data are reported by heating season, so we took the average of consecutive seasons as representative of a calendar year. Mass Energy estimates that their members use 30-50 fewer gallons of fuel oil than average Massachusetts residents. Because of this, we added 40 gallons to the Mass Energy's calculated total gallons per household. For 2013, this resulted in an estimated total use of 652 gallons per household.

Commercial/industrial

Starting with the 2012 inventory, we changed the methodology for estimating commercial/industrial fuel oil consumption in order to link the estimate with a source of annual data.

a. Old methodology: Multiply four factors from different sources: i) average fuel oil use per square foot, ii) amount of commercial/industrial space, iii) percentage of commercial structures using fuel oil, and iv) a factor to account for the long-term decline of fuel oil use.

i) According to the EIA, buildings in the Northeast that used fuel oil used an average of 0.22 gallons per square foot for heating in 2003.
ii) 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 subsequent years is extrapolated from these two data points.
iii) A 2003 Department of Energy study found that about 52 percent of commercial structures used fuel oil.
iv) In 2009, the Commonwealth of Massachusetts released its report *Statewide Greenhouse Gas Emissions Level*, which showed that statewide commercial fuel oil consumption dropped about five percent a year between 1990 and 2007. For Boston, we applied a smaller, three percent annual reduction, and assumed that this trend continued.

b. New methodology: Estimate Boston's C/I fuel oil consumption by taking a proportion of total Massachusetts C/I consumption of fuel oil. The annual state number is reported in the State Energy Data System of the EIA, http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_use/com/use_com_MA.html&sid=MA. The Boston proportion 0.175 is equal to the C/I square footage in Boston (Boston Assessing Database) divided by the corresponding figure for the state (Metropolitan Area Planning Council). (An analogous calculation based on employment would give a Boston factor of 0.170.) We are going to continue to use this proportion for the next several years on the presumption that new Boston construction is unlikely to use heating oil as a source. This methodology has been used to revise the C/I fuel oil figures back to 2005.

The 2013 data have not been released yet, and the average of the last three years was used. 2013, and any other revised years, will be updated with the release of the 2014 inventory.

13. *Transportation*. Starting with the 2012 inventory, we changed the methodology for estimating GHGs from cars and trucks in order to link the estimate with sources of annual data. The change involved our estimates of both vehicle-miles-traveled (VMTs) and the average fuel economy (MPG) of the Massachusetts fleet.

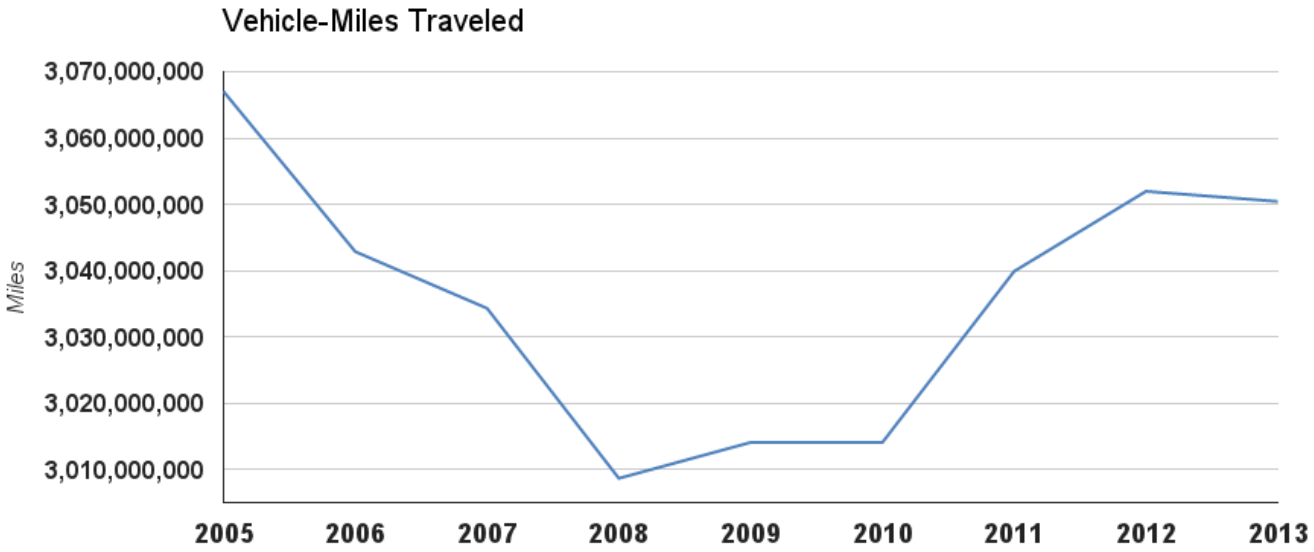
a. VMTs. Previously, we relied on estimates and linear extrapolations from the Commonwealth's Central Transportation Planning Staff (CTPS), which used their computer model of eastern Massachusetts to estimate the number of miles traveled by all vehicles, except transit vehicles, on a high-traffic mid-week day in Boston in 2000 and 2010. To calculate annual VMTs, CTPS recommended a multiplier of 340, taking into account the weekend, holiday, and summer traffic patterns.

The challenge with the CTPS estimate is that the model, including baseline data, is updated infrequently and does not reflect year-to-year changes. For this reason, we have made the following modification to the VMT estimates:

i) Keep the 2005 CTPS-based estimate as the baseline.

ii) Make year-to-year adjustments based on the average change of two other estimates of annual VMTs: Boston VMT estimates for 2006–2008 by Gately et al. (see http://pubs.acs.org/doi/pdf/10.1021/es304238v) and Massachusetts VMT estimates, according to Federal Highway Administration (see http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm); only the state data are used after 2008 when the Gately data end.

The inventory will incorporate the results from the CTPS model, whenever the model is updated with new data, and adjust intermediate years as appropriate.



b. Average fuel economy. Previously, we divided the VMT estimate between gasoline- and diesel-powered vehicles and multiplied by GHG emissions per mile for each type based on the national fleet mix and EPA national fuel efficiency data, as reflected in the CACP software. To link our GHG estimate more closely to local data, we estimated the average GHG emissions per VMT over all vehicles in Massachusetts based on the fact that GHG emissions per BTU for both gasoline and diesel fuel are roughly the same. The method, described below, appropriately weights the contributions of gasoline and diesel fuel; and the resulting factor is likely not appropriate for other states, which will have different proportions of diesel and gasoline vehicles. (The 2013 state data for diesel fuel consumption have not been released yet. We estimated 2013 diesel consumption by applying EIA's

average projected increase in diesel consumption through 2040 to the 2012 number. 2013 diesel data will be updated with the release of the 2014 inventory.)

i) Convert the Commonwealth's total annual gasoline (a) and diesel (b) sales from gallons to BTUs (c_1=conversion factor for gas; c_2=conversion factor for diesel) and add the BTU numbers together to calculate total energy content (d). (That is, $d=ac_1+bc_2$.)
ii) Divide the total energy content in BTUs by the gasoline-to-BTU conversion factor used in step i to calculate gallons of gasoline equivalent ($e=d/c_1$.)
iii) Divide total state-wide VMTs (f) by the number of gallons of gasoline equivalent to calculate a state-wide MPG-equivalent (g=f/e).
iv) Divide Boston VMTs (h) by the state-wide MPG-equivalent to calculate gallons of gasoline-equivalent burned (i=h/g).
v) Multiply by GHG per gallon of gasoline (j) to estimate total GHGs ($k=ij=(ac_1+bc_2)dhj/c_1f$).

This calculation assumes that the amount of fuel in vehicles crossing into Massachusetts is roughly equivalent to the amount in vehicles driving out of the state.

14. *MBTA fuel usage*. The MBTA provided data on its annual system-wide usage of gasoline, diesel, electricity, and natural gas. Starting in 2008, the MBTA was able to separate natural gas usage for vehicles and buildings. We used the 2008 system-wide natural gas usage by vehicles (that is, CNG) as an estimate for 2005 to 2007. Natural gas usage by buildings is included in the commercial/industrial sector number. Starting in 2012, we have introduced two adjustments to the MBTA's data, both of which have been applied all the way back to 2005.

a. The MBTA's system electricity data include usage for both transit vehicles and buildings. According to the MBTA, this breaks down to about 60 percent for trains and 40 percent for buildings. The building energy use is already counted in the commercial/industrial sector data reported by NStar, so is not included in this section.

b. We have further reduced the electricity, gasoline, diesel, and CNG numbers to reflect estimates of the proportion of activity, as determined by the MBTA, that takes place within Boston's geographic boundaries.

i) 61 percent of the MBTA's rapid transit system is within Boston's boundary, and this factor is applied to the electricity number from section a.
ii) Taking into account bus routes and frequency of service, the MBTA estimates that 49 percent of their bus VMTs are within Boston boundaries. We applied this factor to the MBTA's system-wide diesel, CNG, and gasoline consumption.

15. *Waste*. We have eliminated GHG emissions associated with waste from the inventory. As far as we have been able to determine, almost all waste collected in Boston, both residential and commercial, is burned in power plants that use the waste to produce electricity. The GHGs emitted in this process are included in ISO-New England's calculation of the GHG emissions factor for electricity. To include a separate GHG figure for waste would, therefore, be double-counting. Notwithstanding this change, the City of Boston remains committed to reducing solid waste in Boston, and publishes its figures on waste collection in its Boston About Results reports http://www.cityofboston.gov/bar/.

16. *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 separate BWSC emissions, which are incorporated into the commercial/industrial category of the community inventory. 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 the total annual energy used based on measurements of actual water and sewer flows. Boston accounts for about one-third of MWRA system usage. A few MWRA buildings outside of the Deer Island complex are likely included in the commercial/industrial energy consumption reported to us by the utilities, so there may be some double counting of that electricity and natural gas use, but we think that it is negligible.

17. *Other emissions; other methods.* As mentioned in an earlier note, the inventory does not include emissions from airplane travel at Logan Airport. An order-of-magnitude calculation based on average airline travel by U.S. residents suggests that the inclusion of emissions from airplane travel by Boston residents would add on the order of one million tons of CO2e to the annual inventory. The inventory also does not include emissions associated with the production, transportation, and waste disposal of all food and other goods consumed by the community. We made another order-of-magnitude calculation using average consumption data from the U.S. Consumer Expenditures Survey conducted by the Bureau of Labor Statistics and emissions factors from the Berkeley Institute of the Environment, University of California, Berkeley. This calculation suggests that life-cycle emissions from consumption in Boston are on the order of five million tons CO2e. Both of these calculations are very rough and could easily vary, up or down, by a factor of 2 or more. Comments on this paragraph are particularly welcome.

18. *The effects of weather.* The GHG inventory is not adjusted for weather, because the reduction goals are absolute. However, as discussed in the summary, the City does analyze the effects of weather to better understand the factors affecting emissions. Data on heating degree days (HDD) and cooling degree days (CDD) in Boston are available from the National Oceanic and Atmospheric Administration, http://www.ncdc.noaa.gov/IPS/lcd/lcd.html

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Heating Degree Days	5875	5008	5654	5426	5656	5049	5137	4754	5521
Cooling Degree Days	894	801	907	789	591	1082	1007	905	920