



2008 Greenhouse Gas Emissions Inventory Summary and Methodologies

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Introduction

This inventory document provides a breakdown of greenhouse gas emissions for the City of Vancouver's municipal operations and for the community. It also describes sources of information and methodologies used to estimate or quantify (where possible) greenhouse gas emissions based on the most recent 2008 inventory data available to the City.

Greenhouse Gas Protocols

Protocols advance the consistent, comparable, and relevant quantification of emissions and appropriate, transparent and policy-relevant reporting of emissions. Carbon accounting is a new field and protocols are evolving. Therefore, inventories from previous years are sometimes re-cast to support newer versions of the protocols.

The original 1990 and 2000 greenhouse gas inventories and targets for Vancouver were developed under the Partners for Climate Protection Program (PCP)¹, a program of the Federation of Canadian Municipalities (FCM). The guideline followed at the time was the "International Council for Local Environmental Initiatives (ICLEI)/ Cities for Climate Protection (CCP)/ Guidelines for Reporting" (Draft 3.0, April 1999).

The 2008 inventory followed ICLEI's newer International Local Government GHG Emissions Analysis Protocol (release version 1)² which applies to both municipal operations and the community. In future years the City's GHG Accounting protocol(s) will follow those established under the BC Climate Action Charter³.

1 PCP Program - sustainablecommunities.fcm.ca/partners-for-climate-protection/

2 ICLEI International Local Government GHG Emissions Analysis Protocol - iclei.org

3 BC Climate Action Charter - cd.gov.bc.ca/ministry/docs/climate_action_charter.pdf



2008 Community Greenhouse Gas Inventory

In 2008, community wide emissions returned to 1990 levels despite a population increase of 27% (1990-2008).

2012 Target	2020 Target	2050 Target
6% below 1990 level 2,550,000 tonnes of GHG	33% below 2007	80% below 1990

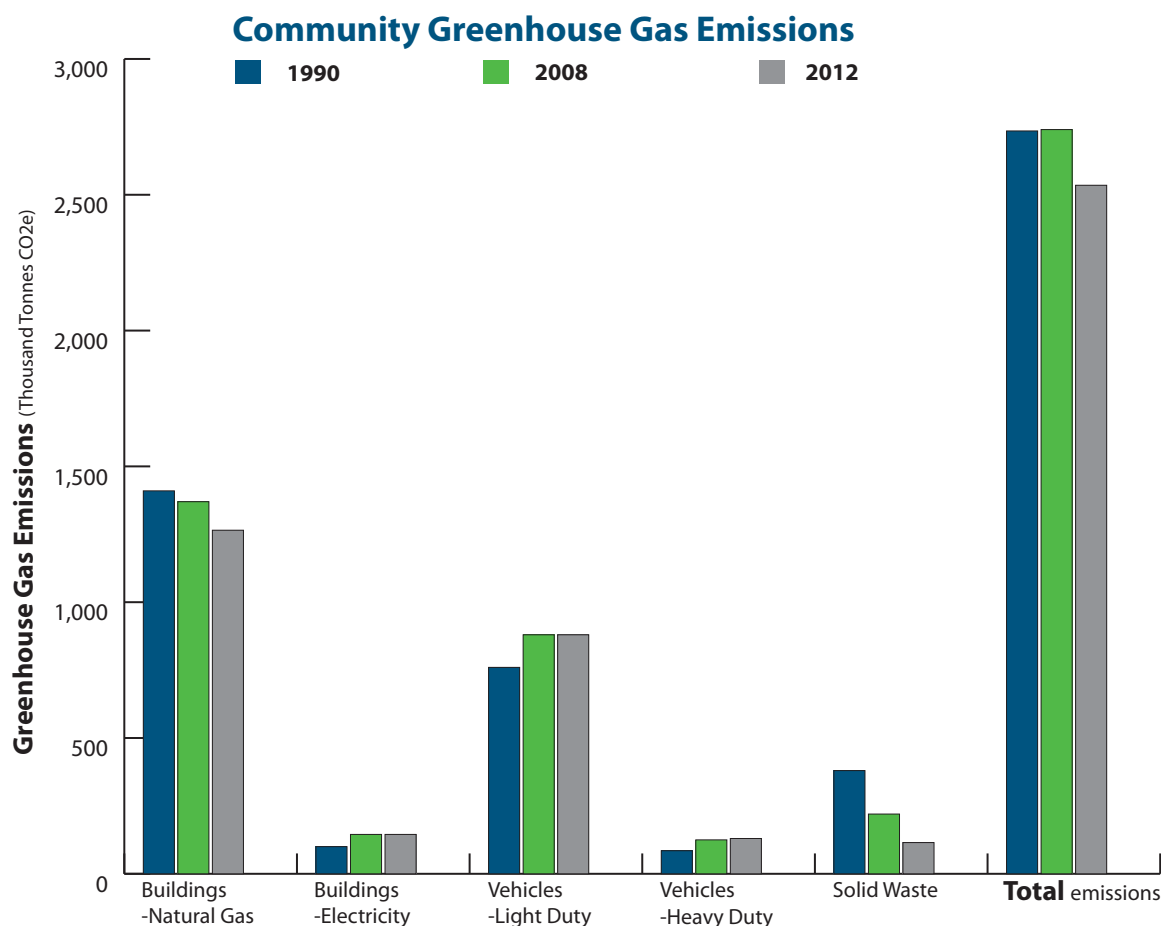
Community GHG Emissions (in tonnes of CO ₂ e)			
	1990	2008	2012 (forecast)
Buildings - Natural Gas	1,410,000	1,370,000	1,265,000
Buildings - Electricity	100,000	145,000	145,000
Light Duty Vehicles	760,000	880,000	880,000
Heavy Duty Vehicles	85,000	125,000	130,000
Solid Waste	380,000	220,000	115,000
TOTAL	2,735,000	2,740,000	2,535,000

Updates and Revisions

For the City of Vancouver 2005 Community Climate Change Action Plan, and subsequent 2007 Climate Protection Progress Report⁴, non-road mobile emissions were included in the inventory. This category was not included in this 2008 inventory as ICLEI Protocols do not require this data to be reported when it is difficult to adequately validate the quality of data at the local level. Other large cities are also not reporting this category in recent inventories.

⁴ City of Vancouver 2006 GHG inventory, 2007 Climate Protection Progress Report. vancouver.ca/sustainability/climate_protection.htm





Community Electricity and Natural Gas Emissions

The original 2005 Community Climate Change Action Plan showed combined emissions relating to electricity and natural gas consumption under end-user categories (residential buildings, commercial buildings and industry). This 2008 Inventory includes emissions by energy type (electricity and natural gas), as local utilities classify users by consumption amount and not by user types.



BC Hydro provided electrical use data for Vancouver from 1995 to 2008. For electrical consumption, the annual growth has been relatively stable (approximately 1.6% per year) over the thirteen years of data. This annual change was used to both backcast to 1990 and forecast to 2012.

For community natural gas use, Terasen Gas provided Vancouver-specific data for 2003 through to 2008. They were unable to re-produce the 1990 and 2000 Vancouver specific data that originally came from the Greater Vancouver Regional District (GVRD) and was used in the 2005 Community Climate Change Action Plan. However, Terasen was able to provide lower mainland regional data for 1993 to 2006 that allowed for a 'reasonableness' check of the old and new data based on Vancouver's share of the regional population. The original but unrepeatably GVRD 1990 and 2000 Vancouver data varied only a few percentage points from the 1993-2006 data, so the original number reported for 1990 was considered reasonable.

For the 2010 and 2012 projections, weather normalised⁵ natural gas use showed a slightly downward trend in overall natural gas use, which Terasen confirmed as being a trend since the mid 1990s. The 2012 forecast assumes normal weather and a slow rise in natural gas prices over time to 2012.

Community Light-Duty Vehicle (LDV) Emissions

Vancouver's LDV emissions for 1990 and 2008 were estimated using annual Vancouver gasoline sales (from tax proceeds data) multiplied by a correction factor and the gasoline emission factor. A correction factor was applied recognizing more people travel to and from Vancouver on a daily basis (and therefore purchase fuel here) than vice versa.

The correction factor was determined using Vancouver's original 2005 Vancouver Community Climate Change Action Plan methodology for estimating LDV GHG emissions which was grounded on vehicle mileage data from AirCare testing for 1993, 1996, 1999, and 2002. While this original methodology was a robust approach, it had to be abandoned due to changes in AirCare testing after 2002. In this original methodology, Vancouver's share of regional gasoline sales for any given year was determined from the ratio of the total mileage

⁵ Terasen Gas normalizes over the previous 20 year period



of vehicles registered and insured in Vancouver compared to the total mileage of vehicles registered and insured in the region.

The correction factor for the current methodology was based on the ratio of Vancouver's share of regional fuel sales compared against actual fuel sales in Vancouver. This approach resulted in a correction factor of 0.91 based on the average ratio for 1996, 1999, and 2002.

The LDV projections for 2012 do not include the forecasted 0.5% reduction in the carbon content of fuel that is anticipated with the introduction of the BC Government Low Carbon Fuel Regulations.

Community Heavy-Duty Vehicle (HDV) Emissions

Vancouver's 1990 and 2000 HDV emissions, for vehicles weighing more than 5,000 kg⁶, were based on Metro Vancouver modelling as reported in their "2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed: Detailed Listing of Results and Methodology". A small adjustment was made to the 1990 and 2000 numbers reported in the 2007 Climate Protection Progress Report after an accounting error was found in apportioned percentage for Vancouver which should have been 16% of Metro Vancouver emissions instead of 12% of those emissions.

Vancouver's 2006 and 2008 HDV emissions, and 2012 projection, were based on Metro Vancouver modelling in the "2005 Lower Fraser Valley Air Emissions Inventory & Forecast and Backcast-Full Report"⁷. This report included new vehicle kilometres travelled (VKT) estimates from Translink's regional transportation model that are applicable for 2005 but not necessarily at the local level for earlier years back to 1990.

For 2005, Metro Vancouver apportioned greenhouse gas emissions for the spatial regions within the Canadian Lower Fraser Valley. For 2005, Vancouver was allocated 14.4% of the Metro Vancouver greenhouse gas emissions (11.3% of the Lower Fraser Valley).

⁶ Closest Metro Vancouver weight classification to AirCare 5,000kg limit was 4,536kg (Mobile6 classification). Therefore HDV portion with the lower threshold would likely have included slightly more vehicles than if the exact 5,000kg cut-off were available. This over-counting is considered negligible.

⁷ Metro Vancouver 2005 Lower Fraser Valley Air Emissions Inventory & Forecast and Backcast Report - metrovancover.org/services/air/emissions/Pages/default.aspx



The percentage of HDV's in the $\geq 5,000$ kg weight class was only available for the Lower Fraser Valley (LFV). Therefore, the same percentage was applied to Vancouver with the assumption that breakdown of HDV vehicles sizes was generally the same at the local and regional level.

The HDV projections for 2012 do not include the forecasted 0.5% reduction in the carbon content of fuel that is anticipated with the introduction of the BC Government Low Carbon Fuel Regulations.

Community Solid Waste Emissions

Greenhouse gas emissions result from the decomposition of organic waste in landfills. Vancouver's Landfill GHG emissions for 1990, 2008, and 2012 are based on CH2M Hill Ltd.'s updated 2009 model for landfill gas generation. This model estimates past, present, and future landfill gas emissions incorporating anticipated increases in waste tonnages and the impacts of past and planned landfill gas recovery projects.

The Vancouver Landfill processes waste from multiple municipalities. The portion of the Landfill waste and emissions attributable to the Vancouver community were as follows:

- 1990 - 83%
- 2008 - 74%
- 2012 projection - 75%

2008 Municipal Operations Greenhouse Gas Inventory

Emissions from municipal operations were 33% below 1990 levels in 2008, exceeding the 2010 target.

2010 Target

20% below 1990 level
400,000 tonnes of GHG

2012 Target

Carbon Neutral
Operations



2008 Greenhouse Gas Emissions Inventory

Summary and Methodologies



Municipal Operations GHG Emissions (in tonnes of CO ₂ e)			
	1990	2008	2010 (forecast)
Buildings	23,500	21,000	18,000
Vehicle Fleet	15,500	18,500	19,000
Street & Traffic Lighting	1,000	1,000	1,000
Vancouver Landfill	461,000	295,000	104,000
TOTAL	501,000	335,500	142,000

Updates and Revisions

For the City of Vancouver 2003 Corporate Climate Change Action Plan, and subsequent 2006 Greenhouse Gas Emissions Inventory⁸, only the waste from municipal operations was included in the municipal operations inventory as per accounting practices at the time. These emissions were a small portion of the overall inventory. The most recent ICLEI protocol directs local governments that operate a landfill to account for all of the landfill waste in the municipal operations inventory, regardless of the source of the waste. As a result of this change the new waste emissions represented a much higher portion of the overall municipal operations inventory.

Municipal Facilities

Natural gas and electricity data for all facilities owned and occupied by the City of Vancouver were provided by Terasen Gas and BC Hydro.

Some facilities owned by the City are leased and operated by other organizations. To determine which buildings should be considered in the inventory, the City used the 'Operational Control' approach as outlined in GHG protocols.

The 2010 projection for GHG emissions from municipal facilities was based on projected impacts of facility energy retrofits currently underway, combined with anticipated energy consumption from new facilities and decommissioning of old facilities.

⁸ City of Vancouver 2006 GHG inventory included in the 2007 Climate Protection Progress Report.



2008 Greenhouse Gas Emissions Inventory

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Municipal Fleet

Emissions from City vehicle operations were based on City bulk fuel sales data. Fuel usage records for 1990 to 2008 were pulled from the City's own internal fuel tracking database which only accounts for fuel that has been dispensed to City vehicles from City pumps. Best efforts were made to capture fuel purchases from retail gas stations, though these numbers are not material when compared with fuel used from City fuel stations. Fuel usage projections were based on the best fit line for annual fuel usage experienced in the last 24 years.

Current fuel estimates are based on a broad data sample size as well as a reasonable fuel data collection process.

Municipal Street and Traffic Lighting

GHG emissions from street, traffic and parks lighting were based on BC Hydro data.

Vancouver Landfill

Greenhouse gas emissions result from the decomposition of organic waste in landfills. Vancouver's Landfill GHG emissions for 1990, 2008, and 2010 are based on CH2M Hill Ltd.'s updated 2009 model for landfill gas generation. This model estimates past, present and future landfill gas emissions incorporating anticipated increases in waste tonnages and the impacts of past and planned landfill gas recovery projects.

The City operates the Landfill therefore all of the Landfill emissions were included in the municipal inventory (per GHG protocols).

Sewer Pumping

The minimal GHG emissions resulting from sewer pumping distribution systems, <50 tonnes, was based on BC Hydro data. This number is considered insignificant and therefore not included in the inventory summary tables.



Organizational Boundaries

Choosing the organizational boundary is an important decision for cities like Vancouver with diverse business planning areas and facilities. For this inventory the City followed the 'Operational Control' approach which is a typical way to represent the emission sources that local government's can influence.

Emission Factors

Natural Gas

51.1 tonnes per terajoule of natural gas as per the BC Government draft 2007 Community Energy and Greenhouse Gas Emissions Inventory (CEEI) for Vancouver⁹.

Electricity

Variable (see 'community energy and natural gas emissions' section within the community inventory summary for further details)

- 1990 - 27 tonnes/GWh
BC Hydro recently updated their methodology for calculating carbon intensity as part of the Global Reporting Initiative (GRI)¹⁰. During the period 1989-1993 the carbon intensity varied significantly from 9-50 tonnes per GWh. Due to high variability in these numbers, BC Hydro recommended using the 5 year average of 27 tonnes per GWh as most representative of carbon intensity for 1990.
- 2008 - 28 tonnes/GWh
The carbon intensity for 2008 was obtained from the BC Hydro GRI.
- 2010 and 2012 projections - 26 tonnes/GWh
An average emission factor of the years 2004-2008 (from the GRI reports) was used to project the 2010 and 2012 electricity emission factors. BC Hydro suggested this was the most reasonable approach given that the variation in intensity is primarily due to variations in rainfall.

⁹ CEEI - env.gov.bc.ca/epd/climate/ceei/reports.htm

¹⁰ BC Hydro Global Reporting Initiative - bchydro.com/about/company_information/reports/gri_index.html



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Vehicle Fuel

Factors taken from Canada's Greenhouse Gas Inventory Report 1990-2005, Greenhouse Gas Division, Environment Canada, April 2007¹¹

- gasoline - 0.00236 tonnes of CO₂/litre of gasoline
- diesel - 0.00273 tonnes of CO₂/litre of diesel
- propane - 0.00155 tonnes of CO₂/litre of propane

The following biodiesel factors reflect the ICLEI Protocol which states that the biogenic portion of the biodiesel fuel should not be included in the inventory because those emissions would have occurred anyway as part of the natural carbon cycle.

- B5 biodiesel - 0.00253 tonnes of CO₂/litre of B5
- B20 biodiesel - 0.00218 tonnes of CO₂/litre of B20

11 Canada's Greenhouse Gas Inventory Report 1990-2005, Greenhouse Gas Division, Environment Canada, April 2007



