METHODOLOGY FOR REPORTING 2011 B.C. LOCAL GOVERNMENT GREENHOUSE GAS EMISSIONS

VERSION 2.0

Ministry of Environment
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Preface

Use of the emission factors and methodologies in this document are required by the Green Communities Committee as part of the common approach to carbon neutrality under the Climate Action Charter. The *Methodology for Reporting BC Local Government Greenhouse Gas Emissions* has been developed for use by those local governments who are using a corporate emissions inventory and reporting tool other than SMARTTool. Local governments who have the time, expertise and resources to develop an inventory tool in-house or who choose to utilize a professionally developed tool other than SMARTTool should use the information provided in this document.

The Methodology document is meant to provide a technical overview for local governments, stakeholders, interested parties and people involved in calculating greenhouse gas (GHG) emissions from the data provided by local governments related to corporate energy consumption.

The document outlines:

- The emission factors used to calculate emissions for different sources and uses, including the energy conversion factors and global warming potentials used;
- The source data for the emissions factors; and
- Any calculations or adjustments made to the emissions factors.

Please note that the information provided in this document has been developed for a B.C.-specific context. Wherever possible, the emission factors stated are B.C.-specific and are based on the best available information. When an emission factor requires updating or is not available, Shared Services BC and the Ministry of Environment will research and provide expert advice to develop a new emission factor. All changes will be reflected annually in this document for transparency. Direct changes to emission factors will be bolded and **color coded** in tables for ease of identifying updates.

- In instances where a local government chooses to develop their own GHG inventory and reporting tool, they may need to consider the following potential challenges: Manually inputting formulas into a spreadsheet such as Excel increases the chances of human error. This can be somewhat mitigated by locking the formula cells so they cannot be changed accidently and having a third party check the formulas and data entry,
- When emissions factors, algorithms, or scope changes occur, these changes will need to be reflected in the GHG management system. This means that when the new Methodology Document is created every year, the emissions factors will need to be checked against those in the most up to date version of the this document, and any addenda or errata produced (available on the Toolkit Website), and
- Local governments who choose to create their own tools for GHG management will need to rely on their own internal or contracted expertise for set-up and trouble-shooting.

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1. Introduction

Since 2007, the majority of local governments in B.C. have voluntarily signed the Climate Action Charter (CAC), committing to develop strategies and take actions to achieve the following goals:

- being carbon neutral in respect of their operations by 2012;[1]
- measuring and reporting on their community's GHG emissions profile; and
- creating complete, compact, more energy efficient rural and urban communities

Under the Climate Action Charter the joint Provincial Government – Union of British Columbia Municipalities (UBCM) Green Communities Committee (GCC) was created to support local governments in planning and implementing climate change initiatives. The Carbon Neutral Working Group (the working group) was established to advise the GCC in carrying out this mandate with respect to corporate carbon neutrality. The GCC and the working group collaborated to produce the Carbon Neutral Workbook (the Workbook), which provides guidance to local governments on what is in scope to measure and offset within the boundaries of their corporate emissions. The boundaries for calculating carbon neutrality are based on the operation and maintenance of traditional local government services:[2]

- Administration and Governance;
- Drinking, Storm and Waste Water;
- Solid Waste Collection, Transportation and Diversion;
- Roads and Traffic Operations;
- Arts, Recreational and Cultural Services; and
- Fire Protection.

With its own commitment to a carbon neutral public sector for 2010, the BC government developed a web-based application to assist with GHG measurement and reporting. "SMARTTool" calculates and reports the GHG emissions from buildings, fleet vehicles and equipment, paper and travel (for core government only).

Recognizing that not all communities will choose to use SMARTTool, the GCC is supporting the use of other GHG measurement tools for the purposes of the Climate Action Charter. To ensure methodology, emission factors and outputs from other tools are consistent and comparable with SMARTTool results, a local government choosing to use another inventory and reporting tool will be required to meet the following standards:

1. Use the same corporate boundaries as defined in the Workbook;
2. Use the GHG measurement methodology and emission factors in this guide, and updates as provided by the Climate Action Secretariat (see Section 1.3)
3. Complete and adhere to the Business Processes Checklist
4. Report on annual total corporate emissions as calculated by a GHG inventory tool; and

[1] Solid waste facilities regulated under *the Environmental Management Act* are not included in operations for the purposes of this Charter.

[2] Within the traditional service sectors not all emissions will be captured. Any emissions related to the operation and maintenance of traditional services are included. Emissions related to new construction, business travel, employee commuting and materials are not included.

5. Provide Chief Administrative Officer (CAO)/ Chief Financial Officer (CFO) attestation that all of the above listed actions were taken.

All of the supporting materials for these standards are available on the Climate Action Toolkit website at: www.toolkit.bc.ca/carbon-neutral-government

The primary purpose of this document is to detail the emission factors and methodology used for calculating and reporting local government emissions. Emission factors express the mass of GHGs resulting from a specific kind of activity (e.g., how many kilograms of carbon dioxide are produced by burning one litre of gasoline in a car). The document is also designed to provide background information regarding how the emissions factors were determined; including references to source materials and any calculations applied to emissions factors.

This document will be periodically revised to reflect changes or clarifications to the emission factors, methodologies and scope. Local government users should ensure that they are using the most current version of this document each year. These will be housed on the Toolkit website at: www.toolkit.bc.ca

By understanding and applying the information contained in this methodology document and completing the *Self Certified Business Process Checklist for SMARTTool/Alternative Tool* available at www.toolkit.bc.ca, local governments can be assured that their GHG emissions inventory are accurate and consistent with those being developed by local governments across British Columbia.

1.1 Principles for Specifying Emission Factors

The following principles have been established by the province to guide in the development of the GHG emission factors found in this document:

1) If information allows, the preference is to identify B.C.-specific emission factors that best reflect local government circumstances – for example, a local government's particular source of electricity or fuel.

2) Where B.C.-specific information is not available, standardized emission factors from national and international data sources will be used. In particular, factors will be taken from Canada's National GHG Inventory Report (NIR),[3] and other recognized sources. Over time efforts will be made to develop and apply B.C.-specific emission factors in order to improve the accuracy of public sector GHG tracking.

3) A key principle is to facilitate emissions tracking and ensure that measurement and reporting requirements are not overly burdensome or costly for local governments. Therefore, in certain cases (such as where an emissions source is too small to justify additional data gathering by an organization) simplified methods for estimating emissions will be provided.

4) In developing simplified estimation methods, upper bound assumptions will be used in accordance with the principle of conservativeness – erring on the side of overestimating rather than underestimating emissions.

[3] Environment Canada. (2011). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2009*. Submission to the United Nations Framework Convention on Climate Change.

1.2 GHG Emission Factors Defined

Emission factors are expressed in kilograms (kg) of GHG emissions per unit of consumption activity. Typically, the factors for a given category of activity – for example, building energy or fleet fuel consumption – are expressed in common units to enable comparison across different fuel types and technologies.

The Carbon Neutral Workbook lists six distinct greenhouse gases or groups of gases: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); sulphur hexafluoride (SF_6); and perfluorocarbons (PFCs). For local governments, the only GHGs emitted in significant amounts are the three principal gases associated with fuel combustion for energy (CO_2, CH_4 and N_2O).

In the case of fossil fuel blends with biofuel (e.g., ethanol, biodiesel), gasoline or diesel are combined with varying proportions of biofuels (e.g., E10, B5, B20), resulting in emission factors that are weighted averages of the biofuel and fossil fuel factors. However, since international rules require the separate reporting of biogenic emissions from combustion (see Section 2.1); the CO_2 emissions from the biofuel component (Bio CO_2) must be calculated and reported separately from those of the fossil fuel component.

Wherever possible, emission factors are specified by individual gas. In certain instances, an aggregate factor for multiple gases is provided in kg of CO_2 equivalent (CO_2e) emissions. CO_2e is the standard unit for measuring and comparing emissions across GHGs of varying potency in the atmosphere (see Sections 1.3 and 5.2).

1.3 Global Warming Potentials and Emissions Calculations

All greenhouse gases vary in their ability to trap heat in the atmosphere. The concept of "global warming potential" (GWP) or "CO_2-equivalent" (CO_2e) has been developed to enable comparison of the ability of different GHGs to trap heat in the atmosphere (radiative forcing).[4] By definition, the GWP from the release of 1 kg of CO_2 equals one, with the GWP of other GHGs stated relative to CO_2. The GWP of a GHG accounts for both the immediate radiative forcing due to an increase in the concentration of the gas in the atmosphere, and the lifetime of the gas. For example: 1 tonne of CH_4 has a GWP of 21, indicating that it's radiative forcing is 21 times that of CO_2. See Annex 5.2 for complete list of GWP for all gases covered by the *Greenhouse Gas Reductions Targets Act* (*GGRTA*.)

For measurement purposes, GWPs are applied after the emission factors have been used to calculate the emissions of each gas (see Section 4). To calculate GHG emissions, the emission factors are simply multiplied by the measure of consumption (activity), and then the GWP.

The primary source document for emission factors is the *British Columbia Greenhouse Gas Inventory Report 2008* (PIR).[5] Where provincial data is not available, the factors from Environment Canada's *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2009* have been used.[6, 7]

[4] The term "radiative forcing" refers to the amount of heat-trapping potential for a GHG, measured in units of power per unit of area (watts per metre squared).
[5] British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*. Annex 10.3 provides standardized factors for stationary and mobile fuel consumption and other emitting activities.
[6] Environment Canada (2011). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2009*.

International documents, such as The Climate Registry's *General Reporting Protocol*,[8] have been used for some emission factors. B.C.-specific emission factors have been developed in other cases, using data provided by energy companies.

The emission factors reported in this document represent the B.C. government's current understanding of the factors appropriate to local government emission sources and fuel types. As experience is gained with estimating GHG emissions in the public sector and with local government, the list of emission factors may be expanded. It is also expected that the factors themselves and other key inputs (e.g., energy conversion factors, GWPs) will be updated as GHG measurement methodologies and data sources evolve.

1.4 Structure of this Report

The remainder of this report provides the information necessary to understand how the emissions factors were determined, what they are and how to apply them to calculate emissions from a given activity/source. The information provided in this document should be used by local governments to calculate emissions and ensure their inventories are consistently based on the standard approach developed by Ministry of Environment and used by SMARTTool.

Sections 2 and 3 provide the emissions factors for Stationary Sources and Mobile Sources, respectively. In each of these sections and for each activity category, a brief description is provided along with an explanation of data sources and emission factor calculations. The data sources and calculations are provided to ensure accountability and transparency in emissions reporting. Sections 2 and 3 also include the emissions factors and energy conversion factors used to calculate emissions for each activity category.

Section 4 provides a Sample Calculation based on the emission factor, energy conversion factor and global warming potentials provided in this document. It provides an example for how emissions are calculated from a given activity, and can be used as the basis for calculating emissions factors using the information provided in this document.

Section 5 provides additional information in the form of Annexes, including the Glossary of Terms and Acronyms (Annex 5.1), Global Warming Potentials (Annex 5.2), SMARTtool Buildings Energy Estimation Method Summary (Annex 5.3), and Selected References (Annex 5.4).

2. Stationary Sources

GHG emissions are produced from activities associated with the lighting, heating and cooling of facilities, and the powering of machinery and equipment within those facilities.

[7] The PIR factors match most of those found in the NIR, however, for simplicity and ease of use, the PIR factors will be referenced throughout this document where the data is available in both documents.
[8] The Climate Registry (2008). *General Reporting Protocol*, Version 1.1. B.C. is a member of the Climate Registry, which is a cross-border initiative to develop common measurement, verification and reporting requirements for GHG emissions. See: www.theclimateregistry.org.

2.1 Direct Emissions: Stationary Fuel Combustion

Description: Several different fossil fuels may be consumed in buildings: natural gas; propane; light fuel oil (No. 2 heating oil); kerosene; marine diesel; diesel fuel; and gasoline. In addition, a few local governments may burn wood fuel and wood waste in some of their buildings. For the purposes of SMARTTool reporting and in alignment with international reporting requirements, emissions from biomass combustion, including wood, wood waste, ethanol and biodiesel must be reported.[9]

For biomass combustion, CO_2 emissions must be reported separately from CH_4 and N_2O emissions[10]. PSOs are only required to offset the CH_4 and N_2O emissions from biomass combustion. PSOs considering biomass should be aware that there are ongoing international discussions around the proper treatment of biomass and how to best account for the CO_2 storage and emissions of different harvested wood products (e.g. waste wood vs. virgin wood) and the associated forest management practices occurring on the land base. The risk of future accounting changes will be minimized to the extent that biomass is diverted from waste streams, that biomass is used for the most appropriate long-term purposes and that non-waste biomass comes from sustainably managed forest lands.

In SMARTTool, building fuel consumption data are entered either in common units of energy usage (i.e., Gigajoules – GJ) or are converted to GJ within the application itself.

Data sources: The standardized emission factors for stationary fuel combustion can be found in two sources; Table 34 of the 2008 PIR,[11] and the 1990-2008 NIR as follows.[12]

- The natural gas CO_2 emission factor is taken from Table A8-1 under the entry "British Columbia – Marketable".
- The natural gas CH_4 and N_2O emission factors are taken from Table A8-2 under "Residential, Construction, Commercial/Institutional, and Agriculture".
- The propane emission factors are taken from Table A8-3 under the entries for "All Other Uses".
- The light fuel oil, kerosene and diesel emissions factors are taken from Table A8-4 (with light fuel oil and diesel falling under "Forestry, Construction, Public Administration and Commercial/Institutional");
- The gasoline and marine diesel emissions factors are taken from Table A8-11 under the respective entries for "Off-Road Gasoline" and "Diesel Ships". The wood emissions factors

[9] The CO_2 released *to* the atmosphere during combustion of biomass is assumed to be the same quantity that had been absorbed *from* the atmosphere during plant growth. Because CO_2 absorption from plant growth and the emissions from combustion occur within a relatively short timeframe to one another (typically 100-200 years), there is no long-term change in atmospheric CO_2 levels. For this reason, CO_2 from biomass is often considered "carbon-neutral" and the Intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories* specifies the separate reporting of CO_2 emissions from biomass combustion. See: IPCC (2006), *2006 IPCC Guidelines for National Greenhouse Gas Inventories,* p. 5.5; and the Climate Registry (2008), *General Reporting Protocol*, pp. 33-34.

[10] Based on current international standards, British Columbia already reports the CH_4 and N_2O portions of biomass combustion as line items in the Provincial Inventory Report. CO_2 biomass emissions are currently reported as memo items.

[11] British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*, pp. 62-63.

[12] Environment Canada (2011). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2009,* Annex 8 pp. 191-205.

are taken from Table A8-26 under the entries for "Wood Fuel/Wood Waste Industrial Combustion" and "Conventional Stoves Residential Combustion".

Energy conversion factors to convert to GJ from cubic metres of natural gas and litres of liquid fuels are from Statistics Canada's most recent *Report on Energy Supply and Demand in Canada* (RESD).[13]

Calculations: In B.C., the *Renewable and Low Carbon Fuel Requirements Regulation* (*RLCFR*) sets benchmarks for the amount of renewable fuel in the provinces transportation and heating fuel blends. Effective January 1st, 2011, fuel suppliers are required to incorporate renewable fuel contents of 5% for gasoline and 4% for diesel into the sum of total fuel sold at a provincial level. In SMARTTool, for any given volume of reported gasoline consumption, 95% of the fuel is fossil fuel gasoline and the remaining 5% is ethanol. For Diesel, 96% is fossil fuel diesel and 4% is biodiesel The emission factors in Table 1 have been calculated by applying the energy conversion factors shown to the emission factors in Table 2. The original emission factors were manipulated only to convert from grams to kg per unit of fuel use, except in the case of gasoline and diesel fuels, where the numbers were adjusted to account for the renewable fuel content under the *RLCFRR*.

Table 1: Stationary Fuel Combustion

Fuel Type	Energy Conversion Factor	Emission Factor (kg/ GJ)			
		Bio CO_2	CO_2	CH_4	N_2O
Natural Gas	0.03843 GJ/ m^3	–	49.86	0.0010	0.0009
Propane	0.02531 GJ/ L	–	59.66	0.0010	0.0043
Light Fuel Oil	0.03880 GJ/ L	2.75	67.42	0.0007	0.0008
Kerosene	0.03768 GJ/ L	–	67.25	0.0007	0.0008
Diesel Fuel	0.03830 GJ/ L	2.75	66.75	0.0035	0.0104
Marine Diesel	0.03830 GJ/L	2.75	66.75	0.0039	0.0287
Gasoline	0.03500 GJ/ L	3.19	62.13	0.0771	0.0014
Wood Fuel - Industrial	0.01800 GJ/ kg	46.67	0	0.0050	0.0011
Wood Fuel - Residential	0.01800 GJ/ kg	83.33	0	0.8333	0.0089

Table 2: Source Emission Factors – Stationary Fuel Combustion[14]

Fuel Type	Units	Bio CO_2	CO_2	CH_4	N_2O
Natural Gas	kg/ m^3	–	1.916	0.000037	0.000035
Propane	kg/ L	–	1.510	0.000024	0.000108
Light Fuel Oil	kg/ L	0.0980	2.616	0.000026	0.000031
Kerosene	kg/ L	–	2.534	0.000026	0.000031
Diesel Fuel	kg/ L	0.0980	2.557	0.000133	0.0004
Marine Diesel	Kg/L	0.0980	2.557	0.00015	0.0011

[13] Statistics Canada (20011). *Report on Energy Supply and Demand in Canada 2009*, p. 125.
[14] See Environment Canada (2011). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2009.*, and British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*.

Gasoline	kg/ L	0.0747	2.175	0.0027	0.00005
Wood Fuel - Industrial	kg/ kg	0.840	0	0.00009	0.00002
Wood Fuel - Residential	kg/ kg	1.500	0	0.015	0.00016

2.2 Indirect Emissions: Purchased Electricity

Description: In a hydroelectric-based power system such as British Columbia's, the GHG emissions from electricity can vary significantly from year to year. This variation is influenced by both the quantity purchased by consumers, and variation in water supply conditions and reservoir levels. During years with low stream flow and/or low reservoir levels, available power must be supplemented through electricity purchase from neighbouring jurisdictions or through thermal (fossil-fuel) generation and thus GHG emissions are relatively high. During years with higher stream flow and/or high reservoir levels, less thermal (fossil fired) power is needed and GHG emissions are relatively low. Emissions also differ between electric utilities relative to the shares of hydro and thermal power in the supply mix of each utility. Depending on building locations, local governments acquire electricity from BC Hydro, FortisBC or a municipal distributor.[15]

SMARTTool captures data on electricity consumption in kilowatt-hours (kWh) and makes the conversion to GJ of energy.

Data sources: BC Hydro tracks GHG emissions in its Annual Report and as part of a Global Reporting Initiative (GRI) Index.[16] This tracking includes domestic purchases of electricity from independent power producers (IPPs), which together account for the largest share of BC Hydro's reported emissions (70 percent in 2009). The emissions associated with electricity imports for domestic use are not included. This exclusion will be evaluated as policy evolves in regard to imported electricity.[17]

Taken from the BC Hydro GRI Comparative Index "EN16(2) Greenhouse Gas Intensities," the emissions factor given in Table 3 for BC Hydro represents the sum of emissions from BC Hydro power facilities and IPP purchases, divided by the electricity generated at those sources.[18]

While FortisBC and the municipal distributors do not publicly report on GHG emissions, their emissions can be estimated from electricity supply data. Information on the recent (2008) supply mix was obtained directly from utility contacts.

Calculations: In Table 3, the BC Hydro emission factor is based on the reported GHG Intensity for the utility's total domestic supply. The emission factor of 25 tonnes CO_2e per Gigawatt-hour

[15] There are six municipal electric utilities, respectively serving the cities of Grand Forks, Kelowna, Nelson, New Westminster, Penticton and Summerland.
[16] BC Hydro (2011). BC *Hydro 2011 Annual Report,* p. 93.
[17] Under voluntary international GHG protocols, BC Hydro is not required to measure and report the emissions from purchased electricity – either domestic or imported – that is passed on to consumers. BC Hydro has chosen to voluntarily report the emissions from domestic IPP purchases, but import-related emissions are not yet included in its GHG inventory. Starting in 2011, importers of electricity are required to report GHG emissions associated with the generation of this electricity.
[18] See Indicator EN16(2) of the GRI Index at: www.bchydro.com/about/company_information/reports/2010_gri/f2010_environmental_EN16_2.html.

(GWh) has been calculated as an average of BC Hydro's GHG intensities for 2007 through 2009.[19] A rolling three-year average is used to partially smooth out the annual fluctuation in the electricity emission factor due to changing water conditions.[20]

The FortisBC emission factor of 6 tCO_2e/GWh has been estimated using a weighted average of the GHG intensity of Fortis' own hydroelectric plants, purchased hydro and other renewable electricity, and purchases from BC Hydro. In calculating this average, a zero emission factor was assigned to existing hydro and other renewable (energy from wood waste) generation and purchases, which accounted for just over three-quarters of the utility's 2009 supply.[21] The BC Hydro emission factor was then applied to the remaining purchases in the supply mix.

Since the cities of Grand Forks, Kelowna, Penticton and Kelowna acquire all of their electricity from Fortis, they are assigned the same emission factor. Likewise, the City of New Westminster and Kyoquat is served by BC Hydro and so is given its emission factor. The City of Nelson's municipal utility, Nelson Hydro, generates about 55 percent of its annual electricity requirements from a local hydro plant and purchases the rest from Fortis.[22] These supply shares and the Fortis emission factor have been used to estimate a weighted average emission factor of 3 tCO_2e/ GWh. The final emission factors in Table 3 represent a weighted average of the fossil fuel factors in proportion to their generation shares.

Table 3: Purchased Electricity

Public Utility	Emission Factor (tCO_2e/ GWh)	Emission Factor (kg/ GJ)
BC Hydro[23]	25	6.9
Kyuquot Power	25	6.9
FortisBC	6	1.7
City of Grand Forks	6	1.7
City of Kelowna	6	1.7
Nelson Hydro	3	0.8
City of New Westminster	25	6.9
City of Penticton	6	1.7
City of Summerland	6	1.7
Note: Energy Conversion Factor = 0.0036 GJ/kWh		

[19] The reported GHG intensities were 23, 28 and 25 tCO_2e/GWh, respectively, for 2007, 2008 and 2009.
[20] Since there is a lag in collecting and reporting GHG emissions data, the emission factor estimated for the most recent calendar year of data available (e.g., 2009) may not necessarily reflect the water conditions in the current year for which emissions are being measured (e.g., 2010). Averaging over a three-year period will reduce the year-to-year differences.
[21] Wood waste generated electricity has been assigned a zero emission factor given that the CO_2 emissions from biomass are not included in Fortis' GHG inventory under international reporting rules.
[22] See: www.nelson.ca/EN/main/services/electrical-services.html.
[23] The BC Hydro emissions factor also applies to emissions from independent power projects that are off of the North American grid, but that sell power to BC Hydro, including the Central Coast Power Corporation (Ocean Falls in Bella Bella), the Clean Power Operating Trust (Hluey Lake in Dease Lake), the Coastal Rivers Power LP (Sandspit), and XEITL Limited Partnership (Pine Creek in Atlin)

2.3 Indirect Emissions: Purchased Steam and Hot Water Etc.

Description: Some local governments may also use steam to heat buildings. Where a local government produces steam for its own consumption, the resulting GHG emissions are estimated by applying the appropriate combustion emission factors to the quantity of fossil fuel burned in the steam boiler. Where a local government purchases steam from another entity, estimating emissions requires information on both the fuel source and the system efficiency.

SMARTTool captures data on purchased steam in pounds or kg and converts to GJ.

Data sources: The RESD provides an average conversion factor for translating kg of steam into GJ of energy.[24] The combustion emission factors for natural gas, light and heavy fuel oil, diesel and wood waste are provided in Table 1 on page 9.

System efficiencies can vary significantly depending on characteristics such as the age of the steam plant, distribution losses and operation and maintenance practices. Existing steam systems typically show average efficiencies of 65 to 75 percent. In the calculations below, a conservative system efficiency of 65 percent is assumed. However, local governments are free to specify a higher system efficiency if they can provide verifiable, documented evidence in support of this efficiency from their steam supplier.

Calculations: The default emission factor in Table 4 is based on a natural gas-fired steam system operating at 65 percent efficiency. It has been calculated by dividing the appropriate combustion emission factor in Table 1 by 0.65.

In many cases, steam plants are dual-fuelled. Typically, this involves boilers that run predominantly on natural gas, with minor amounts of fuel oil or diesel during peak periods. Because the use of other fuels in dual-fuelled steam plants occurs for a very short period of time (e.g. 1-2 days per year), the natural gas-fired steam emission factors may be applied to all energy consumption from these plants.

Note: Where a local government produces steam and sells a portion to another local government or a Public Sector Organization,[25] the producer must separately identify the emissions from the steam sales using the methodology below. These emissions are then deducted from the producer's GHG inventory to avoid double counting.

Table 4: Purchased Steam

Steam Production Fuel Source	Emission Factor (kg/ GJ)		
	CO_2	CH_4	N_2O
Natural Gas	76.71	0.0015	0.0014
Note: Energy Conversion Factor = 0.00275 GJ/kg			

[24] Statistics Canada (2011). *Report on Energy Supply and Demand in Canada 2009*. p. 125.

[25] Public Service Organizations are required under the Carbon Neutral Government Regulation to become Carbon Neutral for the 2010 reporting year. They encompass core government entities funded through the Consolidated Revenue Fund (e.g., ministries, special offices, and tribunals) and broader public sector agencies – health authorities, school districts (K-12), colleges and universities, and Crown corporations under the Government Reporting Entity.

3. Mobile Sources

The local government fleet of vehicles and equipment is a further source of GHG emissions. Direct emissions from burning fossil fuels in vehicles and equipment are tracked.

3.1 Direct Emissions: Mobile Fuel Combustion

Description: Emission factors are specified for seven transport modes:

- Light-duty vehicles;
- Light-duty trucks (including SUVs and minivans);
- Heavy-duty;
- Motorcycles;
- Off-road vehicles and equipment (e.g., snowmobiles, ATVs, lawnmowers and trimmers, tractors, construction equipment);
- Marine; and
- Aviation.

Ten fuel types have different emission factors associated with them:

- Gasoline;
- Diesel;
- Propane;
- Natural gas;
- Biodiesel;
- Ethanol;
- Marine Gasoline;
- Marine Diesel;
- Aviation Gasoline; and
- Aviation Turbo Fuel.

If possible, data is best captured on fuel consumption in litres by mode of transport and fuel type. Alternatively, a local government can calculate litres of fuel consumed based on the average fuel efficiencies by fuel type. This information is required because the emission factors for CH_4 and N_2O are differentiated by type of vehicle or other transport mode.

Hybrid electric vehicles are not identified separately since their fuel consumption is captured under gasoline cars and trucks. The higher fuel economy of these vehicles relative to conventional gasoline cars and trucks is reflected in lower overall fuel consumption, and therefore lower GHG emissions, than if the hybrids had not been purchased.

Data sources: Table A8-11 of the 1990-2009 NIR and Table 34 of the 2008 PIR[26] provide emission factors for mobile fuel combustion sources.[27] The factors for gasoline and diesel cars and trucks are differentiated by the level of emission control technology, which relates to vehicle age.

[26] British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*, p. 62.
[27] Environment Canada (2011). *National Inventory Report 1990-2009,* Part 2, p. 196.

For the purposes of estimating local government emissions, the default emission factors are "Tier 1" for gasoline-fuelled light cars and trucks, "Three-Way Catalyst" for gasoline heavy trucks and "Advance Control" for all diesel-fuelled on-road vehicles.[28] The majority of local government fleets are likely vehicles dating from the mid-1990s, when the introduction of these technologies began in the U.S. Table A8-11 in the NIR also contains emission factors for propane and natural gas vehicles, motorcycles ("Non-Catalytic Controlled"), off-road vehicles, gasoline boats, diesel ships, aviation gasoline and turbo fuel and renewable or biofuels (biodiesel and ethanol). In practice, biofuels are blended with fossil fuels, specifically gasoline or diesel, in varying proportions (e.g., E10, B5, B20), so that the actual emission factor is a weighted average of the biofuel and fossil fuel factors. However, since international rules require the separate reporting of biogenic emissions from combustion, the CO_2 emissions from the biofuel component must be calculated and reported separately from those of the fossil fuel component.

In B.C., the *RLCFRR* sets benchmarks for the amount of renewable fuel in the province's transportation and heating fuel blends.[29] Effective January 1st, 2011, fuel suppliers are required to incorporate renewable fuel contents of 5% for gasoline and 4% for diesel into the sum of total fuel sold at a provincial level. In SMARTTool, for any given volume of reported gasoline consumption, 95% of the fuel is fossil fuel gasoline and the remaining 5% is ethanol. For Diesel, 96% is fossil fuel diesel and 4% is biodiesel. Where applicable, the emissions factors listed in Table 5 have been adjusted to account for the renewable fuel content under the *RLCFRR*. Please note that the regulation does not affect the CH_4 or N_20 factors.

Calculations: With the exception of natural gas, the NIR emissions factors in Table 5 have been converted from grams to kilograms of fuel consumption. This is the only change that has been applied to these factors, except in the case of gasoline and diesel fuels, where the numbers were adjusted to account for the renewable fuel content under the *RLCFRR*. The natural gas emission factor has been converted from kg/L to kg/kg of compressed natural gas – the form in which the fuel is dispensed at the pump. Table 6 outlines how this conversion is done.

[28] The NIR defines light-duty cars and trucks as those with a Gross Vehicle Weight Rating (GVWR) of 3,900 kg or less and heavy duty as those vehicles with a GVWR greater than 3,900 kg. *Ibid.,* p. 43.
[29] Aviation fuels have no similar regulation

Table 5: Fleet Fuel consumption

Transport Mode	Fuel Type	Units	Emission Factor			
			Bio CO_2	CO_2	CH_4	N_2O
Light-duty Vehicle[a]	Gasoline	kg/ L	0.0747	2.175	0.00023	0.00047
	Diesel	kg/ L	0.0980	2.556	0.000051	0.00022
	Propane	kg/ L	–	1.510	0.00064	0.000028
	Natural Gas[b]	kg/ kg	–	2.725	0.013	0.000086
Light-duty Truck (includes SUV and Minivan)[a]	Gasoline	kg/ L	0.0747	2.175	0.00024	0.00058
	Diesel	kg/ L	0.0980	2.556	0.000068	0.00022
	Propane	kg/ L	–	1.510	0.00064	0.000028
	Natural Gas[b]	kg/ kg	–	2.725	0.013	0.000086
Heavy-duty [a]	Gasoline	kg/ L	0.0747	2.175	0.000068	0.00020
	Diesel	kg/ L	0.0980	2.556	0.00011	0.000151
Motorcycle	Gasoline	kg/ L	0.0747	2.175	0.00077	0.000041
Off-Road (Vehicle/ Equipment)	Gasoline	kg/ L	0.0747	2.175	0.0027	0.00005
	Diesel	kg/ L	0.0980	2.556	0.00015	0.0011
Marine	Gasoline	kg/ L	0.0747	2.175	0.0013	0.000066
	Diesel	kg/ L	0.0980	2.556	0.00015	0.0011
Aviation	Gasoline	kg/ L	–	2.342	0.0022	0.00023
	Turbo Fuel	kg/ L	–	2.534	0.000028	0.000071
Various	Biodiesel[c]	Kg/ L	2.449	0	[e]	[e]
	Ethanol[d]	kg/ L	1.494	0	[f]	[f]

Note: PSO emission factors for fleet fuel consumption are based on Tier 1 or Advance Control emission control technologies.

[a] Based on Tier 1 or Advance Control emission control technologies.

[b] Adapted from Table 34 of the 2008 PIR factors and converted to kg of compressed natural gas.

[c] Diesel CH_4 and N_2O emission factors (by transport mode) used for biodiesel.

[d] Gasoline CH_4 and N_2O emission factors (by transport mode) used for ethanol.

[e] Diesel CH_4 and N_2O emission factors (by mode and technology) are used for biodiesel.

[f] Gasoline CH_4 and N_2O emission factors (by mode and technology) are used for ethanol.

3.2 Natural Gas Vehicle Emission Factors

Light-duty natural gas vehicles are fuelled with compressed natural gas, which is measured in kilograms. Some suppliers invoice natural gas in litres even though it actually represents kilograms; this can create some confusion when entering data into SMARTTool. The NIR and PIR provide

emission factors for the mobile combustion of natural gas in grams per litre (g/ L).[30, 31] As a result, these factors do not align with the common unit for compressed natural gas measurement at the pump.

SMARTTool specifies emission factors in kg of emissions per unit of consumption – also kg in the case of compressed natural gas. Table 6 shows the calculations that have been performed to convert the 1990-2009 NIR/2008 PIR emission factors to the format used by SMARTTool. In particular, this involves adjusting for the density of natural gas in its gaseous state at standard temperature and pressure (STP).[32]

Table 6: Natural Gas Vehicle Emission Factor Calculations

	Step	Units	CO_2	CH_4	N_2O
1.	Obtain natural gas emission factors from the 2009 NIR	g/ L	1.89	0.009	0.00006
2.	Convert to g/ m^3 by multiplying by 1,000 (L/ m^3)	g/ m^3	1,890	9	0.06
3.	Convert to g/ kg by dividing by 0.6937 (density of natural gas at STP in kg/ m^3)	g/ kg	2,724.5	13.0	0.086
4.	Convert to kg/ kg by dividing by 1 000 (g/ kg)	kg/ kg	2.725	0.013	0.000086

[30] Environment Canada (2011). *National Inventory Report 1990-2009 Part 2*, p. 191. These emission factors relate to natural gas in its gaseous state as it flows through a pipeline, prior to compression.
[31] British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*, p. 62.
[32] The natural gas density of 0.6937 kg/m^3 at STP is based on 2006 information from Terasen Gas on the chemical composition of natural gas flowing through B.C. pipelines.

4. SAMPLE CALCULATION

Table 7 provides a sample application of an emission factor to calculate GHG emissions, based on 100 litres of propane consumption in buildings, and using the emissions factors, energy conversion factor and global warming potential provided in this manual. To calculate emissions, users should apply the following formulas in the order provided.

Table 7: Sample Emissions Calculation

Step	Formula	Calculation		
1. Convert the actual consumption to a common unit of measurement.	Actual Consumption (L) x Energy Conversion Factor (GJ/ L) = Converted Fuel Consumption (GJ)		100 L X 0.02531 GJ/ L = 2.531 GJ	
		CO_2	CH_4	N_2O
2. Calculate the emissions of each GHG using the appropriate emission factor	Converted Fuel Consumption (GJ) x Emission Factor by GHG (kg/ GJ) = Emissions by GHG	2.531 GJ x 59.66 kg CO_2 / GJ = 149.2 kg CO_2	2.531 GJ x 0.00010 kg CH_4 / GJ = 0.0025 kg CH_4	2.531 GJ x 0.0043 kg N_2O / GJ = 0.0108 kg N_2O
3. Convert the emissions of each greenhouse gas to CO2 equivalency (CO_2e) using the appropriate Global Warming Potential		CO_2	CH_4	N_2O
	Emissions by GHG x GWP = Emissions (kg CO_2e)	149.2 kg CO_2 x 1 = 149.2 kg CO_2e	0.0025 kg CH_4 x 21 = 0.0525 kg CO_2e	0.0108 kg N_2O x 310 = 3.348 kg CO_2e
4. Sum across the gases to calculate total CO2e emissions	CO_2 + CH_4 + N_2O (all in kg CO_2e) = Total CO_2e	149.2 kg CO_2e	+ 0.0525 kg CO_2e + 3.348 kg CO_2e = 152.6 kg CO_2e	
5. Convert total emissions from kg to tonnes for reporting purposes.	Emissions in kg CO_2e / 1 000 kg / t = Emissions in tonnes CO_2e	152.6 kg CO_2e / 1 000 kg / t = 0.153 t CO_2e		

5. Annexes

5.1 Glossary of Terms and Acronyms

Note: Definitions derived from:

- LiveSmart BC, Glossary (available at: www.livesmartbc.ca/learn/glossary.html).
- IPCC Third Assessment Report, Glossary of Terms (available at: www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf).
- Market Advisory Committee to the California Air Resources Board (2007), "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California."
- World Business Council for Sustainable Development and World Resources Institute (2004), *The Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard – Revised Edition,*, pp. 96-102.
- The Climate Registry (2008), *General Reporting Protocol*, pp. 153-158.

Abbreviation, Acronym or Measure	Definition
Carbon dioxide (CO_2)	A naturally occurring gas (0.03% of atmosphere) that is also a by-product of burning fossil fuels and biomass, land-use changes, and other industrial processes. It is the principal anthropogenic greenhouse gas. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1. (IPCC)
Carbon-equivalent (CO_2e)	"The universal unit of measurement to indicate the global warming potential (GWP) of each of the six greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide." (GHG Protocol) Expressing all GHGs in terms of tonnes of CO_2e allows the different gases to be aggregated (LiveSmart BC).
Biofuel	A fuel produced from dry organic matter or combustible oils produced by plants. Examples of biofuel include alcohol (from fermented sugar), black liquor from the paper manufacturing process, wood and soybean oil.
Direct emissions	Emissions from sources that are owned or controlled by the reporting organization (i.e., Local government).
EDF	Environmental Defense Fund, a US-based environmental organization.
Emission factor	"A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions" (GHG Protocol)
Emissions	"The release of substances (e.g., greenhouse gases) into the atmosphere. Emissions occur both through natural processes and as a result of human activities." (CARB)
Energy conversion factor	A factor used to convert a quantity of energy from its original physical unit into a common unit of measurement (e.g., GJ).
EPA	(U.S.) Environmental Protection Agency
Gigajoule (GJ)	One billion joules, where a joule is a common unit of energy for comparing across fuel types and electricity.
Gigawatt-hour (GWh)	One million kilowatt-hours, enough electricity to power 100 homes for a year.

Abbreviation, Acronym or Measure	Definition
Global Warming Potential (GWP)	"Greenhouse gases differ in their effect on the Earth's radiation balance depending on their concentration, residence time in the atmosphere, and physical properties with respect to absorbing and emitting radiant energy. By convention, the effect of carbon dioxide is assigned a value of one (1) (i.e., the GWP of carbon dioxide =1) and the GWPs of other gases are expressed relative to carbon dioxide. For example, in the U.S. national inventory, the GWP of nitrous oxide is 310 and that of methane 21, indicating that a tonne of nitrous oxide has 310 times the effect on warming as a ton of carbon dioxide. Slightly different GWP values for greenhouse gases have been estimated in other reports. Some industrially produced gases such as sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs) have extremely high GWPs. Emissions of these gases have a much greater effect on global warming than an equal emission (by mass) of the naturally occurring gases. Most of these gases have GWPs of 1,300 - 23,900 times that of CO_2. The US and other Parties to the UNFCCC report national greenhouse gas inventories using GWPs from the IPCC's Second Assessment Report (SAR). SAR GWPs are also used for the Kyoto Protocol and the EU ETS. GWPs indicated in this document also refer to the IPCC's Second Assessment Report." (CARB)
Global Reporting Initiative (GRI)	An international initiative that has developed a sustainability reporting framework for organizations to measure and report on their economic, environmental and social performance (see: www.globalreporting.org).
Greenhouse gases (GHGs)	"Greenhouse gases include a wide variety of gases that trap heat near the Earth's surface, slowing its escape into space. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapor and other gases. While greenhouse gases occur naturally in the atmosphere, human activities also result in additional greenhouse gas emissions. Humans have also manufactured some gaseous compounds not found in nature that also slow the release of radiant energy into space." (CARB)
HVAC	Heating, Ventilating and Air Conditioning
Hydrofluorocarbons (HFCs)	"One of the six primary GHGs. Synthetic industrial gases, primarily used in refrigeration and other applications as commercial substitutes for chlorofluorocarbons (CFCs). There are no natural sources of HFCs. The atmospheric lifetime of HFCs is decades to centuries, and they have "global warming potentials" thousands of times that of CO_2, depending on the gas. HFCs are among the six greenhouse gases to be curbed under the Kyoto Protocol." (CARB)
Indirect emissions	Emissions that are a consequence of the operations of the reporting organization (i.e., Local government), but occur at sources owned or controlled by another organization.
Intergovernmental Panel on Climate Change (IPCC)	"Recognizing the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. It is open to all members of the UN and WMO. The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. The IPCC does not carry out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature." (CARB)
Inventory	"A greenhouse gas inventory is an accounting of the amount of greenhouse gases emitted to or removed from the atmosphere over a specific period of time (e.g., one year). A greenhouse gas inventory also provides information on the activities that cause emissions and removals, as well as background on the methods used to make the calculations. Policy makers use greenhouse gas inventories to track emission trends, develop strategies and policies and assess progress. Scientists use greenhouse gas inventories as inputs to atmospheric and economic models" (CARB)
IPP	Independent Power Producer

Abbreviation, Acronym or Measure	Definition
kg	kilogram
kilotonne	1,000 tonnes
km	kilometre
kWh	kilowatt-hour
L	litre
lb	pound (weight)
m^3	cubic metre
Methane (CH_4)	"One of the six greenhouse gases to be curbed under the Kyoto Protocol. Atmospheric CH_4 is produced in nature, but human related sources such as landfills, livestock feedlots, natural gas and petroleum systems, coal mines, rice fields, and wastewater treatment plants also generate substantial CH_4 emissions. CH_4 has a relatively short atmospheric lifetime of approximately 10 years, but its 100-year GWP is currently estimated to be approximately 21 times that of CO_2." (CARB)
MVAC	Motor Vehicle Air Conditioning
NIR	National Inventory Report (Environment Canada)
Nitrous oxide (N_2O)	"One of the six greenhouse gases to be curbed under the Kyoto Protocol. N2O is produced by natural processes, but substantial emissions are also produced by such human activities as farming and fossil fuel combustion. The atmospheric lifetime of N2O is approximately 100 years, and its 100-year GWP is currently estimated to be 310 times that of CO_2." (CARB)
Perfluorocarbons (PFCs)	"PFCs are among the six greenhouse gases to be curbed under the Kyoto Protocol. PFCs are synthetic industrial gases generated as a by-product of aluminum smelting and uranium enrichment. They also are used in the manufacture of semiconductors. There are no natural sources of PFCs. PFCs have atmospheric lifetimes of thousands to tens of thousands of years and 100-year GWPs thousands of times that of CO_2, depending on the specific PFC." (CARB)
PIR	British Columbia Greenhouse Gas Inventory Report (Ministry of Environment)
PSO	A B.C. public sector organization subject to the government's carbon neutral commitment under the *Greenhouse Gas Reduction Targets Act*.
RESD	Report on Energy Supply and Demand (Statistics Canada).
STP	Standard Temperature and Pressure
Sulphur Hexafluoride (SF_6)	One of the six greenhouse gases to be curbed under the Kyoto Protocol. SF_6 is a synthetic industrial gas largely used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cable-cooling systems. There are no natural sources of SF_6. SF_6 has an atmospheric lifetime of 3,200 years. Its 100-year GWP is currently estimated to be 22,200 times that of CO_2." (CARB)
t	metric tonne, a standard measurement for the mass of GHG emissions, equivalent to 1,000 kg, 1,204.6 pounds, or 1.1 short tons.
U.S.	United States (of America)

5.2 Global Warming Potentials

Table 8 presents the 100-year Global Warming Potentials for the GHGs being tracked by the B.C. public sector. These GWPs are listed in the Carbon Neutral Workbook and are the 1995 values from the IPCC's *Second Assessment Report*, as endorsed by Environment Canada and British Columbia, as such, they represent the standard emission factors to be used at this time in greenhouse gas emissions calculations in British Columbia.[33, 34,]

Table 8: Global Warming Potentials

Greenhouse Gas	Chemical Formula	100-Year GWP
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310

[33] Environment Canada (2011). *National Inventory Report 1990-2009*, p..35.
[34] British Columbia (2011). *British Columbia Greenhouse Gas Inventory Report 2008*, p. 61

5.3 SMARTTool Buildings Energy Estimation Method Summary

5.3.1 Introduction

The following information is intended to provide a summary of the building energy estimation methods that can be used when energy consumption data for a building is not readily available (e.g., when a local government leases space.) It was developed by the SMARTTool team as an effective way to estimate building energy usage based on either a regional or fixed energy intensity unit.

5.3.2 Fixed Energy Intensity Unit Estimation Method

The Fixed Energy Intensity Unit (EIU) estimation method applies an energy estimate using pre-determined energy intensity factors published by Natural Resources Canada (NRC) through the Office of Energy Efficiency (OEE) Comprehensive Energy Use Database[35]. This database includes statistics on energy use by province, building use type and fuel.

Calculation:

Table 9: Fixed Energy Intensity Unit Estimation Calculation

Step	Formula
1. For each fuel, determine the annual consumption amount.	EIU (GJ/m^2) x Share(%)/100 x square meters of space = annual consumption amount (GJ)
2. Apply the emission factor by fuel type to yield total emissions by fuel type	Emission Factor (kg/GJ) x Consumption (GJ) = Emissions by GHG (kg)
3. Apply the global warming potentials to yield total emissions	Emissions by GHG (kg) x GWP = Emissions (kg CO_2e)
4. Sum across the gases to calculate total CO2e emissions	CO_2 + CH_4 + N_2O (all in kg CO_2e) = Total CO_2e
5. Convert total emissions from kg to tonnes for reporting purposes.	Emissions in kg CO_2e / 1 000 kg / t = Emissions in tonnes CO_2e

[35] Natural Resources Canada (NRC) through the Office of Energy Efficiency (OEE) Comprehensive Energy Use Database: oee.nrcan.gc.ca/statistics/4307

5.3.3 Regional Calculated Energy Intensity Method Details

The Regional Calculated EIU estimation method allows a local government to estimate the unknown energy use, by building type, from reported data available from their own organization and within the same region, and provides a more accurate estimation for disparate regions across the Province.

For this approach to be useful, there must be sufficient known energy per region per building type within the organization.

This approach requires the calculation of energy use per square meter (i.e., energy intensity) and the application of that energy intensity to the area of like-use buildings. Once consumption is estimated in this way, one applies the appropriate emission factors and GWP to estimate related greenhouse gas emissions.

Table 10: Regional Energy Intensity Unit Estimation Calculation

Step	Formula
1. For similar buildings (ie: office) determine the annual consumption amount of each fuel and divide floor space of all the buildings	Total Electricity / Total square meters of Floor space = Annual Energy Intensity Factor (EIU/m^2) per fuel
2. Estimate the quantity of fuel used in the leased space	Area of leased building x Annual Energy Intensity Factor (EIU/m^2) = Annual Fuel Use in Leased building (GJ)
3. Apply the emission factor by fuel type to yield total emissions by fuel type	Emission Factor (kg/GJ) x Consumption (GJ) = Emissions by GHG (kg)
4. Apply the global warming potentials to yield total emissions	Emissions by GHG (kg) x GWP = Emissions (kg CO_2e)
6. Sum across the gases to calculate total CO2e emissions	CO_2 + CH_4 + N_2O (all in kg CO_2e) = Total CO_2e
7. Convert total emissions from kg to tonnes for reporting purposes.	Emissions in kg CO_2e / 1 000 kg / t = Emissions in tonnes CO_2e

5.3.4 Hybrid Energy estimations

In some instances, directly reported energy may be available for one fuel in a building; but not for another. It is appropriate than to estimate the unknown fuel using one of the methods above.

Similarly, the regional calculation may be used to estimate one fuel type within a building if similar reported data is available, while other fuel types in the same building may use the Fixed EIU for lack of available reported data.

5.4 Selected References

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