2025 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions

For Public Sector Organizations, Local Governments, Modern Treaty Nations, and Community Emissions

December 2025

B.C. Ministry of Energy and Climate Solutions

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Territorial Acknowledgement

The B.C. Public Service acknowledges the territories of First Nations around B.C. and is grateful to carry out our work on these lands. We acknowledge the rights, interests, priorities, and concerns of all Indigenous Peoples – First Nations, Métis, and Inuit – respecting and acknowledging their distinct cultures, histories, rights, laws, and governments.

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1 Introduction

The 2025 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions describes approaches to quantify and report organizational greenhouse gas (GHG) emissions for:

1. B.C.'s provincial public sector organizations (PSOs), for the purposes of meeting legislative requirements to be carbon neutral, and
2. Local governments (LGs) and Modern Treaty Nations (MTNs) for the purposes of reporting under the LGCAP.

This methodology document provides a basis for PSOs, LGs and MTNs to measure their GHG emissions with consistent and up-to-date best practices and enables comparable province-wide organizational emissions reporting.

This document can be used by its target audiences and by other groups wishing to calculate their organization's GHG emissions. Other potential users of this document include, but are not limited to, energy and emissions modelling and planning consultants, energy utilities, academic researchers, non-governmental organizations, and other organizations interested in measuring their GHG emissions.

Private sector entities subject to the B.C. Greenhouse Gas Emission Reporting Regulation (GGERR) must use quantification methods prescribed by the GGERR. Organizations reporting in accordance with the Low Carbon Fuel Standard must follow the guidance provided by the Low Carbon Fuels Branch.

This document consolidates the emission factors, their sources, and emissions calculation methodologies appropriate for use in British Columbia. The numerical emission factors can be found in the Emission Factors Catalogue.[1] This methodology document draws heavily on:

- Protocols established by:
  - The International Standards Organization – Standard 14064 (ISO 14064) on GHGs,
  - The Climate Registry's General Reporting Protocol, and
  - The World Resources Institute and the World Business Council for Sustainable Development's GHG Protocol, and
- Emission factors and energy use intensities published by authoritative sources such as:
  - Environment and Climate Change Canada (ECCC): National Inventory Report (NIR),
  - Natural Resources Canada (NRCan): Comprehensive Energy Use Database (CEUD),
  - Ember: Yearly Electricity Data, and
  - UK Department for Energy Security and Net Zero: GHG reporting: conversion factors.

The Province also administers an annual Community Energy and Emissions Inventory (CEEI) that provides community-level greenhouse gas emissions and energy consumption estimates for

[1] The Emission Factors Catalogue (https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/guidance-documents/emission_factors_catalogue_2025.xlsx) can be accessed on the Carbon Neutral Government program's website (https://www2.gov.bc.ca/gov/content/environment/climate-change/public-sector/carbon-neutral) and the Local Government Climate Action Program's website (https://www2.gov.bc.ca/gov/content/environment/climate-change/local-governments/local-government-climate-action-program).

communities across B.C. CEEI data covers the buildings, municipal solid waste, and on-road transportation sectors for 161 municipalities, 28 regional districts, and one region (Stikine). To promote consistency between community-wide (CEEI) and traditional services (LGCAP) emissions reporting, both initiatives employ the Emission Factors Catalogue. Please see the CEEI webpage and CEEI Technical Methods and Guidance Document for more information.

1.1 Document Structure

Section 1 provides policy context for GHG quantification for the intended users of the document, as well as an overview of GHG emission quantification.

Sections 2 through 6 contain emission quantification information for the following activities:

- Section 2: Stationary Sources – Buildings,
- Section 3: Mobile Sources – Transportation,
- Section 4: Fugitive Sources,
- Section 5: Office Paper, and
- Section 6: Business Travel and Accommodation.

Each activity section includes:

- the emissions **type** (direct or indirect emissions)[2],
- a **description** of the common emissions sources for the activity,
- the **data sources** that have been referenced or incorporated,
- sample **calculations** that explain how:
  - Organizations apply the emission factors, and
  - The Climate Action Secretariat (CAS) determined emission factors in cases where emission factors from authoritative sources are not readily available
- Where needed, **specific instructions** related to the above. Instructions are in call-out boxes if they apply only to B.C. PSOs or only to LGs and MTNs, as follows:

For PSOs

For LGs and MTNs

The document includes six annexes, including a glossary, selected references and document version control, which lists changes made to the document compared to the previous version.

[2] The Climate Registry's General Reporting Protocol defines direct emissions as "emissions from sources within the reporting organization's organizational boundaries that are owned or controlled by the reporting organization, including stationary combustion emissions, mobile combustion emissions, process emissions, and fugitive emissions," and indirect emissions as "Emissions that are a consequence of activities that take place within the organizational boundaries of the reporting organization, but that occur at sources owned or controlled by another organization." See The Climate Registry. (2019). *General Reporting Protocol*, *Version 3.0*. Available: https://theclimateregistry.org/wp-content/uploads/2025/06/General-Reporting-Protocol-3.0_The-Climate-Registry_rev.6-5-25.pdf, pp. E-12 to 13.

1.2 Public Sector Organizations

Public Sector Organizations (PSOs) are defined in the Budget Transparency and Accountability Act under the Government Reporting Entity. They are Provincial government entities as reported through the Consolidated Revenue Fund (e.g., ministries and independent offices) and broader public sector agencies including health authorities, school districts, colleges and universities, and Crown corporations.

To support PSO GHG measurement and reporting requirements, the emission factors and emissions calculation methodologies described in this document are integrated into the Clean Government Reporting Tool (CGRT), the online tool provided by the B.C. government.

CGRT contains emission factors for all PSO reporting categories. When PSOs report their annual energy consumption and activity data in the tool, CGRT calculates total GHG emissions.

1.2.1 Policy Context

This document is not intended to provide legal advice. PSOs remain responsible for ensuring they understand and comply with the relevant legislation described in this section.

Under the Climate Change Accountability Act (CCAA) (formerly the Greenhouse Gas Reductions Targets Act (GGRTA)), the B.C. public sector must be carbon neutral in its operations for 2010 and every year thereafter, unless they are specifically excluded in the CCAA.[3] PSOs are required to report annually in accordance with the CCAA and the Carbon Neutral Government Regulation (CNGR).

The CNGR defines the activities, the emission sources, and the GHGs and GHG categories that are in scope for PSOs to report for their GHG inventories in the Carbon Neutral Government (CNG) program. More advice on in-scope activities/sources is available on the Carbon Neutral Government program scope webpage and in the Scope Summary document.

In May 2018, the Province of B.C. enacted legislation to establish provincial targets for reducing GHG emissions by 40% below 2007 levels by 2030, 60% by 2040, and 80% by 2050. Later that year, the CleanBC Plan set targets for the B.C. public sector to reduce building emissions by 50% and to reduce GHG emissions from government vehicles by 40% by 2030. As 2010 was the first year with complete public sector emissions data, the CleanBC public sector targets are set against a baseline year of 2010.

Measuring GHG emissions is an important first step in reducing emissions and the activities/operations responsible for producing them, in support of meeting B.C.'s legislated GHG emission reduction targets under the CCAA.

1.2.2 In-Scope Activities

Guidance for in-scope PSO activities for the CNG Program is provided in:

[3] See http://www.bclaws.ca/civix/document/id/complete/statreg/07042_01 for the Climate Change Accountability Act (CCAA), Bill 44 – 2007 and https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/392_2008 for the Carbon Neutral Government Regulation, B.C. Reg. 392/2008. The legislation also requires B.C. provincial government business travel to be carbon neutral as of October 2007. This requirement does not apply to the broader provincial public sector.

- Section 2: Stationary Sources: Buildings,
- Section 3: Mobile Sources: Transportation,
- Section 4: Fugitive Sources,
- Section 5: Office Paper, and
- Section 6: Business Travel and Accommodation (applies only to Provincial Government).

PSOs may direct any questions related to GHG quantification, scope, and the Clean Government Report Tool (CGRT) to Carbon.Neutral@gov.bc.ca.

1.3 Local Governments and Modern Treaty Nations

1.3.1 Local Governments

Every LG in B.C. has voluntarily signed the B.C. Climate Action Charter (CAC), committing them to develop strategies and take actions to achieve the following goals:

- Being carbon neutral in respect of their corporate operations, [4, 5]
- Measuring and reporting on their community's GHG emissions profile, and
- Creating complete, compact, more energy efficient rural and urban communities.

The Provincial Government and Union of British Columbia Municipalities (UBCM) jointly created the Green Communities Committee (GCC) under the CAC to support local governments in planning and implementing climate initiatives.

The Provincial Government supports LGs in meeting their CAC commitments by producing the CEEI, which provides a provincial framework for tracking and reporting energy and emissions at a community-wide scale. Additionally, the Local Government Climate Action Program (LGCAP) provides local governments and Modern Treaty Nations with funding, guidance and direct support to effectively implement climate actions across B.C. LGCAP has multiple annual reporting requirements, including reporting on traditional services (corporate) emissions for communities over a population of 5,000 and a survey that must be publicly attested to and posted to track climate action progress. These requirements support LG work in reducing their corporate emissions and developing more compact and complete communities.

1.3.2 Modern Treaty Nations

The relationship between the Province and MTNs in B.C. is distinct and unique. Modern treaties set out constitutionally protected rights and obligations of the parties. The Province works with MTNs to fully

[4] Under the CAC, solid waste facilities regulated under the Environmental Management Act are not included in LG operations. See the Environmental Management Act. Available: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_01

[5] While LGs do not have to achieve carbon neutrality for their traditional services under LGCAP, the LGCAP team continues to support the use of tools and resources such as the Becoming Carbon Neutral Guidebook. See the Becoming Carbon Neutral Guidebook, available: https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/guidance-documents/becoming_carbon_neutral_guidebook.pdf

implement these treaties by engaging directly with individual Nations and collectively through the Alliance of B.C. Modern Treaty Nations.

1.3.3 Policy Context

The Province runs the Local Government Climate Action Program (LGCAP), providing a total of about $24 million in annual, non-application-based funding that is distributed across every local government and Modern Treaty Nation in B.C. to help build local capacity, reduce GHG emissions and prepare for climate impacts. LGCAP is a commitment within the CleanBC Roadmap to 2030, recognizing the critical role communities play in combating climate change. LGCAP enables climate action that is aligned with provincial and local objectives. To be eligible for funding, LGs and MTNs must meet eligibility requirements as described on the LGCAP reporting webpage. Please reference the LGCAP website for more information on the Program.

1.3.4 Measuring and Reporting Emissions

To be eligible for LGCAP funding, LGs with populations exceeding 5,000 residents are required to measure and report their traditional services emissions inventory for the 2025 calendar year (reporting done in 2026). Smaller LGs and MTNs are encouraged to report their traditional services inventory on a voluntary basis. LGs and MTNs can report using the LGCAP methodology. Alternatively, an established reporting protocol, such as CDP[6] can be used to meet this requirement, if the inventory includes emissions from contracted services. It is important that LGs use a consistent methodology over time to meet their requirement under the Green Communities Statutes Amendment Act to track progress to targets. To ensure alignment, comparability, and consistency in GHG quantification approaches, the GCC recommends aligning with the same methodologies used by PSOs in this document.

1.3.4.1 LGCAP Boundaries and In-Scope Activities

The boundaries for calculating emissions are based on the energy used in the delivery of traditional LG and MTN services:[7]

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

[6] CDP was established as the 'Carbon Disclosure Project' in 2000, asking companies to disclose their climate impact. Since then, they have broadened the scope of environmental disclosure, to incorporate deforestation and water security, while also building their reach to support cities, states and regions. More information available at: https://www.cdp.net/en.

[7] "Traditional services" include emissions related to operation and maintenance activities in the delivery of traditional services; however, LGs and MTNs need not report emissions from new construction, business travel, employee commuting, and materials.

To ensure methodology, emission factors and outputs from individual tools are consistent and comparable, an LG or MTN will be required to meet the following standards for their measurement processes:

- Use the same traditional services boundaries and scope as defined in the LGCAP Boundaries and Scope Guidance or another established GHG accounting framework (such as CDP),
- Use the numerical emission factors found in the Emission Factors Catalogue, and
- Report on annual directly delivered, contracted and total traditional services GHG emissions as calculated by a GHG inventory tool (e.g., the Traditional Services Emissions Inventory Reporting Tool).

All supporting materials for these standards are available on the LGCAP website.

The following sections of this document apply directly to LGs and MTNs for their in-scope activities:

- Section 2: Stationary Sources – Buildings, and
- Section 3: Mobile Sources – Transportation.

All LG and MTN questions related to GHG quantification and scope for the LGCAP should be directed to LGCAP@gov.bc.ca. All questions regarding the CEEI should be directed to CEEI@gov.bc.ca.

1.4 Emissions Calculation Fundamentals

This section provides context for organizations seeking to understand how emissions are calculated.

1.4.1 In-Scope Greenhouse Gases

This document includes six distinct GHGs or categories of GHGs:

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons (HFCs),
- perfluorocarbons (PFCs), and
- sulphur hexafluoride (SF_6).

Organizations mostly emit the three main GHGs from fuel combustion – CO_2, CH_4, and N_2O.

International protocols require biogenic CO_2 (bio-CO_2) emissions from combustion to be reported separately from fossil combustion, biogenic non-CO_2 combustion, and fugitive emissions.[8]

[8] The *IPCC's Guidelines for National Greenhouse Gas Inventories* states that CO_2 emissions from the biomass combustion should be reported under the Agriculture, Forestry and Other Land Use (AFOLU) sector, which is outside of the scope of the Energy sector. See: IPCC (2019), *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Energy Section 2.3.3.4, p. 2.4-5 and AFOLU Section 12.5.1, p. 12.33-34, available: *https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/*; and the Climate Registry (2019), *General Reporting Protocol Version 3.0*, p. B-7, available: *General Reporting Protocol Version 3.0*.

For PSOs: the CNG program excludes bio-CO_2 emissions, which are offset exempt, from total emissions when tracking progress towards the public sector's CleanBC emission reduction targets.

For LGs and MTNs: Under LGCAP, LGs and MTNs are only required to report emissions of:

- carbon dioxide (CO_2),
- methane (CH_4), and
- nitrous oxide (N_2O).

1.4.2 Global Warming Potentials

GHGs vary in their global warming potential (GWP), which expresses the climate impact of a greenhouse gas relative to CO_2, which always has a GWP of 1. The GWP is a measure of how much energy the emission of a mass of a GHG will absorb over a given period (typically 100 years), relative to the emission of an equal mass of CO_2.[9] The concept of carbon dioxide equivalent (CO_2e) is used to represent this impact, as required under the CNGR.

For example, methane (CH_4) has a GWP of 28 over a 100-year period. This means that, over 100 years, one tonne of CH_4 will have the same climate warming impact of 28 tonnes of CO_2e (t CO_2e).

Updates to B.C.'s GWPs, specified in the CNGR, are made in line with updates by the United Nations Framework Convention on Climate Change, the Intergovernmental Panel on Climate Change (IPCC), and the Canadian Federal Government. For the 2022 reporting year onward, the GWPs in this document and the Emission Factors Catalogue align with the IPCC's 5th Assessment Report (AR5). Emissions prior to 2022 continue to use the GWPs from the IPCC's 4th Assessment Report (AR4), as the inventory-wide impact of a change from the AR4 is very small. CAS will update historical GWPs when other GHG measurement programs in the BC Government align with the IPCC's 6th Assessment Report.

The CNGR[10] Schedule lists the GWPs for in-scope emissions.

1.4.3 Emission Factors

Emission factors quantify the amount of GHGs released from a specific activity. They are expressed as the mass of emissions (e.g., grams (g), kilograms (kg), metric tonnes (t)) per unit of activity. Typically, the factors for an activity category are expressed in the same or similar units to enable comparison across different fuel types or technologies. For example, fleet fuel emission factors could be expressed as kilograms of carbon dioxide produced per litre of gasoline or litre of diesel fuel combusted in a vehicle.

Wherever possible, emission factors are specified by individual gases. In certain instances, an aggregate factor for multiple gases is provided in kg or t of CO_2e.

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[9] United States Environmental Protection Agency, Understanding Global Warming Potentials. (2024). Available: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

[10] Carbon Neutral Government Regulation. (Deposited Dec. 9, 2008). Available: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/392_2008.

Organizations can calculate their GHG emissions for a given activity or source using the Emission Factors Catalogue (see Table 1 and Table 2 for an example), which CAS maintains to provide organizations with a single point for finding emission factors.

Organizations should determine the amount of the activity or emission source used/consumed (e.g., litres (L) of gasoline, kilowatt hours (kWh) of electricity, reams of paper, kg of refrigerant). They can then calculate emissions in CO_2e, by multiplying the amount of emission source used/consumed either by converting each GHG's emission factor to CO_2e and adding up emissions by CO_2e, or by using the CO_2e emission factor for the emission source. They then report emissions in t CO_2e.

1.4.4 Principles for Determining Emission Factors

CAS uses the following principles to guide development of GHG emission factors and estimation methods in this document:

(1) Use BC-specific emission factors where the required information is available.
   - Example: the electricity emission intensity factors from B.C.-specific data sources.

(2) Use standardized emission factors from national and international data sources where B.C.-specific information is not available. For example, where there is no BC-specific emission factor for the combustion of fossil diesel in heavy-duty vehicles, use the value from the NIR.

(3) Strive to reduce the burden and cost of measurement and reporting. Where gathering the data for an emissions source poses an undue burden, organizations can use simplified emissions estimation methods. For example, if an organization leases a space where utility costs are included and they do not have access to the utility bills, they may provide the floor area of the leased space instead of the energy consumption, then multiply the floor area by an energy use intensity (EUI) value for that type of building to determine their GHG emissions.

(4) In developing simplified emissions estimation methods, use conservative assumptions, i.e. those that are more likely to overestimate, than to underestimate, emissions.

The primary source document for emission factors is ECCC's NIR, which is released annually.[11] Where possible, CAS developed B.C.-specific emission factors, using the NIR, the CEUD, data provided by B.C. energy utilities, and business travel providers. Other sources, such as The Climate Registry's General Reporting Protocol, Ember's Yearly Electricity Data and the UK Department for Energy Security and Net Zero's GHG reporting: conversion factors, provided emission factors that could not be sourced from the NIR or the CEUD.[12]

The emission factors in this document represent CAS's current understanding of the factors appropriate for emission sources and fuel types. CAS will update emission factors and other key inputs (e.g., energy conversion factors, GWPs) as GHG measurement methodologies and data sources evolve.

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[11] Environment Canada. (2025). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2023*. The Canadian Government's Submission to the United Nations Framework Convention on Climate Change. Available: https://publications.gc.ca/site/eng/9.506002/publication.html.

[12] The Climate Registry. (2019). *General Reporting Protocol*, *Version 3.0*. The Climate Registry is a cross-border initiative to develop common measurement, verification, and reporting requirements for GHG emissions. Available: https://theclimateregistry.org/wp-content/uploads/2025/06/General-Reporting-Protocol-3.0_The-Climate-Registry_rev.6-5-25.pdf.

1.4.5 Understanding Scope Categories

The General Reporting Protocol[13] classifies GHG emissions in three scopes:

Scope 1: Direct GHG emissions (e.g., the combustion of fossil fuels in an organization's building, referred to as Direct Fuel Combustion in CGRT),

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling (referred to as Purchased Energy in CGRT), and

Scope 3: All other (non-Scope 2) indirect GHG emissions that occur in the supply chain (referred to as Other Sources in CGRT).

1.4.6 Significant Figures

Where possible, the methodology document presents three significant figures as a standard convention to increase consistency in calculations. More significant figures may be used ahead of the decimal point.

1.4.7 Example Emissions Calculation

Table 1provides an example of applying emission factors to calculate GHG emissions from 100 litres of propane consumption in a building and converting those emissions to CO_2e, while Table 2 shows how to tabulate the results of Table 1 to get total emissions in t CO_2e.

Table 1: Example of Calculating Building Emissions by GHG

Step	Formula	CO_2 Calculation	CH_4 Calculation	N_2O Calculation
(1) Calculate the emissions of each GHG using the appropriate emission factor.	Actual Consumption (L) × Emission Factor by GHG (g/L) = Emissions by GHG	100 L × 1,515 g CO_2/L = 151,500 g CO_2	100 L × 0.024 g CH_4/L = 2.4 g CH_4	100 L × 0.108 g N_2O/L = 10.8 g N_2O
(2) Convert the emissions of each GHG to CO_2 equivalency (CO_2e) using Global Warming Potential.	Emissions by GHG × GWP = Emissions (g CO_2e)	151,500 g CO_2 × 1 = 151,500 g CO_2e	2.4 g CH_4 × 28 = 67.2 g CO_2e	10.9 g N_2O × 265 = 2,888.5 g CO_2e

Note: Table 1 presents emission factors in g/L because the NIR lists fuel emission factors for propane, and most other liquid fuels, in g/L. Table 3 in Section 2.1 identifies the sources of the emission factors in this example.

[13] The Climate Registry. (2019). *General Reporting Protocol*, *Version 3.0*. Available: https://theclimateregistry.org/wp-content/uploads/2025/06/General-Reporting-Protocol-3.0_The-Climate-Registry_rev.6-5-25.pdf, p. B-5.

Table 2: Example of Calculating Building Emissions in t CO_2e

Step	Formula	CO_2e Calculation
(3) Sum across the gases to calculate total CO_2e emissions.	$CO_2 + CH_4 + N_2O$ (all in g CO_2e) = Total CO_2e in g CO_2e	(151,500 + 67.2 + 2,888.5) g CO_2e = 154,456 g CO_2e
(4) Convert total emissions from g to tonnes for reporting purposes and round to significant figures.	Emissions in g CO_2e / 1,000,000 g/t = Emissions in t CO_2e	154,456 g CO_2e / 1,000,000 g/t = 0.154 t CO_2e (from100 L of Propane)

For PSOs: you can input the amount you use of each emission source directly into CGRT, which will automatically calculate the emissions that result from each emission source. You do not need to make these calculations manually.

1.5 Small Emissions Sources

For many organizations, measuring small emissions sources can be challenging. If an emissions' source is onerous to collect and the sum of the small sources is expected to be less than 1% of the organization's total emissions inventory, organizations may consider those sources out of scope. CAS developed a decision tree to help LGs, MTNs and PSOs determine whether a certain source of emissions falls under this rule. Other methods to address small emission sources are outlined in the General Reporting Protocol.

If an organization considers an emission source to be out of scope after using the decision tree, they should include the rationale for its exemption in their annual reporting documentation.

For PSOs: include the exemption rationale in your organization's self-certification documentation and Climate Change Accountability Report for each year that the exemption applies.

2 Stationary Sources – Buildings

This section outlines how to calculate the direct and indirect GHG emissions from providing lighting, space and water heating, cooling, and power to facilities.

2.1 Stationary Fuel Combustion

Type: Direct Emissions

Description: Organizations combust a variety of fuels to produce heat and power. They include, but are not limited to:

- Fossil fuels:
  - natural gas (NG),
  - propane,
  - light fuel oil (No. 2 heating oil),
  - heavy fuel oil (No. 5 heating oil),
  - kerosene,
  - diesel fuel and marine diesel, and
  - gasoline.
- Biofuels:
  - renewable natural gas (RNG),
  - ethanol,
  - biodiesel, and
  - residential and industrial wood fuels.

Data sources: Table 3 includes emission factors for stationary fuel combustion from Part 2 of the 1990-2023 NIR.[14] For the Emission Factors Catalogue, the CO_2 emission factors from the NIR are adjusted to reflect the biofuel component of each fuel:

[14] Environment Canada. (2025). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2023,* Part 2. Available: https://publications.gc.ca/site/eng/9.506002/publication.html

Table 3: Stationary Combustion Emission Factors Sources in the 1990-2023 NIR

Fuel Type	Source Table in NIR	Reference
Natural Gas (FortisBC)	A6.1-1 (CO_2) A6.1-1 (CO_2 as bio-CO_2) A6.1-3 (CH_4, N_2O)	B.C. Emission Factors – Marketable Natural Gas (applied to fossil portion of NG) B.C. Emission Factors – Marketable Natural Gas (applied to RNG portion of NG) Emission Factors for Residential, Construction, Commercial/Institutional, Agriculture
Natural Gas (R0)	A6.1-1 (CO_2) A6.1-3 (CH_4, N_2O)	B.C. Emission Factors – Marketable Natural Gas Emission Factors for Residential, Construction, Commercial/Institutional, Agriculture
Natural Gas (R100)	A6.1-1 (CO_2 as bio-CO_2) A6.1-3 (CH_4, N_2O)	B.C. Emission Factors – Marketable Natural Gas Emission Factors for Residential, Construction, Commercial/Institutional, Agriculture
Propane	A6.1-5	Propane – All Other Uses
Light Fuel Oil	A6.1-6 (CO_2, CH_4, N_2O) A6.1-15 (bio-CO_2)	Light Fuel Oil – Forestry, Construction, Public Administration and Commercial/Institutional Biodiesel (CO_2 as bio-CO_2, applied to biofuel portion of fuel oil)
Heavy Fuel Oil	A6.1-6 (CO_2, CH_4, N_2O) A6.1-15 (bio-CO_2)	Heavy Fuel Oil – Residential, Forestry, Construction, Public Administration and Commercial/Institutional Biodiesel (CO_2 as bio-CO_2, applied to biofuel portion of fuel oil)
Kerosene	A6.1-6	Kerosene – Forestry, Construction, Public Administration and Commercial/Institutional
Diesel Fuel	A6.1-6 (CO_2, CH_4, N_2O) A6.1-15 (bio-CO_2)	Diesel – Refineries and Others Biodiesel (CO_2 as bio-CO_2, applied to biofuel portion of diesel)
Marine Diesel for Stationary Purposes	A6.1-15 (CO_2) A6.1-6 (CH_4, N_2O) A6.1-15 (bio-CO_2)	Marine – Diesel Diesel – Refineries and Others Biodiesel (CO_2 as bio-CO_2, applied to biofuel portion of diesel)
Gasoline	A6.1-6 (CO_2, CH_4, N_2O) A6.1-15 (bio-CO_2)	Motor Gasoline Ethanol (CO_2 as bio-CO_2, applied to biofuel portion of gasoline)
Wood Fuel – Industrial (50% moisture)	A6.6-1	Wood Fuel/Wood Waste – Industrial Combustion
Wood Fuel – Residential (0% moisture)	A6.6-1	Stoves and Fireplaces – Pre-2020 EPA Certified Woodstove – Residential Combustion
Ethanol	A6.1-15 (bio-CO_2) A6.1.6 (CH_4, N_2O)	Renewable Fuels – Ethanol Motor Gasoline
Biodiesel	A6.1-15 (bio-CO_2) A6.1.6 (CH_4, N_2O)	Renewable Fuels – Biodiesel Diesel – Refineries and Others

CAS sourced energy conversion factors for fuels (i.e., the energy density of fuels) from Statistics Canada's *Report on Energy Supply and Demand in Canada* (RESD), which can be found in the Emission

Factors Catalogue. Organizations can use the factors to convert cubic metres (m^3) of natural gas or litres (L) of liquid fuels to GJ.[15]

Calculations: In B.C., the Low Carbon Fuels (General) Regulation, under the Low Carbon Fuel Standard (LCFS) sets the requirements for renewable fuel in the province's transportation and heating fuel blends.[16] Starting on January 1, 2010, fuel suppliers were required to incorporate at least 5% renewable fuel content in gasoline and 3% in diesel. The renewable diesel requirement was increased to 4% in 2011 and 8% in 2025. The minimum renewable content requirement in gasoline remains at 5%.

The Emission Factors Catalogue treats the standard gasoline blend as 95% fossil fuel gasoline and 5% ethanol, and the standard diesel blend as 92% fossil fuel diesel and 8% biodiesel (Table 4).

Table 4: Renewable Fuel Content in Liquid Fuels in CGRT for the 2025 Reporting Year

Fuel	Gasoline (Standard)	Diesel (Standard)
Percent fossil fuel	95% gasoline	92% diesel
Percent biofuel	5% ethanol	8% biodiesel

2.1.1 Natural Gas and Renewable Natural Gas

Biogas: Organizations that capture biogas for their own stationary combustion may calculate the percentage of CH_4 in the biogas (in cases where methane is not separated from the CO_2 in biogas prior to combustion) and apply the emission factors for 100% renewable natural gas (RNG) accordingly.

FortisBC standard blend: FortisBC began designating a portion of the natural gas sold to customers as RNG in 2024. In 2025, FortisBC increased the proportion of RNG in its standard blends to 2% on January 1 and 3% on July 1. The FortisBC emission factor in the Emission Factors Catalogue reflects the middle value of 2.5% RNG for the 2025 reporting year. Organizations that purchase their natural gas from FortisBC should use the FortisBC emission factor if they do not purchase additional RNG.

Fossil natural gas (0% RNG): Organizations that purchase natural gas from other retailers where RNG is not part of the blend should use the Natural Gas (R0) emission factor in the catalogue (new for 2025).

RNG blends: Organizations in the FortisBC or Pacific Northern Gas service areas may choose to purchase gas with a specified percentage of RNG (RNG blends).[17] Those that purchase blends of RNG other than the FortisBC standard blend or 100% RNG should follow the steps in Table 5 to calculate emissions from fossil natural gas and from RNG.

[15] Statistics Canada (2024). *Report on Energy Supply and Demand in Canada 2005-2023*, pp. 14 to 15. Available: https://www150.statcan.gc.ca/n1/en/catalogue/57-003-X

[16] Renewable and Low Carbon Fuel Requirements Regulation, B.C. Reg. 394/2008.

[17] FortisBC (2025). *Renewable Natural Gas.* Available: https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas.

Specific Instructions:

For PSOs: if you purchase 100% RNG, you can continue to report your consumption as 100% RNG in CGRT. PSOs that purchase a non-standard RNG blend should report their purchases as a proportion of fossil natural gas (i.e., R0) and 100% RNG.

Table 5 has an example of the calculations for an organization purchasing 10,000 GJ of natural gas at a 10% RNG blend. Once the calculations are complete, you can enter the amount of R0 natural gas and 100% RNG that represent your blend into CGRT.

Table 5: Calculations for Non-Standard RNG Blend Purchases

Step	Example Calculation
(1) Determine the amount of gas purchased and the RNG blend purchased.	Amount of gas purchased: 10,000 GJ RNG blend purchased: 10%
(2) Calculate the proportion of fossil natural gas (R0) to report by multiplying the amount of gas purchased by 100% minus the RNG blend purchased.	Amount of gas purchased × (100% – RNG blend purchased) = 10,000 GJ × (100% – 10%) = 10,000 GJ × (90%) = 9,000 GJ of R0 natural gas to report
(3) Calculate the amount of 100% RNG to report by multiplying the amount of gas purchased by the RNG blend purchased.	Amount of gas purchased × RNG blend purchased = 10,000 GJ × 10% = 1,000 GJ 100% RNG to report

2.2 Purchased Electricity for Stationary Sources

Type: Indirect Emissions

Description: Organizations purchase electricity in B.C. from the three types of grids: [18]

- the integrated grid (which covers most of B.C.),
- the Fort Nelson grid (from Fort Nelson east to the Alberta border), or
- micro-grids in non-integrated areas. [19]

[18] A map of the B.C. transmission system is available here: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/transmission/maps/Transmission-System-2023-2024.pdf

[19] Non-integrated areas are areas that are not connected to either the integrated grid or the Fort Nelson grid. They range in size from a grid that supplies 18 customers (Ehthlateese) to one that supplies 1,700 customers (southern Haida Gwaii). See BC Hydro (2023). BC Hydro's Non-Integrated Areas Planning Regulatory Framework, pp. 7-9. Available: https://docs.bcuc.com/documents/proceedings/2024/doc_75671_b-1-bch-non-integrated-areas-planning-framework.pdf

Organizations with operations outside of B.C. purchase electricity from local suppliers. An organization that is unsure from which grid it purchases electricity should contact their utility.

Data sources: CAS publishes electricity emission intensity factors (EEIFs) for the integrated grid and the Fort Nelson grid.[20] As per Schedule D of the Greenhouse Gas Emission Reporting Regulation (GGERR), B.C.'s EEIFs are **consumption-based**, calculated using a **"net import" model**. This means that the emissions intensity of electricity used by organizations following this methodology reflects the emissions intensity of electricity generated in B.C., less the export of electricity from B.C., plus the emissions intensity of electricity purchased from other jurisdictions. B.C.'s EEIFs include emissions released from power generated over a four-year period to reduce fluctuations caused by high emission years (e.g., those with large imports from higher carbon electricity jurisdictions).

CAS uses either the integrated grid or the Fort Nelson grid emission factors as proxies for hybrid renewable and diesel micro-grids, depending on the emission intensity of the micro-grid. Facilities located on solely diesel-powered micro-grids diesel should use the off-grid diesel electricity emission factor, developed using the average consumption of diesel and electricity output from diesel-only communities in B.C.

Table 6: Emission Factor Sources for Electricity in Other Provinces in the 1990-2023 NIR

Province	NIR Reference
Alberta	Table A.13-10
Ontario	Table A.13-7
Quebec	Table A.13-6
Nova Scotia	Table A.13-4

[20] B.C. Ministry of Energy and Climate Solutions. Electricity Emission Intensity Factors for Grid-Connected Entities. Available: https://www2.gov.bc.ca/gov/content?id=616BC0B3E8354AD3B500B279FE56B337

Specific Instructions:

For PSOs: CAS draws EEIFs for **other Canadian provinces** from the territorial-based **consumption intensity** values in the 1990-2023 NIR (Part 3, Annex 13). For PSOs: CAS draws EEIFs for **other Canadian provinces** from the territorial-based **distribution intensity** values in the 1990-2023 NIR (Part 3, Annex 13). These distribution intensities include provincial emissions from power generation within the jurisdiction, as well as line losses and SF_6 emissions. CAS then sums up the GHG and SF_6 emissions and divides by the overall generation from the previous four years for each province. PSOs with operations in Canada but outside of B.C. that are in the CNG program's scope should report the emissions the EEIFs for those provinces (Table 6).

CAS sources EEIFs for **countries and regions outside of Canada** from Ember. CAS sums up the electricity generation and CO_2 emissions of the previous four years to get a **generation intensity**.[2] If you have operations located outside of Canada and that are in the scope of the CNG program, you should report the emissions using the EEIFs published by Ember for those countries and regions. This value is not as comprehensive as BC's consumption intensity or the distribution intensity for other provinces.

PSOs with operations located outside of Canada and in the scope of the CNG program should report emissions using the EEIFs published by Ember for those countries and regions.

[1] – Environment Canada (2025). National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2023, Part 3, Annex 13 – Electricity in Canada: Summary and Intensity Tables. Available: https://publications.gc.ca/site/eng/9.506002/publication.html.

[2] – Ember (2025). Yearly electricity data. Available: https://ember-energy.org/data/yearly-electricity-data/. Ember sources data from Global Energy Monitor.

2.2.1 Renewable Energy Certificates (RECs)

Specific Instructions:

For PSOs: The CCAA does not recognize Renewable Energy Certificates (RECs), Green Rights or Green Power Credits as a means of lowering the emissions associated with electricity consumed or offsetting emissions for PSOs to meet their CNG obligations.

2.3 District Energy Systems for Stationary Sources

Type: Indirect Emissions[21]

[21] Organizations that operate their own DES should treat the energy they use from the system as direct emissions, following the guidance in Section 2.1. Section 2.3 applies to PSOs that sell energy to other organizations.

Description: Some organizations purchase energy from district energy systems (DESs) that have one or more energy plants that produce hot water, steam, and/or chilled water, which is then distributed through a network of insulated pipes to provide hot water, space heating, and/or air conditioning for buildings connected to the DES.[22] Several organizations operate DESs and sell their excess energy to customers, while others purchase energy from DES operators. DES operators can use a variety of feedstocks, including, but not limited to, natural gas, diesel fuel, other liquid fossil fuels, solid, liquid or gaseous biofuels, renewable electricity, recovered and/or upgraded waste heat, and cold water, e.g., from an ocean or lake.

Data Sources: Organizations can determine their district energy emission factor and emissions by:

(1) contacting their district energy provider for the emission factor of the DES, or
(2) contacting their district energy provider for the energy source mix, equipment efficiency and distribution efficiency of each fuel source in the DES, and inputting the data into the DES Use and Emissions calculator (described below).

Calculations: When an organization produces district energy for its own consumption, it can determine the resulting GHG emissions by applying the appropriate emission factors of the fuels consumed by the system (refer to Section 2.1 for the emission factors for stationary fuel combustion).

If an organization purchases heating or cooling from another entity, it can determine emissions with information on the fuels consumed by the DES plants and the generation, as well as the distribution, and heat generation/transfer efficiencies of the DES.

The average efficiency of DESs depends on characteristics such as the energy sources used, the energy generation/capture equipment, the physical condition of the energy plants, distribution losses, and operation and maintenance practices. The Emission Factors Catalogue includes ten tiers of emissions intensities for DESs for organizations to use to determine their GHG emissions. The tiers range from a low-carbon DES (Tier 1) to a high-carbon DES (Tier 10).

Specific Instructions:

For PSOs: The CNG program uses DES tiers to represent a range of possible DES performance, and to have a fixed emission intensity for these DESs, as CGRT is currently not designed to enable PSOs to input the specific emission factor for their district energy system.

PSOs that purchase steam can load their purchased steam totals in pounds (lbs) or kg into CGRT for conversion into megajoules (MJ) of energy.

DES Use and Emissions Calculator: CAS developed a DES Use and Emissions Calculator based on guidance from the General Reporting Protocol to help organizations determine which of the tiers to use for emission measurement and reporting purposes.[23] The DES Use and Emissions Calculator outputs the

[22] US Department of Energy, Office of Energy Efficiency & Renewable Energy (2020). District Energy Systems Overview. Available: https://www.energy.gov/sites/default/files/2021/03/f83/District_Energy_Fact_Sheet.pdf

[23] The Climate Registry (2019). General Reporting Protocol, Version 3.0. Available:

emission intensity at the upper bound of each tier to provide conservative estimates across all tiers. The exception is Tier 10 which is based on a DES system using gasoline with 75% system efficiency. While CAS chose the upper bound of Tier 10 to be conservative, it is possible for some DESs to have higher emissions intensities than this upper bound. The calculator is on the Carbon Neutral Government Program website under "Greenhouse gas calculation and reporting tools." The steps for using the DES Calculator are:

(1) Use the calculator to determine the district energy system's emissions intensity.
(2) Compare the calculated emissions intensity with the tier thresholds provided in the calculator.
(3) Select the higher of the two tiers the calculated value falls between. That is, if Tier 1 has a cutoff of 0.2 kg CO_2e/kWh and Tier 2 has a cutoff of 0.25 kg CO_2e/kWh, and the DES has an emission factor of 0.22 kg CO_2e/kWh, it would be reported as Tier 2, with an emission factor of 0.25 kg CO_2e/kWh.

For PSOs: CGRT requires PSOs to use specified emission factors that align with the 10 tiers in the Emission Factors Catalogue. PSOs enter the tier identified for their district energy use in the DES Use and Emissions Calculator into CGRT.

CGRT does not include bio-CO_2 emissions for DESs, because systems can reach the same tier using very different energy sources. However, you are required to add your energy and emissions data, including bioenergy and bio-CO_2 emissions from DESs. PSOs that purchase district energy can use the DES Use and Emissions Calculator to determine the bio-CO_2 emissions of their district energy purchases. The calculator then provides an equivalent biofuel consumption using RNG. You should then input the equivalent RNG consumption from the calculator into the RNG position in CGRT, following the CGRT User Manual's instructions.

PSOs that own or lease and operate a DES need only report the fuel consumed by the DES as per Section 2.1, not the energy purchased from the DES, except as described in Section 2.4.

PSOs using the DES Use and Emissions Calculator should document all the variables they input into the calculator for reference by other/future staff, for annual self-certification purposes, and for possible third-party verification. PSOs should update the documentation annually, as system operations and efficiencies will vary based on climate, exposure, occupancy patterns, heating controls, insulation, fuel types, and other factors. PSOs may submit documentation or any questions about DES calculations to Carbon.Neutral@gov.bc.ca.

https://theclimateregistry.org/wp-content/uploads/2025/06/General-Reporting-Protocol-3.0_The-Climate-Registry_rev.6-5-25.pdf.

2.4 Energy Sold by a PSO

For PSOs: If your organization sells energy to an organization that is not a PSO, including the private sector, LGs or MTNs, the PSO remains responsible for reporting the energy and emissions associated with that energy. PSOs shall report as their own all energy sold from their buildings or facilities to any non-PSO.

Energy sold by a PSO to another PSO, irrespective of the site ownership structures, should only be entered in CGRT by the purchasing PSO. If the PSO selling energy to another PSO reports all of energy they originally purchased, including what it sells to the other PSO, it should subtract the sales to other PSOs to avoid double counting when aggregating the associated emissions across the B.C. public sector.

Where ownership of a building is joint between one or more PSOs and another entity or entities, and there is clarity on the structure of the ownership model, the PSO(s) need only report their portion of the energy consumption.

For more information, please see the Carbon Neutral Government program scope webpage.

2.5 Estimating a Building's Energy Use

Type: Direct and Indirect Emissions

Description: Organizations have two options for estimating energy consumption in buildings when utility data is not readily available: the Regional Calculated Energy Use Intensity method, and the Fixed Energy Use Intensity method. Both methods rely on the organization having the building's conditioned space[24] floor area in square metres (m^2). The conditioned space floor area includes all areas inside the building such as tenant areas, common areas, mechanical equipment areas, and storage rooms.[25]

Figure 1 depicts the process of choosing the best approach for estimating the use of an energy source in a building.

[24] The term "conditioned space" is defined in the 2024 BC Building Code as "any space within a *building*, the temperature of which is controlled to limit variation in response to the exterior ambient temperature by the provision, either directly or indirectly, of heating or cooling over substantial portions of the year." BC Ministry of Housing and Municipal Affairs (2024). 2024 British Columbia Building Code, p. 20. Available: https://www2.gov.bc.ca/gov/content?id=95E068C480804BCDA9ECE716CA921B1D.

[25] Energy Star Portfolio Manager. Glossary – Gross Floor Area. Available: https://portfoliomanager.energystar.gov/pm/glossary

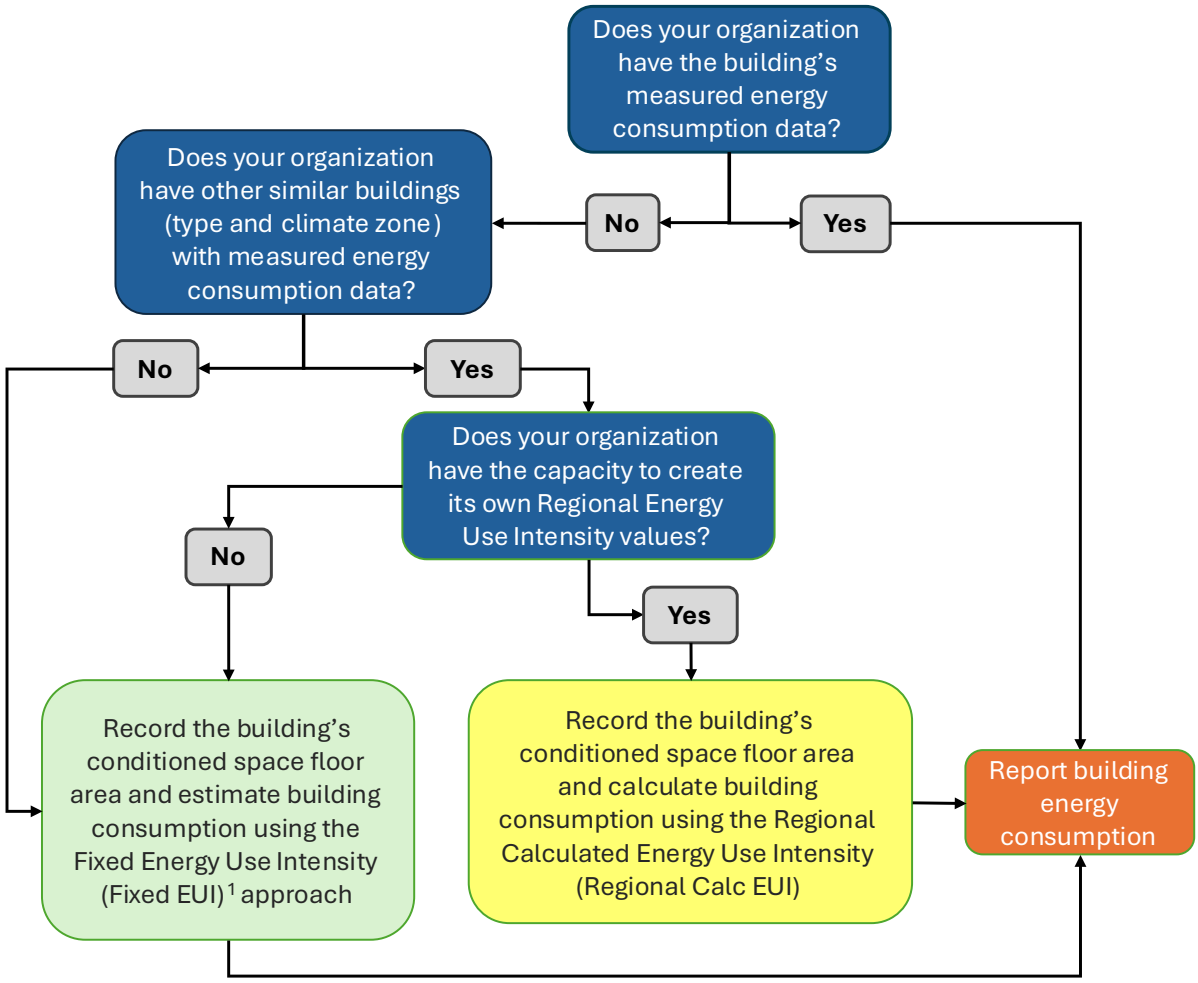

Figure 1. Decision-making flow chart for when and how to estimate building emissions.

2.5.1 Regional Calculated Energy Use Intensity

The Regional Calculated Energy Use Intensity (Regional Calc EUI) method estimates a building's energy use by employing data from similar buildings in the organization's portfolio. To use the Regional Calc EUI method, organizations should have measured utility data for the majority of their buildings in a category (e.g., educational facilities, hospitals, residences, long-term care centres) within similar climates zone.[26] Organizations should use at least two years of utility data to smooth out annual climate variability.

[26] The 2024 BC Building Code describes the climate zones by the annual heating degree-days of the building location. BC Ministry of Housing (2024). 2024 British Columbia Building Code, p. 1011. Available: https://www2.gov.bc.ca/gov/content?id=95E068C480804BCDA9ECE716CA921B1D. Climate data is located on pp. 1573 to 1578 of the BC Building Code. The Better Homes BC Program shared a map with communities in B.C. and their climate zones.

To estimate the building's energy use, organizations should:

(1) Collect utility energy data and conditioned space floor area for all their buildings with reported utility data and aggregate these buildings by building category and by climate zone,
(2) For each energy source (e.g., natural gas, electricity, propane, etc.) divide the energy used in the aggregated buildings by the conditioned space floor area of the aggregated buildings to get the Regional Calc EUI for each energy source by building type and climate zone,
(3) Multiply the floor area of the building to be estimated (BTBE) by the Regional Calc EUI for each energy source used in the BTBE to estimate its energy consumption,
(4) Apply each GHG's emission factor for the estimated energy source used to estimate emissions,
(5) Apply the GWPs to each GHG to estimate total CO_2e emissions by GHG, and
(6) Sum estimated GHGs to develop total estimated building emissions.

Organizations follow the calculations in Table 7 to convert estimated energy use to GHG emissions.

Table 7: Regional Energy Use Intensity Estimation Calculation

Step	Formula (apply for each energy source)
(1) For buildings with reported utility data, collect utility energy data and conditioned space floor area, and aggregate these buildings by building category and by climate zone.	$Area_{,building\ 1} + \ldots + Area_{,building\ N}$ = Total Conditioned Spaced Floor Area with Reported Energy Source Use[a] (m^2) $Energy_{,building\ 1} + \ldots + Area_{,building\ N}$ = Total Annual Energy Source Use (GJ/year)
(2) For aggregated buildings (i.e., similar building category and climate zone) for which the organization has energy use data, determine the combined reported annual consumption for each energy source and divide by the combined conditioned space floor area.	Total Annual Energy Source Use (GJ/year) ÷ Total Conditioned Space Floor Area with Reported Energy Source Use[a] (m^2) = Regional Calculated Energy Use Intensity (Regional Calc EUI) (GJ/m^2/year)
(3) Multiply the floor area[a] of the Building(s) to be Estimated (BTBE) by the Regional Cal EUI to estimate annual consumption by each energy source.	Floor area of the BTBE (m^2) × Regional Calc EUI (GJ/m^2/year) = Estimated Annual Energy Source Use in BTBE (GJ/year)
(4) Multiply the emission factor for each GHG by the estimated annual consumption by each energy source in BTBE to estimate emissions by GHG.	Emission Factor by GHG for Energy Type (t/GJ) × Estimated Annual Energy Source Use in BTBE (GJ) = Estimated Emissions by GHG in BTBE (t)
(5) Apply the GWPs to each GHG to estimate total BTBE CO_2e emissions by GHG.	Estimated emissions by GHG in BTBE (t) × GWP of GHG (t CO_2e/t) = Estimated emissions (t CO_2e) by GHG in BTBE
(6) Sum estimated GHGs to develop BTBE emissions.	Emissions of ($CO_2 + CH_4 + N_2O$) in BTBE (t CO_2e) = Total Estimated Emissions in BTBE (t CO_2e)

a. If the floor area of a building changes in a reporting period, multiply each area by the number of days during the year in the floor area, add the results and divide the sum by 365 to get a prorated area for the year.

Specific Instructions:

For PSOs: if you use the Regional Calc EUI approach, you may enter the estimated energy use (Step 3 in Table 7Table 7) into CGRT, instead of following CGRT's internal emissions estimation

2.5.2 Fixed Energy Use Intensity

The Fixed Energy Use Intensity (Fixed EUI) method uses the energy intensity factors in NRCan's CEUD.[27] This database includes statistics on energy use by province, building use, building type, and energy source. The Emission Factors Catalogue includes the EUIs for different building classifications. The Fixed EUI method is less complex than the Regional Calc EUI, but may be less accurate.

Organizations may choose either method, but the Fixed EUI estimation method (Table 8) may be the only option available, if:

- They do not have access to enough data to determine a Regional Calc EUI, or
- They do not have the capacity to determine a Regional Calc EUI.

Table 8: Fixed Energy Use Intensity Estimation Calculation

Step	Formula (apply for each energy source)
(1) For each energy source, determine the annual consumption amount by multiplying the conditioned space floor area [a] of the BTBE by the Energy Use Intensity [b] from the CEUD.	BTBE's Conditioned Space Floor Area (m^2) × Energy Use Intensity (GJ/m^2/month) × 12 months = BTBE's Annual Energy Consumption Estimate (GJ)
(2) Apply the emission factor by energy source to yield total BTBE emissions by energy source	Emission Factor by GHG (t/GJ) × BTBE's Annual Energy Consumption Estimate (GJ) = Emissions by GHG (t)
(3) Apply the global warming potentials to yield total emissions	Emissions by GHG (t) × GWP = Emissions (t CO_2e)
(4) Sum across the gases to calculate total BTBE CO_2e emissions	Emissions of (CO_2 + CH_4 + N_2O) (t CO_2e) = Total BTBE Emissions (t CO_2e)

a. If the area of a building has changed within a monthly reporting period, multiply each area by the number of days during the month for which it was effective. Sum the results and divide that sum by the total number of days in the month to get a prorated area to use for that month.

b. The CEUD provides annual energy intensity. In CGRT, the EUI has been divided by 12 so PSOs can measure energy use and emissions monthly, so PSOs can measure new estimated building energy use based on occupancy date. If working directly from the CEUD, there is no need to multiply by 12 months.

[27] NRCan through the Office of Energy Efficiency. Comprehensive Energy Use Database. Available: https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm

Specific Instructions:

For PSOs: enter the conditioned space floor area into CGRT for each building to be estimated (BTBE). CGRT completes the calculations described in Table 8.

2.5.3 Hybrid Energy Estimations

In some instances, organizations can access energy data for one energy type in a building but not for another. In those instances, organizations may estimate the unknown energy type using one or a combination of the methods above. For example, the Regional Calc EUI may be used to estimate one energy type within a building while other energy types in the same building may use the Fixed EUI.

3 Mobile Sources – Transportation

This section outlines how to calculate the direct and indirect GHG emissions from operating seven modes of vehicles or equipment:

- Light-duty vehicles (excluding trucks, sport utility vehicles (SUVs), and minivans),
- Light-duty trucks (including SUVs and minivans),[28]
- Heavy-duty vehicles,
- Motorcycles,
- Off-road vehicles and equipment (e.g., snowmobiles, all-terrain vehicles, lawnmowers and trimmers, tractors, construction equipment),
- Marine vessels, and
- Aviation.

3.1 Mobile Fuel Combustion

Type: Direct Emissions

Description: Organizations use a variety of fuels and energy sources to power vehicles and equipment. The fuels include, but are not limited to:

- Fossil fuels:
  - gasoline,
  - diesel,
  - marine gasoline,
  - marine diesel,
  - aviation gasoline,
  - aviation turbo fuel,
  - natural gas[29] and
  - propane.
- Biofuels:
  - biodiesel,
  - ethanol, and
  - renewable natural gas.
- Electricity.

The Emission Factors Catalogue does not include emission factors for hybrid electric and plug-in hybrid electric vehicles, because their fuel consumption is captured under gasoline cars and trucks. Their higher fuel economy relative to conventional gasoline cars and trucks is reflected in their lower overall fuel consumption, and therefore, lower GHG emissions.

[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.

[29] Natural gas is often sold by kg for transportation purposes. To enable conversions, the density of natural gas needs to be set in CGRT and in the Emission Factors Catalogue. CAS has set it at 0.72487 kg/m^3 at standard temperature and pressure, based on the conversion of one cubic metre of natural gas to one tonne of liquified natural gas, from Canada's Energy Regulator.

Organizations that collect vehicle electricity consumption data separately from the buildings hosting charging infrastructure (e.g., through separate charging infrastructure meters) may report electricity consumed by vehicles as mobile electricity. To calculate mobile electricity emissions, organizations may use the appropriate EEIF for their electricity utility (see Section 2.2).

Hydrogen powered vehicles do not produce tailpipe GHG emissions and are not included in emissions reporting for mobile sources.

Data sources: The Emission Factors Catalogue includes mobile fuel combustion emission factors that are largely sourced from Table A6.1-15 in the 1990-2023 NIR (Part 2).[30] Table 9 describes where in NIR Table A6.1-15 users can find the emission factors for each vehicle type and fuel type. However, NIR Table A6.1-15 does not reference fuel blends. Therefore, the CO_2 and bio-CO_2 emission factors for fossil/renewable fuel blends in the Emission Factors Catalogue have been calculated based on the proportion of renewable fuel in each fuel blend listed in the catalogue.

Table 9: Mobile Combustion Emission Factors Sources in the 1990-2023 NIR.

Vehicle Type	Fuel	Vehicle Emissions Performance or Type of Fuel
Light-duty Vehicle	Gasoline Diesel	Tier 2 Advanced Control
Light-duty Truck (includes SUV and Minivan)	Gasoline Diesel	Tier 2 Advanced Control
Heavy-duty	Gasoline Diesel	Three-way Catalyst Advanced Control
Motorcycle	Gasoline	Non-catalytic Controlled
Off-Road (Vehicle/Equipment)	Gasoline Diesel Propane	Off-road Gasoline 4-stroke Off-road Diesel ≥ 19kW, Tier 4 Off-road
Marine	Gasoline Diesel	Marine
Aviation	Gasoline Turbo Fuel	Aviation
Propane Vehicles (light-duty vehicle, light-duty truck, heavy-duty vehicle)	Propane	Propane Vehicles
All fleet using renewable fuels	Biodiesel Ethanol	Renewable Fuels[a]

[a] In Table A6.1-15 in the NIR, only bio-CO_2 emissions are reported for renewable fuels. The CH_4 and N_2O emissions from renewable fuels are influenced by the type of fleet, engine and fuel type.

[30] Environment Canada (2025). *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2023*, Part 2, p. 275. Available: https://publications.gc.ca/site/eng/9.506002/publication.html

Natural gas vehicles require a separate approach from the vehicles in Table 9. The mobile CO_2 emission factor in table A6.1-15 of the NIR for natural gas vehicles dates to a reference from 2000, and the composition of natural gas in British Columbia has since changed (evident in Table A6.1-1 of the NIR).

For 2025, the Emission Factors Catalogue will use the stationary emission factor for CO_2 in Table A6.1-1 of the NIR, less the renewable natural gas content of FortisBC's standard supply where applicable, and less the carbon in the fuel that is not combusted and instead released as methane. Emission factors for CH_4 and N_2O in the NIR are the same for all types of natural gas vehicles, as these emissions are the result of the performance of the natural gas vehicle's engine, not the composition of natural gas. Table 10 lists the sources of emission factors for natural gas vehicles. RNG is assumed to have the same physical characteristics of fossil natural gas.

Table 10. Sources for EFs for natural gas vehicles

Fuel Type	Source Table in NIR	Reference
Natural Gas (R0, FortisBC, R100)	A6.1-1 (CO_2)	B.C. Emission Factors – Marketable Natural Gas (applied to fossil portion of NG)
	A6.1-1 (CO_2 as bio-CO_2)	B.C. Emission Factors – Marketable Natural Gas (applied to RNG portion of NG)
	A6.1-15 (CH_4, N_2O)	Natural Gas Vehicles

Calculations: In B.C., the Low Carbon Fuels (General) Regulation sets the requirements for renewable fuel in the province's transportation and heating fuel blends.[31] Starting January 1, 2010, fuel suppliers were required to incorporate at least 5% renewable fuel content in gasoline and 3% in diesel. The renewable diesel requirement increased to 4% in 2011 and 8% in 2025. The minimum renewable content requirement in gasoline remains at 5%.

The Emission Factors Catalogue and CGRT treat the standard gasoline blend as 95% fossil fuel gasoline and 5% ethanol, and the standard diesel blend as 92% fossil fuel diesel and 8% biodiesel (Table 4).

In B.C., biofuels are almost always blended with fossil fuels, most commonly gasoline or diesel, in varying proportions (e.g., E10, B5, B20).[32] The values in the Emission Factors Catalogue and CGRT for bio and non-bio mobile emissions for standard blends already include the proportion of biofuels consumed. Table 11 demonstrates the calculation of the bio-CO_2 emission factors for light-duty vehicles that consume standard gasoline and diesel blends. Values for renewable fuels are derived from the NIR and are available in the Emission Factors Catalogue.

[31] Renewable and Low Carbon Fuel Requirements Regulation, B.C. Reg. 394/2008.

[32] International protocols require the separate reporting of biogenic emissions from fossil fuel-based emissions (see Section 2.1), and the CO_2 emissions from the biofuel component must be calculated and reported separately from those of the fossil fuel component.

Table 11: Calculations for Bio-CO_2 emission factors (EFs) for Standard Fuels

Standard Fuel Classification	100% Biofuel Bio-CO_2 EF	Minimum Renewable Fuel Content	Bio-CO_2 EF for Standard Fuel
Light-duty Vehicle – Gasoline (Standard)	1.508 kg/L (Ethanol)	× 5% =	0.0754 kg bio-CO_2/L
Light-duty Vehicle – Diesel (Standard)	2.472 kg/L (Biodiesel)	× 8% =	0.1978 kg bio-CO_2/L

The blends represented in the Emission Factors Catalogue and CGRT are:

Ethanol/gasoline blends:

- 0% ethanol,
- 5% ethanol (standard),
- 10% ethanol,
- 15% ethanol, and
- 100% ethanol.

Biodiesel/diesel blends:

- 0% biodiesel,
- 5% biodiesel,
- 8% biodiesel (standard),
- 20% biodiesel, and
- 100% biodiesel.

Starting in 2025, the Emission Factors Catalogue includes 0% renewable content emission factors for all fuel and vehicle types in the NIR Table A6.1-15.

Specific Instructions:

For PSOs: CGRT only includes 0% blends for the most commonly reported fuel/vehicle types in the CNG program: heavy-duty diesel, gasoline, and natural gas vehicles, and light-duty gasoline trucks. Organizations seeking to report fossil gasoline (i.e., E0), diesel (i.e., B0) and natural gas (i.e., R0) for other vehicle types, or blends other than those listed in CGRT, can use the Biofuel Blends Converter (found under "files" in CGRT) to report consumption in CGRT.

3.1.1 Renewable Fuel Blends

FortisBC began designating a portion of its marketable natural gas as RNG in 2024. In 2025, FortisBC increased the proportion of RNG in its standard blend to 2% on January 1 and to 3% on July 1. The FortisBC emission factor in the Emission Factors Catalogue reflects the middle point of 2.5% RNG for the 2025 reporting year.

Organizations that purchase their natural gas from FortisBC report their natural gas as standard if they do not purchase additional RNG. Organizations in both the FortisBC and Pacific Northern Gas service areas may choose to purchase gas with RNG blends.[33]

A new emission factor has been created for organizations that purchase natural gas from other retailers where RNG is not part of the blend; this is labelled as Natural Gas (R0) in the catalogue.

Organizations that purchase any mix of RNG other than the standard mix may follow the steps in Table 5 to calculate their consumption of fossil natural gas and RNG.

Similarly, organizations purchasing renewable fuel blends, e.g., diesel/biodiesel or gasoline/ethanol that differ from the blends listed in Section 3.1, can follow the example in Table 12 to calculate the volume of fossil and renewable fuels that should be reported to their program.

Specific Instructions:

For PSOs: PSOs using vehicles that do not have a zero renewable content position in CGRT can use the Biofuels Blend Converter located under Files in the CGRT dashboard to calculate their standard fuel and renewable fuel consumption.

Table 12: Calculations for Mobile Fuel Blend Purchases

Step	Example Calculation
(1) Determine the amount of fuel purchased and the biofuel blend purchased.	Amount of fuel purchased: 10,000 L Biodiesel blend purchased: 25%
(2) To calculate the fossil diesel and renewable diesel consumption, multiply the amount of fuel purchased by 100% minus the biodiesel blend purchased.	Amount of fuel purchased × (100% – biofuel blend purchased) = 10,000 L × (100% – 25%) = 10,000 L × 75% = 7,500 L of fossil diesel to report
(3) To calculate the renewable diesel consumption, multiply the amount of fuel purchased by the biofuel blend purchased.	Amount of diesel purchased × biofuel blend purchased = 10,000 L × 25% = 2,500 L of 100% biodiesel (B100) to report

The Emission Factors Catalogue does not include emission factors for renewable diesel or renewable gasoline. Organizations seeking to report renewable diesel and renewable gasoline use the CO_2 emission factors of fossil diesel and gasoline from the NIR as their bio-CO_2 emission factors.

[33] FortisBC (2025). *Renewable Natural Gas.* Available: https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas

Specific Instructions:

For PSOs: CGRT calculates biogenic emissions (bio-CO_2, CH_4, and N_2O) from combusting ethanol, biodiesel, and renewable natural gas, in alignment with international emissions reporting protocols. It then reports bio-CO_2 emissions separately from bio-CH_4 and bio-N_2O emissions.

While bio-CO_2 emissions are tracked, you do not have to offset bio-CO_2 emissions. Further, bio-CO_2 emissions are no longer (as of 2023) included in total GHG emissions when measuring progress towards emission reduction targets.

CGRT requires that users enter fuel consumption by vehicle type and fuel type in CGRT, because the emission factors for CH_4 and N_2O vary by vehicle and fuel.

CGRT does not have positions for renewable diesel or renewable gasoline. PSOs using renewable diesel and renewable gasoline should report their biofuel consumption as biodiesel and ethanol, respectively.

4 Fugitive Sources

This section explains how to calculate direct emissions from fugitive sources.

Type: Direct Fugitive Emissions

Description: Fugitive emissions are unintended leaks of GHGs, such as hydrofluorocarbons (HFCs), from equipment into the atmosphere. Unlike emissions from combustion, these emissions come from wear and tear or poor installation (e.g., aging seals or damaged valves).

This section provides two methods for quantifying HFC emissions from refrigeration equipment, that is, refrigeration units. Refrigeration units employ the expansion and compression of refrigerants, regardless of their application. Refrigeration units include refrigerators, heat pumps, air conditioners, and similar devices. The two quantification methods are:

1. Unit-based methodology (section 4.3), and
2. Asset group-based methodology (section 4.4).

The unit-based methodology relies on direct measurements of leaked refrigerants by technicians and should be used for units that have robust refrigerant tracking systems in place. The asset group-based methodology involves estimation and may be used where refrigerant tracking is unreliable.

Data sources: The approach in this section relies on the following sources:

- Accounting Tool to Support Federal Reporting of Hydrofluorocarbon Emissions: Supporting Documentation,
- B.C. Refrigerants Offset Protocol,
- ASHRAE's Refrigerant Designations, and
- Carbon Neutral Government Regulation.

1.1 Common fugitive gases from equipment

The most common type of fugitive emissions from PSO equipment is refrigerants. Refrigerants include hydrofluorocarbons (HFCs), Ozone Depleting Substances (ODSs), natural refrigerants (e.g., water), or hydrocarbons.

Fugitive emissions can also come from leaks of sulphur hexafluoride (SF_6) from very large circuit breakers or methane leaks from natural gas storage.

4.1.1 Hydrofluorocarbons (HFCs)

HFCs are synthetic compounds commonly used as refrigerants in air conditioning, refrigeration, and heat pump systems. They are composed of carbon, hydrogen, and fluorine atoms, and are designed to replace ODSs. While HFCs do not deplete the ozone layer, they are potent greenhouse gases with 100-year Global Warming Potentials (GWPs) ranging from hundreds to thousands of times that of carbon dioxide (CO_2).

Table 13 lists the GWPs of common HFCs.

Table 13: GWP of common HFCs[34]

HFC	GWP (t CO_2e/kg refrigerant)
HFC-134	1.12
HFC-134a	1.3
HFC-404a	3.94
HFC-407c	1.62
HFC-410a	1.92
HFC-507	3.98

For PSOs: Enter the mass of refrigerant into CGRT, which will calculate emissions given mass of refrigerant leaked.

For PSOs: Given the wide variety of refrigerant blends, some refrigerants being used by PSOs are not currently available in CGRT. If you have any units using one of these refrigerants, please email carbon.neutral@gov.bc.ca.

4.1.2 Ozone Depleting Substances

ODSs are potent GHGs that have previously been used as refrigerants. However, they have been mostly phased out by the Montreal Protocol[35].

Common ODSs include:

- Dichlorodifluoromethane – designated as R-12
- Chlorodifluoromethane – designated as R-22
- Trichlorofluoromethane – designated as R-11
- 1,1-Dichloro-1-fluoroethane – designated as R-141b

For PSOs: ODSs are out of scope for reporting under the CNGR.

4.1.3 Hydrocarbon refrigerants

Hydrocarbons are organic compounds composed entirely of hydrogen and carbon atoms. In refrigeration systems, common hydrocarbon refrigerants include propane (R-290), isobutane (R-600a), and ethane (R-170). These refrigerants are naturally occurring substances with very low GWPs and no ozone depletion potential, making them environmentally preferable alternatives to synthetic

[34] Carbon Neutral Government Regulation and ASHRAE's Refrigerant Designations.

[35] The Montreal Protocol: fixing the ozone layer and taking climate action - Canada.ca

refrigerants such as HFCs. However, hydrocarbons are highly flammable, which can limit their use in certain applications due to safety regulations and design constraints.

Hydrocarbon refrigerants are typically found in small, sealed systems such as household refrigerators and some commercial units.

Common hydrocarbons include:

- Propane – designated as R-290
- Isobutane – designated as R-600a
- Ethane – designated as R-170
- Butane – designated as R-600

For PSOs: Hydrocarbon refrigerants are out of scope for reporting under the CNGR.

4.1.4 Natural refrigerants

Natural refrigerants are substances that occur naturally in the environment, are not hydrocarbons, and can be used as refrigerants in cooling and heating systems. Common natural refrigerants include:

- Carbon dioxide (CO_2) – designated as R-744
- Ammonia (NH_3) – designated as R-717
- Water (H_2O) – designated as R-718

These refrigerants typically have very low or zero GWP and no ozone depletion potential, and are environmentally preferable alternatives to HFCs. However, they may have other considerations such as toxicity (e.g., ammonia) or high operating pressure (e.g., CO_2) that reduce their suitability for specific applications.

For PSOs: Natural refrigerants are out of scope for reporting under the CNGR.

4.1.5 Perfluorocarbons

Perfluorocarbons (PFCs) are synthetic compounds with very high GWP. PFCs are occasionally used as niche refrigerants in specialized cooling applications.

For PSOs: PFCs are in scope for reporting under the CNGR. However, they are very rarely used. If you use PFCs in your organization, please email Carbon.Neutral@gov.bc.ca.

4.1.6 Sulfur hexafluoride

SF_6 (sulfur hexafluoride) is a potent greenhouse gas used as an electrical insulator in high-voltage systems. Fugitive emissions can occur when SF_6 leaks from large circuit breakers, often installed in hydroelectric dams.

4.1.7 Methane (natural gas)

Methane (CH_4) is the primary constituent in natural gas and is a GHG with a global warming potential much higher than CO_2. Fugitive emissions can occur when natural gas leaks from equipment.

For PSOs: Fugitive methane is only in scope if it leaks from equipment owned by PSOs, not from their utility provider.

4.2 Common refrigeration unit types[36]

4.2.1 Room air conditioners

A self-contained air conditioning (A/C) unit is a compact system that integrates all necessary components such as the compressor, condensing coil, evaporator coil, blower, and controls into a single casing. These units are designed to be installed in a window, mounted through a wall, or used as portable devices to cool individual rooms.

Examples include:

- Window-mounted A/C units
- Packaged Terminal Air Conditioners (PTACs)

These are small units with typical capacities as follows:

- Window and wall-mounted units generally range from 1.4 kW to 7.0 kW, with heavy-duty models reaching up to 8.7 kW.
- PTAC units typically have capacities between 2.1 kW and 4.3 kW.

4.2.2 Residential A/C and heat pumps

Residential A/C systems and heat pumps include a variety of configurations designed to cool or heat entire homes or individual zones. These systems typically fall into two categories: ducted split systems, often referred to as central A/C, and ductless split systems, such as mini-splits and multi-splits. Each system consists of separate indoor and outdoor units that work together to condition indoor spaces.

These are medium sized systems that generally have cooling capacities of less than 19 kW, making them suitable for residential applications.

4.2.3 Commercial A/C and heat pumps

Commercial A/C systems and heat pumps are designed to meet the cooling and heating needs of larger commercial facilities including offices and retail buildings. These systems include commercial ducted

[36] CAS based these equipment categories on Appendix B: Equipment Types in the HFC Emissions Accounting Tool: Accounting Tool to Support Federal Reporting of Hydrofluorocarbon Emissions. This is also the source for Environment and Climate Change Canada's (ECCC) Refrigerants Offset Protocol.

split systems (commonly known as commercial central A/C), ductless split systems (such as variable refrigerant flow systems and other multi-split configurations), and packaged rooftop units.

These are large systems with typical capacities as follows:

- Small (for this category) commercial units generally range from 19.0 kW to 39.6 kW.
- Large commercial units generally range from 39.6 kW to 70.3 kW.

Note: This category does not include chillers, which are used for larger scale cooling applications.

4.2.4 Chillers

A chiller is a mechanical device that removes heat from a liquid through a refrigeration cycle. The cooled liquid is then circulated through equipment or systems to provide cooling. Chillers are a core component in many large-scale cooling applications especially air conditioning.

Chillers may use centrifugal, screw, scroll, rotary, or reciprocating compressors, depending on the design and capacity requirements.

These are large systems which are classified by type. The capacities for each type are as follows:

- Chillers with scroll, screw, rotary, or reciprocating compressors generally range from 105 kW to 703 kW.
- Chillers with centrifugal compressors typically range from 527 kW to 7030 kW.

4.2.5 Household refrigerators and freezers

A household refrigerator is a common kitchen appliance used to keep food and drinks cold. It runs automatically and continuously, using a built-in cooling system to maintain a safe temperature for storing perishable items.

These are small units, with capacities less than 1 kW.[37]

4.2.6 Stand-alone retail refrigerators and freezers

Stand-alone retail refrigeration units are self-contained systems used to keep food, beverages, or other items cold without being connected to a central cooling system. These units are commonly found in retail, food service, and institutional settings.

They include equipment like reach-in refrigerators and freezers, glass door merchandisers, beverage coolers, and specialized kitchen equipment such as chef's tables and blast chillers.

There is not a large and small distinction in this category.

[37] U.S. Department of Energy. (2021). Refrigerator and Freezer Energy Rating Online Search Tool: 2011 – July 2021.

4.2.7 Ultra-low temperature stand-alone units

Ultra-low temperature stand-alone units are typically small, specialized fridges used in research or medical applications. They are typically cascade systems,[38] with two phases of cooling and two compressors, each using a different refrigerant.

Recently installed cascade systems typically use hydrocarbons and natural refrigerants. Older systems may use R-23, R-508B and R-403B.[39]

Since these units are specialized and variable, organizations should use the unit-based method in section 4.3 below, not the asset group-based method.

4.2.8 Walk-in refrigerators and freezers

Walk-in refrigerators and freezers are enclosed cold storage spaces designed to hold significant quantities of perishable items. They are commonly used in commercial kitchens, cafeterias, hospitals, and other institutional settings where bulk storage is needed.

These units typically operate with remote condensing systems, which means the cooling equipment is located outside the walk-in space.

There is no distinction in this category between small and large systems.

4.2.9 Supermarket refrigeration and condensing systems

Supermarket refrigeration systems are large, complex networks designed to provide cooling across multiple display cases, reach-ins refrigerators and freezers, and walk-in cold rooms within retail grocery stores. These systems often consist of racks of multiple compressors, a remote condenser, and a piping network that distributes refrigerant throughout the store.

These are distinguished from stand-alone display units by their distributed nature. Supermarket refrigeration pipes refrigerant through several display cases before returning to a separate room to be compressed.

Designs may vary, including centralized, distributed, indirect, or cascade systems, but all are engineered to maintain reliable and efficient cooling across large areas. They are typically used in grocery stores and by big-box retailers with extensive food sections.

There is no distinction in this category between small and large systems.

4.2.10 Medium cold storage

Medium cold storage facilities are refrigerated rooms or warehouses that maintain controlled temperatures for storing perishable food, beverages, or other temperature-sensitive products such as

[38] Farrar Scientific. (2024). Understanding Cascade Refrigeration – the Science Behind Ultra-Low Temperature Storage.

[39] Engineer's Edge. (2025). ASHRAE Refrigerant Applications.

chemicals. These spaces are designed for bulk storage and distribution, providing reliable cooling across large, enclosed areas.

These are medium units which typically range from 1,100 to 11,000 square metres of floor space or have a refrigerant charge size between approximately 90 and 900 kilograms.

4.2.11 Large cold storage

Large cold storage facilities are refrigerated rooms or warehouses that maintain controlled temperatures for storing perishable food, beverages, or other temperature-sensitive products such as chemicals. These facilities provide bulk storage and distribution capacity on a large scale, often supporting regional or national supply chains.

These large units typically exceed 11,000 square metres of floor space, or have a refrigerant charge size greater than approximately 900 kilograms.

4.2.12 Light-duty vehicle climate control system

Light-duty vehicle climate control systems are compact refrigeration units integrated into light-duty vehicles to provide cabin cooling. These systems typically consist of a compressor, condenser, evaporator, and expansion device connected by refrigerant lines.

4.2.13 Light-duty truck climate control system

Light-duty truck climate control systems operate using the same core components as passenger vehicle A/C systems. That is, a compressor, condenser, evaporator, and expansion device but are typically larger to accommodate higher loads.

4.2.14 Bus climate control system

Bus climate control systems are large refrigeration units designed to cool the passenger cabin of buses. These systems typically include a high-capacity compressor, condenser, evaporator, and expansion device, often mounted externally on the roof or integrated into the bus structure.

For PSOs: Off-road vehicle climate control systems (e.g., A/C units in tractors, excavators, ATVs) should be classified as light-duty vehicle or light-duty truck based on cooling needs. For example, if the space that needs cooling is similar to a passenger car, use the light-duty vehicle classification.

4.3 Assessing the significance of a group, or groups of refrigeration units

Some units, such as household refrigerators and room air conditioners, have a small amount of refrigerant, and very low estimated leak rates. If the total estimated emissions from small sources is likely less than 1% of an organization's total, it can be excluded from the organization's GHG inventory (see the one percent rule).

The estimated percent of total emissions from a group of units is calculated as:

$$Estimated\ \% = \frac{\sum_{type=i}(number\ of\ units\ of\ type\ i) \times (estimation\ factor\ i)}{Organizations\ total\ emissions\ for\ 2024} \times 100\%$$

Where the estimation factors are the estimated annual fugitive emissions per unit in Table 14.

Table 14: Estimation factors for common equipment[40]

Equipment (unit) type	Estimated annual fugitive emissions (t CO_2e/unit)
Room air conditioners (A/C)	0.00866
Residential A/C and heat pumps	0.769
Commercial A/C and heat pumps	2.00044
Household refrigerators and freezers	0.000975
Stand-alone retail refrigerators and freezers	0.0052
Walk-in refrigerators and freezers	4.731
Light-duty vehicle climate control system	0.0694
Light-duty vehicle climate control system	0.0926
Bus climate control system	0.65

For PSOs: you can exclude negligible sources from your CNG reporting if the sum of those sources is likely to be less than 1% of your total emissions and if the source data is onerous to collect. Your organization should document this determination for your own records.

4.4 Unit-based methodology

Some refrigeration and air conditioning equipment is maintained or monitored on a regular schedule, such as through maintenance contracts or built-in leak detection. A regular maintenance schedule can help organizations detect and address malfunctioning (i.e., leaking) units. The emissions from these units can be quantified on their own, rather than as part of an asset group.[41]

The unit-based methodology is recommended when any of the following conditions apply:

- The unit is inspected or tested for leaks at least once per year. That is, maintenance or service records are available that show:
  - Whether a leak occurred,
  - How much refrigerant was added to the equipment (if any), and
  - That the unit was functioning normally if no leak occurred, or

[40] Estimation factors are calculated as: (estimated full charge mass)*(GWP of most likely HFC)*(estimated leak rate).

[41] Asset groups are described in section 4.5.

- The organization has a system in place that tracks all refrigeration equipment maintenance and all end-of-life disposal.

4.4.1 Maintenance emissions

The refrigerant added during maintenance is equivalent to the refrigerant leaked during the malfunction. Therefore, the emissions for the unit are calculated as:

$$Emissions = (Refrigerant\ added) \times GWP$$

If no refrigerant was reported lost during the year, emissions are reported as zero.

Note: Do not include refrigerant added to newly installed equipment.

4.4.2 End of life emissions

The amount of refrigerant missing from the unit at the time of disposal is the amount of refrigerant that has leaked. Therefore, the emissions from the unit are calculated as:

$$Emissions = \big((full\ charge\ mass) - (refrigerant\ remaining\ at\ disposal)\big) \times GWP$$

If the refrigerant remaining at disposal is unknown, organizations should use a conservative estimate.

4.5 Asset group-based methodology

If a unit-based methodology is not appropriate for some or all units (per the conditions identified in section 4.3 above) organizations should use an asset group-based methodology. An asset group is a set of similar equipment with comparable design, usage, and/or maintenance practices.

Fugitive emissions usually come from a small number of malfunctioning units, not from every unit leaking equally. Most equipment will operate without significant losses, while a few may release substantial amounts of refrigerant.

An asset group-based methodology provides results that are complete (i.e., every unit is accounted for) and is more accurate than combining estimation with selective measurement; that is, if units are estimated unless a leak is noticed, the sum will overstate emissions. This is especially true when only a few leaks are detected but the rest of the group is still assumed to leak.

By organizing units into asset groups and using maintenance records where available:

- PSOs can avoid double-counting,
- Actual leaks are reported,
- Units that did not leak are not assumed to have emissions, and
- The result reflects real-world performance and improves over time as more data is collected.

For PSOs: Enter the mass of refrigerant into CGRT, which will calculate emissions given mass of refrigerant leaked.

4.5.1 Developing an asset group

To develop asset groups, organizations should create an inventory of their refrigerant-containing units, identify attributes to support grouping, and calculate asset group sizes. Asset groups that have many units are more likely to experience actual leak events, which reduces the risk of assuming leaks that don't exist. However, group size should be balanced with equipment similarity. Aggregating similar equipment improves estimation accuracy and makes it reasonable to attribute a leak event to the entire group.

Create an inventory

- Compile a list of refrigeration and air conditioning equipment used by the organization.
- If the list is not available, estimate the quantity and type of equipment using the organization's understanding of its assets.

Identify attributes to support grouping

Units may be grouped together when they share key characteristics likely to influence leak rates or detection likelihood. Organizations should avoid putting units that differ significantly into the same asset group.

The following attributes, listed in order of importance, may be helpful in determining whether units should be grouped together:

1. Unit type (see section 4.2 for unit type descriptions)
2. Refrigerant type (see section 1.1 for refrigerant type descriptions)
3. Subtype within the type (e.g., single-split or multi-split systems)
4. Cooling capacity (e.g., kW or BTU rating)
5. Charge size, if known (kg of refrigerant)
6. Age or install year
7. Operating environment (e.g., rooftop, kitchen, coastal, computer/server room)

It is not necessary to collect all this information. Organizations are encouraged to use available data to group equipment in a way that is defensible and reasonable, given their operational context.

Calculate asset-group sizes

If the number of units is equal to or less than the recommended asset group size in Table 15, treat all units of that type as one group. If there are more, consider subdividing them based on the characteristics listed above.

There is no fixed rule on group size. However, each group should be large enough that the probability of at least one malfunction is reasonably high. The grouping approach should remain practical and proportional to the size and complexity of the inventory.

A high probability of at least one leak event reduces the likelihood that emissions are reported for units that didn't leak. Organizations can calculate this probability for their own group sizes. Please see Annex 3: Calculating the Probability of Malfunction for an Asset Group or refer to Table 15 for guidance. However, knowing the probability of a malfunction within your asset group is not required.

Table 15: Recommended asset group sizes and probability of a leak event in the asset group

Unit type	Number of units in an asset group[42]	Probability of at least one leak event
Room air conditioners	180	80%
Residential A/C and heat pumps	30	90%
Commercial A/C and heat pumps	30	90%
Chillers[43]	80	70%
Household refrigerators and freezers	320	80%
Stand-alone retail refrigerators and freezers	160	80%
Walk-in refrigerators and freezers	20	90%
Light-duty vehicle climate control system	25	90%
Light-duty truck climate control system	25	90%
Bus climate control system	25	90%

4.6 Fugitive emissions from refrigeration asset groups

For PSOs: Equipment owned by PSOs is in-scope for reporting under the CNGR. Equipment owned by third parties, but used by PSOs, is out of scope. For more information see Carbon Neutral Government program fleet and contracted services - Province of British Columbia.

Refrigeration equipment includes any unit that employs the expansion and compression of refrigerants, regardless of its application. See Section 4.2 for examples.

If records of maintenance are available for at least one unit within an asset group, the total of all refrigerants added during maintenance is the emissions from the asset group. This is referred to as:

- Measured emissions from asset groups (Section 4.6.1).

If records of maintenance are not available, there are two methods for determining emissions from refrigeration asset groups:

- General estimation method for asset groups (Section 4.6.2), and
- Specific estimation method for asset groups (Section 4.6.3).

4.6.1 Measured emissions from asset groups

If one or more units in an asset group received a refrigerant top-up due to a leak during the reporting year, that measured amount should be used as the emissions total for the group (Table 16). No estimation is required in that case.

[42] See Annex 3: Calculating the Probability of Malfunction for an Asset Group for methodology.

[43] Chillers are typically regularly maintained and will follow the unit-based method.

This approach ensures that:

- Actual leaks are counted, and
- Emissions are not overestimated by combining measurements and estimates.

Table 16: Calculating measured fugitive emissions from an asset group.

Step	Action
(1) Leak event is reported	The type and amount of refrigerant leaked (kg refrigerant) is recorded.
(2) Identify the group	The leak event's unit's asset group is identified.
(3) Attribute the emissions to the group	The mass of HFC leaked from the leak event becomes the emissions from the entire asset group. When maintenance occurs, emissions from the asset group are calculated as: $Maintenance\ emissions = \sum_i (refrigerant\ leaked_i) \times GWP_i$

4.6.2 General estimation method for asset groups

If no records of maintenance are available for an asset group, and the group is large enough, it is likely that at least one unit has malfunctioned and the emissions from the unit(s) that malfunctioned should be estimated. Table 17 shows the steps to calculate emissions from an asset group.

Table 17: Estimating emissions for asset groups

Step	Example
(1) **Estimate the amount of refrigerant**	Estimate the full charge size for each unit in the group using Table 18. Then, estimate the amount of refrigerant in the group by multiplying by the asset group size. $amount\ of\ refrigerant = (estimated\ full\ charge\ size) \times (number\ of\ units)$
(2) **Estimate the leak rate**	Identify the likely HFC in the group's equipment from Table 18 and the estimated leak rate for the group from Table 19.
(3) Calculate Emissions	Calculate the estimated emissions from the group as: $Emissions = (Mass\ refrigerant\ leaked) \times GWP = (amount\ of\ refrigerant\ in\ the\ group) \times (leak\ rate) \times GWP$

For PSOs: The HFC Inventory Template Tool, available in CGRT, completes steps 1-3 above given unit type and asset group size. The tool helps you collect, format, and upload your HFC emissions data.

Table 18: Estimated full charge size and estimated refrigerant type for common unit types[44]

Equipment Type	Default Refrigerant	Charge Size (kg)
Room air conditioners	HFC R-410a	0.5
Residential A/C and heat pumps	HFC R-410a	5
Commercial A/C and heat pumps	HFC R-410a	13
Chillers	HFC R-134a	500
Household refrigerators and freezers	HFC R-134a	0.15
Stand-alone retail refrigerators and freezers	HFC R-134a	0.4
Walk-in refrigerators and freezers	HFC R-404a	10
Supermarket refrigeration and condensing	HFC R-404a	1360
Medium cold storage	HFC R-404a	565
Large cold storage	HFC R-404a	7546
Light-duty vehicle climate control systems	HFC R-134a	0.6
Light-duty truck climate control systems	HFC R-134a	0.8
Bus climate control systems	HFC R-134a	5

Table 19: Default leak rates for common units[45]

Unit Type	Leak rate (% of capacity/yr)
Room air conditioners	0.9%
Residential A/C and heat pumps	8%
Commercial A/C and heat pumps	8%
Chillers	2%
Household refrigerators and freezers	0.5%
Stand-alone retail refrigerators and freezers	1%
Walk-in refrigerators and freezers	12%
Supermarket refrigeration and condensing	25%
Medium cold storage	25%
Large cold storage	25%
Light-duty vehicle climate control systems	8.9%
Light-duty truck climate control systems	8.9%
Bus climate control systems	10%

[44] ICF. (2016). Accounting Tool to Support Federal Reporting of Hydrofluorocarbon Emissions: Supporting Documentation. Retrieved November 27, 2025, from: https://www.epa.gov/sites/default/files/2015-09/documents/hfc_emissions_accounting_tool_supporting_documentation.pdf, Table 3.6.

[45] Ibid., Table 3.3.

4.6.3 Specific estimation method for asset groups

Organizations can improve the accuracy of their emissions estimates by calculating the amount and type(s) of refrigerant(s) specific to their asset groups. Unless the units in the group change, these values are constant. Organizations would use this method when they have more detailed records.

Table 20. Steps for performing the specific estimation method for asset groups.

Step	Example
(1) Calculate the amount of refrigerant in the group	Calculate the amount of refrigerant in the asset group by adding charge size for each unit i: $$Amount\ of\ refrigerant = \sum_i Charge\ size\ of\ unit\ i$$
(2) Develop a default refrigerant type (or types)	Each asset group must have one or more default refrigerant types to use in emissions calculations. If all units in the group use the same refrigerant, that refrigerant becomes the default for the group. If the group contains more than one refrigerant type, the estimated emissions should be divided proportionally based on the amount of each refrigerant installed. How to calculate the amount of refrigerant: For each refrigerant type A in the group: $$Amount\ of\ refrigerant\ A = \frac{\sum_i mass\ of\ refrigerant\ A\ in\ unit\ i}{amount\ of\ refrigerant\ in\ the\ group}$$ That is: • Add up the refrigerant charge for all units using refrigerant A and divide by the total charge for the entire group (including all refrigerant types)
(3) Estimate the leak rate	Estimate the leak rate for the group from Table 19.
(4) Calculate asset group emissions	Calculate the estimated emissions from the group as: $$Emissions = (amount\ of\ refrigerant\ in\ the\ group) \times (leak\ rate) \times GWP$$ If there is more than one refrigerant type in the asset group: $$Emissions = \sum_i (amount\ of\ refrigerant\ in\ the\ group) \times (leak\ rate) \times (weight\ of\ refrigerant\ i) \times (GWP\ of\ refrigerant\ i)$$

For PSOs: The refrigeration inventory template completes steps 1-4 given equipment type, asset group size, default refrigerant type and weight of each refrigerant.

5 Office Paper

This section outlines how to calculate the lifecycle emissions associated with office paper use.

Type: Indirect Emissions

Description: Unlike the other emission factors, the office paper category uses lifecycle[46] emission factors.

Office paper is differentiated by size (8.5″×11″, 8.5″×14″ and 11″×17″) and the type of fibre (virgin wood fibre, virgin wood fibre mixed with recycled fibre, recycled fibre only, or alternative fibre, e.g., sugarcane bagasse). In practice, the recycled fibre content ranges between 0 and 100 percent.

Some organizations use alternative paper types, i.e. paper made from agricultural residues such as sugarcane bagasse, wheat straw, bamboo, etc. Alternative paper excludes paper made solely from wood fibres and/or recycled content. The predominant alternative paper type currently in use by PSOs[47] is sugarcane bagasse paper.

Data sources: Ideally, paper emission factors accurately reflect the extraction, transportation, manufacturing, and disposal processes of the specific paper types that organizations use. However, this information is challenging to obtain and requires expertise to assess using a science-based life cycle assessment approach. CAS currently sources proxy emission factors from the Paper Calculator provided by the Environmental Paper Network.

The Paper Calculator tool assesses the life cycle impacts of different wood fibre-based paper products with varying percentages of recycled content. It does not currently include alternative paper options. The Paper Calculator is based on a life cycle assessment approach that considers raw material extraction and processing through to the end-of-life phase. It uses aggregated industry data from North America to estimate the associated GHG emissions in pounds of CO_2e based on a specified paper grade (e.g., copy paper), quantity by weight, and recycled content. It is publicly available and updated regularly with peer-reviewed data.

In 2018, the Paper Calculator underwent a major modernization[48] which resulted in an approximately three-fold increase in the resulting emission factors. The paper emission factors for the CNG program, however, have not been updated since 2012. They are currently based on information from the 2012 version of the Paper Calculator.

Alternative paper types have lifecycle emission factors that differ from conventional wood fibre and recycled paper. CAS is preparing a suite of life cycle emission factors that better reflect the specific paper types that PSOs use, including emission factors specific to sugarcane bagasse paper. The updated lifecycle emission factors for paper are expected to be finalized and implemented in the CNG program

[46] Lifecycle emissions account for all emissions relating to the production, use, and end-of-life of a product, including the extraction of raw materials, product manufacturing, and intermediate transport steps.

[47] In the 2024 Public Sector Climate Leadership Survey, nearly 30% of respondents reported using some amount of sugarcane bagasse paper in the 2024 reporting year.

[48] Details regarding the 2018 modernization, including a link to the Paper Calculator methodology, are available on the Environmental Paper Network's website: https://c.environmentalpaper.org/faq.html

in the 2026 reporting year. In the meantime, CAS recommends organizations report emissions from alternative paper by applying the emission factors for 100% recycled paper of the corresponding paper size as an approximation.

Calculations: To determine the paper emission factors, CAS entered the weight of a 500-sheet package for each paper size and the percent recycled content into the 2012 version of the Paper Calculator, and converted the resulting GHG emission estimates from lbs to kg CO_2e.

Organizations can interpolate between the emission factors for other percentages of recycled content (e.g., 85 percent) by averaging between the values shown.

Specific Instructions:

For PSOs: Emissions from office paper are in scope of the CNG program. There are three different sizes of office paper in the CNG program – 8.5″×11″, 8.5″×14″ and 11″×17″. In each case, you can enter data on the number of 500-sheet (20lb) packages, or reams, into CGRT, by percentage recycled content.

Beginning in the 2025 reporting year, CGRT includes three new positions for sugarcane bagasse paper (one for each of 8.5″×11″, 8.5″×14″ and 11″×17″). These new positions currently use proxy emission factors for 100% recycled paper. CAS anticipates updating this with emission factors specific to sugarcane bagasse paper in the 2026 reporting year.

For LGs and MTNs: Paper is out of scope for the LGCAP program.

6 Business Travel and Accommodations

This section outlines the approach to measuring and reporting business travel and accommodation emissions. The business travel sub-sections include calculations for travel by land, air and water, based on distance travelled or amount spent. CAS refined this business travel methodology in 2024; no substantial updates have been made in 2025. All hardcoded emission factors for sources that have changed their emission intensity elsewhere in this document remain as they were in 2024.

This section reflects these improvements and provides guidance for:

- The provincial government that, in accordance with the CCAA, is required to quantify, reduce, offset, and report business travel and accommodation emissions of its public officials; and
- Organizations who wish to voluntarily report their business travel emissions.

Specific Instructions: The Provincial government reports business travel either via a tool called iExpenses or based on direct expenditures. Annex 4 presents a description of these accounting systems. PSOs, Local Governments and Modern Treaty Nations that voluntarily measure and report business travel emissions may organize data to align with the descriptions of iExpenses in Annex 4.

For PSOs: PSOs can use the methodology described in this section to voluntarily measure and report their business travel emissions. PSOs are not to enter business travel data into CGRT, because the system is unable to differentiate voluntarily reported data from data that is required under the CCAA. They may use Section 6 to guide quantification of travel related emissions, and voluntarily report these emissions in their Climate Action Accountability Reports (CCARs). PSOs that choose to report travel emissions in their CCARs may omit these emissions from their organization's totals for the purposes of meeting the requirements of the CCAA, including offsetting.

The GHG Protocol provides three methods for quantifying business travel emissions, which are listed below in order of accuracy, [49] and recommends selecting a method based on data availability:

1. Fuel-based method: follow Section 3.1 of this document;
2. Distance-based method: determine the distance and travel mode and apply the emission factors for the travel mode, per Sections 6.1, 6.2 and 6.3 of this document; and
3. Spend-based method: determine the expenditures and travel mode and apply the emission factors for the travel mode per Sections 6.4 and 6.5 of this document.

The instructions in the business travel sections apply a mix of these three methods.

[49] World Resources Institute and the World Business Council for Sustainable Development (2015). The Greenhouse Gas Protocol, Revised Edition. Available: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

6.1 Light-duty Vehicles and Light-duty Trucks (Distance-based)

Type: Direct Emissions

Description: This section covers travel by rental vehicles and business use of personal vehicles, specifically light-duty vehicles and light-duty trucks. Vehicle types are:

- Light-duty vehicles: includes taxi, compact, full-sized, mid-sized and mini compact. This covers regular gasoline, diesel and hybrid vehicles.
- Light-duty trucks: Includes pickup trucks, SUVs and mini vans. This covers regular gasoline, diesel and hybrid vehicles.

Data sources: For gasoline, diesel, and hybrid vehicles, CAS uses 2018-2024[50] data from NRCan's[51] fuel consumption ratings search tool to calculate fuel efficiency.[52] The NRCan data contains up-to-date information that allows users to distinguish between hybrid and non-hybrid cars. CAS obtained data for electric vehicles from the Government of Canada website. [53]

For road travel, NRCan publishes "city", "highway" and "combined" fuel economy ratings by vehicle manufacturer and model in the fuel consumption ratings research tool.[54] Most business travel includes city and highway driving. Considering this mixed nature, CAS only uses the "combined" measure from the research tool for estimating car efficiencies in Table 21.

Fuel efficiencies from NRCan are expressed in litres per 100 kilometres driven. For easier interpretation, this document converts NRCan's units to litres per kilometre (L/km) driven. Emission factors are expressed in kg CO_2e/km in CGRT.

[50] This timespan reflects the seven-year fleet replacement cycle of the B.C. provincial government.

[51] Explanation of terms used in public datasets can be found here in NRCAN (n.d.). *Understanding Tables*. Available: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/personal-vehicles/choosing-right-vehicle/buying-electric-vehicle/understanding-the-tables/21383

[52] Natural Resources Canada. (2024c). Fuel consumption ratings search tool. Available: https://fcr-ccc.nrcan-rncan.gc.ca/en

[53] Natural Resources Canada. (2024b). Fuel consumption ratings. Available: https://open.canada.ca/data/en/dataset/98f1a129-f628-4ce4-b24d-6f16bf24dd64/resource/026e45b4-eb63-451f-b34f-d9308ea3a3d9

[54] Natural Resources Canada. (2024a). 2024 Fuel Consumption Guide. Available*: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/2024-fuel-consumption-guide/21002*.

Table 21: Average Fuel Efficiencies for light-duty vehicles and light-duty trucks

Travel Mode	Vehicle/ Fuel Type	Average Fuel Efficiency (L/km)	Emission Factor (kg CO_2e/km)	Dataset	Source	Reference[a]
Light-Duty Vehicles (includes taxi, compact, full-sized, mid-sized, and mini compact)	Gasoline	0.082	0.181	(1) and (2)	(3)	Light-duty vehicles / gasoline
	Diesel	0.067	0.176	(1) and (2)	(3)	Light-duty vehicles / diesel
	Hybrid	0.050	0.111	(1) and (2)	(3)	Light-duty hybrid vehicles / gasoline
Light-Duty Trucks (includes pick-up truck, SUV and minivan)	Gasoline	0.1126	0.247	(1) and (2)	(3)	Light-duty trucks / gasoline
	Diesel	0.099	0.261	(1) and (2)	(3)	Light-duty trucks / diesel
	Hybrid	0.076	0.167	(1) and (2)	(3)	Light-duty hybrid trucks / gasoline
Electric Vehicles	Electricity	0.225 kWh/km	0.002	(4)	Consumption – combined	Light-duty vehicles and light-duty trucks

a. All emission factors are based on the fuel economy of the combined driving test cycle, which is a combination of the highway and city driving test cycles.

Sources referenced in Table 21:

(1) 2024 Fuel Consumption Ratings – Natural Resources Canada
(2) National Inventory Report 1990 –2023: Part 2. Table A6.1–15 – Environment and Climate Change Canada
(3) 2024 Fuel Consumption Ratings – Natural Resources Canada and National Inventory Report 1990 – 2023: Part 2. Table A6.1–15 – Environment and Climate Change Canada
(4) Fuel consumption ratings - Battery-electric vehicles 2012-2024 – Natural Resources Canada

Calculations: CAS calculated emissions for distance-based, light-duty vehicle and light-duty truck travel by applying the relevant Average Fuel Efficiency (L/km) in Table 21 multiplied by the corresponding estimated carbon dioxide emissions (CO_2e) for the vehicle and fuel type (available in Section 3.1 and the Emission Factors Catalogue).

Table 22 shows the calculations for the distance-based gasoline light-duty vehicle emission factor in kg CO_2e per km. The average fuel efficiency in column 2 is multiplied by the estimated CO_2e emission factors of light-duty vehicles (column 7).

Table 22: Example of Emission Factor Calculation for Light-Duty Vehicles

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vehicle/ Fuel Type	Average Fuel Efficiency (L/km)	Emission Factor (kg/L)[a]					Emission Intensity (kg CO_2e/km)
		Bio-CO_2	CO_2	CH_4	N_2O	CO_2e[b]	(7) × (2)
Gasoline light-duty vehicle	0.082	0.075[c]	2.191	0.00014	0.000022	2.201	0.181

a. Emission factors in columns (4) through (6) are those for gasoline (regular) in the Emission Factors Catalogue, taken from the National Inventory Report Part 2 (Table A6.1–15), adjusted for 5% ethanol.

b. CAS calculates the total non-bioCO_2 emissions using the following equation, where numbers in brackets refer to the column number:
(7) = (4) + (5) × GWP_{CH4} + (6) × $GWP_{N2O.}$ Refer to GWPs in Section 1.4.2.

c. The bio-CO_2 emission factor is from Table 11. National guidelines for reporting GHG emissions recommend separating bio- and non-bio-CO_2 emissions.

Where:

- GWP_{CH4} represents the GWP of methane (CH_4), which is 28, following CNGR.[55]
- GWP_{N2O} represents the GWP of nitrous oxide (N_2O), which is 265, following CNGR.[56]

the calculation for kg CO_2e/L in Table 22 is:

kg/L CO_2e = (column 4)	+ (column 5)	× GWP_{CH4}	+ (column 6)	× GWP_{N2O}
kg/L CO_2e = 2.191	+ 0.00014	× 28	+ 0. 000022	× 265
kg/L CO_2e = 2.191	+ 0.00392		+ 0. 00583	
kg/L CO_2e = 2.201				

6.2 Ferry (Distance-based)

This section provides guidance on business travel using ferries using distance-base emission factors.

Type: Indirect Emissions

Description: This section describes emission factors for the main routes used by B.C. provincial government staff. In the context of ferry travel, the emission factor is expressed in kilograms of CO_2e per passenger kilometre (kg CO_2e/psg-km).

[55] Carbon Neutral Government Regulation. (Deposited Dec. 9, 2008). Available: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/392_2008.

[56] Ibid.

Data sources: BC Ferries provided emission factors for the following five ferry routes in kg CO_2e per passenger trip (kg CO_2e/psg-trip) (Table 23).[57] CAS employed those emissions and calculated an average of five years spanning from fiscal year 2017 to fiscal year 2021.

Table 23: Emission Factors for BC Ferries Routes

Route Number	Ferry Route	Emission Factor (kg CO_2e/psg-trip)
(1)	Tsawwassen – Swartz Bay	5.77
(2)	Horseshoe Bay – Departure Bay	5.90
(3)	Horseshoe Bay – Langdale	2.21
(8)	Horseshoe Bay – Snug Cove	1.39
(30)	Duke Point – Tsawwassen	7.41

Specific Instructions:

For PSOs: CAS configured CGRT with a single emission factor for ferry travel in kg CO_2e/psg-km. Therefore, CAS calculated a five-year weighted average of the above routes to determine a single emission factor for ferry travel (see Table 24).

Calculations: BC Ferries provided emission factors for the routes mentioned above in kilograms of CO_2e per passenger trip (kg CO_2e/psg-trip). CAS calculated a five-year utilization percentage (2017-2021) by dividing the five-year average of automobile equivalents, which represents the amount of the vessel's capacity occupied by vehicles, expressed as the number of under height vehicles, divided by the five-year average capacity provided of each ferry route.[58]

CAS extracted ferry travel data from iExpenses for trips made by Provincial government between 2016 and 2020, and found that about 85% of the trips occurred between Metro Vancouver and Vancouver Island on average (routes 1, 2, and 30). iExpenses does not distinguish data from these routes, and therefore CAS weighted them based on BC Ferries automobile equivalents for each route. Trips from Metro Vancouver to the Sunshine Coast corresponded to the Horseshoe Bay to Langdale route. CAS assumed that the remaining trips had similar GHG intensities to the Horseshoe Bay to Snug Cove route. iExpenses reported these trips as Haida Gwaii to Inside Passage (Prince Rupert), Vancouver Island to Inside Passage (Prince Rupert), Metro Vancouver to Gulf Islands, and Other.

CAS weighted trips by multiplying each route's total trip numbers by the average percent of trips made for each route by government employees. The overall emission factor can be calculated by dividing the emission factors provided for each route by the five-year average route utilization rate, and then

[57] BC Ferries average emission factors (2017-2021) were provided by BC Ferries Services.

[58] In its annual reports, BC Ferries provides an example for automobile equivalents: "A bus which displaces three under height vehicles – or cars – would have an AEQ of three." *Plans, Reports, Policies and Other Resources*, "Annual Reports to the Commissioner". Available: https://www.bcferries.com/in-the-community/resources.

multiplying by the route length. Multiplying each route's emission factor by its proportion of total trips provides the weighted contribution to total emissions.

BC Ferries uses renewable fuel in its diesel blends, and CAS reduced the fossil CO_2 intensity to reflect 4% biodiesel, which was the minimum provincial requirement under the LCFS prior to 2025. The fossil emission factor is calculated for each route by subtracting the bio-CO_2 component from total emissions and taking an average of all routes to obtain a single emission factor for ferry travel (Table 24).

Table 24: Emission Factor for Ferry Travel

Travel Mode	Emission Factor (kg CO_2e/psg-km)
Ferry	0.1117

6.3 Air Transport (Distance-based)

This section provides distance-based emission factors for different modes of air travel in B.C. and elsewhere, including float plane, helicopter and airplane travel.

Type: Indirect emissions

Description: Organizations can calculate air travel emissions by using the distance staff have travelled on during business air travel.

Data sources: Harbour Air's 2017 GHG Report contains emission factors for distance-based float plane.[59] Helijet provided the emission factor for helicopter transportation.

For airplane travel emissions, the UK Department for Energy Security & Net Zero (UKDES)[60] estimated emission factors for three categories of flights:

(1) Domestic flights,
(2) Short-haul international flights, and
(3) Long-haul international flights.

Calculations: CAS calculates the emission factor for float planes by using Harbour Air's emissions per passenger on the Victoria-Vancouver route (41.3 kg CO_2e) and dividing this by the distance between the Vancouver and Victoria harbour airports (99 km).

CAS applied the UKDES emission factors for airplane travel by equating:

(1) domestic flights to B.C. short-haul flights,
(2) short-haul international flights to B.C. medium-haul flights, and
(3) long-haul international flights to long-haul flights (i.e., out of province).[61]

[59] Harbour Air. (2017). *Harbour Air's 2016-2017 Greenhouse Gas Report.* Available: https://www.harbourair.com/wp-content/uploads/2019/01/Harbour-Air-2017-GHG-Report.pdf

[60] UKDES. (2024). *Greenhouse Gas Reporting: Conversion factors 2024*. Available: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024

[61] CAS assessed the UKDES categories by distance rather than by flight type because typical Canadian domestic flights are often much longer than typical domestic flights in the United Kingdom or the European Union.

The UKDES airplane travel emission factors include an eight percent uplift factor based on the recommendation of the IPCC to account for discrepancies between geographical distance and actual flight distance.[62] The uplift factor adjusts for the difference between the shortest distance calculation, the actual travel path of the aircraft, non-linear routing, delays or circling. Additional forcing from emissions being released higher in the atmosphere is not included.

Table 25: Distance-based Air Transport

Travel Mode	Source	Emissions ($kgCO_2e$/psg-km)
Float plane (Vancouver to Victoria)	Harbour Air 2017 GHG Report	0.417
Helicopter	Helijet	0.446
Airplane (short-haul: <415km)	UKDES Conversion Factors 2024: condensed set[a]	0.160
Airplane (medium-haul: 415 to 1316km)		0.109
Airplane (long-haul: >1316km)		0.154

a. Emission factors are in the 'Scope 3 factors: Business travel – air' spreadsheet of the Emission Factors Catalogue.

6.4 Air travel (Spend-based)

This section provides spend-based estimates for float plane, helicopter and airplane travel.

Type: Indirect emissions

Description: Organizations can calculate air travel emissions by using the amount spent on staff business air travel. This approach is the least accurate option.

Data sources: CAS calculated spend-based emission factors by dividing distance-based emission factors (Table 25) by the cost of air travel per km, as collected from the B.C. Government's iExpenses tool. The distance between the origin and destination of flights enables the categorization of flights by short-, medium-, and long-haul.

Calculations: The spend-based emission factor for each travel mode uses the following formula:

Emission Factor: **Travel Mode's Distance-Based Emission Factor ($kg\ CO_2e$/km)** ÷ **Travel Mode's Cost per kilometre ($/km)** = **Travel Mode's Spend-Based Emission Factor ($kg\ CO_2e$/$)**

[62] IPCC (1999). *Aviation and the Global Atmosphere*, Section 8.2.2.3. Available: http://www.ipcc.ch/ipccreports/sres/aviation/index.php?idp=118

For float plane and helicopter travel, CAS used the average cost from 2019[63] and adjusted it to 2023 prices using the Bank of Canada's Consumer Price Index (CPI) calculator.[64]

For airplane travel, CAS calculated the average cost per kilometre using iExpenses, based on air travel data from 2022-2023 for employees who:

- Selected "float plane", "helicopter", "airplane" as travel modes, and
- Specified a destination (i.e., Did not select "Other" or "Other BC" as their destinations).

Table 26 presents the calculated spend-based emission factors for air travel (column 4). These emission factors are the result of dividing the distance-based factor (column 2) by the average cost (column 3).

Table 26: Emission Factors for Spend-based Air Transport

Travel Mode (1)	Distance-based Emission Factor (kg CO_2e/psg-km) (2)	Average Cost ($/km) (3)	Spend-based Emission Factor (kgCO_2e/$) (4)
Float plane	0.417	1.77[a]	0.235
Helicopter	0.446	2.62[b]	0.170
Airplane – Short Haul	0.160	1.74	0.092
Airplane – Medium Haul	0.109	0.94	0.115
Airplane – Long Haul	0.154	0.19	0.789
Airplane – Weighted Average of Short/Med/Long Haul[c]	0.139	1.32	0.105

a. Previous value: $1.52. CAS adjusted prices to 2023 Canadian dollars using the Bank of Canada consumer price index (CPI) calculator.
b. Previous value: $2.25. CAS adjusted prices to 2023 Canadian dollars using the Bank of Canada CPI calculator.
c. If the organization does not have distance data, it is not possible to distinguish between short-, medium-, and long-haul airplane travel. In this case, CAS employs a weighted average emission factor based on total distance reported in iExpenses for each category in 2022 and 2023 for both distance-based and spend-based estimations.

The air transport categories are presented in Table 27. The emission factor selected for each subaccount was based on historical data which identifies the modes most frequently taken for each subaccount (i.e., trip category).

[63] For details on previously calculated emission factors for float plane and helicopter, see British Columbia Ministry of Environment and Climate Change Strategy (2023). *2023 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions*, pages 35-37. Available: https://www2.gov.bc.ca/assets/download/2282FF46047E44DEBA3CCF16590638A8

[64] Bank of Canada (n.d.). *Inflation Calculator*. Available: https://www.bankofcanada.ca/rates/related/inflation-calculator/

Specific Instructions:

For PSOs: In the context of ministry directly-paid expenditures on travel, CAS provides spend-based emission factors for the following air transport categories, which line up with the provincial government's internal financial coding:

- Victoria-Vancouver travel,
- in-province travel,
- out-of-province travel, and
- out-of-country travel.

Table 27: Emission Factors for Spend-based Ministry Directly-Paid Air Transport

Directly Paid Sub-account[65]	Common Air Transport Modes	Spend-Based Emission Factor ($kgCO_2e/\$$)	Reference
Victoria to Vancouver	Float plane Helicopter	0.235	Table 26: Helicopter
In-Province	Short-haul	0.092	Table 26: Short-haul
Out-of-Province	Medium-haul	0.115	Table 26: Medium-haul
Out-of-Canada	Long-haul	0.789	Table 26: Long-haul

6.5 Public Transport (Spend-based)

This section provides public transport distance-based, trip-based and spend-based emission factors. This includes travel by TransLink and BC Transit on local buses, rail and SeaBus. This section also covers emission factors for travel by public transport between communities, e.g., inter-city rail and buses, and spend-based emission factors for taxis and ride-hailing services. CAS recommends using distance-based emission factors in Table 28 for ride hailing services.

Type: Indirect Emissions

Data sources:

- Taxi – fare rates from the Passenger Transportation Board.
- Bus – data from BC Transit Annual Service Plan Report and TransLink Accountability Report 2023. Additionally, CAS used a Vancouver Panel Survey report for estimating bus trip distance.
- SeaBus – TransLink Accountability Report 2023.
- Rail – Railway Association of Canada 2024 report.

[65] The Standard Object of Expenditure (STOB) account numbers for these subaccounts are: 5711 for Victoria to Vancouver, 5712 for In-Province, 5713 for Out-of-Province, and 5714 for Out-of-Canada.

Calculations: Table 28 presents spend-based emission factors and their supporting information where applicable. Please refer to Annex 5: Public Transport Emission Factors for details on how CAS calculated the individual emission factors.

Table 28: Emission Factors for Spend-based and trip-based Public Transport

Public Transport Mode	Distance-based Emission Factor ($kgCO_2e$/psg-km)	Trip-based Emission Factor ($kgCO_2e$/trip)	Average Cost ($/km OR $/trip)	Spend-based Emission Factor ($kgCO_2e$/$)
Taxi	0.181[a]	N/A	2.28/km	0.079
City Bus	N/A	0.475	2.85/trip	0.166
Skytrain	N/A	0.011	4.65/trip	0.002
SeaBus	N/A	0.728	4.65/trip	0.156
Average - Transit	N/A	N/A	N/A	0.108
Rail	0.093	N/A	0.39/km	0.238
Intercity Bus	N/A	N/A[b]	N/A[b]	0.166
Average – Public Transport, Other	N/A	N/A	N/A	0.202

a. The distance-based emission factor for taxis is from Table 21.
b. Not shown, as the value for city buses is used to represent intercity buses.

6.6 Accommodation

This section outlines how to calculate the indirect emissions from business travel accommodations.

Type: Indirect Emissions

Description: Employees may stay in accommodations while traveling for business. CAS provides emission factors only for hotels in B.C. and in the rest of Canada.

Data sources: CAS derived the B.C. and rest-of-Canada accommodation emission factors using the Cornell Hotel Sustainability Benchmark 2024 study. This source provides information on energy and water usage, as well as emission factors for overnight stays, in over 20,000 hotels across 83 countries, using data from 2022.[66] Additionally, CAS employed iExpenses data (

[66] Ricaurte, Eric, and Rehmaashini Jagarajan. (2024). Hotel Sustainability Benchmarking Index 2024: Carbon, Energy, and Water. Available: https://hdl.handle.net/1813/115166.

Annex 4: BC Government Travel Management Systems) to calculate the weighted average in Table 29.

Calculations: CAS calculated emissions using non-resort accommodations, specifically 432 observations for Canada and 58 for British Columbia. This includes establishments with varying subclassifications.[67] Using these observations allows for the calculation of a comprehensive emission factor within the province and the country. iExpenses tracks accommodations in terms of the number of nights per person. For the 2022-2023 period, 89.6% of B.C. provincial government accommodation nights were in B.C.

Table 29: Emission Factor for Accommodation

	Location	kg CO_2e / room / night
Hotel Stay	Rest of Canada B.C.	18.92 9.65
Weighted Average[a]		10.61

a. Based on 89.6% B.C.-stay rate in 2022-2023.

Voluntary reporters who wish to account for international hotel accommodations should refer to the relevant country in the Hotel Stay spreadsheet on the UK Department for Energy Security and Net Zero's Greenhouse gas reporting: conversion factors 2024 workbook.

Specific Instructions:

For PSOs: business travel and accommodations data are out of scope for the CNG program, and you should not enter this data into CGRT, as CGRT is not able to treat travel emissions as being offset-exempt, and there will be offset payment implications for any data in this section.

[67] These consist of several market segments, number of stars, etc. Refer to the Ricaurte and Jagarajan's methodological section (p. 11).

Annex 1: Glossary

Note: The Climate Action Secretariat derived the Terms and Acronyms in from:

- Environment and Climate Change Canada. (2025). National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2023. The Canadian Government's Submission to the United Nations Framework Convention on Climate Change. Available: https://publications.gc.ca/site/eng/9.506002/publication.html
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Table 30: Terms, Abbreviations and Acronyms

Term, Abbreviation or Acronym	Definition
Biofuel	A fuel made from biomass, including, for example, wood and wood waste, vegetal waste (straw, hay, grass, leaves, roots, bark, crops), animal materials/waste (fish and food meal, manure, sewage sludge, fat, oil and tallow), landfill gas, other sources of biogas, bio-ethanol, biodiesel, and other liquid biofuels which are added to, blended with, or used straight as a fuel. (The Climate Registry, 2019)

Term, Abbreviation or Acronym	Definition
Carbon dioxide (CO_2)	A naturally occurring gas (0.03% of atmosphere) that is also a by-product of the combustion of 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, 2014)
Carbon dioxide 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." (The Climate Registry, 2019) Expressing all GHGs in terms of tonnes of CO_2e enables the summation of the emissions of different GHGs.
Comprehensive Energy Use Database (CEUD)	The Comprehensive Energy Use Database (CEUD) provides an overview of sectoral energy markets in Canada and in each region of the country. Its tables are used by the Carbon Neutral Government Program to develop energy use intensities (EUIs). (NRCan, 2025)
Direct emissions	Emissions from sources within the reporting organization's organizational boundaries that are owned or controlled by the reporting organization, including stationary combustion emissions, mobile combustion emissions, process emissions, and fugitive emissions. (The Climate Registry, 2019) For PSOs, these are sources owned or leased by the PSO. For LGs and MTNs, these are sources used by LGs and MTNs to deliver traditional local government services.
Emission factor	GHG emissions expressed on a per unit activity basis (e.g., tonnes of CO_2 emitted per GJ of natural gas combusted, or tonnes of CO_2 emitted per MWh of electricity consumed). (The Climate Registry, 2019)
Fugitive emissions	Intentional or unintentional releases from the production, processing, transmission, storage, and use of fuels and other substances, that do not pass through a stack, chimney, vent, exhaust pipe or other functionally equivalent opening (such as releases of sulfur hexafluoride from electrical equipment; hydrofluorocarbon releases during the use of refrigeration and air conditioning equipment; landfill gas emissions; and CH_4 leakage from natural gas transport). (The Climate Registry, 2019)
Greenhouse gases (GHGs)	Gases that trap heat in the atmosphere, in the form of infrared radiation. (USEPA, 2024)
Hydrofluorocarbons (HFCs)	A group of human-made chemicals with various commercial uses (e.g., refrigerants) composed of one or two carbon atoms and varying numbers of hydrogen and fluorine atoms. Most HFCs are highly potent GHGs with 100-year GWPs in the thousands. (The Climate Registry, 2019)

Term, Abbreviation or Acronym	Definition
Indirect emissions	Emissions that are a consequence of the operations of the reporting organization (i.e., PSO, local government, community), but occur at sources owned or controlled by another organization. (The Climate Registry, 2019)
Intergovernmental Panel on Climate Change (IPCC)	An international body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change. (The Climate Registry, 2019)
Inventory	A comprehensive, quantified list of an organization's GHG emissions and sources. An inventory report provides an emissions summary and related information reported as part of an inventory. (The Climate Registry, 2019)
Methane (CH_4)	A colorless, odorless, flammable gas that is the simplest hydrocarbon and is the major constituent of natural gas. Methane is present in the Earth's atmosphere at low concentrations and acts as a greenhouse gas. Methane, usually in the form of natural gas, is used as feedstock in the chemical industry (e.g., hydrogen and methanol production), and as fuel for various purposes (e.g., heating homes and operating vehicles). Methane is produced naturally during the decomposition of plant or organic matter in the absence of oxygen, as well as released from wetlands (including rice paddies), through the digestive processes of certain insects and ruminant animals such as termites, sheep and cattle. Methane is also released from industrial processes, fossil fuel extraction, coal mines, incomplete fossil fuel combustion, and garbage decomposition in landfills. (Government of Canada, 2015).
National Inventory Report (NIR)	Under the United Nations Framework Convention on Climate Change (UNFCCC), national inventories of sources and sinks of GHGs must be submitted annually. The NIR is part of Canada's annual inventory submission to the UNFCCC. (Environment and Climate Change Canada, 2025).
Nitrous oxide (N_2O)	A colourless, non-flammable, sweet-smelling gas, which is heavier than air. Used as an anesthetic in dentistry and surgery and as a propellant in aerosol cans, nitrous oxide is most commonly produced via the heating of ammonium nitrate (NH_4NO_3). It is also released naturally from oceans, by bacteria in soils, and from animal wastes. Other sources of nitrous oxide emissions include the industrial production of nylon and nitric acid, combustion of fossil fuels and biomass, soil cultivation practices, and the use of commercial and organic fertilizers. (Government of Canada, 2015)
Office Paper	A variety of paper products used in offices and businesses, including writing, computer and copying paper. (Waste 360, 2009)

Term, Abbreviation or Acronym	Definition
Perfluorocarbons (PFCs)	A group of human-made chemicals composed of one or two carbon atoms and four to six fluorine atoms, containing no chlorine. PFCs have no commercial uses and are emitted as a byproduct of aluminum smelting and semiconductor manufacturing. PFCs have very high GWPs and are very long-lived in the atmosphere. (The Climate Registry, 2019)
Report on Energy Supply and Demand in Canada (RESD)	This report summarizes changes in energy consumption and production in Canada. It also tracks energy conversion factors, which are useful in determining how much of an energy source is required to produce a unit of energy.
Sulphur Hexafluoride (SF_6)	A synthetic gas that is colourless, odorless, non-toxic (except when exposed to extreme temperatures), and non-flammable. SF_6 is primarily used in the electricity industry as insulating gas for high voltage equipment. (Government of Canada, 2015)

Table 31: Units of Measurement

Unit	Definition
MJ	One million joules, (a joule is a common unit of energy for comparing across fuel types and electricity).
GJ	One billion joules (equal to 1,000 MJ)
kWh	kilowatt-hour, a common unit for measuring electricity, equal to one kilowatt of power delivered over one hour, or 3.6 MJ.
kg	Kilogram
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.
kt	kilotonne, or 1,000 tonnes
lb	pound (weight) (equal to 0.4536 kg)
km	Kilometre
L	litre
m^3	cubic metre (equal to 1,000 L)
pkg	package (e.g., a ream of paper)

Annex 2: References

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Annex 3: Calculating the Probability of Malfunction for an Asset Group

This guidance is for organizations that want to determine the probability of leaks for their own asset groups. Some values have been pre-calculated according to this methodology and are available in Table 14.

Leak event rate

For an asset group with N units and an average annual leak rate, the rate of malfunctioning units can be estimated using basic assumptions about how leaks are detected.

Most units do not leak; those that do are considered malfunctioning. The rate of malfunctions due to leaking can be estimated based on:

- The average annual leak rate for the group (as a fraction of total refrigerant charge lost across all units), and
- An assumption about how much must leak from a single unit before the leak is likely to be noticed or detected.

Definitions

- L = average annual leak rate of the asset group (expressed as a fraction of the total installed charge)
- s = minimum fraction of a unit's charge that must be lost before a leak is noticed

Then the annual malfunction rate per unit, denoted by λ, must fall within the following range:

$$\frac{\mathrm{L}}{\mathrm{s}} \geq \lambda \geq \frac{\mathrm{L}}{1}$$

This range reflects two boundary cases:

- Lower bound (λ = L/1): Each malfunctioning unit results in a complete loss of charge.
- Upper bound (λ = L/s): Each malfunction results in only the minimum detectable amount, requiring more frequent malfunctions to produce the same average leak rate.

The total expected number of malfunctioning units across the group is then:

$$\frac{\mathrm{L}}{\mathrm{s}} \times \mathrm{N} \geq \lambda_{group} \geq \frac{\mathrm{L}}{1} \times N$$

Probability of a leak event

A Poisson distribution[68] was used to estimate the probability of a certain number of events occurring within a fixed period, given a known average event rate. In this context, the Poisson distribution is used to estimate how many units in an asset group are likely to malfunction in a given year.

Define:

- x as the number of leak events,
- p(x) is the probability of exactly x malfunctions,
- λ_{group} is the rate of malfunctions across the asset group, and
- e is Euler's number (e = 2.71828).

Then the probability of exactly x malfunctions in an asset group is:

$$p(x) = \frac{e^{-\lambda_{group}} \lambda_{group}^{x}}{x!}$$

Example: The probability of at least 1 malfunction in an asset group is:

$$p(x \leq 1) = 1 - p(0) = 1 - \left(\frac{e^{-\lambda_{group}} \lambda_{group}^{0}}{0!} \right)$$

[68] Pennsylvania State University - Eberly College of Science. Statistics 414 - Introduction to Probability Theory. Section 12.1 - Poisson Distributions

Annex 4: BC Government Travel Management Systems

Organizations in the B.C. Provincial Government (ministries and independent offices) report their business travel expenses employing two different systems: the iExpenses system, and through Ministry directly-paid expenditures on air travel. This annex provides an overview of those systems.

iExpenses: Distance and Spend-based Methods

The B.C. provincial government's iExpenses system is used to reimburse employees for out-of-pocket travel expenses. iExpenses tracks travel modes, some fuel types, and some travel distances, in addition to related expenditures for B.C. Provincial Government employees only.

Where travel distances are collected by iExpenses, employees can quantify business travel emissions using the distance-based method. Otherwise, they may calculate travel emissions using the spend-based method. Table 1 below illustrates when each method is used with iExpenses data. For details on the individual business travel calculations, refer to the appropriate mode in Section 6.

Employees enter mandatory information into iExpenses about business trips, including the expense type (Table 32, column 2), travel mode (column 3) and fuel used along with other details (column 4).

Table 32: iExpenses Business Travel Selections

(1) Employee's Travel Mode	(2) iExpenses "Expense Type" Selection	(3) iExpenses "Travel Mode" Selection	(4) Key iExpenses Dropdown Selection	(5) GHG Estimation Method	(6) Section w/ Detailed Description
Air Travel, common routes	Air You Paid	Helicopter, Airplane, Float Plane	Route	Distance-Based	6.3
Air Travel, Other routes	Air You Paid	Helicopter, Airplane, Float Plane	"Other" or "Other BC" as Route option	Spend-Based	6.4
All rental vehicles	Car Rental	Car, other, Truck/SUV	Fuel type, vehicle type	Distance-Based	6.1
Personal vehicle	Mileage	Car, other, Truck/SUV	Fuel type, vehicle	Distance-Based	6.1
Ferries	Ferry	N/A	Route	Distance-Based	6.2
Rail, Intercity Bus, other public transport	Public Transport	Other	N/A	Spend-Based	6.5
Taxis	Public Transport	Taxi	N/A	Spend-Based	6.5
City Bus, Skytrain, SeaBus	Public Transport	Transit	N/A	Spend-Based	6.5
Accommodation	Accommodation	Hotel, Private, Other	N/A	Nightly stay-based	6.6

The distance data, in combination with mode and fuel type, enables voluntary reporters to apply the distance-based method for quantifying business travel emissions. In addition, voluntary reporters using iExpenses may not possess all the necessary data points to use distance-based methods. In such a case, CAS recommends employing the spend-based methods. All these approaches are reflected in column 5 of the following table 1. Similarly, Column 6 indicates which section of the document provides detail on the corresponding estimation method.

Other Accounting System Data

An additional government accounting system tracks Employee travel expenditures. This is done through ministry directly-paid expenditures on airfare. Column 5 of Table 33 indicates which section of this document provides more detail on this travel mode. See transportation method in the following table (Column 4).

Table 33: Non-iExpenses Business Travel Selections for Directly Paid Air Travel

(1) Subaccount/Route	(2) Travel Mode Possibilities	(3) Most Frequent Travel Mode	(4) Section with Detailed Description
Victoria to Vancouver	Float Plane, helicopter, short-haul air	Float Plane	6.4
In-Province	Short-haul flights; medium-haul air	Short-Haul	6.4
Out-of-Province	Medium and long-haul flights	Long-Haul	6.4
Out-of-Canada	Long-haul flights	Long-Haul	6.4
Victoria to Vancouver; In-Province; Out-of-Province; Out-of-Canada	All ground transport modes and accommodations	N /A	6.5

Annex 5: Public Transport Emission Factors

The following sections provide a description of how each public transport mode's emission factors in Table 25 were calculated to derive emission factors for the reporting categories. The sections are:

- Public Transport – Taxi;
- Public Transport – Transit: City Bus, Skytrain, SeaBus, and
- Public Transport – Other: Rail and Intercity Bus.

Public Transport - Taxi

Type: Indirect Emissions

Description: This was calculating considering only regular taxi companies and excludes hailing transportation taxi services. The spend-based emission factor for Taxi was calculated using equations which require:

- Average taxi cost per km
- Taxi emissions per km

Calculations:

Average Taxi Cost Per Kilometre

In British Columbia, the Passenger Transportation Board, an independent tribunal of the Ministry of Transportation and Infrastructure, regulates the rates charged by all taxis.[69] Rates vary across the province's operating areas. CAS calculated a provincial average using the approved Board prices since September 2023, namely:

- **Flag Fee average:** $3.76: The flag fee is the automatic minimum fee a passenger pays for a taxi, i.e., the meter will already be at $3.76 when a passenger steps inside.
- **Per Kilometre Fee average:** $2.28: Passengers are charged this fee for every kilometre they travel in a taxi if the taxi is not in traffic and forced to drive slowly. If it is, the following fee may apply.
- **Wait Time average:** $44.13 per hour: This fee is charged if the taxi must wait.

Average Taxi Emissions Per Kilometre

Based on the conservative assumption that taxis are generally standard gasoline-fuelled cars, the distance-based emission factor is 0.181 kg of CO_2e per km travelled (refer to Table 18). This is a conservative assumption, as taxi companies are increasingly using hybrid and plug-in electric vehicles.[70] This assumption will be reviewed in future iterations of this document.

Spend-Based Taxi Emission Factor

CAS calculated the spend-based emission factor as follows:

[69] Passenger Transportation Board. (2024). *Taxi Rates.* Available: http://www.ptboard.bc.ca/taxi-rates.htm

[70] In the preparations of this document, CAS reviewed the Passenger Transportation Board policy manual for 2023 and verified that no mandatory provision exists to date.

Taxi **Distance-Based** Emission Factor ($kg CO_2e/km$)	÷	Taxi **Cost per kilometre** ($/km)	=	Taxi **Spend-Based** Emission Factor ($kg CO_2e/$)
0.181	÷	2.28	=	**0.0795**

Public Transport - Transit (City Bus, Skytrain, SeaBus)

Employees who travel on a local bus, Skytrain, or SeaBus must select "Transit" within the iExpenses system. For this reason, CAS calculates the spend-based emission factor for the transit travel as a simple average of the city bus, Skytrain, and Seabus factors.

City Bus:

City bus emissions are based on two bus service providers: BC Transit and TransLink. The spend-based emission factor for total City Bus was estimated using equations that require:

- Average City Bus cost per trip
- Average City Bus emissions per trip

Average Cost Per Trip

A standard trip on a city bus costs $2.50 in Victoria and $3.20 in Vancouver. BC Transit fares are currently less in some of the 51 transit systems they operate. For example, a single ride ticket costs $1.75 in Williams Lake, $2 in Chilliwack and Prince Rupert, $2.25 in West Kootenay, Central Fraser Valley and Salt Spring Island and $2.50 in Prince George and Nanaimo.[71] Considering these discrepancies, CAS used the average of $2.85 between Greater Victoria and Metro Vancouver as the standard price for a single bus trip.

Average Emissions Per Trip – BC Transit

In the 2023 reporting year, BC Transit's revenue bus fleet emitted 41,203,000 kg CO_2e.[72] BC Transit reported approximately 54.13 million rides during the same period (April 1, 2023 to March 30, 2024).[73] CAS calculated BC Transit's emission factors as follows:

BC Transit Revenue Fleet Emissions ($kg CO_2e$)	÷	**BC Transit Passenger Trips**	=	**Emissions per Passenger Trip** ($kg CO_2e$/trip)
41,203,000	÷	54,128,000	=	0.761

Average Emissions Per Bus Trip – TransLink

[71] BC Transit lists fares individually by regional transit system, at their website https://www.bctransit.com/. For example, fares for Regional District of Nanaimo Transit are posted at https://www.bctransit.com/nanaimo/fares/.

[72] Internal report generated in CGRT.

[73] IBID, page 18.

TransLink provided their 2023 revenue fleet emissions.[74] TransLink reported 99,009,000 kg CO_2e from 240,913,000 annual bus boardings in 2023.[75]

Calculating Total Emissions Per Bus Trip –TransLink

TransLink Bus Emissions (kg CO_2e)	÷	**TransLink Bus Boardings**	=	**Emissions per Boarding** (kg CO_2e/trip)
99,009,000	÷	240,913,000	=	0.411

By combining emissions from BC Transit and TransLink, CAS calculated total city bus emissions as 0.475 kg CO_2e/trip:

Bus Emissions (kg CO_2e)	÷	**Bus Boardings**	=	**Emissions per Boarding** (kg CO_2e/trip)
140,212,000	÷	295,041,000	=	0.475

Spend-Based City Bus Emission Factor

Using the previous equation and the cost per trip, the spend-based emission factor for City Bus travel is calculated as follows:

Bus Emissions per Trip (kg CO_2e/trip)	÷	**Bus Cost per Trip** ($/trip)	=	**Bus Spend-Based Emission Factor** (kg CO_2e/$)
0.475	÷	2.85	=	0.166

Skytrain:[76]

CAS estimated the spend-based emission factor for Skytrain using equations requiring:

- Average Skytrain cost per trip, and
- Average Skytrain emissions per trip.

Average Skytrain Cost Per Trip

Skytrain fares depend on the number of zones travelled (1, 2, or 3). Many different possibilities exist for trip distance within each zone. This estimate uses the price for a 2-zone trip ($4.65) combined with the average trip distance reported to the City of Vancouver peaking to 11.2 km/trip.[77]

[74] Internal communication with TransLink.

[75] Source for trips by bus: TransLink (2024). Bus: Annual indicators by route and year . Available: https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/tspr/csv-data/2023/tspr2023_bus_yearline.csv. Bus related emissions are from private communications with TransLink.

[76] For the purposes of this document, the Canada Line is included within Skytrain.

[77] McElhanney (2021). 2020 Vancouver Panel Survey. Summary Report prepared for the City of Vancouver. Available: https://vancouver.ca/files/cov/2020-transportation-panel-survey.pdf

Average Skytrain Emissions Per Trip

TransLink calculated the Skytrain emissions to be 0.001 kilograms per passenger per kilometre travelled (kg CO_2e/psg-km).[78] Using the 11.2-kilometre distance per trip noted above, and the distance-based emission factor of 0.001 kg CO_2e/km, CASe estimates that a standard trip will generate 0.0112 kg of CO_2e.

Spend-Based Skytrain Emission Factor

Using the information above and the following equation, the spend-based emission factor for Skytrain travel is calculated at 0.0024 kg CO_2e/$:

Skytrain Emissions per Trip (kg CO_2e/trip)	÷	Skytrain Cost per Trip ($/trip)	=	Skytrain Spend-Based Emission Factor (kg CO_2e/$)
0.0112	÷	4.65	=	0.0024

SeaBus:

The spend-based emission factor for SeaBus was estimated using:

- The average SeaBus cost per trip, and
- The average SeaBus emissions per trip.

Average SeaBus Cost Per Trip

A one-way trip on the SeaBus costs $4.65.

Average SeaBus Emissions Per Trip

TransLink[79] reported in 2023 that SeaBus trips generate 0.224 kg CO_2e/psg-km, or 0.728 kg CO_2e/trip over the 3.25 km one-way distance.

Spend-Based SeaBus Emission Factor

The spend-based emission factor for SeaBus travel is calculated as follows:

SeaBus Emissions per Trip (kg CO_2e/trip)	÷	SeaBus Cost per Trip ($/trip)	=	SeaBus Spend-Based Emission Factor (kgCO_2e/$)
0.728	÷	4.65	=	0.156

[78] TransLink (2023). Accountability report 2023. Available: https://www.translink.ca/-/media/translink/documents/about-translink/corporate-reports/accountability_reports/2023/accountability_report_2023.pdf

[79] TransLink (2023). Accountability report 2023. Page 74. Available: https://www.translink.ca/-/media/translink/documents/about-translink/corporate-reports/accountability_reports/2023/accountability_report_2023.pdf

Transit Average

The spend-based emission factor for the Transit travel mode was calculated as a simple average of the city bus, Skytrain, and Seabus factors:

$$\frac{(0.166) + (0.0024) + (0.156)}{3} = 0.108 \text{ kg } CO_2e/\$$$

Public Transport - Other Public Transport (Rail, Intercity Bus)

Employees who travel by rail and intercity buses must select "Other" under Public Transport within the iExpenses system. For this reason, the spend-based emission factor for the transit travel mode was calculated as the simple average of the factors for these two modes of travel.

Rail:

The spend-based emission factor for rail was estimated using an equation which require:

- Average cost of rail per kilometre, and
- Average rail emissions per kilometre.

Average Cost of Rail Per Kilometre

CAS used iExpenses data for the period of 2008 to 2016 to calculate an average passenger rail transportation cost of $0.31/km.[80] Using the Bank of Canada's inflation calculator tool,[81] CAS updated this value to $0.39/km for passenger rail.

Average Rail Emissions Per Kilometre

The Railway Association of Canada published a distance-based emission factor of 0.093 kg CO_2e/psg-km for passenger railway transportation in 2022.[82]

Spend-Based Rail Emission Factor

Using the information above and the following equation, CAS calculated the spend-based emission factor for rail travel to be 0.238 kg CO_2e/$:

Rail Distance-Based Emission Factor (kg CO_2e/km)	÷	Rail Cost per kilometre ($/km)	=	Rail Spend-Based Emission Factor (kg CO_2e/$)
0.093	÷	0.39	=	0.238

[80] BC Ministry of Environment and Climate Change Strategy. (2017). *2017 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions*. Available: https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2017-pso-methodology.pdf

[81] Bank of Canada (n.d.). *Inflation Calculator*. Available: https://www.bankofcanada.ca/rates/related/inflation-calculator/

[82] Railway Association of Canada. (2024). *Locomotive Emissions Monitoring Report 2022.* Page 5. Available: https://www.railcan.ca/wp-content/uploads/2024/02/SPARK-RAC-LEM-2024-EN.pdf

Intercity Bus:

iExpenses does not capture Intercity Bus travel. In the absence of reliable cost data, the spend based emission factor of city bus (0.166 kg CO_2e/$) has been applied to intercity buses. This is a conservative approach, as NRCan's Comprehensive Energy Use Database indicates that the BC intercity bus emission factor for BC is about 35% of city buses per passenger-kilometre.[83]

Simple Average – Other Public Transport

The spend-based emission factor for the "Other" public transport mode was calculated as a simple average of the rail and intercity bus factors.

$$\frac{(0.238) + (0.166)}{(2)} = 0.202 \text{ kg } CO_2e/\$$$

[83] Natural Resources Canada. (2023). *Comprehensive Energy Use Database, Transportation Sector, 2000-2021*. Available: https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=tran&juris=bct&year=2021&rn=23&page=0

Annex 6: Document Version Control

Reporting Year	Section(s)	Updates Include:
2025	Throughout	Reflected changes from updates to reference documents
	1.3	Added clarity and additional context for how Local Governments and Modern Treaty Nations use the document
	1.4.1	Clarified that the CNG program excludes bio-CO_2 from total emissions when tracking progress towards the public sector's CleanBC targets
	2.1, 3.1	Outlined how CO_2 emission factors from the NIR are adjusted to reflect the biofuel component of each fuel
	2.1, 3.1	Reflected the 8% minimum renewable diesel content in standard diesel in 2025 under the Low Carbon Fuels (General) Regulation
	2.1.1, 3.1.1	Described FortisBC's RNG approach for all customers, CAS's approach for standard FortisBC natural gas, and how to calculate consumption for RNG blends
	2.2	Added a description of the "net import" model for determining EEIFs
	2.4	Clarified instructions for PSOs selling energy to other PSOs
	3.1	Clarified renewable blend calculations in Emission Factors Catalogue
	3.1	Updated approach to determining the density and emissions intensity of natural gas in mobile applications
	3.1	Added propane vehicles to Table 9; created a separate natural gas vehicle table (Table 10)
	3.1.1	Added instructions for PSOs to use the Biofuel Blends Converter to report consumption from vehicles without a fossil position in CGRT
	4	Created Section 4 on Fugitive Sources, consolidating the previous sections 2.2 (Stationary Space Conditioning and Refrigeration) and 3.2 (Mobile Air Conditioning)
	4	Defined commonly used refrigerant types
	4	Refined methodology for quantifying fugitive refrigerant emissions through unit-based and asset group-based approaches
	5	Clarified that paper emission factors are from the 2012 version of the Paper Calculator and have not been updated since
	5	Indicated that CAS is preparing updated life cycle emission factors that are expected to be implemented in the 2026 reporting year
	5	Added instructions for PSOs to report consumption of sugarcane bagasse paper using three new positions in CGRT
	6.3	Clarified that only combustion-related forcing from air travel is included
	Annex 2	Updated reference list and separated Province of BC references from other references

Reporting Year	Section(s)	Updates Include:
2025 (cont.)	Annexes 3, 4, 5, 6	Added a new annex, shifting the numbering of the remaining annexes: Annex 3 from the 2024 version is now Annex 4, Annex 4 is now Annex 5, Annex 5 is now Annex 6
2024	Throughout	Made document more accessible
	Throughout	Increased readability (including removing passive language)
	Throughout	Reflected changes from reference document updates
	Throughout	Added boxes for content specific to PSOs and LGs and MTNs
	1.1	Created a new section on the document's structure
	1.2	Added a disclaimer for PSOs that the document is not intended to provide legal advice
	1.3	Updated context for LGs and MTNs on the LGCAP
	1.5	Reorganized Emission Calculation Fundamentals section to improve flow and clarity for document users
	2.1	Informed organizations of changes made to reflect FortisBC's decision to provide 1% RNG to all clients as of July 1, 2024
	2.2	Significantly updated section to facilitate refrigerants reporting
	2.3	Clarified how electricity for stationary sources should be reported, and providing more context on sources for EEIFs
	2.4	Substantially revised the DES section to make more consistent with other sections of the document
	2.6	Increased clarity on approaches for calculating energy estimates, including revising the decision-making flow chart
	3.1	Clarified context on calculating emissions from renewable blends
	4	Updated context on in-scope paper
	5	Combined Sections 5 through 7 into a single section Made substantial changes to the structure of the sections, including: • Moving much of the previous Section 5 into an Annex on BC Government Travel Management Systems, • Updating most emission factors and some calculation approaches based on newer emissions and cost data, and Moving much of the public transport emission factor guidance to an Annex
	Annex 1	Updated glossary to provide more relevant references Separated out units of measurement into their own table
	Annex 2	Revised references to include those most relevant to the document

Reporting Year	Section(s)	Updates Include:
2023	Throughout	Formatting and font changes to align with B.C.'s Visual Identity
		Clarified context under which the document, its sections and its references apply
		Updated references and sources
		Calculation explanations updated and units made more consistent
	1	Reorganized to create PSO, LG/MTN, and Other user sections; added and updated policy context for the sections
	1.4	Incorporated previous section 1.3 as Section 1.4.3. in a new section on Emissions Calculations Fundamentals, with other sections on GWPs, EFs, scope categories and in-scope GHGs
	1.4.1	Removed references to radiative forcing and focused section on GWPs
	1.5	Moved section on small emissions sources from within the buildings section (Section 2.2.1.) to the front material, so it is clearer that it applies beyond stationary sources
	2.1	Clarified that CO_2 emissions from biogenic sources are separate from total emissions in the CNG Program.
	2.1	Fixed NIR reference for stationary gasoline (shifted from Table A6.1-14 of NIR to Table A6.1-5)
	2.4	Enhanced clarity on district energy tiers and conservativeness
	2.5	Change language from Energy Intensity Unit to Energy Use Intensity to align with language in other Province of B.C. guidance (e.g., B.C. Energy Step Code)
	Annex 1	Update definitions of GHGs to remove references to AR4 GWPs
	Annex 2, 3 and 4	Removed Annex 2 from 2022 MD, Annex 3 is now Annex 2, Annex 4 is now Annex 3
2022	Throughout	Improved accessibility
		Changed GWP references from AR4 to AR5
	1.1	Moved the Community Emissions Inventory (CEEI) to section 1.1.2
	2.3	Updated Renewable Energy Certificate policy
	3.1	Update mobile emission factors to reflect more stringent federal air pollution standards
		Added electricity as a mobile fuel option
	4	Added research being undertaken on the relative merits of alternative types of paper

Reporting Year	Section(s)	Updates Include:
2021	Table of Contents (TOC)	Updated structure
		Removed Section 3.2 Natural Gas Vehicle Emission Factors
		Removed Section 3.3.2 Public Transport (distance-based)
		Removed Section 6 Agricultural Emission Factors
	Throughout	Removed references to Local Governments and other users in Section 1.4 Users/Audience and throughout document
		Updated emission factors and their respective sources
		Section 2.3 Purchased electricity emission factors aligned with GGIRCA
2020	Figure 2	Updated decision tree to reflect available CGRT configuration
	Throughout	Updated references from SMARTTool to CGRT to reflect transition to the new tool and decommissioning of SMARTTool in 2019
	Table 21	Updated Energy Intensity Unit factors based on primary function to align with those adopted by Energy Star Portfolio Manager and configured in CGRT
	Section 2.2	Updated intention to align with GGIRCA's grid-based electricity emission factors for 2021 reporting year
	Section 3.2	Reinstated reference to the conversion of compressed natural gas to litres of gasoline and diesel equivalent
	Section 3.2	Ferry emission calculation correction
2018	Section 1	Updated dates from 2017 to 2018
	9, 12	Updated Carbon.Neutralapps@gov.bc.ca to Carbon.Neutral@gov.bc.ca
	7, 8, 29	Changed *Greenhouse Gas Reductions Target Act* (GGRTA) to *Climate Change Accountability Act* (CCAA)
	Section 3.2	Removed reference to the conversion of compressed natural gas to litres of gasoline and diesel as the web references are no longer valid
	Annex 1	Updated Glossary of Terms and Acronyms
2017	TOC	Removed Section 1.5 Structure
	Section 1.3	Reference to the National Inventory Report: Greenhouse Gas Sources and Sinks in Canada updated from 1990-2013 to 1990-2014
	Table 1, Table 2	Marine Diesel Emission Fraction for CH_4, N_2O and CO_2e updated
	Table 1, Table 2	Wood Fuel - Residential emission factor for bio-CO_2, CH_4, N_2O and CO_2e updated
	Section 2.2	Electricity emission factors for Quebec and Nova Scotia added

Reporting Year	Section(s)	Updates Include:
2017 (cont.)	Table 3	Emission factors updated for BC Hydro, Kyuquot Power, Hemlock Valley, Alberta, Ontario, United Kingdom, India, Japan, China, Hong Kong, Nova Scotia, Quebec
	Table 4	Added Table 4: Historical Emission Factors for Purchased Electricity
	Table 7	Updated Emission Factors for Fleet: Off-Road Vehicle (Diesel), Marine (Gasoline), Marine (Diesel)
	Section 4	Updated Business Travel reporting methods
	Table 22	Fixed EIU Factors updated for all Building Classifications
	Annex 5	Business Travel Methodology Added

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