METHODOLOGY BOOK
FOR THE
BRITISH COLUMBIA PROVINCIAL INVENTORY OF GREENHOUSE GAS EMISSIONS

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1. PURPOSE AND STRUCTURE

The *British Columbia Provincial Greenhouse Gas Inventory* (Provincial Inventory)[1] provides sound, science-based, comparable, and consistent reporting of greenhouse gas (GHG) sources and sinks in BC in support of the requirements of the *Climate Change Accountability Act* (CCAA)[2]. The Provincial Inventory is the foundation on which progress towards BC's legislated GHG emissions reduction targets is measured.

This Provincial Inventory Methodology Book is intended to:

- Serve as a reference for the evaluation and analysis of GHG emissions in BC by sector and over time by providing information on the definitions and scopes of the categories, sectors, and line items used in the Provincial Inventory;
- Support a general understanding of the methodologies and data sources used by Environment and Climate Change Canada (ECCC) in preparing the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada* (NIR)[3] where BC uses the same data for the Provincial Inventory; and
- Explain in detail the data sources and methodologies used for the emissions line items directly compiled by BC.

The United Nations Framework Convention on Climate Change (UNFCCC) has adopted reporting categories and methodologies[4] set out by the Intergovernmental Panel on Climate Change (IPCC)[5] for estimating emissions and removals of specified GHGs. BC follows this reporting structure. This Provincial Inventory Methodology Book is divided into sections by emissions categories laid out in these international standards, beginning with Energy in Section 3. Each section includes a brief description of the category, its line items, the data sources drawn from, and the methodologies used to calculate the GHG emissions estimates reported in the Provincial Inventory.

Most line items in the Provincial Inventory are taken from the BC data in the NIR. If BC deviates from the NIR methodology for a line item, the differing methodology is described in detail in the appropriate section of this Methodology Book. Where the NIR remains the sole source of BC data for a line item, this document makes no attempt to fully document the methods used, as these are fully described in the NIR itself. The 1990-2018 Provincial Inventory published in 2020 uses NIR data exclusively and, while some is recatagorised for inclusion in the Provincial Inventory, none is replaced by data derived using a different methodology.

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1 BC Provincial Inventory: https://www2.gov.bc.ca/gov/content/environment/climate-change/data/provincial-inventory

2 CCAA: http://www.bclaws.ca/civix/document/id/complete/statreg/07042_01

3 NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

4 UNFCCC reporting requirements: https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements

5 IPCC GHG inventory guidelines: https://www.ipcc-nggip.iges.or.jp/public/2006gl

2. REPORTING METHODOLOGY

2.1 Reporting Principles

Territoriality

The UNFCCC reporting requirements use a strict geographic territoriality approach to the reporting of GHG emissions. A jurisdiction is responsible to report only those emissions that occur within its boundaries. Emissions that occur within the source jurisdiction for imported products and emissions that occur within the receiving jurisdiction for exported products are reported in the source and receiving jurisdiction respectively. This is a production-based inventory methodology as emissions from the production of goods are reported where production occurs; the alternative is consumption-based, in which emissions from the production of goods are reported in the jurisdiction where the goods are used.

A single standardized method of reporting internationally on GHG emissions is required to avoid some emissions being double-counted and/or some remaining uncounted. It is therefore necessary to keep strictly to the principle of production-based territorial reporting (or territoriality) for all emissions because this has been adopted as the internationally accepted standard. Territorial reporting can also align emissions with the jurisdiction that has the greatest ability to reduce them.

Local accounting rules may differ from international inventory reporting rules and can allow for trade of emissions reductions, offsets, and similar instruments across geographic borders.

Global Warming Potential

The concept of global warming potential (GWP) has been developed to enable comparison of the extent to which different GHGs trap heat in the atmosphere (radiative forcing) and to compare emissions of different GHGs on an equivalent basis.

The GWP of a GHG is a measure of the time-integrated change in radiative forcing due to the instantaneous release of an amount of that GHG, expressed relative to the radiative forcing that would result from the same mass of CO_2. This allows all GHG emissions to be treated equivalently in units of carbon dioxide equivalent (CO_2e). As GHGs have different lifetimes in the atmosphere, the GWP of each gas depends on the time period over which it is calculated (100 years is most common).

The IPCC develops and updates the GWP values used in international reporting for all GHGs. They are updated regularly to remain consistent with the best available science and information. The 100-year GWP values provided by the IPCC in its *Fourth Assessment Report* (AR4)[6] are used for BC's Provincial Inventory. These GWPs are listed in Table 1 for the GHGs most emitted or influenced by

[6] IPCC AR4: https://www.ipcc.ch/assessment-report/ar4

human activities and of greatest concern for GHG emissions reduction policies. GWPs for other GHGs are listed in Table 1-1 in Part 1 of the NIR.[7]

Table 1: The Global Warming Potential (GWP) of Major GHGs

GHG	100-Year GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
Nitrogen trifluoride (NF_3)	17,200
Sulphur Hexafluoride (SF_6)	22,800
Hydrofluorocarbon 23 (CHF_3)	14,800
Hydrofluorocarbon 32 (CH_2F_2)	675
Perfluoroethane (C_2F_6)	12,200

Quantification Approach Tiers

The most accurate emissions quantification method that is available and practical for each emissions estimate should always be used. To facilitate high-level comparison of the accuracy and quality of quantification approaches, they can be categorized based on general properties into three tiers, as outlined in the IPCC *Guidelines for National Greenhouse Gas Inventories*.[8] Tier 1 comprises broad approaches that utilize aggregated statistical data to estimate emissions; Tier 2 comprises intermediate-level approaches; and Tier 3 comprises bottom-up approaches such as site-specific quantification of emissions. The level of methodological accuracy increases with increasing tier number from 1 to 3, however the methodological complexity also increases. It should be noted that methodologies in all three tiers are generally estimations, rather than direct measurements, of GHG emissions. The NIR and the Provincial Inventory use methods across all three tiers, depending on the availability of data for each line item.

2.2 General Methodology

The National Inventory Report

The main data source for BC's Provincial Inventory is Canada's *National Inventory Report*, the NIR,[9] which is prepared and submitted annually by ECCC to the UNFCCC. The specific data sources and methodologies used to compile the NIR are listed in Chapters 3-7 of Part 1 of the NIR and Annex 3 of Part 2 of the NIR. The data and methodologies for the Provincial Inventory follow those of the NIR except where explicitly specified in this document.

[7] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html
[8] IPCC GHG inventory guidelines: https://www.ipcc-nggip.iges.or.jp/public/2006gl
[9] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

BC's Provincial Inventory deviates from the NIR in the following ways:

- The Provincial Inventory includes provincial-level data for the Land Use, Land Use Change, and Forestry (LULUCF) category, which is only included in the NIR at the national level.
- The Provincial Inventory includes afforestation and deforestation emissions in emissions totals.
- The Provincial Inventory disaggregates Forest Management into more specific line items.

The Provincial Inventory may also use different emissions data for individual line items if better BC-specific data is available than was used to compile the NIR. The BC Ministry of Environment and Climate Change Strategy reviews the NIR data to ensure that it is accurate, consistent with reliable supporting data sources, and free from errors before using it to compile the Provincial Inventory and may replace a line item or individual data point with more accurate data as part of this process. This Methodology Book, issued annually with the BC Provincial Inventory, explains the data sources and methodologies used for any line item that is replaced, temporarily or permanently, by BC-derived data. There are no such replacements in the 1990-2018 inventory published in 2020.

Emission Factors

GHG emissions reported in the NIR and the Provincial Inventory are typically estimated by multiplying measured activity data by emission factors, which parameterize the mass of GHGs emitted per unit of a specific activity. The emission factors are generally determined using mass balance, chemical equations, or other relationships under average conditions. The emission factors for many inventory categories are developed in consultation with other government departments, industry associations, and agencies, reflecting the most accurate available methodologies and international standards and practices set out by the IPCC. Emission factors can be calculated at a national, provincial, local, or facility-specific level, depending on the availability of data. The emission factors used in the Provincial Inventory are from the NIR and are listed in Annex 6 of Part 2 of the NIR.[10]

Recalculations and Changes from Previous Emissions Estimates

In preparing each year's NIR, ECCC recalculates the inventory estimates for each line item by province for each data year (from 1990 to the latest year covered). This ensures that any changes in methodology or source data are applied uniformly across all years covered by the inventory (referred to as back-casting), which allows for the direct comparison of emissions across years.

As a result of these recalculations, emissions estimates for any past year may change when a new inventory is published. These changes can be due to:

- changes to inventory methods following science updates or the availability of new foundational reports or survey information;
- correction of inaccuracies found when reviewing previous inventory reports; and
- updates to the source data used in the inventory calculations, some of which undergo similar annual updates to those of the NIR itself.

[10] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

This methodology book does not record such changes in the NIR data as they are fully documented in Chapter 8 of Part 1 of the NIR itself.[11]

3. ENERGY EMISSIONS

GHG emissions reported in the energy category are from:

- Stationary combustion of fuel;
- Transport fuel combustion; and
- Fugitive emissions from the fossil fuel and mining industries.

BC relies on the NIR data from ECCC for estimates of provincial emissions in the energy category. ECCC uses Statistics Canada's annual *Report on Energy Supply and Demand in Canada* (RESD)[12] as the principal source of activity data used to estimate stationary combustion and transport emissions. The RESD is a compilation of activity data from fuel producers and consumers drawn from annual and monthly censuses and surveys of industries, federal agencies, and provincial energy departments.

3.1 Stationary Combustion Emissions

Stationary combustion emissions, described by line item in Table 2, are from stationary devices that combust solid, liquid, or gaseous fuel in order to generate useful heat, cooling, or electricity. Sources include boilers, combustion turbines, engines, incinerators, and process heaters. Devices used to transport oil and gas through pipelines are not included in this category and are instead included in the transport category.

Table 2: Stationary Combustion Sources Line Item Descriptions

Emissions Line Item	Description
Public Electricity and Heat Production	Production of electricity and useful heat in public or privately owned utility power plants, the primary activity of which is supplying electricity or heat to the public.
Petroleum Refining Industries	Production of petroleum products such as heavy fuel oil, residential fuel oil, aircraft fuel, gasoline, and diesel from a raw feedstock of conventional or synthetic crude oil in petroleum refineries.
Oil and Gas Extraction	Extraction and processing of natural gas and oil.
Mining	Metal and non-metal mining (including coal), stone and gravel quarrying, mineral exploration, and contract drilling operations.
Manufacturing Industries	Production of iron and steel, non-ferrous metals, chemicals, pulp and paper, cement and other non-metallic minerals, and other manufacturing activities (including production of vehicles, textiles, food, beverages, etc.)
Construction	Construction of buildings, roads, and other infrastructure.

[11] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html
[12] RESD: https://www150.statcan.gc.ca/n1/en/catalogue/57-003-X

Emissions Line Item	Description
Commercial and Institutional	Service industries related to mining, communication, wholesale and retail, finance and insurance, real estate, education, health, social services, train stations and airports, defence, etc. Primarily space heating in buildings.
Residential	Personal residences including houses, apartment hotels, and condominiums. Primarily space heating in buildings.
Agriculture and Forestry	On-site stationary machinery operation and space heating in the agriculture, forestry, and logging industries.

Methodology

BC has adopted NIR emissions data for all line items in the stationary combustion (energy) category. Detailed descriptions of the methodologies and data sources used can be found in Chapter 3 of Part 1 of the NIR and Annex 3.1 of Part 2 of the NIR.[13]

The methodology used for stationary combustion emissions is an IPCC Tier 2 approach. Emissions are calculated using nationally reported activity data, mostly from the RESD, and national emission factors or province-specific emission factors where they are available.

3.2 Transport Emissions

Transport emissions, described by line item in Table 3, are from mobile devices that combust liquid or gaseous fuels for the purpose of generating useful energy for propulsion. Sources include road-vehicles, marine vehicles, and jet engines. Emissions from stationary combustion devices used to transport oil and gas through pipelines are also included in the transport category.

Table 3: Transport Line Item Descriptions

Emissions Line Item	Description
Domestic Aviation	Aircrafts flying domestically within Canada and fueled in BC, including commercial, private, and agricultural flights.
Road Transportation	Vehicles licensed to operate on roads operating in BC.
Light-Duty Gasoline Vehicles	Gasoline-powered vehicles with a gross vehicle weight rating (GVWR) less than or equal to 3,900 kg (mainly cars).
Light-Duty Gasoline Trucks	Gasoline-powered vehicles with a GVWR less than or equal to 3,900 kg (pickups, minivans, SUVs, etc.).
Heavy-Duty Gasoline Vehicles	Gasoline-powered vehicles with a GVWR greater than 3,900 kg.
Motorcycles	Two-wheeled motor vehicles.
Light-Duty Diesel Vehicles	Diesel-powered vehicles with a GVWR less than or equal to 3,900 kg (mainly cars).

[13] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

Emissions Line Item	Description
Light-Duty Diesel Trucks	Diesel-powered vehicles with a GVWR less than or equal to 3,900 kg (pickups, minivans, SUVs, etc.).
Heavy-Duty Diesel Vehicles	Diesel-powered vehicles with a GVWR greater than 3,900 kg.
Propane and Natural Gas Vehicles	Vehicles powered by propane or natural gas.
Railways	Railway locomotives operating in BC.
Domestic Navigation	Marine vessels travelling domestically within Canada and fueled in BC.
Other Transportation	Other vehicles not licensed to operate on roads operating in BC.
Off-Road Agriculture and Forestry	Farm tractors, etc.
Off-Road Commercial and Institutional	Airport ground support equipment, railway maintenance equipment, etc.
Off-Road Manufacturing, Mining, and Construction	Mining vehicles, tracked construction vehicles, etc.
Off-Road Residential	Lawnmowers, etc.
Off-Road Other Transportation	Off-road recreational vehicles, etc.
Pipeline Transport	Transportation and distribution of crude oil, natural gas, and other products through a pipeline.

Methodology

BC has adopted NIR emissions data for all line items in the transport (energy) category. Detailed descriptions of the methodologies and data sources used can be found in Chapter 3 of Part 1 of the NIR and Annex 3.1 of Part 2 of the NIR.[14]

The methodology for domestic aviation emissions is a modified IPCC Tier 3 approach. It employs a mix of Canada-specific, aircraft-specific, and IPCC default emission factors. The estimates are generated using the Aviation Greenhouse Gas Emission Model (AGEM) and are calculated based on the reported quantities of aviation gasoline and turbo fuel consumed published in the RESD.

A Canada-specific version of the United States Environmental Protection Agency's (US EPA) Motor Vehicle Emissions Simulator (MOVES) model[15] is used to estimate road transportation emissions, in a Tier 3 approach. MOVES uses a range of activity data to calculate energy consumption by a range of vehicle classes. The energy consumption data is then multiplied by Canada-specific emission factors.

[14] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html
[15] MOVES: https://www.epa.gov/moves

The methodology for railway emissions is a Tier 2 approach for CO_2 and Tier 1 for CH_4 and N_2O. Fuel data from the RESD is multiplied by Canada-specific emission factors.

The methodology for domestic navigation emissions is a Tier 2 approach for CO_2 and Tier 1 for CH_4 and N_2O. Emissions are estimated using fuel-specific emission factors and fuel-use data calculated by the Marine Emissions Inventory Tool (MEIT),[16] which uses accurate vessel tracking information to allocate reported fuel quantities.

Off-road transport emissions are estimated using a modified version of the US EPA's NONROAD model[17] based on Canada-specific emission factors, equipment populations, and usage factors, which is a Tier 3 approach.

An IPCC Tier 2 methodology with Canada-specific emission factors and fuel consumption data from the RESD is used for Pipeline transport emissions.

3.3 Fugitive Emissions

Fugitive source emissions, described by line item in Table 4, are intentional and unintentional emissions from the production, processing, transmission, storage, or delivery of fossil fuels, as well as the intentional combustion of fossil fuels not used to generate useful heat or electricity.

Table 4: Fugitive Sources Line Item Descriptions

Emissions Line Item	Description
Coal Mining	Exposed coal surfaces, coal rubble, and CH_4 venting at active and abandoned underground and surface coal deposits; and post-mining activities including preparation, transportation, storage and processing.
Oil and Natural Gas	Oil and gas production and processing; petroleum refining; natural gas Transmission, storage, and distribution; and other oil and gas processes.
Oil	Conventional crude oil wells, flow lines, and batteries; venting of casing and solution gas; and evaporative losses from storage facilities.
Natural Gas	Natural gas wells, gathering systems, field facilities and batteries; seal leaks; line cleaning operations; formation CO_2 removal; and pneumatic devices.
Venting	Equipment leaks; process vents including activities such as compressor start-up venting and purging of lines during maintenance.
Flaring	Burning gas without the extraction of useful heat or power.

[16] MEIT: https://www.canada.ca/en/environment-climate-change/services/managing-pollution/marine-emissions-inventory-tool.html

[17] NONROAD: https://www.epa.gov/moves/nonroad-technical-reports

Methodology

BC has adopted NIR emissions data for all line items in the fugitive sources (energy) category. ECCC compiled the NIR fugitive emissions data directly from a wide range of external reports, which are referenced, along with detailed descriptions of the methodologies used, in Chapter 3 of Part 1 of the NIR and Annex 3.2 of Part 2 of the NIR.[18]

The coal mining fugitive emissions methodology is a hybrid of IPCC Tier 3 and Tier 2. Coal production data was used with emission factors that were developed by coal type, mine type, and coal field where possible.

Oil and gas fugitive emissions data was compiled from a range of sources. Estimates for upstream oil and gas and for natural gas transmission and storage were developed using a Tier 3 bottom-up assessment, aggregating emissions from individual facilities for some years and interpolating or extrapolating for others. Natural gas distribution emissions were calculated as for transmission and storage for some years and for others using emission factors calculated for the United States of America with activity data from surveys of gas system companies (Tier 3 in both cases). Petroleum refining emissions were estimated using data on energy consumption and production of refined petroleum products from the RESD with emission factors developed from a survey of the refining industry (Tier 3). Emissions from abandoned wells were estimated using emission factors calculated for the United States of America, with annual counts of abandoned wells from provincial databases (Tier 1).

4. INDUSTRIAL PROCESSES AND PRODUCT USE EMISSIONS

Sources of GHG emissions reported in the industrial processes and product use (IPPU) category are described by line item in Table 5. Industrial processes include activities that produce GHG emissions, not from the combustion of a fuel, but from a chemical or physical reaction inherent in the industrial activity that transforms materials into GHGs.

Table 5: Industrial Processes and Product Use Line Item Descriptions

Emissions Line Item	Description
Mineral Products	Cement production, lime production, and use of mineral products.
Cement Production	Calcination of raw materials to make Portland cement.
Lime Production	Production of dolomitic lime and high-calcium lime by heating limestone to decompose carbonates through calcination.

[18] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

Emissions Line Item	Description
Mineral Products Use	Calcination of limestone or dolomite into lime for purposes other than cement or lime production, which include glass manufacturing, non-ferrous metal production, pulp and paper production, flue gas desulphurization, and wastewater treatment. Also the decomposition of soda ash (Na_2CO_3), used in glass manufacturing, chemical production, pulp and paper manufacturing, and wastewater treatment.
Chemical Industry	Production of ammonia, nitric acid, adipic acid, carbide and petrochemicals.
Metal Production	Aluminum production, iron and steel production, and magnesium production and casting.
Iron and Steel Production	Carbon oxidation when iron ore is reduced to pig iron; oxidation of carbon in crude iron and electrode consumption during steel production; limestone flux in blast furnaces; and metallurgical coke use as a reductant.
Aluminium Production	Aluminium smelting, including electrolytic reduction of alumina (Al_2O_3) with carbon-based anodes, pre-baking of carbon anodes, and anode effects.
SF_6 Used in Magnesium Smelters and Casters	Use of SF_6 as a cover gas to prevent oxidation of the molten metals during magnesium production and casting.
Production and Consumption of Halocarbons, SF_6, and NF_3	By-product production of hydrofluorocarbons (HFCs); use of HFCs and/or perfluorocarbons (PFCs) in air conditioning units, refrigeration units, fire extinguishers, aerosol cans, solvents, foam blowing, semiconductor manufacturing, and electronics; and use of SF_6 and NF_3 in semiconductor manufacturing.
Non-energy Products from Fuels and Solvent Use	Feedstock use of waxes, paraffin, and unfinished petrochemical derivatives; residual and non-residual non-energy use of petroleum products; use of natural gas liquids and refinery output as feedstocks in the chemical industry; use of lubricants such as engine oil and grease in transportation and industrial applications; non-energy use of hydrocarbons or fossil fuels that are not reported elsewhere in the inventory.
Other Product Manufacture and Use	Use of N_2O as an anaesthetic and propellant; use of urea in selective catalytic reduction equipped vehicles; use of SF_6 in electrical equipment; use of PFCs in the electronics industry; and any other product manufacture or use.

Methodology

BC has adopted NIR emissions data for all line items in the industrial processes and product use category. Detailed descriptions of the methodologies and data sources used can be found in Chapter 4 of Part 1 of the NIR and Annex 3.3 of Part 2 of the NIR.[19]

In general, ECCC uses an IPCC Tier 2 approach to estimate BC's IPPU GHG emissions, by using data sources specific to each sub-category or line item to compile activity data (e.g. quantity of the product produced) and calculate Canada-specific emissions factors for each process or product.

[19] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

However, some line items are more complex, such as aluminum production, and necessitate the use of more elaborate formulae.

5. AGRICULTURE EMISSIONS

Emissions reported in the agriculture category are described by line item in Table 6. They do not include emissions associated with stationary farm equipment (e.g. greenhouse heaters), emissions associated with on-farm transportation (e.g. tractors), or the emission and sequestration of CO_2 by agricultural soils (N_2O emissions from soils due to fertilizer use are included), which are included in the stationary combustion, transport, and other land use (memo item) categories respectively.

Table 6: Agriculture Line Item Descriptions

Emissions Line Item	Description
Enteric Fermentation	Digestion of plant material by ruminant animals, such as cattle, involving microbial fermentation in the rumen.
Manure Management	Decomposition of nitrogen-containing compounds by microbial organisms in stored or concentrated manure and farm animal bedding.
Agricultural Soils	N_2O emissions from application of fertilizers to agricultural land and management practices such as crop rotations, tillage, summer fallow, and irrigation.
Direct Sources	Application of synthetic and manure-based fertilizers, decomposition of crop residue, irrigation, losses of soil organic matter through mineralization, cultivation of organic soils, and changes to tillage practices, summer fallow, and irrigation.
Indirect Sources	Volatilization and subsequent re-deposition, leaching, erosion, or run-off of nitrogen from crop residue, animal manure, and synthetic fertilizer.
Field Burning of Agricultural Residues	Burning crop residues for convenience or disease control.
Liming, Urea Application, and Other Carbon-containing Fertilizers	CO_2 emissions from using limestone to neutralize acidic soils and as a fertilizer; using urea or urea-based fertilizers; and using other carbon-containing fertilizers.

Methodology

BC has adopted NIR emissions data for all line items in the agriculture category. Detailed descriptions of the methodologies and data sources used can be found in Chapter 5 of Part 1 of the NIR and Annex 3.4 of Part 2 of the NIR.[20]

Enteric fermentation and manure management emissions are both estimated using an IPCC Tier 2 approach by multiplying animal populations from surveys of the agriculture industry by corresponding regionally derived, animal type-specific emission factors.

[20] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

Agricultural soil emissions are calculated for a range of contributing processes, generally using a Canada-specific Tier 2 methodology that takes into account several soil and process variables. A range of activity data (e.g. amount of each type of fertilizer applied to agricultural soils), which generally comes from surveys of the agriculture industry, is multiplied by corresponding emissions factors calculated for each ecodistrict.

Emissions from burning agricultural residue are estimated using activity data on the type and percentage of each crop residue subject to field burning, collected from Canadian agricultural industry surveys and expert consultation, however IPCC default emission factors and parameters are used due to a lack of Canada-specific data, making the methodology Tier 1.

Liming, urea, and other carbon fertilizer emissions were calculated using a Tier 1 approach by multiplying activity data on the amounts of materials used, from surveys of the mineral industry and sales reporting, by default IPCC emission factors.

6. WASTE EMISSIONS

GHG emissions reported in the waste category, described by line item in Table 7, are related to the treatment and disposal of both solid waste and wastewater. Waste emissions are influenced by the quantity of waste sent to landfills and the amount of methane captured from them.

Table 7: Waste Line Item Descriptions

Emissions Line Item	Description
Solid Waste Disposal	Decomposition of organic waste sent to municipal solid waste landfills through anaerobic (i.e. without oxygen) digestion by bacteria and other microorganisms.
Biological Treatment of Solid Waste	Composting and anaerobic digestion of solid waste at biogas facilities.
Wastewater Treatment and Discharge	Decomposition of organic matter in wastewater through aerobic and anaerobic digestion by bacteria added at municipal and industrial wastewater treatment facilities.
Incineration and Open Burning of Waste	Incineration of municipal solid, hazardous, and clinical waste and sewage sludge to reduce the amount of solid waste sent to landfills.
Industrial Wood Waste Landfills	Decomposition of organic waste sent to industrial wood waste landfills through anaerobic digestion by bacteria and other microorganisms.

Methodology

BC has adopted NIR emissions data for all line items in the waste category. Detailed descriptions of the methodologies and data sources used can be found in Chapter 7 of Part 1 of the NIR and Annex 3.6 of Part 2 of the NIR.[21]

Emissions from solid waste disposal and industrial wood waste landfills are both estimated using first-order decay modelling of organic matter decomposition in landfills. The model uses relevant activity data (e.g. quantity of waste disposed, waste composition, landfill gas captured or flared, etc.), which comes from waste industry surveys and external studies, with a mix of default IPCC, Canada-specific, and province-specific parameters and average site characteristics (e.g. precipitation levels, landfill depth, etc.).

Emissions from biological treatment of solid waste are estimated by a Tier 1 method, using default IPCC emission factors applied to data from waste industry surveys on the quantities of organic waste diverted by province.

Emissions from wastewater are estimated using a Tier 3 methodology by multiplying treatment-type specific emission factors, calculated by the IPCC, by relevant activity data obtained through surveys of households and from industrial wastewater treatment facilities directly.

Waste incineration emissions are compiled using a Tier 3 methodology. They are reported directly by most facilities and estimated at the facility level using activity data from an industry survey for the rest.

7. LAND USE, LAND-USE CHANGE, AND FORESTRY EMISSIONS

The Land Use, Land Use Change, and Forestry (LULUCF) category consists of two sub-categories of emissions: afforestation and deforestation; and other land use. BC accounts for these two sub-categories differently in the Provincial Inventory: afforestation and deforestation emissions are included in the inventory total, because they are anthropogenic or subject to human influence like the other reported emissions. However, other land use emissions are more volatile and largely determined by natural factors outside of human control. Because of this they are not included in the inventory total, in accordance with international practice, but reported as a memo item for completeness and transparency.

Emissions estimates for the LULUCF category have a high degree of uncertainty relative to estimates in other sectors. Sources of uncertainty include the limited size of sampled land area relative to the total land area of the province and the difficulty in accounting for complex ecological processes such as carbon uptake by vegetation and carbon release through organic matter decomposition.

LULUCF emissions are categorized by land-use categories as described in Table 8.

[21] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

Table 8: Definitions of Individual Land Types

Land Type	Description
Cropland	All land in annual crops, summer fallow, or perennial crops (mostly forage, but also including berries, grapes, nursery crops, vegetables, and fruit trees) and non-forest pasture or rangeland used for grazing domestic livestock that does not meet the definition of grassland. This definition of cropland is broader than some definitions in common use in BC due to the inclusion of non-forest land used for pasture and grazing.
Forestland	All land with woody vegetation that has: • land area of at least 1.0 ha; • tree crown cover at maturity of at least 25%; and • tree height at maturity of at least 5 metres. Forestland includes systems with vegetation that currently falls below, but is expected to exceed, these thresholds. These criteria are known to underestimate total afforestation and deforestation area; e.g. small linear land clearings from minor forest service roads and oil-and-gas rights of way are excluded.
Grassland	Unimproved pasture or rangeland that is only used for grazing domestic live-stock and occurs only in geographical areas where the grassland would not naturally re-grow to forest if unused. In addition, vegetated areas that do not and will not meet the definition of forestland or cropland are generally included in this category.
Settlements	All built-up land: urban land, rural residential land, land devoted to industrial and recreational use; roads, rights-of-way and other transportation infrastructure; land used for resource exploration, extraction, and distribution; and urban tree growth.
Wetland	Areas where permanent or recurrent saturated conditions allow the establishment of vegetation and soil development typical of these conditions and that are not otherwise categorized as forestland, cropland, or agricultural grassland. Wetland includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

7.1 Afforestation and Deforestation Emissions

GHG emissions reported in the afforestation and deforestation category, described by line item in Table 9, are from the conversion of land from one type to another. The deforestation line item is shown disaggregated into its constituent land type changes, emissions from each of which are aggregated by BC to calculate the deforestation line item.

Table 9: Afforestation and Deforestation Line Item Descriptions

Emissions Line Item	Description
Deforestation	Long-term conversion of forestland to other land types.
Forestland Converted to Cropland	Removal of biomass, decay of organic matter, changes in soil composition or management, and diminishment of the ability of the land to sequester carbon from the atmosphere due to clearing forestland for agricultural use.

Emissions Line Item	Description
Forestland Converted to Settlements	Removal of biomass, decay of dead organic matter, and diminishment of the ability of the land area to sequester carbon from the atmosphere due to clearing forestland for transportation, energy infrastructure, municipal development, resource extraction activities, and recreation.
Forestland Converted to Wetland	Decomposition of cleared biomass, decomposition of submerged soils and organic matter, and diminishment of the ability of the land to sequester carbon from the atmosphere due to clearing forestland for hydroelectric or municipal reservoirs or for peat harvesting. Emissions are reported here for 10 years following the year of flooding. Emissions occurring after 10 years are reported in wetland remaining wetland.
Forestland Conversion Associated with Harvested Wood Products	Use and disposal anywhere in the world of harvested wood products (HWPs) manufactured from wood coming from forest harvest or forest conversion activities in BC.
Afforestation	Cropland converted to forestland. Increased sequestration of carbon and minor emissions of GHGs due to the decay of dead organic matter caused by direct conversion by humans of unused cropland into forestland. Post-harvest tree re-planting and natural growth of vegetation in unused cropland are not included in this category.
Grassland Converted to Cropland	Decay of dead organic matter, change in soil composition, change in soil management practices, and change in the ability of the land to sequester carbon from the atmosphere due to clearing grassland for agricultural use.
Other Land Converted to Wetland	Conversion of non-forestland to peatland (for peat extraction) or flooded land (for hydroelectric reservoirs). Because of methodological limitations, this includes only large hydroelectric reservoirs created by land flooding. Existing water bodies dammed for water control or energy generation are not considered if flooding is small.

Methodology

BC obtains provincial LULUCF data from the federal government, which publishes it at the national level in the NIR but does not publish provincial-level data. Detailed descriptions of the methodologies and sources used can be found in Chapter 6 of Part 1 of the NIR and Annex 3.5 of Part 2 of the NIR.[22]

Estimation of GHG emissions in the LULUCF sector requires extensive modelling developed from a wide range of data sources. The Canadian Forest Service's (CFS) Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)[23] is used to estimate GHG emissions and removals related to BC's managed forests. Experts in the BC Government collaborate with CFS to compile the activity data from the National Forest Carbon Monitoring, Accounting, and Reporting System (NFCMARS).[24]

[22] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

[23] CBM-CFS3: https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/carbon-accounting/carbon-budget-model/13107

[24] NFCMARS: https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/carbon-accounting/13087

Land use change emissions are calculated for each combination of initial and final land type. BC aggregates these emissions together to give the afforestation and deforestation line items as described in Table 9.

7.2 Other Land Use Emissions

GHG emissions reported in the other land use category, described by line item in Table 10, are from processes occurring on land remaining the same land type. They are not included in the Provincial Inventory total, but are included as a memo item for completeness and transparency.

Table 10: Other Land Use Memo Line Item Descriptions

Emissions Line Item	Description
Forest Management	Activity on forestland that does not permanently change the land type.
Forest Growth Minus Decay	Annual processes within forestland remaining forestland. Increased carbon sequestration in biomass and soils from growth of biomass in forestland. GHG emissions from vegetation respiration, decay of organic matter in biomass and soils, and logging followed by replanting.
Slash Pile Burning	Slashburn following clearcut within forestland remaining forestland. Controlled burning of forest harvest residues to reduce the risk of wildfire.
Wildfires	Wildfires within forestland remaining forestland. Unintentional or uncontrolled forest burning followed by regrowth.
Decomposition of Harvested Wood Products	Decomposition of HWPs from harvest.
Cropland Management	Cropland remaining cropland. Carbon sequestration by crops, transfer and storage of carbon in soils, and emissions through soil and crop decomposition.
Wetland Management	Wetland remaining wetland. Residual decay of biomass cleared from the land and decomposition of soils in areas flooded for hydroelectric reservoirs and peat harvesting. Emissions from residual decay of cleared biomass are reported here beginning 10 years after the year of flooding. Emissions occurring in the first 10 years are reported in forestland converted to wetland. Small hydroelectric reservoirs are not included in this category.
Grassland Management	Grassland remaining grassland. Natural burning of grassland by lightning, by accidental ignition, as a management tool to control invasive plants and stimulate the growth of native species, or as part of military training exercises.
Settlement Management	Settlements remaining settlements. Carbon sequestration by urban trees.

Methodology

BC obtains provincial LULUCF data from the federal government, which publishes it at the national level in the NIR but does not publish provincial-level data. Detailed descriptions of the methodologies and sources used can be found in Chapter 6 of Part 1 of the NIR and Annex 3.5 of Part 2 of the NIR.[25]

Estimation of GHG emissions in the LULUCF sector requires extensive modelling developed from a wide range of data sources. The Canadian Forest Service's (CFS) Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)[26] is used to estimate GHG emissions and removals related to BC's managed forests. Experts in the BC Government collaborate with CFS to compile the activity data from the National Forest Carbon Monitoring, Accounting, and Reporting System (NFCMARS).[27]

Emissions are generated for several activities occurring on each land type and these are generally aggregated together by BC to give the other land use line items as described in Table 10. However, emissions from the constituent activities of forestland remaining forestland (reported in the Provincial Inventory as forest management) are reported as separate line items because of their generally larger magnitude and individual volatility.

8. ECONOMIC SECTORS

In addition to BC's GHG emissions disaggregated by the categories set out in international standards compiled by the IPCC and adopted by the UNFCCC,[28] the Provincial Inventory also reports the same emissions disaggregated instead by economic sector, as defined by ECCC.

Reallocating emissions from IPCC categories into economic sectors is useful for analyzing trends and policy effects, as it is often more intuitive to consider all GHG emissions from a particular economic activity together, and because some policies affect emissions associated with an economic activity regardless of emissions mechanism.

There is no different methodology for collecting or estimating the emissions data shown by economic sector; it is the same data described in sections 3-7, simply categorized in a different way. For example, the coal production economic sector line item includes emissions from fuel used in stationary mine equipment that are reported under the stationary combustion sources IPCC category; emissions from fuel used in on-site vehicles that are reported under the transport IPCC category; and fugitive emissions that are reported under the fugitive sources IPCC category.

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[25] NIR: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

[26] CBM-CFS3: https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/carbon-accounting/carbon-budget-model/13107

[27] NFCMARS: https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/carbon-accounting/13087

[28] UNFCCC reporting requirements: https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements
IPCC GHG inventory guidelines: https://www.ipcc-nggip.iges.or.jp/public/2006gl

As for the emissions data in the rest of the Provincial Inventory, the reallocation of BC's emissions to economic sectors is performed by ECCC for the NIR and BC adopts this data after thorough review. The economic sectors used are described in Table 11.

Table 11: Economic Sector Line Item Descriptions

Emissions Line Item	Description
FOSSIL FUEL INDUSTRY	
Coal Production	Underground and surface coal mines. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Mining • Energy > Transport > Other Transportation • Energy > Fugitive Sources > Coal Mining
Upstream Oil and Gas	Production, processing, and transportation of natural gas and crude oil.
Natural Gas Production and Processing	Production and processing of natural gas. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Public Electricity and Heat • Energy > Stationary Combustion > Oil and Gas Extraction • Energy > Transport > Other Transportation • Energy > Fugitive Sources > Oil and Natural Gas • IPPU > Non-Energy Products from Fuels and Solvent Use
Conventional Oil Production	Production of conventional light and heavy crude oil. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Oil and Gas Extraction • Energy > Transport > Other Transportation • Energy > Fugitive Sources > Oil and Natural Gas
Oil and Natural Gas Transmission	Transport and storage of crude oil and natural gas. Includes emissions from the following activity categories: • Energy > Transport > Other Transportation • Energy > Fugitive Sources > Oil and Natural Gas
Downstream Oil and Gas	Refining petroleum and distributing natural gas to consumers.
Petroleum Refining	Petroleum refining industries. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Petroleum Refining Industries • Energy > Fugitive Sources > Oil and Natural Gas • IPPU > Non-Energy Products from Fuels and Solvent Use
Natural Gas Distribution	Combustion and fugitive emissions from local distribution of natural gas. Includes emissions from the following activity categories: • Energy > Transport > Other Transportation • Energy > Fugitive Sources > Oil and Natural Gas
ELECTRICITY	
Electricity	Utility electricity generation, steam production (for sale), and transmission of both. Excludes utility owned cogeneration at industrial sites. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Public Electricity and Heat • IPPU > Other Product Manufacture and Use

Emissions Line Item	Description
TRANSPORTATION	
Passenger Transport	Vehicles that primarily move people around.
Cars, Trucks, and Motorcycles	Light-duty cars and trucks with a GVWR up to 3,900 kg and motorcycles. Includes emissions from the following activity categories: • Energy > Transport > Road Transportation • Energy > Transport > Other Transportation • Industrial Processes and Product Use > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Other Product Manufacture and Use
Bus, Rail, and Domestic Aviation	Buses and the passenger component of rail and domestic aviation. Includes emissions from the following activity categories: • Energy > Transport > Domestic Aviation • Energy > Transport > Road Transportation • Energy > Transport > Railways • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Other Product Manufacture and Use
Freight Transport	Vehicles that primarily move cargo or freight around.
Heavy-Duty Trucks and Rail	Vehicles with a GVWR greater than 3,900 kg and the freight component of rail. Includes emissions from the following activity categories: • Energy > Transport > Road Transportation • Energy > Transport > Railways • Energy > Transport > Other Transportation • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Other Product Manufacture and Use
Domestic Aviation and Marine	Domestic navigation and the cargo component of domestic aviation. Includes emissions from the following activity categories: • Energy > Transport > Domestic Aviation • Energy > Transport > Domestic Navigation • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use
Other: Recreational, Commercial, and Residential	Non-industrial use of off-road engines (e.g. all-terrain vehicles, snowmobiles, personal watercraft), including portable engines (e.g. generators, lawn mowers, and chain saws). Includes emissions from the following activity category: • Energy > Transport > Other Transportation
HEAVY INDUSTRY	
Mining	Metal and non-metal mines, stone quarries, and gravel pits. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Mining • Energy > Transport > Other Transportation • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3

Emissions Line Item	Description
Smelting and Refining (Non-Ferrous Metals)	Production of aluminium, magnesium, and other non-ferrous metals. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Metal Production • IPPU > Non-Energy Products from Fuels and Solvent Use
Pulp and Paper	Manufacture of pulp, paper, and paper products. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Non-Energy Products from Fuels and Solvent Use
Iron and Steel	Iron production, steel foundries, casting, and rolling mills. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Non-Energy Products from Fuels and Solvent Use
Cement	Production of cement and other non-metallic minerals. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Non-Energy Products from Fuels and Solvent Use
Lime and Gypsum	Manufacturing lime and gypsum products. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Non-Energy Products from Fuels and Solvent Use
Chemicals and Fertilizers	Manufacture of fertilizers and other organic and inorganic chemicals. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3
BUILDINGS	
Service Industry	Service industries related to mining, communication, wholesale and retail trade, finance and insurance, real estate, education, offices, health, arts, accommodation, food, culture; federal, provincial, and municipal establishments; national defence and the Canadian Coast Guard; and train stations, airports, and warehouses. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Commercial and Institutional • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Other Product Manufacture and Use

Emissions Line Item	Description
Residential	Personal residences (houses, apartment hotels, condominiums, etc.). Includes emissions from the following activity categories: • Energy > Stationary Combustion > Residential • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3
AGRICULTURE	
On-Farm Fuel Use	Fuel used in the agricultural, hunting, and trapping industry (excluding food processing and farm machinery manufacture and repair). Includes emissions from the following activity categories: • Energy > Stationary Combustion > Agriculture and Forestry • Energy > Transport > Other Transportation
Crop Production	Application of inorganic nitrogen fertilizers, decomposition of crop residues, loss of soil organic carbon, cultivation of organic soils, leaching and volatilization, field burning of agricultural residues, liming, and urea application. Includes emissions from the following activity categories: • Agriculture > Agricultural Soils • Agriculture > Liming, Urea Application, and Other Carbon-Containing Fertilizers
Animal Production	Animal housing, manure storage, manure deposited by grazing animals, and application of manure to managed soils. Includes emissions from the following activity categories: • Agriculture > Enteric Fermentation • Agriculture > Manure Management • Agriculture > Agricultural Soils
WASTE	
Solid Waste	Municipal landfills, wood waste landfills, and composting of municipal solid waste. Includes emissions from the following activity categories: • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • Waste > Solid Waste Disposal • Waste > Biological Treatment of Solid Waste • Waste > Industrial Wood Waste Landfills
Waste Incineration	Incineration of sewage sludge and municipal solid, hazardous, and clinical waste. Includes emissions from the following activity category: • Waste > Incineration and Open Burning of Waste
Waste Water	Municipal and industrial wastewater treatment. Includes emissions from the following activity category: • Waste > Wastewater Treatment and Discharge
LIGHT MANUFACTURING, CONSTRUCTION, AND FOREST RESOURCES	
Light Manufacturing	All manufacturing industries not included in heavy industry. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Manufacturing Industries • Energy > Transport > Other Transportation • IPPU > Mineral Products • IPPU > Production and Consumption of Halocarbons, SF_6, and NF_3 • IPPU > Non-Energy Products from Fuels and Solvent Use • IPPU > Other Product Manufacture and Use

Emissions Line Item	Description
Construction	Construction of buildings, highways, and other infrastructure. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Construction • Energy > Transport > Other Transportation • IPPU > Non-Energy Products from Fuels and Solvent Use
Forest Resources	Forestry and logging services. Includes emissions from the following activity categories: • Energy > Stationary Combustion > Agriculture and Forestry • Energy > Transport > Other Transportation • IPPU > Non-Energy Products from Fuels and Solvent Use
AFFORESTATION AND DEFORESTATION	
Deforestation	The same emissions category described in section 7.1.
Afforestation	The same emissions category described in section 7.1.
Grassland Converted to Cropland	The same emissions category described in section 7.1.
Other Land Converted to Wetlands	The same emissions category described in section 7.1.

9. APPENDICES

9.1 Glossary of Terms

Anthropogenic:
Occurring as a result of human activity.

Afforestation:
The direct human-induced conversion of land that has not been forested since December 31, 1989 to forestland (e.g. through planting, seeding, and/or the human-induced promotion of natural seed sources). The international afforestation and reforestation definitions have been combined into the definition of afforestation used here to avoid confusion with the conventional BC use of the word reforestation within a forest management context.

Cropland:
All land in annual crops, summer fallow, or perennial crops (mostly forage, but also including berries, grapes, nursery crops, vegetables, and fruit trees) and non-forest pasture or rangeland used for grazing domestic livestock that does not meet the definition of grassland. This definition of cropland is broader than some definitions in common use in BC due to the inclusion of non-forest land used for pasture and grazing.

Deforestation:
The direct human-induced conversion of forestland to non-forestland. Harvesting followed by regeneration is not deforestation, although forestry operations can cause deforestation (e.g. when permanent roads and landings are established and permanent conversion of land type category occurs).

Forestland:
All land with woody vegetation that has:

- land area of at least 1.0 ha;
- tree crown cover at maturity of more than 25%; and
- tree height at maturity of at least 5 metres.

Forestland includes systems with vegetation that currently falls below, but is expected to exceed, these thresholds. These criteria are known to underestimate total afforestation and deforestation area; e.g. small linear land clearings from minor forest service roads and oil-and-gas rights of way are excluded.

Forest Management:
A system of practices for stewardship and use of forestland aimed at fulfilling relevant ecological (including biological diversity), economic, and social functions of the forest in a sustainable manner.

Grassland:
Unimproved pasture or rangeland that is only used for grazing domestic livestock and occurs only in geographical areas where the grassland would not naturally re-grow to forest if unused. In addition,

vegetated areas that do not and will not meet the definition of forestland or cropland are generally included in this category.

Managed Forest:
A forest subject to some kind of human interaction (e.g. commercial management, harvest of industrial round-wood (logs) and fuel-wood, production and use of wood commodities, management for amenity value, or environmental protection) and with defined geographical boundaries.

Radiative Forcing:
The amount of heat-trapping potential of a GHG, measured in units of power per unit of area (e.g. Watts per metre squared).

Removal:
Either of the following:

- An amount of GHG removed from the atmosphere using an industrial or biological process.
- An amount of GHG that was not emitted into the atmosphere as a result of storage of that GHG or its components.

Settlements:
All built-up land: urban land, rural residential land, land devoted to industrial and recreational use; roads, rights-of-way and other transportation infrastructure; land used for resource exploration, extraction, and distribution; and urban tree growth.

Sink:
A physical unit or process that removes an amount of GHG from the atmosphere. Notation in the final stages of reporting uses the negative (-) sign.

Slash Pile Burning:
Slash is the leftover tree limbs, tops, and other residue left by logging activities. Slash pile burning is the piling together and burning of the slash during safe conditions, usually during the winter after it has been left to season (i.e. dry).

Source:
A physical unit or process that releases an amount of GHG into the atmosphere. Notation in the final stages of reporting uses the positive (+) sign.

Tier:
A level of methodological complexity defined by the IPCC.[29] Tier 1 comprises top down approaches that utilize aggregated statistical data to estimate emissions; Tier 2 comprises intermediate level

[29] IPCC GHG inventory guidelines: https://www.ipcc-nggip.iges.or.jp/public/2006gl

approaches; and Tier 3 comprises bottom-up approaches such as site-specific quantification of emissions. The level of accuracy increases with increasing tier number, from 1 to 3, however the methodological complexity also increases.

Wetland:
Areas where permanent or recurrent saturated conditions allow the establishment of vegetation and soil development typical of these conditions and that are not otherwise categorized as forestland, cropland, or agricultural grassland. Wetland includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

9.2 Abbreviations and Acronyms

Table 12: Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AGEM	Aviation Greenhouse Gas Emission Model
AR	Assessment Report
Al_2O_3	Alumina
BC	British Columbia
CCAA	*Climate Change Accountability Act*
CBM-CFS3	Carbon Budget Model of the Canadian Forest Sector, version 3
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
ECCC	Environment and Climate Change Canada
GHG	Greenhouse gas
GVWR	Gross vehicle weight rating
GWP	Global warming potential
HFC	Hydrofluorocarbon
HWP	Harvested wood product
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
LULUCF	Land Use, Land-Use Change, and Forestry
MEIT	Marine Emissions Inventory Tool
MOVES	Motor Vehicle Emissions Simulator
Na_2CO_3	Soda ash
NFCMARS	National Forest Carbon Monitoring, Accounting, and Reporting System
NF_3	Nitrogen trifluoride
NIR	National Inventory Report
N_2O	Nitrous oxide
PFC	Perfluorocarbon
RESD	*Report on Energy Supply and Demand in Canada*
SF_6	Sulphur hexafluoride
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency

Ministry of
Environment and
Climate Change Strategy