

# Emission Factors and Reference Values

Version 2.0  
May 2024

Canada's Greenhouse Gas  
Offset Credit System



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## Document revision history

Version number	Publication Date	Summary of changes
2.0	May 6, 2024	<p>Addition of reference values applicable to the <i>Improved Forest Management on Private Land</i> federal offset protocol</p> <p>Update of emission factors and reference values in alignment with the <i>National Inventory Report 1990 – 2022: Greenhouse Gas Sources and Sinks in Canada</i></p> <p>Addition of rules on the timing applicability of emission factors and reference values</p> <p>Changes to clarify the structure and facilitate the use of the document</p>
1.1	June 13, 2023	<p>Update of information and emission factors in alignment with the April 2023 publication of the <i>National Inventory Report 1990 – 2021: Greenhouse Gas Sources and Sinks in Canada</i></p>
1.0	June 8, 2022	<p>Initial version</p>

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# 1.0 Introduction

[Canada's Greenhouse Gas \(GHG\) Offset Credit System](#) is established under Part 2 of the *Greenhouse Gas Pollution Pricing Act* (GGPPA) to provide an incentive to undertake projects that result in domestic GHG reductions that would not have been generated in the absence of the project, that go beyond legal requirements and that are not subject to carbon pollution pricing mechanisms.

Canada's GHG Offset Credit System consists of:

- the [Canadian Greenhouse Gas Offset Credit System Regulations](#) (the Regulations), which establish the system, implement the operational aspects and set the general requirements applicable to all project types
- federal offset protocols, included in the [Compendium of Federal Offset Protocols](#) (the Compendium), each containing requirements for project implementation and methods for quantifying GHG reductions for a given project type, and
- the [Credit and Tracking System](#) (CATS) to register offset projects, issue and track offset credits, and share key information through [Canada's GHG Offset Credit System Public Registry](#)

The Regulations apply to a proponent of a project which is of a type for which a protocol has been included in the Compendium; that aims to generate GHG reductions by preventing GHG emissions or removing GHGs from the atmosphere; and with respect to which the GHG reductions are real, additional, quantified, verified, unique and permanent. Offset credits will be issued to a proponent of a project for the period covered by a project report in the amount determined in accordance with subsection 29(2) of the Regulations if requirements of subsection 29(1) of the Regulations are met.

As per subsection 19(1) of the Regulations, this document provides emission factors and reference values that a proponent must use in conjunction with a federal offset protocol to quantify the GHG reductions generated by a project. It also specifies timing applicability for the emission factors and reference values that are to be used for the quantification of GHG reductions occurring in a given calendar year.

This document is categorized into general emission factors and reference values that are applicable to more than one federal offset protocol, and protocol-specific emission factors and reference values. For all emission factors and reference values, it is specified which parameter in a given protocol the emission factors and reference values correspond to. The proponent may need to convert the units of the emission factors and reference values provided in this document to align with the units presented in the quantification methodology of the relevant federal offset protocol.

Emission factors and reference values are subject to periodic updates when a new federal offset protocol is included in the Compendium, or when updated versions of the sources referenced in this document are published. As per subsection 1(2) of the Regulations, proponents must use the latest version of this document.

## 2.0 Abbreviations and acronyms

CH <sub>4</sub>	methane
CO <sub>2</sub>	carbon dioxide
CO <sub>2e</sub>	carbon dioxide equivalent
g	gram
kg	kilogram
kWh	kilowatt hour
L	litre
m <sup>3</sup>	cubic meter
N <sub>2</sub> O	nitrous oxide
SF <sub>6</sub>	sulfur hexafluoride
t	metric tonne

## 3.0 General

### 3.1 Global warming potentials

Global warming potentials (GWPs) are provided in Column 2 of Schedule 3 to the GGPPA.

GWPs to be used for the quantification of GHG reductions are the ones published in Schedule 3 to the GGPPA at the time GHG reductions occur.

## 4.0 General emission factors and reference values

Emission factors and reference values in Section 4.0 may be applicable to more than one federal offset protocol.

### 4.1 Fossil fuel combustion

Emission factors contained in Tables 1.1 and 1.2 correspond to the parameter  $EF_{CO_2,j}$  in applicable protocols.

Emission factors contained in Table 1.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

**Table 1.1 – CO<sub>2</sub> emission factors for natural gas (g CO<sub>2</sub>/m<sup>3</sup> natural gas) for 2023 and 2024**

Province / Territory	Marketable <sup>1*</sup>	Non-marketable <sup>2**</sup>
British Columbia	1966	2162
Alberta	1962	2109
Saskatchewan	1920	2441
Manitoba	1915	2401
Ontario	1921	2401
Quebec	1926	-
New Brunswick	1919	2401
Nova Scotia	1919	2494
Prince Edward Island	1919	-
Newfoundland and Labrador	1919	2202

<sup>1</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-1, "CO<sub>2</sub> Emission Factors for Marketable Natural Gas"

<sup>2</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-2, "CO<sub>2</sub> Emission Factors for Non-Marketable Natural Gas"

Province / Territory	Marketable <sup>1*</sup>	Non-marketable <sup>2**</sup>
Yukon	1966	2401
Northwest Territories	1966	2466
Nunavut	1966	-

\* The term “marketable” applies to the fuel consumed by the Utility, Industry, Residential, Commercial, and Transport subsectors.

\*\* The term “non-marketable” applies to raw/unprocessed gas consumption, mainly by natural gas producers.

Emission factors contained in Table 1.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 1.2 – CO<sub>2</sub> emission factors for natural gas (g CO<sub>2</sub>/m<sup>3</sup> natural gas) for 2025**

Province / Territory	Marketable <sup>3</sup>	Non-marketable <sup>4</sup>
British Columbia	1966	2162
Alberta	1962	2113
Saskatchewan	1920	2441
Manitoba	1915	2401
Ontario	1921	2401
Quebec	1926	-
New Brunswick	1919	2401
Nova Scotia	1919	2494
Prince Edward Island	1919	-
Newfoundland and Labrador	1919	2340
Yukon	1966	2401
Northwest Territories	1966	2466
Nunavut	1966	-

Emission factors contained in Tables 2.1 and 2.2 correspond to the parameters EF<sub>CH<sub>4</sub>,j</sub> or EF<sub>N<sub>2</sub>O,j</sub> in applicable protocols.

<sup>3</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada, Part 2, Table A6.1-1, “CO<sub>2</sub> Emission Factors for Marketable Natural Gas”*

<sup>4</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada, Part 2, Table A6.1-2, “CO<sub>2</sub> Emission Factors for Non-Marketable Natural Gas”*



Emission factors contained in Table 2.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

**Table 2.1 – CH<sub>4</sub> and N<sub>2</sub>O emission factors for natural gas (g GHG/m<sup>3</sup> natural gas)<sup>5</sup> for 2023 and 2024**

Source	CH <sub>4</sub>	N <sub>2</sub> O
Electric Utilities	0.490	0.049
Industrial	0.037	0.033
Producer Consumption (Non-marketable)	6.4	0.060
Producer Consumption (Non-marketable) – Newfoundland and Labrador	0.490	0.060
Pipelines	1.900	0.050
Cement	0.037	0.034
Manufacturing Industries	0.037	0.033
Residential, Construction, Commercial/Institutional, Agriculture	0.037	0.035

Emission factors contained in Table 2.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 2.2 – CH<sub>4</sub> and N<sub>2</sub>O emission factors for natural gas (g GHG/m<sup>3</sup> natural gas)<sup>6</sup> for 2025**

Source	CH <sub>4</sub>	N <sub>2</sub> O
Electric Utilities	0.490	0.049
Industrial	0.037	0.033
Producer Consumption (Non-marketable)	6.4	0.060
Producer Consumption (Non-marketable) – Newfoundland and Labrador	0.490	0.060
Pipelines	1.900	0.050
Cement	0.037	0.034
Manufacturing Industries	0.037	0.033
Residential, Construction, Commercial/Institutional, Agriculture	0.037	0.035

<sup>5</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-3, “CH<sub>4</sub> and N<sub>2</sub>O Emission Factors for Natural Gas”

<sup>6</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-3, “CH<sub>4</sub> and N<sub>2</sub>O Emission Factors for Natural Gas”

Emission factors contained in Tables 3.1 and 3.2 correspond to the parameters  $EF_{CO_2,j}$ ,  $EF_{CH_4,j}$  or  $EF_{N_2O,j}$  in applicable protocols.

Emission factors contained in Table 3.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

**Table 3.1 – Emission factors for natural gas liquids (g GHG/L fuel)<sup>7</sup> for 2023 and 2024**

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Propane - Residential	1515	0.027	0.108
Propane - All Other Uses	1515	0.024	0.108
Ethane	986	0.024	0.108
Butane	1747	0.024	0.108

Emission factors contained in Table 3.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 3.2 – Emission factors for natural gas liquids (g GHG/L fuel)<sup>8</sup> for 2025**

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Propane - Residential	1515	0.027	0.108
Propane - All Other Uses	1515	0.024	0.108
Ethane	986	0.024	0.108
Butane	1747	0.024	0.108

Emission factors contained in Tables 4.1 and 4.2 correspond to the parameters  $EF_{CO_2,j}$ ,  $EF_{CH_4,j}$  or  $EF_{N_2O,j}$  in applicable protocols.

Emission factors contained in Table 4.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

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<sup>7</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-4, “Emission Factors for Natural Gas Liquids”

<sup>8</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-5, “Emission Factors for Natural Gas Liquids”

**Table 4.1 – Emission factors for refined petroleum products (g GHG/L fuel)<sup>9</sup> for 2023 and 2024**

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Light Fuel Oil - Electric Utilities	2 753	0.18	0.031
Light Fuel Oil - Industrial	2 753	0.006	0.031
Light Fuel Oil - Producer Consumption	2 670	0.006	0.031
Light Fuel Oil - Residential	2 753	0.026	0.006
Light Fuel Oil - Forestry, Construction, Public Administration and Commercial/Institutional	2 753	0.026	0.031
Heavy Fuel Oil - Electric Utilities	3 156	0.034	0.064
Heavy Fuel Oil - Industrial	3 156	0.12	0.064
Heavy Fuel Oil - Producer Consumption	3 190	0.12	0.064
Heavy Fuel Oil - Residential, Forestry, Construction, Public Administration and Commercial/Institutional	3 156	0.057	0.064
Kerosene - Electric Utilities	2 560	0.006	0.031
Kerosene - Industrial	2 560	0.006	0.031
Kerosene - Producer Consumption	2 560	0.006	0.031
Kerosene - Residential	2 560	0.026	0.006
Kerosene - Forestry, Construction, Public Administration and Commercial/Institutional	2 560	0.026	0.031
Diesel - Refineries and Others	2 681	0.078	0.022
Diesel - Upgraders	2 681	0.078	0.022
Petroleum Coke - Refineries and Others	3 877 <sup>10</sup>	0.12	27.5 g/m <sup>3</sup> <sup>11</sup>
Petroleum Coke - Upgraders	3 494 <sup>10</sup>	0.12	24.0 g/m <sup>3</sup> <sup>11</sup>
Still Gas - Refineries and Others	1 755 g/m <sup>3</sup> <sup>10</sup>	0.032 g/m <sup>3</sup> <sup>12</sup>	0.00002

<sup>9</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-5, "Emission Factors for Refined Petroleum Products"

<sup>10</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-6, "CO<sub>2</sub> Emission Factors for Petroleum Coke and Still Gas"

<sup>11</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-7, "N<sub>2</sub>O Emission Factors for Petroleum Coke"

<sup>12</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-8, "CH<sub>4</sub> Emission Factors for Still Gas (Refineries and Others)"

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Still Gas - Upgraders	2 140 g/m <sup>3</sup> <sup>10</sup>	0.000039	0.00002
Motor Gasoline	2 307	0.100	0.02

Emission factors contained in Table 4.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 4.2 – Emission factors for refined petroleum products (g GHG/L fuel)<sup>13</sup> for 2025**

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Light Fuel Oil - Electric Utilities	2 753	0.18	0.031
Light Fuel Oil - Industrial	2 753	0.006	0.031
Light Fuel Oil - Producer Consumption	2 670	0.006	0.031
Light Fuel Oil - Residential	2 753	0.026	0.006
Light Fuel Oil - Forestry, Construction, Public Administration and Commercial/Institutional	2 753	0.026	0.031
Heavy Fuel Oil - Electric Utilities	3 156	0.034	0.064
Heavy Fuel Oil - Industrial	3 156	0.12	0.064
Heavy Fuel Oil - Producer Consumption	3 190	0.12	0.064
Heavy Fuel Oil - Residential, Forestry, Construction, Public Administration and Commercial/Institutional	3 156	0.057	0.064
Kerosene - Electric Utilities	2 560	0.006	0.031
Kerosene - Industrial	2 560	0.006	0.031
Kerosene - Producer Consumption	2 560	0.006	0.031
Kerosene - Residential	2 560	0.026	0.006
Kerosene - Forestry, Construction, Public Administration and Commercial/Institutional	2 560	0.026	0.031
Diesel - Refineries and Others	2 681	0.078	0.022
Diesel - Upgraders	2 681	0.078	0.022

<sup>13</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada, Part 2, Table A6.1-6, "Emission Factors for Refined Petroleum Products"*

Fuel	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Petroleum Coke - Refineries and Others	3 776 <sup>14</sup>	0.12	27.5 g/m <sup>3</sup> <sup>15</sup>
Petroleum Coke - Upgraders	3 494 <sup>14</sup>	0.12	24.0 g/m <sup>3</sup> <sup>15</sup>
Still Gas - Refineries and Others	1 780 g/m <sup>3</sup> <sup>14</sup>	0.032 g/m <sup>3</sup> <sup>16</sup>	0.00002
Still Gas - Upgraders	2 140 g/m <sup>3</sup> <sup>14</sup>	0.000039	0.00002
Motor Gasoline	2 307	0.100	0.02

## 4.2 Grid electricity consumption

A 'consumption intensity' indicator is derived to reflect the GHG emissions intensity of electricity as it is delivered to the consumer.

Reference values contained in Tables 5.1 and 5.2 correspond to the parameter EF<sub>EL,GHG</sub> in applicable protocols.

Reference values contained in Table 5.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

**Table 5.1 – Electricity consumption intensity values (g CO<sub>2</sub>e/kWh electricity consumed)<sup>17</sup> for 2023 and 2024**

Province / Territory	Consumption intensity <sup>18</sup>
British Columbia	15
Alberta	540
Saskatchewan	730
Manitoba	2.0
Ontario	30
Quebec	1.7
New Brunswick	300
Nova Scotia	690

<sup>14</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-7, "CO<sub>2</sub> Emission Factors for Petroleum Coke and Still Gas"

<sup>15</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-8, "N<sub>2</sub>O Emission Factors for Petroleum Coke"

<sup>16</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.1-9, "CH<sub>4</sub> Emission Factors for Still Gas (Refineries and Others)"

<sup>17</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 3, Table A13-2 to Table A13-14, 2021 values.

<sup>18</sup> Consumption intensity values are impacted by unallocated energy and SF<sub>6</sub> transmission emissions.

Province / Territory	Consumption intensity <sup>18</sup>
Prince Edward Island <sup>19</sup>	300
Newfoundland and Labrador	17
Yukon	80
Northwest Territories	170
Nunavut	840

Reference values contained in Table 5.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 5.2 – Electricity consumption intensity values (g CO<sub>2</sub>e/kWh electricity consumed)<sup>20</sup> for 2025**

Province / Territory	Consumption intensity <sup>21</sup>
British Columbia	15
Alberta	490
Saskatchewan	670
Manitoba	1.4
Ontario	38
Quebec	1.7
New Brunswick	350
Nova Scotia	700
Prince Edward Island <sup>22</sup>	350
Newfoundland and Labrador	18
Yukon	70
Northwest Territories	190
Nunavut	820

<sup>19</sup> Due to the high level of imports from New Brunswick, Prince Edward Island takes New Brunswick's value.

<sup>20</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 3, Table A13-2 to Table A13-14, 2022 values.

<sup>21</sup> Consumption intensity values are impacted by unallocated energy and SF<sub>6</sub> transmission emissions.

<sup>22</sup> Due to the high level of imports from New Brunswick, Prince Edward Island takes New Brunswick's value.

## 4.3 Biogas combustion

Biogas includes landfill gas.

Emission factors contained in Tables 6.1 and 6.2 correspond to the parameter  $EF_{LFG,N_2O,i}$  in applicable protocols.

Emission factors contained in Table 6.1 are to be used for the quantification of GHG reductions occurring in calendar years 2023 and 2024.

**Table 6.1 – N<sub>2</sub>O emission factors for biogas combustion (kg N<sub>2</sub>O/tonne CH<sub>4</sub>)<sup>23</sup> for 2023 and 2024**

Description	N <sub>2</sub> O
Combustion of biogas for energy through a boiler, turbine, internal combustion engine or station for natural gas network	0.005
Flaring of biogas <sup>24</sup>	0

Emission factors contained in Table 6.2 are to be used for the quantification of GHG reductions occurring in calendar year 2025.

**Table 6.2 – N<sub>2</sub>O emission factors for biogas combustion (kg N<sub>2</sub>O/tonne CH<sub>4</sub>)<sup>25</sup> for 2025**

Description	N <sub>2</sub> O
Combustion of biogas for energy through a boiler, turbine, internal combustion engine or station for natural gas network	0.005
Flaring of biogas <sup>26</sup>	0.005

## 5.0 Protocol-specific emission factors and reference values

Emission factors and reference values in Section 5.0 are only applicable to the federal offset protocol specified.

<sup>23</sup> *National Inventory Report 1990-2021: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.6-2, "Emission Factors for Landfill Gas Combustion"

<sup>24</sup> This emission factor is currently reported as "not estimated" in Canada's National Inventory Report. A value of zero has been assigned to this emission factor for the purposes of the quantification of GHG reductions.

<sup>25</sup> *National Inventory Report 1990-2022: Greenhouse Gas Sources and Sinks in Canada*, Part 2, Table A6.6-2, "Emission Factors for Landfill Gas Combustion"

<sup>26</sup> This emission factor is currently reported as "not estimated" in Canada's National Inventory Report. To be conservative, the emission factor applicable to combustion of biogas for energy is applied to flaring of biogas.

## 5.1 Improved forest management on private land

Reference values contained in Tables 7 and 8 are to be used for the quantification of GHG reductions generated by projects undertaken under the *Improved Forest Management on Private Land* protocol and occurring from calendar year 2024 onwards.

Reference values contained in Table 7 correspond to the parameter  $PC_{i,C}$  in the protocol.

**Table 7 – Percentage of harvest by wood product class<sup>27</sup>**

Wood product class	Percentage of harvest (%)
Softwood lumber	37.76
Hardwood lumber	0.38
Pulp and paper	34.60
Panels (plywood and oriented strandboard)	12.42
Other industrial roundwood	3.55
Fuelwood	11.29

Reference values contained in Table 8 correspond to the parameter  $SF_j$  in the protocol.

**Table 8 – 100-year storage factor by wood product class<sup>28</sup>**

Wood product class	100-year storage factor
Softwood lumber	0.213
Hardwood lumber	0.156
Softwood plywood	0.215
Oriented strandboard	0.285
Non-structural panels	0.174
Other industrial roundwood	0.149
Fuelwood	0
Pulp and paper	0

<sup>27</sup> Values are based off the national average harvested wood product production ratios developed by the Food and Agriculture Organization (FAO) based on a reference period of 1990-2020. Ratio of softwood lumber to hardwood lumber for harvested industrial roundwood was based on a reference period of 2014-2021 from Statistics Canada (Table 16-10-0017-01 Lumber production, shipments, and stocks by species, monthly (x 1,000), [doi: 10.25318/1610001701-eng](https://doi.org/10.25318/1610001701-eng)).

<sup>28</sup> Hoover et al. (2014). [Chapter 6: quantifying greenhouse gas sources and sinks in managed forest systems](#). M., D. Pape, M. Flugge, R. Steele, D. Man, M. Riley-Gilbert, and S. Biggar, (Eds.). *Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory* (Technical Bulletin Number 1939). US Department of Agriculture.