Infrastructure Canada

Canada

THE GHG GUIDANCE MODULES

New Mobile Fleets v1.0

Infrastructure Canada

Aussi disponible en français sous le titre : Les lignes directrices sur les GES modules : Nouveaux parcs de véhicules v1.0

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Disclaimer

This document is intended to be a learning tool for project developers and to introduce greenhouse gas (GHG) quantification and the consideration of GHG mitigation measures into project designs in the context of the Canadian environment. The GHG quantification approach presented in this document is to ensure consistency and comparability of GHG estimates between projects. The quantification processes here are not intended to be applied to crediting mechanisms or emission trading systems. However, specific aspects of this approach (i.e. baselines and mitigation measures) can be modified to demonstrate specific GHG performance in order to realize a program's particular GHG emission objectives or targets.

The scope of the GHG sources presented here is not purported to be a comprehensive life-cycle analysis of the project. Such an exercise can only be done credibly ex-post and with a large amount of information. For instance, GHG emissions resulting from embodied carbon or the decommissioning of the project are not considered. This guidance describes an approach to estimate GHG emissions ex-ante, when minimal information and resources are available. In addition, the methodologies proposed in this document are intended to capture the most significant of emission sources only.

Finally, this document is evergreen – meaning it will be periodically updated to remain aligned with advancing assessment methodologies. Please ensure you consult the Infrastructure Canada website to ensure you have the most recent version of this guidance before undertaking a GHG Assessment.

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Introduction

This GHG Guidance Module provides information to help quantify greenhouse (GHG) emission reductions from the implementation of a new mobile fleet, which is either more fuel efficient or uses a cleaner fuel for energy. Emission reductions are based on the difference between the combustion of conventional fuel (gas/diesel) in less efficient vehicle fleets (the baseline) and the combustion of fuel in more efficient vehicle fleets, or those that use a cleaner form of energy (the project).

The GHG Guidance Modules provide a simple, sector-specific approach to GHG quantification for various projects across Canada. They are intended to be used by qualified professionals with expertise related to the project and preferably some level of GHG accounting experience. Each GHG Guidance Module is based on international standards and sets out a pre-determined set of technical elements (i.e. baselines, activities and variables) and other considerations, required to quantify GHG benefits from a specific project type or sector.

The GHG Guidance Modules are built upon the following 3 principles:

1. Integrity – The Modules provide an approach to ensure GHG assessments are developed according to specific standards to ensure they have a consistency, comparability and transparency that allows intended users to make decisions with reasonable confidence.

2. Rationality – The Modules provide guidance that is intended to be straightforward and logical to administer, while ensuring a rigorous commitment to the environmental reliability of the system.

3. Legacy – the Modules build on experience and tools gained from existing project-based programs in jurisdictions across Canada, international standards and methodologies and existing Canadian projects

Definitions:

Fuel: includes a form of energy that is combusted or transformed to generate usable energy or provides motive force to a mechanical process. Examples of fuel include fossil fuels (oil/gas/diesel) or electricity. Biofuels and hydrogen fuel cells are excluded from the scope of this module.

Fleets: Mobile fleets include motorcycle, passenger, light-duty, medium-duty and heavy-duty trucks, buses, mobile agricultural machinery and construction equipment. Rail systems, waterborne vessels and aircraft are excluded from the scope of this module.

Principles

When developing any type of GHG assessment or inventory, developers should follow relevant GHG standards, guidance documents and methodologies suggested by the specific program authority. However, as the process of GHG quantification has inherent flexibility and room for interpretation, developers of GHG assessments will still be faced with making specific decisions that are outside the scope of any guidance document. On these occasions, developers should make decisions based on the overarching objectives of integrity and credibility. To achieve these objectives, developers should follow a set of common GHG quantification principles, found throughout the many GHG standards, protocols and guidance documents worldwide.

The following principles have been adapted from the ISO 14064:2 Standard and should be followed when developing a GHG assessment of a project:

Relevance
Selected sources (activities) of GHG emissions, data and methodologies must be appropriate to the project and the needs of the intended user.

Completeness
Include all relevant GHG emission sources. Include all relevant information to support program criteria and the GHG emission estimates.

Consistency
Developers should apply estimation methods and assumptions consistently across all aspects of the project and for all individual GHG emission sources. In other words, developers should maintain the same "quantification rules" throughout the GHG assessment.

Transparency
All assumptions, methods, calculations, and associated uncertainties should be provided in order to allow intended users to make decisions with reasonable confidence and allow for successful validation and verification of the results.

Accuracy
Estimates and calculations should be unbiased, and uncertainties should be reduced as far as practical. Calculations should be conducted in a manner that minimizes uncertainty.

Conservativeness
Where there are uncertainties, the values used to quantify GHG emissions should err on the side of underestimating potential reductions.

GHG basics

Baseline scenario: The baseline scenario is the "business as usual" or hypothetical reference case against which the GHG performance of the project is measured. A variety of baseline approaches are available to quantify GHG emissions from a project, although not all approaches are applicable to any given project type. The baseline is an important aspect to a GHG quantification reduction, and pending the choice of a baseline, can result in varying estimates of GHG emissions reductions.

Project scenario: The project scenario consists of the project activities, which include the GHG mitigation measures that go beyond standard codes and practice and are aimed to reduce energy and GHG emissions. The performance of the project and its mitigation measures are compared to an alternative hypothetical reference case with average energy intensity and GHG performance (i.e. the baseline scenario).

Sources & sinks: Under ISO 14064:2, a source is any process or activity that releases a greenhouse gas into the atmosphere, whereas a sink is any process, activity or mechanism that removes a greenhouse gas from the atmosphere. Although there are numerous sources and/or sinks related to a project or baseline scenario, only a few relevant (i.e. significant) activities are typically selected for quantification, as they are likely to result in significant amounts of GHG emissions.

Elements: GHG sources and sinks can be further broken down into the specific elements which are responsible for completing the activity and result in GHG emissions. For example, for the activity of heating a building, the associated element will be the stationary combustion unit such as a boiler or furnace. The specifications of an element, including how it operates, are important factors to identify and state in a GHG assessment, as they will impact the overall quantification

End variable: An end variable is the annual input/output or activity level of an element (i.e. the amount of fuel combusted in one year) and estimated for each year of the project lifetime. End variables are generally calculated using specific data from an element or activity and gathered from various sources. Examples of end variables include: litres (L) of fuel, kilowatt hours (kWh) of electricity or tonnes (T) of hydrofluorocarbons (HFCs).

Emission factor: An emission factor is a representative value that relates the quantity of GHGs released with a specific level or output of an activity. Emission factors are based on the unique characteristics of elements or processes, and can also be specific to the location where an activity is placed. A common equation used to estimate GHG emissions from a project or baseline activity involves an end variable and a relevant emission factor, which is typically found in Canada's National Inventory Report. The equation is structured in the following way: GHG Emissions = End Variable (EV) × Emission Factor (EF).

Ex ante estimation: The estimation of GHG emissions prior to the development and operation of a project and actual generation of GHG emissions. As no actual data has yet been generated by the project at this stage, project proponents must look to comparable sources of data such as the following: similar projects completed by the proponent in the past; similar projects completed by others in the surrounding area; contracts, work plans or estimates for the project provided by third party contractors involved; any modeling work performed by project developers, energy consultants, etc.; and estimates developed to the best of the proponent's ability.

GHG assessment table of contents

A general GHG assessment provides an estimation of the total GHG emissions and/or reductions resulting from a project and includes important information related to the quantification process such as the scope of the assessment, relevant sources and sinks, calculations and assumptions. Information should be provided in a clear and organized format, to ensure the principles of GHG quantification have been carefully followed and GHG estimates can be easily validated. An assessment is composed of the following main sections as shown in Table 1.0:

Table 1.0 Sample Table of Contents for GHG Assessment of a Project

Project Scenario	**Project Description**	The project description provides a brief overview of the project activities including the product or service provided by the project and any specific technologies that will be employed.
	Project Location	Provides information on the exact location of the project
	Project Timeline	Provides the project operation start and end date, as well as any potential significant maintenance and refurbishment events
	Project Operation & GHG Emissions	The GHGs from all project activities are identified and quantified in this section.
Baseline Scenario	**Baseline Description**	The baseline description provides an overview of the alternative scenario that would have happened in the absence of the project and describes how the baseline is functionally equivalent to the project.
	Baseline Operation & GHG Emissions	The GHGs from all baseline activities are identified and quantified in this section.
Total GHG Reductions	**Total GHG Reductions**	The GHG emissions reductions resulting from the whole project are presented in this section, including annual reductions and cumulative GHG reductions for the lifetime of the project.
ANNEXES	**Supporting Information**	References, list of documents used in quantification Tables of equipment Equipment specifications

GHG sources & measures

GHG emissions from the transportation sector result from the combustion of petroleum-based products, like diesel or gasoline, in internal combustion engines. The majority of GHG emissions emitted during fuel combustion are carbon dioxide (CO_2), but small amounts of methane (CH_4) and nitrous oxide (N_2O) are also emitted. In addition, a small amount of hydrofluorocarbons (HFC) emissions are also released from the use of mobile air conditioners and refrigerated transport.

There are a variety of GHG mitigation measures that can be implemented to reduce the GHGs associated with transportation. Some of the most common measures for reducing GHGs focus on using cleaner fuels such as electricity (pending location), biofuels and liquefied petroleum gas. Other measures include implementing energy efficient equipment and technologies that reduce the amount of fuel combusted in the mobile fleet or even influencing driver behavior.

Clean Fuels: Electricity, propane (LPG), compressed natural gas (CNG), biofuels and green hydrogen.

Vehicle Maintenance: Air and fuel filter replacement, air leak detection, use of synthetic lubricants, proper tire inflation and axle alignment and good

Driver Behavior: Proper speed and gear management, idling and start-up/cool-down times, minimizing accessory loads on engine, use of electronic devices to provide feedback to drivers, route optimization and fuel use tracking.

Vehicle Characteristics: Transmission selection, diesel-electric/diesel-hybrid power systems (regenerative braking, power-on-demand controls), reducing weight of material and better aerodynamic designs.

Retrofit Technologies: Diesel oxidation catalysts, diesel particulate filters and selective catalytic reduction.

Idle Reduction Equipment: Automatic low idle mode switching, automatic shut-down/start-up systems, battery powered engine-off systems, diesel fired heaters, auxiliary power units and external electrification systems.

Energy Efficient Equipment: Engine cooling designs (high performance fan blades), load-sensing hydraulics, electronically controlled fuel injection timing, aerodynamic devices (air deflectors, side skirts, boat tails, gap fairings) and low-rolling resistant tires.

Step-by-step instructions

This section provides step-by-step instructions for completing a GHG assessment for the replacement or purchase of a new mobile fleet. Annex A provides a list of GHG sources and relevant information to be used along with these step-by-step instructions. For additional supporting information, please refer to the references in Annex D.

Part 1: project scenario

1.1 Project Description

The project description lays out the foundation for the types of activities that may release or sequester GHGs from the project, and that will need to be quantified in the assessment.

Key Actions

- *Document a brief description of the new mobile fleet and its main services.*
- *Document how the new mobile fleet will be more fuel efficient and result in less GHG emissions.*
- *Record the number of new vehicles that will be purchased and maximum passenger or freight capacity.*
- *Identify any maintenance/repairs that will be needed throughout the operational lifetime of the project.*

1.2 Project Geographical Location

The identification of the project site is important as many data values will need to be sourced and obtained from the local area, including emission factors. Validators need to be able to assess if the proper values representing the area were used or not in the quantification of the GHG emissions, and to ensure all GHG sources or sinks have been properly accounted for in the assessment.

Key Actions

- *Record the address and/or GPS coordinates of the project.*
- *Identify the service location of the new mobile fleet and delineate the boundaries of the service area on a map if possible.*

1.3 Project Timeline

It is important to know when the project will be implemented and in full operation, including if and when GHG emission reductions will start taking place and for how long. Other important dates are the maintenance and repair schedules which will result in downtimes and interruptions in service, which will also impact any emission reductions.

Key Actions

- *Record a detailed project timeline outlining the timing of operational activities. Specifically, the following estimated dates are required:*
  - *Operational start and end dates*
  - *Dates of any major maintenance/repairs/refurbishments expected*
  - *Expected lifetime of project (service life of the new fleet)*
- *Identify any risks that could substantially affect the project's operational timelines.*

Part 2: project operation

2.1 Identification of Project GHG Activities & Elements

In this section, all the relevant activities for the operation of the project are identified, including all elements.

The new mobile fleet may result in fewer GHG emissions as it may operate on cleaner fuel than traditional fossil fuels, and/or have a number of various energy efficient technologies or equipment installed (see Page 7 for various GHG-reducing mechanisms).

The most common sources of GHGs related to the implementation of a new mobile fleet is the combustion of fuel from the operation of the new fleet, as well as any fuels combusted for the transport of fuel to the project location (which can be significant in rural and remote regions). Fugitive emissions (GHG emissions resulting from air conditioning units/refrigeration, maintenance and leaks/spills of fuels and other maintenance products) is not included. In addition, GHG emissions resulting from the mobile storage and maintenance facility (such as increased heating required for electric battery maintenance during winter months or vehicle block heating) and charging stations are also excluded under this GHG module at this time.

Key Actions

- *Using Table 2.0 Annex A as a guide, select all activities related to the project and document a brief description of each activity.*
- *Document the characteristics of the cleaner fuel and/or the energy efficient mechanisms found in the new mobile fleet.*

2.2 Quantification of Project Activity 1: New Mobile Fleet Operation

Key Actions

- *Identify the type and amount of fuel (L/kWh) expected to be used for the operation of the new mobile fleet on a yearly basis.*
- *Amount of fuel can be estimated by multiplying the fuel efficiency of the new mobile fleet by the expected vehicle kilometers travelled, which can be based on historical kms travelled from the operation of the existing mobile fleet or based on new transportation modelling scenarios. An average of the last three years of kms travelled from internal records should be used, and any year with kms travelled that is out of the ordinary due to extraordinary circumstances, should be discarded. The combined fuel efficiency value can be used (50-50 mix of highway and city) or the most appropriate fuel efficiency value can be selected for the operational scenario and can be found in the Fuel Consumption Guide by Natural Resources Canada or from the fleet manufacturer's specification. The following calculation can be used:*

  Fuel Efficiency (L/km) x kms travelled/year = L of fuel/year

- **If the new mobile fleet is electric:** *Obtain the provincial/territorial electrical grid emission intensity for your location. Emission intensities should be dynamic and reflect cleaning of provincial/territorial (P/T) grids in future years. P/T Emission intensities can be found in Annex B. To quantify GHG emissions, apply the following calculation:*
  Energy (MWh/year) x P/T Emission Intensity (tonnes CO_2e/MWh) = Emissions tonnes CO_2e/year

- **If the new mobile fleet is using gas/diesel/LPG/CNG:** *Obtain the relevant emission factors from Annex C or Canada's National Inventory Report (Annex 6), and apply the following calculation:*

Fuel (L) x Specific mobile fuel combustion emission factor (tonnes/L)= Emissions tonnes CO_2e/year

- *The yearly fuel use, emission factors and the associated GHG emissions is most useful when presented in a table or other legible format.*
- *Document all assumptions and references used to calculate the amount of fuel associated with the operation of the new mobile fleet.*

2.3 Quantification of Project Activity 2: Transport of Fuel to Project Location (if applicable)

Key Actions

- *Identify the type and amount of fuel (L/kWh) expected to be used for the transport of fuel for the new mobile fleet to the project location on a yearly basis.*
- *Identify the type of vehicles used to transport the fuel.*
- *The amount of fuel can be estimated by multiplying the fuel efficiency of the transport vehicle by the expected vehicle kilometers travelled. The combined fuel efficiency value can be used (50-50 mix of highway and city) or the most appropriate fuel efficiency value can be selected for the operational scenario and can be found in the Fuel Consumption Guide by Natural Resources Canada or the fleet manufacturer's specification. The following calculation can be used (adjust metrics to relate to appropriate fuel type):* ***Fuel Efficiency (L/kms) x kms travelled/year = L of fuel/year***

- **If the transport vehicle is electric:** *Obtain the provincial/territorial electrical grid emission intensity for the fueling origin of the transport vehicle. Emission intensities should be dynamic and reflect cleaning of provincial/territorial (P/T) grids in future years. P/T Emission intensities can be found in Annex B. To quantify GHG emissions, apply the following calculation:*
  Energy (MWh/year) x PT Emission Intensity (tonnes CO_2e/MWh) = Emissions tonnes CO_2e/year

- **If the transport vehicle is using gas/diesel/LPG/CNG:** *Obtain the relevant emission factors from Annex C or Canada's National Inventory Report (Annex 6), and apply the following calculation:*
  Fuel (L) x Specific mobile fuel combustion emission factor (tonnes/L)= Emissions tonnes CO2e/year

- *The yearly fuel use, emission factors and the associated GHG emissions are most useful when presented in a table or other legible format.*
- *Document all assumptions and references used to calculate the amount of fuel associated with the transport of fuel to the project site.*

2.4 Total Project Operational GHG Emissions

Key Actions

- *For each project activity, input the associated GHG emissions into a Table such as the one below.*
- *Calculate the total tonnes CO_2e per year using the following equation:*
  Activity 1 + Activity 2 = Total Project Emissions (tonnes CO_2e /year)
- *Sum all the years to obtain the cumulative tonnes CO_2e over the project lifetime.*

Table 2.0 Total Project Operational Emissions (in tonnes of CO_2e)

Year	Activity 1 New Mobile Fleet Operation	Activity 2 Transport of Fuel (if applicable)	Total Project Emissions

2023			
2024			
2025….			
2030			
2031….			
2050			
TOTAL			

Part 3: baseline scenario

3.1 Baseline Description

The Baseline Scenario is the "business as usual" or hypothetical reference case against which the GHG performance of the project is measured. Under this GHG Guidance Module, the most appropriate baseline scenario for the implementation of a new mobile fleet would be the following:

The continued operation of the current mobile fleet or the purchase of a conventional gas or diesel-based mobile fleet with average fuel efficiency.

The baseline must also follow these requirements:

- Level of service or capacity (ex. # of passengers or tonnes of freight transported) must be equal to the level of service anticipated in the project scenario. The level of output or services provided must be the same in the project as in the baseline, to ensure that the project is not reducing GHG emissions solely by providing fewer services.

- Travel routes will be of the same length in the baseline as in the project scenario. All other travel variables, such as terrain and vehicle speeds, are also assumed to be the same in the baseline as in the project scenario.

- Adjustments for future anticipated changes in refurbishment/ replacement of the baseline mobile fleet must be included. For vehicles equipment efficiency levels, the current performance level may be applied until the natural end of the lifetime of the vehicles. After this date, the vehicle efficiency level must reflect any refurbishments set to occur or reflect the current regulated performance level for the **vehicles or** the current standard efficiency for its replacement. **Simply ending the services provided by the mobile service is not an acceptable alternative when the vehicles are no longer operational.**

Key Actions

- *Document a description of the baseline scenario, including the current mobile fleet characteristics, level of services, type of fuel used and sources of fuel.*
- *Document the maximum passenger or freight capacity of the current mobile fleet.*
- *Include all assumptions under the baseline scenario as applicable.*

Part 4: baseline operation

4.1 Identification of Baseline GHG Activities & Elements

In this section, all the relevant activities for the operation of the baseline are identified, including all elements.

The most common sources of GHGs related to the operation of conventional mobile fleets is the combustion of fuel from the operation of the fleet, as well as any fuels combusted for the transport of fuel to the project location (which can be significant in rural and remote regions). Fugitive emissions (GHG emissions resulting from air conditioning units/refrigeration, maintenance and leaks/spills of fuels and other maintenance products is not included. In addition, GHG emissions resulting from the mobile storage and maintenance facility are also excluded under this GHG module.

Key Actions

- *Using Table 2.0 Annex A as a guide, select all activities related to the baseline and document a brief description of each activity.*
- *Ensure all information is presented in a table or other legible format.*

4.2 Quantification of Baseline Activity 1: Operation of Standard Mobile Fleet

Key Actions

- *Identify the type and amount of fuel (L) that is currently being combusted on a yearly basis in the existing fleet or that would be used in a new conventional mobile fleet of average fuel efficiency.*
- *The amount of fuel used annually can be obtained one of two ways:*
  1. *Amount of fuel used annually can be obtained by looking at historical internal fuel purchase records and assuming the same amount of fuel will be used in the future. An average of the last three years of fuel records should be used, and any year with fuel use that is out of the ordinary due to extraordinary circumstances, should be discarded.*
  2. *Amount of fuel can be estimated by multiplying the fuel efficiency of the mobile fleet by the expected vehicle kilometers travelled, which can be based on historical kms travelled from the operation of the existing mobile fleet or based on new transportation modelling scenarios. An average of the last three years of kms travelled from internal records should be used, and any year with kms travelled that is out of the ordinary due to extraordinary circumstances, should be discarded. The combined fuel efficiency value can be used (50-50 mix of highway and city) or the most appropriate fuel efficiency value can be selected for the operational scenario and can be found in the Fuel Consumption Guide by Natural Resources Canada or from the fleet manufacturer's specification. The following calculation can be used:*

     Fuel Efficiency (L/kms) x kms travelled/year = L of fuel/year

- *To obtain the yearly GHG emissions from the conventional mobile fleet, identify the relevant emission factors from Annex C or Canada's National Inventory Report (Annex 6) and apply the following calculation:*
  Fuel (L) x Specific mobile fuel combustion emission factor (tonnes CO_2e/L)= Emissions tonnes CO_2e/year

- *The yearly fuel use, emission factors and the associated GHG emissions is most useful when presented in a table or other legible format.*

- *Document all assumptions and references used to calculate the amount of fuel associated with the operation of the existing or conventional mobile fleet.*

4.3 Quantification of Baseline Activity 2: Transport of Fuel (if applicable)

Key Actions

- *Identify the type and amount of fuel (L/Kwh) that would be used for the transport of fuel for the existing or conventional mobile fleet to the project location on a yearly basis.*
- *Identify the type of vehicles used to transport the fuel.*
- *The amount of fuel can be estimated by multiplying the fuel efficiency of the transport vehicle by the expected vehicle kilometers travelled. The combined fuel efficiency value can be used (50-50 mix of highway and city) or the most appropriate fuel efficiency value can be selected for the operational scenario and can be found in the Fuel Consumption Guide by Natural Resources Canada or from the fleet manufacturer's specification. The following calculation can be used (adjust metrics to relate to appropriate fuel type):* ***Fuel Efficiency (L/kms) x kms travelled/year = L of fuel/year***

- **If the transport vehicle is electric:** *Obtain the provincial electrical grid emission intensity for the fueling origin of the transport vehicle. Emission intensities should be dynamic and reflect cleaning of provincial grids in future years. Emission intensities can be found here: Canada's 7th National Communications to the UNFCC (add BC and Alberta references). To quantify GHG emissions, apply the following calculation:*
  Energy (MWh/year) x P/T Emission Intensity (tonnes CO_2e/MWh) = Emissions tonnes CO_2e/year

- **If the transport vehicle is using gas/diesel/LPG/CNG:** *Obtain the relevant emission factors from Annex C or Canada's National Inventory Report (Annex 6) and apply the following calculation:*
  Fuel (L) x Specific mobile fuel combustion emission factor (tonnes/L)= Emissions tonnes CO_2e/year

- *The yearly fuel use, emission factors and the associated GHG emissions are most useful when presented in a table or other legible format.*
- *Document all assumptions and references used to calculate the amount of fuel associated with the transport of fuel to the project site.*

4.4 Total Baseline Operational GHG Emissions

Key Actions

- *For each project activity, input the associated GHG emissions into a Table such as the one below.*
- *Calculate the total tonnes CO_2e per year using the following equation:*
  Activity 1 + Activity 2 = Total Baseline Emissions (tonnes CO_2e /year)
- *Sum all the years to obtain the cumulative tonnes CO_2e over the project lifetime.*

Table 4.0 Total Baseline Operational Emissions (in tonnes of CO_2e)

Year	Activity 1 Standard Mobile Operation	Activity2 Transport of Fuel (if applicable)	Total Baseline Emissions
2023			
2024			
2025….			
2030			

2031….			
2050			
TOTAL			

Part 5: total net GHGs

5.1 Total Net GHG Reductions

The general equation for calculating total GHG emission reductions is:

Baseline Emissions - Project Emissions = Total GHG Emission Reductions

Emission reductions are calculated per year of the project lifetime, by subtracting the project emissions from the baseline emissions. Then all emission reductions for the given years are summed to obtain the total estimated emission reductions from the implementation of the Project.

Key Actions

- *Input the project and baseline emission values into a table (sample provided below). Under the Climate Lens, the following values are required to be highlighted:* ***Total Emission Reductions in 2030*** *(single year) and* ***Total Cumulative emissions over the project lifetime.***
- *Calculate the total GHG emission reductions by subtracting project emissions from the baseline emissions*.

Table 5.0 Total Net GHG Reductions (in tonnes of CO_2e)

Year	Baseline Emissions	Project Emissions	Total Reductions
2023			
2024			
2025….			
2030			
2031….			
2050			
TOTAL			

ANNEX A – Mobile fleet GHG activities and related information

Activity 1	Description	Element	Data Required	Sources of Data	End Variables
Operation of Mobile Sources	Emissions from the combustion of fuels used in the mobile source.	Mobile sources i.e. vehicle fleets, buses	Type of mobile source Number of mobile sources Type of fuel Age (for existing fleets) and technical life of mobile sources Fuel efficiency Capacity of mobile source	Equipment specifications Internal records Fuel purchase records Local survey data, Fuel Consumption Guide, NRCAN Modeling analysis	Fuel (L/kWh)
Activity 2	**Description**	**Element**	**Data Required**	**Sources of Data**	**End Variables**
Transportation of Fuel to Project Site *Only included if significant i.e. Rural communities	Emissions from the combustion of fuel in vehicles used to transport fuel to facilities.	Vehicles	Type/# of vehicles (make/model) Fuel type Distance travelled Fuel efficiency of vehicle	Operational logs (kms) Fuel Consumption Guide, NRCAN Fuel purchase records	Fuel (L/kWh)

Other requirements:

- As a default, use the combined fuel efficiency values in calculations (50-50 mix of highway and city).
- Travel routes will be of the same length in the baseline as in the project scenario. All other travel variables, such as terrain and vehicle speeds, are also assumed to be the same in the baseline as in the project scenario.
- Ensure annual service provided remains functionally equivalent between the project and the baseline. A performance standard can be used to ensure functional equivalency (tonnes CO_2e/passenger, tonnes CO_2e/kg freight, etc.).

ANNEX B – Average PT grid electricity emission intensities (tonnes/MWh)*

Region	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Alberta	0.517	0.446	0.357	0.250	0.232	0.211	0.225	0.223	0.217	0.208	0.207	0.201	0.204	0.203	0.203	0.204
British Columbia	0.004	0.002	0.003	0.003	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Manitoba	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
New Brunswick	0.276	0.259	0.269	0.268	0.275	0.273	0.274	0.272	0.258	0.252	0.124	0.116	0.124	0.113	0.123	0.114
Newfoundland	0.091	0.068	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.011	0.010	0.010	0.009
Northwest Territories	0.058	0.067	0.062	0.051	0.017	0.008	0.008	0.008	0.010	0.012	0.014	0.016	0.020	0.014	0.013	0.009
Nova Scotia	0.634	0.562	0.458	0.457	0.463	0.464	0.417	0.401	0.384	0.361	0.118	0.116	0.112	0.109	0.105	0.101
Nunavut	0.747	0.747	0.744	0.712	0.635	0.498	0.480	0.469	0.470	0.455	0.457	0.442	0.435	0.447	0.454	0.458
Ontario	0.034	0.044	0.067	0.065	0.066	0.077	0.093	0.081	0.067	0.064	0.062	0.060	0.058	0.041	0.035	0.030
Prince Edward Island	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Quebec	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Saskatchewan	0.410	0.366	0.299	0.306	0.252	0.249	0.253	0.221	0.173	0.167	0.163	0.157	0.146	0.142	0.137	0.133
Yukon Territory	0.045	0.121	0.068	0.077	0.086	0.089	0.099	0.074	0.046	0.029	0.018	0.014	0.018	0.023	0.032	0.041

Region	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Alberta	0.206	0.207	0.209	0.210	0.212	0.213	0.215	0.216	0.217	0.219	0.220	0.221	0.221	0.221	0.222
British Columbia	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Manitoba	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
New Brunswick	0.124	0.111	0.118	0.114	0.129	0.129	0.120	0.121	0.122	0.124	0.125	0.126	0.128	0.130	0.131
Newfoundland	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007
Northwest Territories	0.008	0.006	0.006	0.006	0.008	0.025	0.026	0.031	0.020	0.018	0.016	0.017	0.019	0.020	0.022
Nova Scotia	0.094	0.088	0.088	0.086	0.084	0.082	0.081	0.079	0.076	0.074	0.074	0.074	0.074	0.074	0.073
Nunavut	0.470	0.482	0.488	0.488	0.501	0.505	0.515	0.523	0.525	0.529	0.535	0.544	0.547	0.556	0.561
Ontario	0.024	0.021	0.019	0.017	0.016	0.015	0.015	0.015	0.014	0.013	0.011	0.009	0.009	0.011	0.013
Prince Edward Island	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Quebec	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Saskatchewan	0.130	0.126	0.123	0.121	0.117	0.115	0.112	0.108	0.105	0.098	0.095	0.092	0.089	0.085	0.082
Yukon Territory	0.054	0.067	0.052	0.039	0.027	0.019	0.013	0.017	0.020	0.026	0.033	0.042	0.050	0.034	0.022

Notes:

1. Grid Emissions intensity is defined as: (utility generation emissions) + (industrial net sales to grid by sector) x (industrial electricity generation emissions factor) *divided by* electricity consumption from the grid.
2. Prince Edward Island: Emissions intensity for PEI production. P.E. uses New Brunswick emissions intensity because PEI production P.E. consists of non-dispatchable wind energy and the rest is imported.
3. British Columbia, Manitoba and Quebec: The power grids of British Columbia, Manitoba and Quebec are zero emissions. The generation of residual emissions is not considered relevant.
4. For alternative emission intensities from B.C. electricity consult the provincial emission intensities found here.
5. Alternative emission intensities from Quebec can be here.

Source: ECCC's Greenhouse Gas Emissions Projections. Link: Canada's Greenhouse Gas Emissions Projections - Environment and Climate Change Canada Data. Last Modified by ECCC: June 2022

***Emission intensities will be updated periodically. Please refer to INFC's Climate Lens website for the most recent version of the Power System P/T Average Emissions Intensities Table.**

ANNEX C – Emission factors for mobile combustion sources

			Emission Factor			
Transport Mode	Fuel Type	Units (kg/L or kg/kg)	CO_2	CH_4	N_2O	CO_2e
Light-duty vehicle	Gasoline (E5)	kg/L	2.3073	0.00023	0.00047	2.453
	Diesel (B4)	kg/L	2.6805	0.000051	0.00022	2.747
	Propane	kg/L	1.515	0.00064	0.000028	1.539
	Natural Gas	kg/kg	2.738	0.013	0.000086	3.089
Light-duty truck (includes SUV and minivan)	Gasoline (E5)	kg/L	2.3073	0.00024	0.00058	2.486
	Diesel (B4)	kg/L	2.6805	0.000068	0.00022	2.747
	Propane	kg/L	1.515	0.00064	0.000028	1.539
	Natural Gas	kg/kg	2.738	0.013	0.000086	3.089
Heavy-duty	Gasoline (E5)	kg/L	2.3073	0.000068	0.00020	2.372
	Diesel (B4)	kg/L	2.6805	0.00011	0.000151	2.728
	Natural Gas	kg/kg	2.738	0.013	0.000086	3.089
Motorcycle	Gasoline (E5)	kg/L	2.3073	0.00077	0.000041	2.339

Source: Canada's National Inventory Report (2021)

ANNEX D – References

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