

METHODOLOGICAL DOCUMENT TRANSPORTATION SECTOR

BCR0006 Quantification of GHG Emission
Reductions from the conversion of vehicles
from gasoline to natural gas

BIOCARBON CERT®
CARBO SOSTENIBLE

Version 1.1 | January 2024



© 2024 BIOCARBON CERT®. All rights reserved. Reproduction in whole or in part without the express permission of BIOCARBON CERT is prohibited.

BIOCARBON CERT.2024. METHODOLOGICAL DOCUMENT. TRANSPORTATION SECTOR. BCR0006 Quantification of GHG Emission Reductions from the conversion of vehicles from gasoline to natural gas. Version 1.1. January 26, 2024. Bogotá, Colombia. 28 p. <http://www.biocarbonstandard.com/>

Table of Contents

1.	Introduction	6
1.1	Objectives	7
2	Source.....	7
3	Version and validity	7
4	Scope	7
5	Applicability	8
6	Normative references.....	8
7	Terms and definitions.....	9
8	Sources of GHG	13
9	Project boundaries	13
9.1	Addition of vehicles after validation.....	13
10	Identification of baseline scenario and additionality	14
10.1	Baseline scenario	14
10.2	Additionality analysis.....	14
11	Quantification of GHG emission reductions	19
11.1	Quantification of emission reduction Ex – Ante	19
11.1.1	Estimation of emissions in the baseline scenario (Ex-ante scenario)	19
11.1.2	Project emissions – Ex-Ante Scenario.....	20
11.1.3	Emission reduction – Ex-Ante Scenario	20
11.2	Quantification of Reductions in the Project Scenario.....	20
11.2.1	Emissions generated in baseline scenario with project.....	20
11.2.2	Emissions generated with the project.....	21
11.2.3	Leakage.....	21
11.2.4	Emission reduction	21
12	Monitoring plan	22
12.1	Monitoring of the project boundaries	22
12.2	Monitoring of the execution of vehicle conversion activities.....	22
12.3	Monitoring of VNG consumption.....	23
12.4	Monitoring of the project's net GHG reductions.....	23
12.5	Quality control and quality assurance procedures.....	24
12.6	Field data verification	25
12.6.1	Verification of the data collected in the field.....	25

12.6.2	Information management.....	25
12.6.3	Control of documents and records	25
13	References.....	26
	Appendix	27
	Emission factors – Decree 926 / 2017	27
	Table for VNG consumption monitoring presentation	27
	Table for reporting project GHG reduction information	27

Acronyms and abbreviations

CO ₂	Carbon dioxide
CCV	Verified Carbon Credit
EMBI	Emerging Markets Bonds Index
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
MADS	Ministry of Environment and Sustainable Development
MAVDT	Ministry of Environment, Housing, and Territorial Development
PNACC	National Plan for Adaptation to Climate Change
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

The Ministry of Environment and Sustainable Development (MADS) establishes that Colombia is a country highly vulnerable to the effects of climate change, which is why it is essential to consider the consequences that climate variation has on communities, territories, ecosystems, and the economy (Ministerio de Ambiente y Desarrollo Sostenible, 2019). Thus, the National Plan for Adaptation to Climate Change (PNACC) was formulated (Ministerio de Ambiente y Desarrollo Sostenible, 2019) for developing adaptation and mitigation mechanisms and moderate the potential damages generated by climate change.

Considering the above, Colombia proposed in the Nationally Determined Contribution a goal of 20% reduction of its Greenhouse Gas (GHG) emissions by 2030, compared with the established projected growth baseline (Gobierno de Colombia, s.f.).

On the other hand, in the document Hoja de Ruta para la Elaboración de los Planes de Adaptación dentro del Plan Nacional de Adaptación al Cambio Climático, it is proposed to design and implement plans, projects and policies that tend to mitigate Greenhouse Gases (GHG), including diversifying the energy mix -reducing the participation of hydrocarbons- in order to reduce GHG emissions (DNP, MinAmbiente, República de Colombia, SNGRD, UNGRD, IDEAM, 2013).

Additionally, as part of climate change's institutionalization process, Colombia constituted the National Climate Change System (SisClima) and has developed economic instruments such as the Carbon Tax, established in Decree 926 of 2017. Carbon tax is a fee associated to different fossil fuels burning. Conversion factors for these fuels are, e. g., 9 KgCO₂/Gal of gasoline, and 1.95 KgCO₂/m³ of natural gas.

In this context, this methodology provides holders of sectoral GHG emission reduction projects in the transport sector with the requirements for implementation, best practices related to procedures, equations, parameters, and data to estimate the GHG reductions generated as a consequence of project implementation.

This methodological document complies with the criteria defined in Resolution 1447 of 2018, guiding the construction of the projects' baseline, maintaining consistency with the emission factors and activity data. Likewise, it contemplates identifying the baseline scenario, additionality considerations, GHG emissions reduction by vehicle conversion, variables subject to monitoring, and the monitoring plan, considering quality control processes.

That said, according to the information contained in this document, the holders of sectoral GHG reduction projects in the Transport sector have complete and detailed guidance for designing GHG emission reduction projects for vehicle conversion from gasoline to NGV.

1.1 Objectives

The objectives of the methodological document (from now on methodology) are:

- a) To provide requirements for the quantification of GHG reductions from vehicle conversion activities from gasoline to VNG.
- b) Provide the methodological requirements for the identification of the baseline for vehicle conversion activities.
- c) Provide the methodological requirements to demonstrate the additionality of the project activities to convert vehicles from gasoline to VNG.
- d) Describe the requirements for monitoring and follow-up of sectoral GHG reduction projects in the Transportation sector (vehicle conversion activities from gasoline to VNG).

2 Source

This methodological document is developed based on the MDL methodology "AMS-III.S. Small-scale Methodology. Introduction of low-emission vehicles/technologies to commercial vehicle fleets", and the tools considered in this methodology, applicable to the Transport sector.

3 Version and validity

This document constitutes Version 1.1. January 26, 2024.

This version of the document may be adjusted periodically, and intended users shall ensure that they are using the current version.

The above applies for documents referenced in this and other documents of the BIOCARBON.

4 Scope

This methodology constitutes a baseline methodology for quantifying GHG emission reductions and monitoring sectoral GHG reduction projects.

This methodology is limited to sectoral GHG reduction projects in the transportation sector, particularly gasoline vehicles' conversion to VNG.

¹ <https://cdm.unfccc.int/methodologies/DB/CAEL7OU5NIMXWM9E4RU2C4MV9WHXJN>

This methodology shall be used by initiative holders, classified as sectoral GHG reduction projects, certified and registered with the Certification and Registration Program for GHG Mitigation Initiatives and other Greenhouse Gas Projects. BIOCARBON®

5 Applicability

This methodology is applicable under the following conditions:

- a) The vehicles to be covered by the projects correspond to vehicles converted from gasoline to VNG.
- b) The types of vehicles included in the projects are buses, cars, vans, and station wagons.
- c) The project activity will not involve a modal shift in transportation.
- d) Project participants shall identify the number of vehicles converted from gasoline to VNG and their VNG consumption.
- e) The projects are developed in Colombia.

6 Normative references

The following references are essential for the application of this methodology:

- a) BCR Standard, corresponding to the latest published version.
- b) Decree 926 of 2017. "Whereby the heading of Part 5 is amended and Title 5 is added to Part 5 of Part 5 of Book 1 of Decree 1625 of 2016 Sole Regulatory Decree on Tax Matters and Title 11 of Part 2 of Book 2 to Decree 1076 of 2015 Sole Regulatory Decree of the Environment and Sustainable Development Sector, to regulate paragraph 3 of Article 221 and paragraph 2 of Article 222 of Law 1819 of 2016", or that which amends or updates it.
- c) Resolution 1447 of 2018, issued by the MADS. "Whereby the system for monitoring, reporting, and verification of mitigation actions at the national level referred to in Article 175 of Law 1753 of 2015 is regulated, and other provisions are issued", or that which modifies or updates it.
- d) The guidelines, other orientations, and guides defined by BIOCARBON, within the scope of projects in the Transportation sector.

7 Terms and definitions

Additionality

It is the characteristic that allows demonstrating that GHG emission reductions or removals resulting from the implementation of a GHG mitigation initiative generate a net benefit to the atmosphere in terms of reduced or removed GHG emissions.

Baseline

A scenario in which GHG emissions that occur in the absence of GHG mitigation policies, plans, strategies, or initiatives are estimated. It is the state against which a change is measured.

Carbon credits

Reductions and removals of greenhouse gases that can be traded to mitigate GHG emissions generated by anthropogenic activity. A carbon credit is equivalent to a metric ton of CO₂e, which has been verified by an CAB, based on the rules and procedures defined for this purpose, and which has a unique serial code granted by a certification standard/program. The carbon credit can also be defined as a verified removal (Decree 926 of 2017 of the Ministry of Finance and Public Credit.

Carbon dioxide (CO₂)

It is the gas produced naturally and as a by-product of fossil fuel and biomass combustion, land use changes, and other industrial processes. It is the primary anthropogenic greenhouse gas that affects the radiation balance of the planet. It is the reference gas against which other GHGs are measured and therefore has a global warming potential of 1.

Carbon dioxide Equivalent (CO₂e)

It is the unit of measurement that compares the global warming potential of each GHG for Carbon Dioxide.

Emission Factor

The factor relating activity data to GHG emissions or removals.

Fossil Fuel Emissions

GHG emissions from the burning of fuels from fossil carbon deposits, such as oil, coal, or gas.

Gasoline

A mixture of hydrocarbons obtained by fractional distillation of crude oil. It is used as a fuel in internal combustion engines and as a solvent.

GHG certification programs or carbon standards

These are voluntary or mandatory, international or national systems or schemes that have a set of principles and requirements for the formulation, development, validation, and verification of the design and implementation of GHG mitigation initiatives. These systems or schemes adopt or develop methodologies for the quantification of GHG emission reductions or removals that are verifiable within the framework of ISO 14064-3 or the one that adjusts or updates it, have a public registry that allows the certification and assignment of a unique serial number for verified GHG emission reductions or removals.

GHG emissions

The total mass of greenhouse gas released to the atmosphere in a given period.

GHG Inventory

The sources, sinks, emissions, and removals of GHGs from an organization, project, entity, or country.

GHG Mitigation Initiative

These are programs, projects, actions, or activities implemented at the national, regional, local or sectoral level whose objective is to reduce GHG emissions, avoid emissions, remove and capture GHGs. Initiatives are classified into GHG emission reduction initiatives and GHG removal initiatives.

GHG Project

Activity or activities that alter the conditions identified in the baseline scenario, causing a reduction in GHG emissions or increase in GHG removals.

GHG reduction

It is the calculated decrease in GHG emissions between a baseline scenario and the calculated net emissions in the scope of implementing the GHG mitigation initiative.

They are independent entities that carry out validation and verification processes of GHG mitigation initiatives. The VVB is responsible for conducting an objective assessment and issuing a validation or verification statement concerning the information submitted by the

holder of a mitigation initiative and the other criteria defined by the GHG Certification Programs or carbon standards and the National Government.

Conformity Assessment Body (CAB)

These are voluntary or mandatory, international, or national systems or schemes that have a set of principles and requirements for the formulation, development, validation, and verification of the design and implementation of GHG mitigation initiatives. These systems or schemes adopt or develop methodologies for the quantification of GHG emission reductions or removals that are verifiable within the framework of ISO 14064-3 or the one that adjusts or updates it, have a public registry that allows the certification and assignment of a unique serial number of verified GHG emission reductions or removals.

Greenhouse Gases (GHG)

A gaseous component of the atmosphere, both natural and anthropogenic, absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. Some of the GHGs are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆), as defined by the UNFCCC.

Initiative holder

A natural or legal person, public or private, responsible for the formulation, implementation, monitoring, and registration of a GHG mitigation initiative.

Monitoring

Continuous or periodic evaluation of GHG emissions and remissions.

Period of quantification of reductions

The period of quantification of reductions attributable to GHG mitigation initiatives is the period during which the initiative holder will quantify the GHG emission reductions or removals measured against the baseline to apply to the certification program for the issuance of Verified Carbon Credits (VCCs).

The date selected by the initiative holders as the beginning of the quantification period shall be after or equal to the date on which the initiative generates the first GHG emission

reductions or removals. The quantification periods shall not be longer than the operational period of the project

Registration

Registration is the official acceptance by the Certification and Registration Program Manager of a validated initiative. Registration is a prerequisite for certification and issuance of VCCs.

Sectoral GHG mitigation project

It is a GHG mitigation initiative that includes GHG emission reduction or removal activities other than REDD+, which are developed at subnational and sectoral scales. These initiatives demonstrate their mitigation results in the framework of meeting national climate change targets established under the UNFCCC.

Start date

The start date of GHG mitigation initiatives is when activities that will result in actual GHG emission reductions/removals begin. That is the date on which the actual implementation, construction, or action of a GHG initiative begins.

For sectoral GHG mitigation projects in the energy and transportation sectors, the start date rules defined by the Clean Development Mechanism will apply.

Uncertainty

A parameter associated with the result of quantification that characterizes the dispersion of values that could reasonably be attributed to the quantified quantity. Uncertainty information generally specifies quantitative estimates of the likely dispersion of values and a qualitative description of the dispersion's likely causes.

Vehicle conversion

A process by which modifications and installations are made to a vehicle's engine to operate with another fuel (e.g. natural gas).

Vehicular Natural Gas

Refers to the use of natural gas of fossil origin, extracted from the subsoil, compressed to facilitate its transportation, and used as fuel for vehicles.

Validation

It is the systematic, independent, and documented process for the evaluation of the baseline against defined criteria.

Process of assessing the reasonableness of the assumptions, constraints, and methods underlying a statement about future activities' outcome (ISO 14064-2:2019).

Verification

It is the systematic, independent, and documented process for evaluating a GHG statement against agreed verification criteria.

8 Sources of GHG

The emission sources and associated GHGs are presented below.

Table 1. Sources of GHG emissions

Source	Gas	Included	Justification/Explanation
Land mobile sources (buses, cars, vans, and pickup trucks))	CO ₂	Yes	The main source of GHG emissions
	CH ₄	No	CH ₄ emissions are a minor source of total CO ₂ e emissions from mobile sources.
	N ₂ O	No	N ₂ O emissions are a minor source of total CO ₂ e emissions from mobile sources.

9 Project boundaries

The limits of the project are:

- a) Project vehicles included in the project, in this case, those that have been converted from gasoline to VNG.

9.1 Addition of vehicles after validation

The holders of sectoral GHG mitigation projects in the Transport sector may add converted vehicles to the project under the following conditions:

- a) The project holder shall identify the vehicles to be incorporated into the project during the validation process and define the inclusion criteria.
- b) Comply with the Certification and Registration Program guidelines for GHG Mitigation Initiatives and other Greenhouse Gas Projects in its most recent version.
- c) Comply with all the provisions of the BIOCARBON METHODOLOGICAL DOCUMENT. TRANSPORT SECTOR. GHG Reduction Activities and Conversion of Gasoline Vehicles to Natural Gas.
- d) Include emission reductions only for validated project activities.

- e) Implement the activities in the Transportation sector described in the validated project document.
- f) Demonstrate that the additionality and the baseline scenario are consistent with the validated descriptions in the project document.

10 Identification of baseline scenario and additionality

10.1 Baseline scenario

Sectoral GHG mitigation project holders shall identify the baseline scenario to demonstrate that the project is additional.

For vehicle conversion projects, the baseline scenario corresponds to the calculation or estimation of CO₂ emissions generated during vehicle operation without conversion from gasoline to VNG.

10.2 Additionality analysis

For this methodology, the additionality of the project is demonstrated from the following procedure:

Step 0. Project start date

The start date of sectoral GHG mitigation projects corresponds to when the activities to reduce GHG emissions were initiated. In this step, it is necessary to take into consideration what it is established by the BIOCARBON Program.

Step 1. Identification of alternatives

The GHG mitigation initiative holder shall identify available alternatives that provide comparable levels of service/performance. The holder shall include project activities without being registered as a GHG emission reduction initiative in this step.

Sub-step 1a. Definition of project alternatives

The GHG mitigation initiative holder shall identify alternatives for project participants that provide products or services comparable to those proposed in the project activity. These include:

1. Vehicles continue to operate on gasoline.

2. Vehicles operate with VNG without this activity being registered as a GHG emissions reduction initiative.
3. Vehicles operate on another low-emission fuel instead of VNG.

Sub-step 1b. Consistency with law and regulations

Alternatives shall comply with all applicable mandatory legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions. If any of the alternatives cause regulatory non-compliance, it shall be excluded.

Step 2. Investment Analysis

The initiative holder shall establish whether the proposed project activity is not:

- a) The most economically or financially attractive, or
- b) Economically or financially viable, without the income from the sale of the CCVs.

The following steps are recommended to perform the Investment Analysis:

Sub-step 2a. Determine the method of analysis

The initiative holder shall establish whether the method of analysis will be a simple cost analysis, investment comparison, or a Benchmark analysis.

If the project activity and alternatives identified in step 1 do not generate revenues or economic benefits other than those associated with the project, a simple cost analysis is recommended. Otherwise, the analysis shall be developed based on an investment comparison or benchmark analysis.

Sub-step 2b. Option I: Simple cost analysis

To perform the simple cost analysis, the initiative holder shall define the costs associated with the GHG emission reduction initiative and the alternatives identified in Step 1. It shall also demonstrate that at least one of the alternatives is more economical than the cost of the project activity.

If it is established that one of the alternatives is less costly than the one proposed with the project activity, refer to step 4 (Project Registration Impact and Common Practice Analysis).

Sub-step 2b. Option II: Analysis based on comparison of investments

The initiative holder shall identify the financial indicator (IRR, NPV, cost-benefit ratio, or unit cost of service) that best suits the project and the applicable decision-making context.

Sub-step 2b. Option III: Benchmark Analysis

The initiative holder shall identify the most appropriate financial indicator for the project and the context for decision making.

When applying Option II or Option III, the financial analysis shall be performed based on standard market parameters, considering the project's characteristics. In particular, cases where the project participant can implement the project activity, a specific situation can be considered in a financial scope.

Sub-step 2c. Calculation and comparison of financial indicators (for investment comparison and benchmarking)

The initiative holder shall estimate the appropriate financial indicators for the project activity. If Option II is used, the financial indicators for the project alternatives shall also be estimated. Relevant project costs (investment, operation, and maintenance), and revenues (other than those derived from the commercialization of VCC, where applicable) shall be included, as appropriate.

Similarly, the initiative holder shall present the investment analysis transparently and provide the relevant assumptions, preferably in the GHG reduction initiative's Project Document or in separate annexes.

Sub-step 2d. Sensitivity Analysis (for investment comparison and Benchmarking)

The holder of the initiative shall include a sensitivity analysis indicating whether the financial analysis results are sensitive to significant variations in the critical assumptions.

The investment analysis provides a valid argument in favor of additionality only if it consistently supports the conclusion that the project activity is unlikely or unlikely to be the most financially or economically attractive.

Step 3. Barrier Analysis

The GHG mitigation initiative holder shall rank the alternatives identified in Step 2, considering the investment, technological, local tradition, and other barriers identified by the project proponent.

To do so, the initiative holder shall follow the following steps:

Sub-step 3a. Identification of barriers to project implementation

Establish that there are barriers that would prevent the project from being implemented. Barriers shall be analyzed concerning project activities, not about project participants. Barriers include:

a) Investment barriers:

- Vehicle conversion activities from gasoline to VNG using subsidies on a similar scale and in a comparable environment to the regulatory framework.
- Unavailability of private capital in domestic or international markets due to the risks (real or perceived) associated with vehicle conversion.

b) Technological barriers: a less technologically advanced alternative (representing less performance risk) could lead to higher emissions.

- Low availability of skilled labor to operate and maintain the technology in the country.
- Lack of infrastructure for implementation and logistics for technology maintenance. For example, the absence or low capacity to evaluate a converted vehicle's technical and economic performance.
- Risk of technological failure: the risk of VNG technology failure in local circumstances is significantly higher than for other technologies that provide comparable services or products, such as gasoline.
- The technology to be used in the proposed project activity is not available in the region.

c) Local tradition (cultural) barriers: these are the predominant practices whose implementation could increase emissions.

- Citizen perception of the performance of a low-emission technological alternative.
- Customs and market conditions.
- Traditional equipment and technology.

d) Institutional barriers:

- Regulatory change (public policy or governmental laws).

e) Market barriers:

- Taxes and low availability of subsidies to encourage vehicle conversion.

The identified barriers constitute sufficient evidence to demonstrate the additionality of the project. Besides, the initiative holder shall provide transparent and documented evidence and offer conservative interpretations as to how it demonstrates the existence and importance of the identified barriers. It is recommended that the evidence include at least one of these sources:

- i. Regulatory information, relevant legislation, administrative acts, among others.
- ii. Statistical information from recognized and reliable sources.
- iii. Documentation of relevant market aspects (i.e., incentives, market prices, taxes)

Sub-step 3b. Demonstration that the identified barriers do not interfere with or prevent implementation of at least one of the identified alternatives, other than the project activity:

If the identified barriers interfere with other project alternatives, the proponent shall demonstrate how they are less affected than the project, i.e., that they do not prevent the implementation of at least one of the alternatives.

At least one viable alternative other than the one proposed in the project shall be identified.

Step 4. Project Registration Impact and Common Practice Analysis

The GHG mitigation initiative holder shall explain how the registration and certification of the project, and the benefits and incentives derived from its implementation, will reduce the impact of financial and economic constraints and those derived from other identified barriers.

Project benefits and incentives can be of various types, among which are:

- a) GHG emissions reductions.
- b) Financial benefits associated with the commercialization of VCC.
- c) Attract new stakeholders that provide the capacity to implement new technologies that benefit the atmosphere.

The initiative holder shall also demonstrate that the project activity is not considered a "common practice"². He or she shall analyze, compare, and point out the distinctions between

² According to the information provided in the Tool for the demonstration and assessment of additionality, Version 07.0.0, the proposed project activity is considered a common practice if similar activities can be observed, and essential distinctions between the activities of the proposed initiative and similar activities cannot be identified.

other activities similar to the project activity and the project activity. Then, analyze why the similar activities were able to access benefits that made them more financially attractive (i.e., subsidies). Or, explain why similar activities did not face the same barriers as the proposed project activity.

If the project complies with Step 4, it does not correspond to the baseline scenario, and therefore the project is additional. If the project does not meet Step 4 (its implementation does not generate benefits or incentives, and the project activity is considered common practice), the project is not additional.

11 Quantification of GHG emission reductions

The holder of the mitigation initiative shall calculate the reduction of GHG emissions following the quantification methodology described herein.

The mitigation initiative holder shall ensure that uncertainty is minimized, and that accurate, consistent, and reproducible results are obtained. Additionally, concerning the required parameters and the factors needed for the calculations, priority shall be given to available local or national information, and the selection of the emission factor values used and the equivalent consumption of NGV and gasoline shall be explained and justified, taking into account that relevant, recognized and reliable sources of information are referenced.

11.1 Quantification of emission reduction Ex – Ante

11.1.1 Estimation of emissions in the baseline scenario (Ex-ante scenario)

To estimate the Ex-Ante scenario's baseline emissions, the CO₂ emission factors per unit volume of reference are established in Technical Annex IV of Decree 926 of 2017, or the one that modifies or replaces it. Likewise, registered gasoline consumption will be used to calculate the CO₂ emissions that would occur in the project's absence.

Baseline emissions will be calculated as shown below in equation (1):

$$BL_{Ex-Ante} = \sum FC_{Gasoline} * EF_{Gasoline} \quad (1)$$

Where:

- FC_{Gasoline} = Gasoline consumption per vehicle i in the year y (Gal/year)
- EF_{Gasoline} = CO₂ Emission Factor VNG (KgCO₂/Gal)

11.1.2 Project emissions – Ex-Ante Scenario

Project emissions are determined from the reported VNG consumptions for vehicles converted from gasoline to VNG and the CO₂ emission factor per unit volume established in Technical Annex IV of Decree 926 of 2017, for the case of Natural Gas. For this, equation (2) shall be used:

$$PE_{Ex-Ante} = \sum (FC_{Gasoline} * EF_{GNV}) * \mu \quad (2)$$

Where:

- $FC_{Gasoline}$ = Gasoline consumption per vehicle in the year y (Gal/y)
 EF_{VNG} = CO₂ emission factor VNG (KgCO₂/m³)
 μ = Equivalent VNG consumption per gallon of gasoline (2,86 m³/Gal)

11.1.3 Emission reduction – Ex-Ante Scenario

The estimation of emission reductions considers the change in the fuel used for the operation of the converted vehicles in the project area due to the project activities. Therefore, emission reductions are calculated based on equation (3).

$$ER_{Ex-Ante} = BL_{Ex-Ante} - PE_{Ex-Ante} \quad (3)$$

Where:

- $PE_{Ex-Ante}$ = Project emissions in the Ex-Ante scenario (vehicles using VNG as fuel)
 $BL_{Ex-Ante}$ = Baseline emissions in the Ex-Ante scenario (gasoline-fueled vehicles)

11.2 Quantification of Reductions in the Project Scenario

11.2.1 Emissions generated in baseline scenario with project

To estimate the project's baseline emissions, the CO₂ emission factors per unit volume established in Technical Annex IV of Decree 926 of 2017, or the one that modifies or replaces it, will be taken as a reference. Likewise, VNG consumption and a conversion factor from VNG to gasoline consumption will be used to calculate the CO₂ emissions that would occur in the absence of the project.

Baseline emissions will be calculated annually, using the monitored data, as shown below in equation (4):

$$BL = \sum \frac{(FC_{GNV,i} * EF_{Gasoline})}{\mu} \quad (4)$$

Where:

- $EF_{Gasoline}$ = CO₂ emission factor of gasoline engines (KgCO₂/Gal)
 μ = Equivalent VNG consumption per gallon of gasoline (2,86 m³/Gal)
 $FC_{VNG,i}$ = VNG consumption in year y (m₃/year) in vehicle i converted to VNG

11.2.2 Emissions generated with the project

Project emissions are determined from the reported VNG consumptions for vehicles converted from gasoline to VNG, and the CO₂ emission factor per unit volume established in Technical Annex IV of Decree 926 of 2017, for the case of Natural Gas. For this, equation (5) shall be used:

$$PE = \sum (FC_{GNV} * EF_{GNV}) \quad (5)$$

Where:

- FC_{VNG} = VNG consumption per vehicle i in year y (m₃/year)
 EF_{VNG} = CO₂ emission factor VNG (KgCO₂/m₃)

11.2.3 Leakage

No project leakage calculation is required since it is assumed that there is complete combustion of fuels (as provided by Law 1819 of 2016 and Decree 926 of 2017).

11.2.4 Emission reduction

The estimation of emission reductions considers the change in the fuel used for the operation of the converted vehicles in the project area due to the project activities. Therefore, emission reductions are calculated based on equation (6).

$$ER = BL - PE \quad (6)$$

Where:

- PE = Project Emissions (vehicles using VNG as fuel)
 BL = Baseline emissions (gasoline-fueled vehicles)

12 Monitoring plan

The holders of sectoral GHG mitigation projects shall describe the procedures that will be carried out to monitor project activities and GHG emission reductions within the project's scope.

The monitoring plan shall provide for the collection of information necessary to:

- a) Verify that the conditions of applicability listed in section "5. Applicability" of this document have been complied.
- b) Verify project emissions.
- c) Corroborate that there is a reduction in emissions.

The information collected shall be archived for at least two years after the end of the last project period. This information shall include: i) data and parameters monitored, ii) data collection, generation, and archiving methods, iii) data quality control processes.

The monitoring plan shall include:

- a) Project boundary monitoring.
- b) Monitoring the execution of vehicle conversion activities.
- c) Monitoring of VNG consumption.
- d) Monitoring the quantification of the project's net GHG reductions.

12.1 Monitoring of the project boundaries

In this case, the limits of the project, vehicles converted from gasoline to VNG, shall be presented in the project document. Likewise, they shall be periodically verified, and, in case of variations, these shall be reported.

The identification of vehicles converted from gasoline to VNG will be made from their license plate, imprint, or other vehicle identification form.

12.2 Monitoring of the execution of vehicle conversion activities

The monitoring of vehicle conversion activities' execution shall include the annual review and update of the number of vehicles converted from gasoline to VNG. Likewise, the city and place where the vehicle conversion was carried out shall be indicated.

12.3 Monitoring of VNG consumption

To ensure the quality of the VNG consumption data and to confirm that the project activities have been implemented, following the descriptions presented in the project document, the following parameter will be monitored:

Table 2. Parameter to monitor: VNG consumption.

Parameter	$FC_{VNG,i}$
Unit	m ³ /year
Description	m ³ de of VNG consumed by project vehicle i in year y
Source of information	Records of VNG volume purchased at refueling stations
Measurement procedure	Monitor during the project
Frequency of monitoring	According to verification and certification needs, the GHG mitigation initiative holder shall establish a monitoring frequency. For these projects, it is suggested that the frequency be annual.
Comments	-

12.4 Monitoring of the project's net GHG reductions

The estimation of GHG reductions considers the CO₂ emissions that would have occurred in the absence of the project and the estimation of CO₂ emissions derived from the use of VNG, as a result of the implementation of the project activities. For this purpose, equations (4), (5) and (6) presented in this document shall be used, which consider the following parameters:

Table 3. Parameter: gasoline emission factor.

Parameter	$EF_{Gasoline}$
Unit	KgCO ₂ /Gal of gasoline
Description	CO ₂ emission factor for gasoline consumed by vehicles
Source of information	Decree 926/ 2017
Value	9,00 KgCO ₂ /Gal
Comments	Constant value. Used to determine CO ₂ emissions per gallon of gasoline consumed. However, the methodology may consider relevant emission factors source's changes, depending on the country and the fuels' quality and energy efficiency.

Table 4. Parameter: VNG emission factor.

Parameter	EFNGV
Unit	KgCO ₂ /m ₃ of VNG
Description	CO ₂ emission factor for VNG consumed by vehicles
Source of information	Decree 926 of 2017
Value	1,95 KgCO ₂ /m ₃
Comments	Constant value. Used to determine CO ₂ emissions per m ₃ of VNG. However, the methodology may consider relevant emission factors source's changes, depending on the country and the fuels' quality and energy efficiency.

Table 5. Parameter: VNG to gasoline conversion factor.

Parameter	μ
Unit	m ₃ /Gal
Description	Equivalent VNG consumption per gallon of gasoline.
Source of information	National information - Analysis of Natural Gas Vehicles' Competitiveness in converted vehicles, developed by the Colombian Association of Natural Gas in 2017 (p.5).
Value	2,86 m ₃ /Gal
Comments	Constant value. It is used to determine the equivalence between m ₃ of VNG and gallon of gasoline. It is determined from the energy required per kilometer for each fuel.

12.5 Quality control and quality assurance procedures

The GHG mitigation initiative holder shall design a management and quality assurance system that guarantees the excellent management, quality, and reliability of the information; or, shall include the GHG emission reduction initiative in its Quality Management System (QMS), in case it has one. Quality assurance and quality control shall be in line with IPCC recommendations. Protocols and manuals shall be developed for all project activities to provide consistency in processes.

It is recommended that the holder of the mitigation initiative designate an internal member or unit trained to exercise this responsibility, who will be in charge of ensuring the implementation of a management system that ensures the quality of the project's information.

This person or unit shall establish, implement and maintain documented procedures for the management of information on GHG reductions that ensure the following:

- a) Periodic reviews to ensure the collection of VNG consumptions per vehicle.
- b) Identification and treatment of errors and omissions identified in the quantification of GHG removals.

12.6 Field data verification

This activity consists of monitoring and evaluating the data recorded on the field forms. The purpose is to identify the accuracy and consistency of the sampling data. It also verifies that the required percentage of error (10%) is met.

For this purpose, it is recommended to follow the protocols established to measure the variables to be monitored. If errors are identified, they will be corrected and documented, indicating the percentage of total measurements.

12.6.1 Verification of the data collected in the field

The processing of the data collected in the field and the digital systems recording shall be reviewed. The recorded data shall be reviewed using a sample of 10% of the records (selected at random), in order to identify possible inconsistencies. If there are errors, a percentage estimate of the errors shall be made. The typing error shall not exceed 10%, in which case the entire data shall be reviewed and the necessary corrections made.

12.6.2 Information management

The responsible for the mitigation project shall have a database or information system that includes records of the annual VNG consumption of the converted vehicles that are part of the project (for the duration of the project), parameters related to the estimation of GHG emission reductions, results of the quantification of the reductions, agreements related to carbon rights (support that evidences the transfer of ownership of the GHG reductions).

Besides, the project manager shall have an information system that allows tracking of verified removals in order to ensure that there is no double-counting of emission reductions and, therefore, no overestimation of the reductions generated by project activities.

12.6.3 Control of documents and records

A documented procedure shall be established that defines the necessary controls for:

- a) Collection, indexing, access, filling, storage, protection and retrieval of records, retention time and disposition of records, ensuring traceability of information, and project verification.

- b) Approval of documents that are part of the management system, identification of changes in documents, and removal of obsolete documents at the time of use.
- c) Ensure that current and relevant versions of applicable documents are available for use.
- d) It shall be ensured that the documents remain legible and easily identifiable.

Documentation, regardless of the format in which it is found, shall be handled following the procedures for document retention and keeping record of GHG information.

Note 2: Documentation, whether in electronic, paper, or another format, may be handled by the document retention and keeping record of procedures for GHG information management.

Note 3: When the term "documented procedure" appears, it means that the procedure shall be established, documented, implemented, and maintained. A single document may include the requirements for one or more procedures. A requirement for a documented procedure may be covered by more than one document.

13 References

DNP, MinAmbiente, República de Colombia, SNGRD, UNGRD, IDEAM. (octubre de 2013). *Hoja de Ruta para la Elaboración de los Planes de Adaptación dentro del Plan Nacional de Adaptación al Cambio Climático*. Obtenido de MinAmbiente: http://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/2._hoja_ruta_planes_adaptacion_v_o.pdf

Gobierno de Colombia. (s.f.). *Contribución Prevista y Determinada a Nivel Nacional*. Obtenido de MinAmbiente: http://www.minambiente.gov.co/images/cambioclimatico/pdf/colombia_hacia_la_COP21/iNDC_espanol.pdf

Ministerio de Ambiente y Desarrollo Sostenible. (2019). *Plan Nacional de Adaptación al Cambio Climático*. Obtenido de MinAmbiente: <http://www.minambiente.gov.co/index.php/component/content/article/476-plantilla-cambio-climatico-32#documentos>

Paris Process on Mobility and Transport. (13 de noviembre de 2016). *An Actionable Vision of Transport Decarbonization*. Obtenido de PPMT: <http://www.ppmc-transport.org/wp-content/uploads/2016/11/An-actionable-Vision-of-Transport-Decarbonization-web.pdf>

Appendix

Emission factors – Decree 926 / 2017

In the technical annex IV of decree 926 of 2017, the fuel conversion factors to CO_{2e} are established. The emission factors established for gasoline and VNG are:

Table 6. Emission factors established in Technical Annex IV of Decree 926 of 2017 (page 13)

Fuel	Amount of fuel expressed in:	Fuel conversion factor in kg CO ₂
Natural Gas	m ³	1,95 kg CO ₂ /m ³
Gasoline	Gal	9,00 kg CO ₂ /Gal

Table for VNG consumption monitoring presentation

Table 7. Table showing VNG consumption per vehicle.

Vehicle license plate	VNG consumption (m ³ /year)				
	Year 1	Year 2	Year 3	Year 4	Year n
Total consumption (m ³ /year)					

Table for reporting project GHG reduction information

Table 8. Table showing GHG emission reductions resulting from project implementation.

Year	Calendar year	Annual GHG emission reductions (tons of CO _{2e})	Cumulative GHG emissions reduction (Tons of CO _{2e})
1			
2			
.			
.			
.			
n			
Total			

Document history

Date	Type of document	Nature of the document
October 16, 2020	Methodological document. Sectoral projects Transportation Sector	Initial version – Document submitted to the public consult
January 28, 2021	Methodological document. Sectoral projects Transportation Sector	Actualized version – After consultation
January 26, 2024	Methodological document. Sectoral projects Transportation Sector	Updated version BioCarbon Cert Methodology Number Projects in Colombia Conformity Assessment Body CAB