GAPS IN GHG INVENTORIES IN LAC

Analysis of the maturity of National Greenhouse Gas Inventories for the Oil and Gas industry in Latin American and Caribbean countries

Methane Emissions Observatory of Latin America and the Caribbean

OEMLAC
Observatorio de Emisiones de Metano de América Latina y el Caribe

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ACRONYMS

LAC	Latin America and the Caribbean
PA	The Paris Agreement
BTR	Biennial Transparency Reports
BUR	Biennial Update Report
CATF	Clean Air Task Force
CCAC	Climate & Clean Air Coalition
CBIT	Capacity-building Initiative for Transparency
CH_4	Methane
UNFCCC	United Nations Framework Convention on Climate Change
AD	Activity data
EDF	Environmental Defense Fund
EF	Emission factors
GEF	Global Environment Facility
GHG	Greenhouse gases
GGGI	Global Green Growth Institute
IEA	International Energy Agency
IMEO	International Methane Emissions Observatory of UNEP
IPCC	Intergovernmental Panel on Climate Change
MBPD	Millions of Barrels Per Day
MRV	Measurement, Reporting and Verification
ETF	Enhanced Transparency Framework
NDCs	Nationally Determined Contributions
NC	National Communications
NIR	National Inventory Report
OEMLAC	Methane Emissions Observatory for Latin America and the Caribbean
OGMP	The Oil & Gas Methane Partnership
OLADE	Latin American Energy Organization
GWP	Global Warming Potential (of methane, in this case)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
SIDS	Small Island Developing States
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

EXECUTIVE SUMMARY

The document ***Gaps in GHG Inventories in LAC*** is the first study generated by OLADE's Methane Emissions Observatory for Latin America and the Caribbean (OEMLAC). Its purpose is to present the maturity status of national greenhouse gas (GHG) inventories in the countries of the region and delve into the reporting of methane emissions in the oil and gas sector. The study identifies the main progress achieved and the existing gaps in the region, as well as the countries' priorities to address these gaps.

The study is set within a decisive regional and global context, during this critical decade to accelerate action and increase climate ambition. It considers the transitional period between the Monitoring, Reporting, and Verification (MRV) systems for climate mitigation and the full implementation of the Enhanced Transparency Framework established under the Paris Agreement. In addition to the call made at the COP28, in the Global Stocktake, to expedite substantial methane emissions reductions by 2030.

Therefore, detailed measurement and accurate data collection, emission estimations with lower levels of uncertainty, and continuous reporting on progress in implementing mitigation measures are becoming increasingly important to ensure consistency, comparability, traceability, and transparency. These aspects are expected to be reflected in future reports submitted by countries, their planning processes, and the strategic decisions anticipated for the third update cycle of Nationally Determined Contributions (NDCs), as well as in the national and global implementation assessments of the climate commitments undertaken.

This study thus becomes a tool both to guide the technical assistance interventions that the Observatory will offer to countries to enhance the effectiveness of their methane mitigation actions and to serve as a reference for national governments, institutional actors, the private sector, civil society, and regional and international initiatives in their individual and collective efforts toward climate transparency and the reduction of emissions in the sector.

The study presents a compilation of the existing regulatory frameworks in the countries of the region related to national GHG inventories, along with the implementation status of National GHG Inventory Systems and the coordinating entities responsible for their preparation. It also provides relevant information on the latest national GHG inventory reported by each country to the United Nations Framework Convention on Climate Change (UNFCCC).

This includes the category levels reported for methane emissions in the oil and gas industry within the Energy sector, following the classification of the Intergovernmental Panel on Climate Change (IPCC). It also encompasses the types of emission factors, global warming potentials, methodological guidelines, and funding sources used, as well as the level of disaggregation of activity data, the frequency of updates, the most recent inventory year, and the historical series reported, among other aspects.

Some of its main findings include a great disparity between the states of progress throughout the region in terms of the creation and implementation of regulatory frameworks supporting the preparation of national GHG inventories, interinstitutional and intersectoral governance, the

availability of mitigation information systems and national GHG inventory systems, as well as the assurance of information access for interested stakeholders.

Countries such as Chile, Argentina, Colombia, and Brazil, followed by Panama and Paraguay, stand out for their progress in developing their Inventory Systems, establishing institutional arrangements, and implementing improvements to enhance the data incorporated into their inventories both comprehensively and specifically in the oil and gas sector. Meanwhile, countries classified as Small Island Developing States (SIDS), along with Venezuela, face significant challenges in data availability, reporting frequency, and the evolution of their MRV Systems.

In addition, there is a marked dependence on the availability of international cooperation resources for updating in most of the countries. However, in some cases, there are good practices associated with the advance allocation of resources from various sources, which makes it possible to anticipate their preparation and ensure planned progress in improving the reports.

Common challenges become evident in ensuring the continuity of specialized working teams, in the coordination between energy ministries and the entities responsible for inventories, mainly linked to environmental ministries. Other challenges include the standardization of document management processes, the reproducibility of estimates, and access to capacity-building and technological transfers for the strengthening of estimates and the transition to measurement at technology and plant levels.

On the other hand, progress is highlighted in the multidisciplinary nature of the working teams, the development of cooperation and data transfer arrangements, and the involvement of professionals engaged in the preparation of national GHG inventories in the management of national energy policies, among other areas.

At the same time, common interests are highlighted in strengthening national capacities, reducing dependence on external enabling conditions, promoting regional integration in the exchange of best practices and lessons learned, and in developing country-specific emission factors. Additionally, there is a focus on disaggregating activity data at scales more suited to national contexts and reducing the reporting frequency as well as the gap between the reporting date and the currency of the data.

In summary, the outlook presents a wide range of opportunities and challenges that demand interventions at various scales, as well as the integration of multiple stakeholders to achieve more effective and sustainable progress over time.

1. INTRODUCTION

1.1 Methane emissions in the Energy Sector - Background

Methane emissions (CH_4) are responsible for approximately 45%[1] of global warming and account for around 16% of all greenhouse gases (GHGs). The main sources of methane emissions are agriculture, livestock farming, energy, and waste.

The oil and gas industry is one of the main sources of methane. It has been estimated that up to 2023[2] the global production and use of fossil fuel released approximately 78 million tons of methane. Within the energy sector, 38.2% and 22.6% of these emissions are attributed to oil and gas (O&G), respectively, and 22.2% to other global anthropogenic activities.

This level of emissions remains unchanged since 2019, when a historical peak was reached with the recovery of the oil industry, which released 52 million tons. Considering that the use of fossil fuel continues to increase, only a marginal reduction in the mean intensity of methane emissions has been observed for this period[3].

In this industry, most methane emissions result from the incomplete combustion of flared gases (i.e., methane released together with carbon dioxide and black carbon) or are released directly into the atmosphere through venting or gas leaks generated at all stages of the production chain.

It has been determined that around 75%[4] of methane emissions from oil and gas operations are abatable and represent the most cost-effective alternative to reduce the total concentration of emissions in the atmosphere in the short term. In addition to this, there are technological and operational mitigation strategies that could be used to manage methane emissions and innovative solutions are being tested to improve the industry's capacity to detect and repair leaks.

The O&G industry poses a major challenge because of its high impact on the increase in global temperature and the great incidence of regional and global decarbonization and energy transition policies. These challenges include, among others, measuring, processing, disclosing, and reporting in a clear, accurate, and accessible manner the environmental impact of their operations and the results of the mitigation actions implemented to reduce their emissions. Another challenge is the need to invest and allocate resources to conversion technologies and to build specialized capacities for their rapid implementation.

For this reason, GHG inventories occupy a decisive role in this industry to reach compliance and to measure and manage environmental and climate impact by designing intervention and monitoring strategies, making informed technology-investment decisions, enhancing operational efficiency, strengthening climate governance, optimizing processes and cost-effectiveness, and enhancing corporate image and transparency in operations.

[1] According to the Global Methane Hub (2024)
[2] International Energy Agency, included in the Global Methane Tracker 2024.
[3] Ibidem
[4] Ibidem

1.2 Methane Emissions Observatory of Latin America and the Caribbean - Background

As part of their initiative to support LAC countries' efforts to achieve GHG reduction targets and in the light of the decision made by the 52nd Ministerial Meeting held in December 2022, the Latin American Energy Organization (OLADE) created the Methane Emissions Observatory for Latin America and the Caribbean (OEMLAC) in October 2023.

OEMLAC's main objective is to facilitate and promote the sustainable reduction of methane emissions in Latin America and the Caribbean (LAC) by offering technical assistance to national governments, oil and gas companies, and other relevant stakeholders. OMELAC's technical assistance includes, among others, methodological standardization, and means of implementation facilitation, including capacity-building, and identifying sources of financing.

In the light of the previous section about methane emissions and the energy sector, identifying barriers, priorities, and areas for future improvement is especially relevant for countries to meet their reduction commitments and to make progress towards including activity data and emission sources that better reflect the particular reality of each country.

Strengthening data collection methods, financing mechanisms, reporting frequency, inter- and intra-industry coordination in the reporting cycle, and the use, systematization, and documentation of more advanced methods (especially in key sectors with substantial emissions) is equally important.

Based on the foregoing, OEMLAC has defined three main objectives that are part of its strategic framework:

1. To empower LAC countries for them to understand and manage their methane emissions;
2. To support national commitments with clearly defined action plans and regional capacities;
3. To provide an institutional framework for the visibility and traceability of regional efforts aimed at reducing methane emissions.

The Observatory has already completed its initial phase of work (i.e., preparing and defining its enabling framework) and is now moving into the implementation of its work plan. This analysis is OEMLAC's first published work.

1.3 National GHG inventories - Background

Under the United Nations Framework Convention on Climate Change (UNFCCC), over the years, Parties -member countries- have made different commitments and have agreed to fulfill their reporting obligations on greenhouse gas emissions by submitting different reports, providing specific information on the adoption of methodological guidelines[5], reporting frequency, improvements, and initiatives aimed at building their capacity to meet the measurement, monitoring, reporting, and following up objectives of their commitments to mitigate climate change.

[5] Decision 24/CP.19

For almost 30 years, to ensure that countries provide increasingly accurate and comparable data on their GHG emissions and the progress in their efforts to achieve medium- and long-term mitigation targets, the establishment of the Enhanced Transparency Framework[6] has been agreed upon, in the gradual quest to move from Monitoring, Reporting and Verification (MRV) systems to the Enhanced Transparency Framework.

2024 will be a crucial year on the global climate transparency agenda because the Parties must submit their first Biennial Transparency Report (BTR)[7], which includes, among others, the latest update of their national GHG inventory and detailed information on their progress towards their Nationally Determined Contributions (NDC) in a biennial reporting cycle.

It is worth mentioning that national greenhouse gas inventories are an essential component of climate action, among others:

- to share information between the Parties about GHGs emissions released by different industries and to understand their contribution to climate change;
- to help members focus primarily on actions and measures aimed at designing and implementing effective climate policies taking into consideration GHGs sources, activities, and emissions trends;
- to facilitate monitoring the progress towards compliance with international commitments.

To better understand the inclusion of the preparation and subsequent updating of national GHG inventories in the reports created and agreed upon by the countries within the framework of climate negotiations, which are the subject of analysis in this study, the following is a description of the purpose, content, and scope of each of these reports:

[6] Article 13 of the Paris Agreement.

[7] Their purpose is to submit detailed and transparent information on member countries' greenhouse gases emissions, mitigation actions, and financial and technological assistance and capacity building actions. BTRs must be submitted every two years and undergo a technical expert review to ensure data transparency, consistency, and accuracy. The BTR is due by December 31, 2024. Decision 18/CMA.1, Decision 5/CMA.3.

Figure 1.a Description of the reports submitted by countries to the UNFCCC

National Communications on Climate Change - NC	› Their purpose is to provide relevant information to meet the objectives of the UNFCCC. › NCs cover, among others, anthropogenic emissions by source and removals by sinks of all GHGs not controlled by the Montreal Protocol, which includes CH_4.
Biennial Update Report - BUR	› These reports must be submitted by non-Annex I countries with updates of their national GHG inventories, information on mitigation measures and their impact and information on support and assistance received. (Note 1) › BURs also include a national inventory report, which is described below.
National Inventory Report - NIR	› The purpose of this report is to submit detailed descriptive and numerical information on Emission Factors (EF), Activity Data (AD), and all greenhouse gases emissions and removals included in all the categories of national inventories.
Biennial Transparency Report - BTR	› The purpose of BTRs is to provide relevant information on the implementation of the Paris Agreement. › BTRs include, among others, the national GHG inventory (covering all anthropogenic sources and sinks of GHG in the country) and the information necessary to monitor progress towards implementing and achieving NDCs.

Note 1. Non-Annex I countries are countries not included among developed countries or those classified as “economies in transition” at the time of creation of the UNFCCC. These countries are subject to more flexible requirements—based on their capacity—regarding the type, frequency, level of detail, international review and assessment, and financial and technical assistance for their reports. All LAC countries are included in the group of Non-Annex I countries.

Figure 1.b Basic content of the reports submitted by the countries to the UNFCCC

National Communications on Climate Change - NC	› National circumstances and institutional arrangements. › National GHG emissions inventory › Description of measures in place to implement the Convention (mitigation and adaptation). › Other relevant information: technology transfer, education, training, public awareness, capacity building, information and networking. › Limitations, deficiencies, financial and technical needs, and capacity-building needs.
Biennial Update Report - BUR	› National circumstances and institutional agreements. › National GHG emissions inventory › Mitigation actions, type, scope (per sector and type of gases), objectives and indicators, estimation methodology, progress made in connection with such actions, national MRV. › Limitations, deficiencies, financial and technical needs, capacity-building needs, and assistance received. › Other relevant information.
National Inventory Report - NIR	› Executive summary. › Overview of country-specific information (geographic, demographic, and economic profile). › Methodology. › Detailed results of the inventory. › Emissions trends. › Analysis of uncertainty and data quality validation. › Methodological improvements from previous reports.
Biennial Transparency Report - BTR	› Report on the national GHG inventory, including the inventory and common reporting tables. › Progress made towards NDCs. › Assistance needed and received in connection with financing, technology transfer, and capacity building. › Effects of climate change and adaptation efforts.

Figure 1.c Characteristics of the reports submitted by the countries to the UNFCCC

National Communications on Climate Change - NC	› Reporting frequency: Quarterly › Years: first NC from base year 1994 or, alternatively, 1990, and 2000 for the second NC. › Methodology and metrics: revised 1996 IPCC Guidelines. Countries are encouraged to rely on IPCC Good Practice Guidance.
Biennial Update Report - BUR	› Reporting frequency: Biennial, as from 2014 (see Notes 2 and 3). › Years: inventory data for 4 years before year of submission. › Methodology and metrics: revised 1996 IPCC guidelines (as updated in 2006) and Good Practice Guidance. › BURs undergo a technical analysis as part of the International Consultation and Analysis (ICA) process.
National Inventory Report - NIR	› This is mandatory for Annex I countries and voluntary for Non-Annex I countries like LAC countries (Note 4). › Reporting frequency: Biennial, submitted as an independent document or within the BUR or the BTR, at the country's discretion (see Notes 2 and 3). › Years: must be consistent with the report for which information is provided. › Methodology and metrics: must be consistent with the report for which information is provided.
Biennial Transparency Report - BTR	› BTRs will replace BURs. Standardized report metrics and format for all countries. › Reporting frequency: Biennial, starting on December 2024. › Years: ideally, inventory data for 2 years before year of submission. › Methodology and metrics: the use of 2006 IPCC guidelines is mandatory, and the use of the 2019 Refinement is recommended. › BTRs will undergo an international technical review. The resulting report will be delivered to the country to be discussed in a national forum.

Source: Own authorship; adapted from UNFCCC 2014 and 2022.

Note 2. In the case of developing countries, BURs are due by December 31, 2024, and the revision cycle covers 2024-2026.

Note 3. Under the UNFCCC, small island developing states (SIDS) have more flexible requirements in terms of the frequency and scope of their reports based on each country's criteria and capacities (UNFCCC, 2005). LAC countries classified as SIDS are Antigua and Barbuda, Bahamas, Barbados, Belize, Cuba, Grenada, Guyana, Haiti, Jamaica, Dominican Republic, and Trinidad and Tobago.

Note 4. The voluntary submission of NIRs by Non-Annex I countries is aimed at enhancing transparency and strengthening countries' capacity to manage climate change.

It is worth noting that, in addition to the decisions made by the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) regularly defines and refines guidelines on estimation methodologies, level of detail, strategies to manage uncertainty, updates, and improvements in all categories and all sectors to standardize national GHG inventories periodically incorporating existing scientific and technological developments.

Thus, in 1995, the IPCC published the first version of its Guidelines for National Greenhouse Inventories, which were ratified in 1997 at the COP3 with the signing of the Kyoto Protocol to provide a technically sound basis to estimate member countries' greenhouse gas emissions. The 2006[8] update of the IPCC Guidelines was followed by the 2013[9] supplement and the 2019[10] refinement to reflect the improvements made in all sectors and categories.

As for greenhouse gas emissions from the oil and gas industry, the IPCC classifies them as emissions released by the *Energy Sector* and classifies them into combustion GHG emissions (CO_2, CH_4 and N_2O), generated during the combustion of fossil fuels for energy use to produce heat, and fugitive emissions resulting from flaring and venting to relieve pressure in the systems.

With regard to the *Energy Sector*, IPCC Guidelines have been updated with more accurate methods to estimate greenhouse gas emissions and fugitive emissions from extraction, processing, transport, and storage in the industries of oil and natural gas, coal mining, and transport.

In addition to this, the IPCC improved the level of detail and emission factors in its Guidelines and provides alternative estimation methods for emerging renewable technologies and different practices, energy sources, and geographic locations, offering guidance on energy efficient processes, non-conventional oil and gas exploration, and emission factors for abandoned wells, providing a higher level of disaggregation and specificity within each category.

Finally, IPCC Guidelines emphasize recommendations for the adoption of better practices and the implementation of monitoring, leak detection, carbon capture and reinjection technologies, and to reduce venting and flaring.

1.4 The oil and gas industry in LAC

According to several sources, LAC countries account roughly for 10-12% of the global oil production. The region is very diverse in terms of supply and demand and, therefore, it is essential to characterize countries by the level of use of their own oil and gas reserves and their role in the regional and global economy.

Such characterization is important to identify different stages of industry development, opportunities to implement decarbonization actions, and existing challenges, given the magnitude, in terms of technology transfer, capacity building, and investment needs.

The classification suggested as part of this analysis is presented below:

[8] Available on: https://www.ipcc-nggip.iges.or.jp/public/2006gl/spanish/index.html
[9] With focus on Agriculture, Forestry and Other Land Uses (AFOLU).
[10] Available on: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

Figure 2. Classification of LAC countries based on oil and gas production

Source. OLADE

Note 1. A micro-producer is a country producing less than 0.01 millions of barrels per day (MBPD) or less than 1 billion cubic meters of gas and a small producer is a country producing between 0.01 and 0.1 MBPD of oil or between 1 billion and 10 billion cubic meters of gas.

Note 2. A medium-sized producer is a country producing between 0.1 and 1 MBPD of oil or between 10 billion and 100 billion cubic meters of gas and a large producer is a country producing more than 1 MBPD of oil or more than 100 billion cubic meters of gas.

2. SCOPE OF THE ANALYSIS

The scope of this study includes an analysis of official national GHG inventories as a first step to analyze the progress made by countries towards estimating, monitoring, and reporting methane emissions from the oil and gas industry in the region.

This report presents the main results of the initial diagnosis, a gap analysis, and the most relevant priorities identified by the departments of energy (or equivalent agencies) of 20 LAC OLADE-member countries[11] considering the level of maturity of their national GHG inventories for the oil and gas industry.

The study is framed within the OEMLAC's Objective (1) focus on *enabling countries in the region to understand and manage their emissions* and goal (1.1) *progressively standardize methodological consistency in national methane inventories in the region* to act as a catalyst for further action and technical assistance from the Observatory to countries in the region.

Although the scope of this report is limited to official national GHG inventories, there are several international initiatives that have made significant progress in the development of different approaches for GHG inventories.[12] Many of them have been considered and/or adopted by national governments to different extents and have become tools for private sector companies to estimate GHGs emissions in the context of environmental management systems, emission offsets, decarbonization, corporate carbon neutralization, and environmental responsibility programs. Analyzing these initiatives in future Observatory publications could be of great interest.

One of these initiatives is the GHG Protocol published in 1998 by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) as an international standard for corporate accounting and reporting of GHG emissions directly or indirectly attributable to sources owned or controlled by the company or third parties.

Industry-specific methodologies have been developed under the GHG Protocol, including one to measure and report potential emissions from companies' fossil fuel reserves of oil, coal, and gas[13].

Another initiative is the Oil & Gas Methane Partnership (OGMP), which was launched in 2014 by the Climate and Clean Air Coalition (CCAC) and then submitted in 2020 in its 2.0 version by the United Nations Environment Programme (UNEP) and the International Methane Emissions Observatory (IMEO), which together with the European Commission, the World Bank, the Environmental Defense Fund (EDF), and the Clean Air Task Force (CATF) provide a common reporting framework for state-owned companies and private sector companies to identify, quantify, and report methane emissions across the oil and gas industry (upstream, midstream, and downstream), with an evidenced-based progressive approach based on different reporting levels that take into account reporting capacity and monitoring technologies in place.

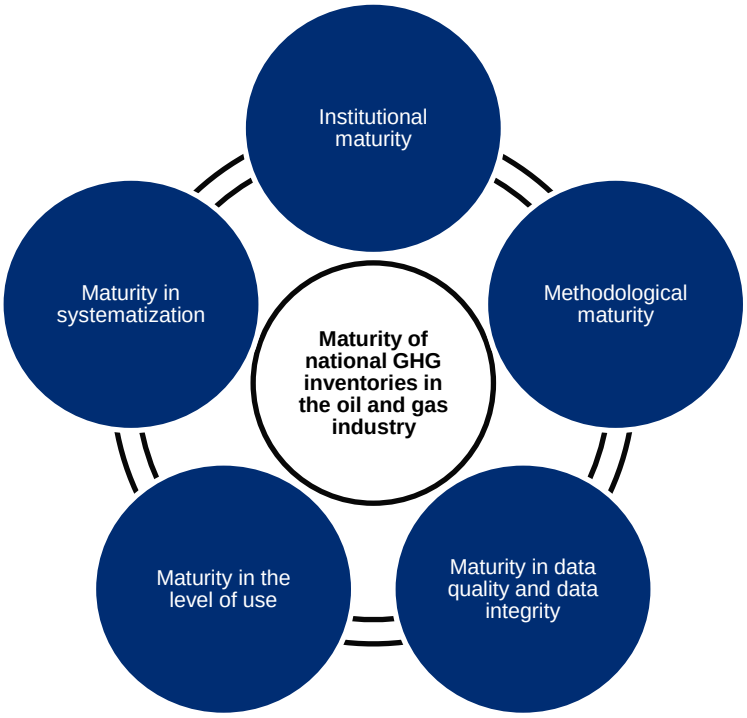
[11] Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Dominican Republic, Trinidad and Tobago, Uruguay and Venezuela.
[12] That may be analyzed in the future in the context of OEMLAC's road map implementation.
[13] Available on: https://ghgprotocol.org/sites/default/files/2023-03/WRI16_WorkingPaper_FF.pdf

3. METHODOLOGY

Five maturity criteria were defined with their respective assessment parameters as a first step to understand the level of development, accuracy, consistency, transparency, and improvement capacity of LAC greenhouse gas national inventories to provide useful and reliable data to make informed decisions in the implementation of public policies and climate mitigation actions.

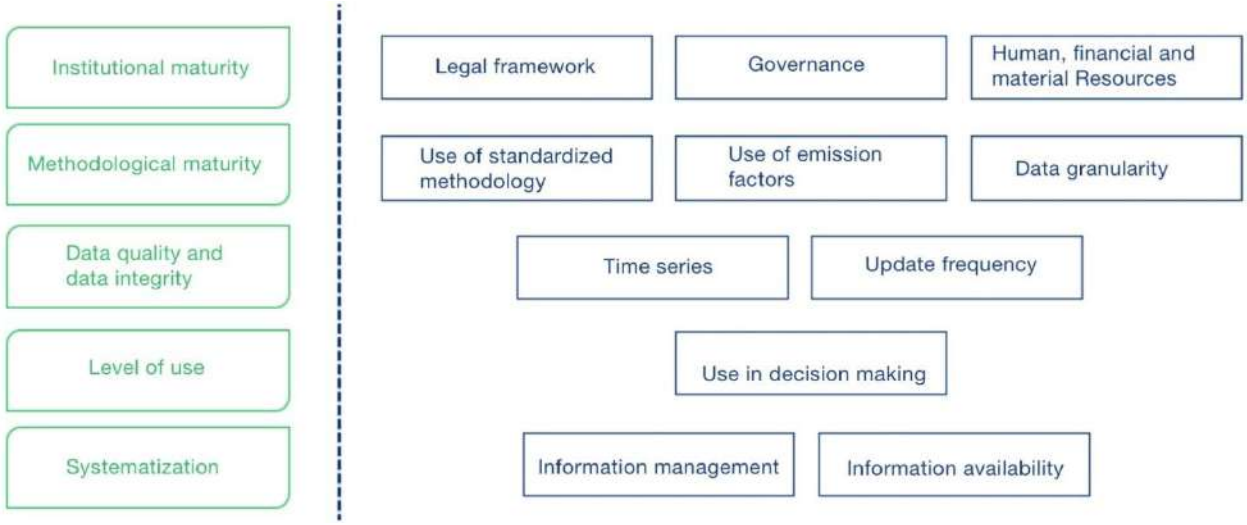
Said criteria were defined by OEMLAC taking into account IPCC guidelines and recommendations and qualitative aspects considered strategic to assess how sophisticated and robust is a national GHG inventory and to determine its capacity to offer reliable and useful information to make decisions aimed at mitigating climate change focusing on the main areas of intervention and improvement.

Figure 3.a Maturity criteria defined to assess National GHG Inventories



Source. Own authorship

Figure 3.b Assessment parameters defined by maturity criteria



Source. Own authorship

The above-mentioned maturity criteria and their respective assessment parameters were included in an initial assessment questionnaire that was sent to all point persons for OEMLAC, whose responses were processed and supplemented with verification interviews and were compared to each country's official public information.

In order to perform a more in-depth analysis, we reviewed the reports submitted by the countries with the latest update of their respective national GHG inventories and compared the resulting information vis-à-vis UNFCCC and Paris Agreement guidelines.

The concept underlying each maturity criterion are presented below:

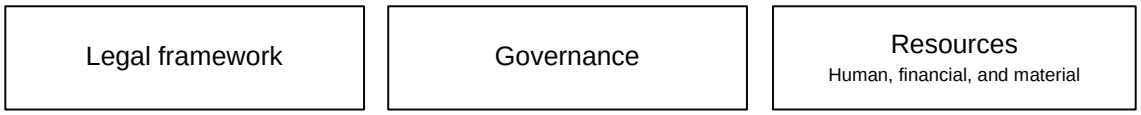
3.1 Institutional maturity

This criterion refers to a country's organizational and structural capabilities and its capacity to coordinate different institutions and industries for the preparation and improvement of reports with information on national GHG inventories, including legal aspects, the flow of information in its Monitoring, Reporting and Verification (MRV) system, the transition towards the Enhanced Transparency Framework (ETF), the allocation of roles and responsibilities in regulatory instruments and clearly defined institutional arrangements.

Institutional maturity also refers to the human capacities (i.e., management and technical skills, appointment and long-lasting teams, ongoing education and training, among others), financial capacities (i.e., allocation of sufficient and permanent financial resources, type and sources of financing) and material capacities (i.e., infrastructure, technology) needed to achieve quality, transparency, and consistency in national GHG inventories.

For the purposes of this analysis, the above-mentioned aspects were standardized and defined three assessment criteria:

Figure 4. Assessment parameters for the institutional maturity criterion



Source. Own authorship

3.2 Methodological maturity

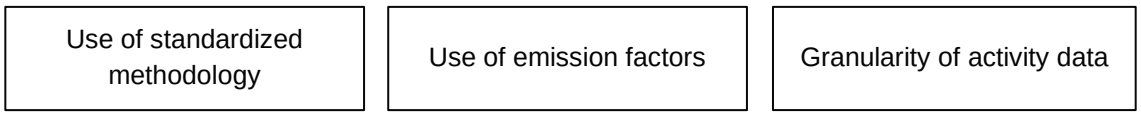
Methodological maturity in the preparation of national GHG inventories refers to the degree of development, incorporation and/or use of guidelines, modalities, methods, approaches, and procedures established in international standard methodological frameworks (in this particular case, the ones established and recommended by the IPCC, the most authoritative technical body of the UNFCCC) and the flexibility to adapt them to a country's particular context without compromising accuracy, comparability, and reliability.

Among others, this criterion refers to the level of complexity and detail used in determining emission factors and activity data to estimate and report greenhouse gas emissions and to the progress made towards using more specific and accurate methods and data from more sophisticated measurement and monitoring systems and more advanced technological developments, depending on each country's technical, documentary, and financial capacity.

This criterion also includes uncertainty quantification, management, and analysis in GHG emission estimations and the country's capacity to prioritize and incorporate in inventory preparation cycles the improvements identified by technical teams and expert review processes, lessons learned, better practices, and the latest methodological updates.

For the purposes of this analysis, the above-mentioned aspects were standardized in three assessment parameters:

Figure 5. Assessment parameters for the institutional maturity criterion



Source. Own authorship

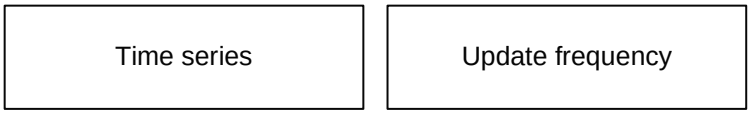
3.3 Maturity in data quality and data integrity

This criterion includes the level of definition and integration of systems and/or standardized procedures to manage and control data quality and data repositories to minimize uncertainty from data processing, increasing data collection frequency, seeking better temporary resolutions and, therefore, having updated and available information.

This criterion assesses the strength of preparing GHG inventories to provide reproducible, comparable, and methodologically consistent data over time.

For the purposes of this analysis, three assessment parameters were defined:

Figure 6. Assessment parameters for data quality and data integrity



Source. Own authorship

3.4 Maturity in the level of use

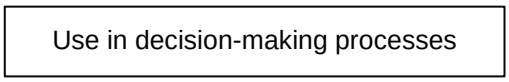
This includes the degree of relevance assigned to national GHG inventories as a tool to design, make, monitor, and assess political decisions and climate change mitigation initiatives at national and industry level (in this case, for the *Energy Sector*), taking into account the categories with the highest impact in terms of percentage of emissions, removal potential, historical trends and uncertainty, understood as a good practice recommended by 2006 IPCC Guidelines.

In addition to this, this criterion refers to the integration of national GHG inventories with other national or local information and management systems, climate and environment records, reporting platforms, or statistical tools, and other sources of information or industry databases, as well as their use as a benchmark to determine mitigation scenarios based on projected emissions and historical trends in other types of climate instruments like NDCs.

The extent to which the information resulting from preparing inventories proves useful depends on institutions' flexibility and capacity to adapt new emission monitoring and reporting guidelines and methodologies and to incorporate the improvements identified in institutional arrangements and updated procedures.

For the purposes of this analysis, the above-mentioned aspects were standardized in the following assessment parameter:

Figure 7. Assessment parameter for the maturity in the level of use criterion



Source. Own authorship

3.5 Maturity in terms of systematization

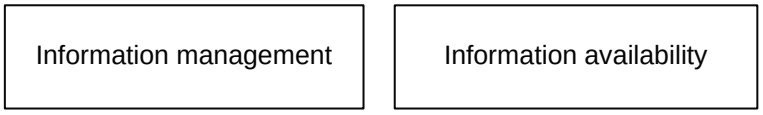
This criterion refers to the level of detail, feedback, and implementation of procedures, roles, and coordination activities needed to ensure reproducibility, availability over time, and access for consultation to data gathered to prepare the inventories and data resulting from estimation processes.

A mature system relies on thorough documents on methods and data, data sources, references, assumptions, and prioritized criteria for methodological choices; and having documentary or data management systems in place, and adequate infrastructure and technological tools for data collection, storage, and analysis.

In addition to this, it is necessary to have the channels to make national GHG inventories' information and detailed documents available to all stakeholders and to have strategies and means to inform results and improvements to enhance transparency and accountability.

For the purposes of this analysis, the above-mentioned aspects were standardized in the following assessment parameters:

Figure 8. Assessment parameters for the maturity in systematization criterion



Source. Own authorship

4. IDENTIFIED GAPS

4.1 Reports submitted to the UNFCCC by LAC countries

The number and thoroughness of the reports submitted to the UNFCCC by LAC countries to inform their GHG emissions, climate policies, and mitigation methods differs significantly between countries. Based on the information provided in the UNFCCC's report submission portal[14] regarding the submission of National Communications (NC) on Climate Change, Biennial Update Reports (BUR), and National Inventory Report (NIR), to date, it is possible to state that:

- Out of the 20 countries included in this report, 100% have submitted at least their first National Communication on Climate Change, 85% (17 countries[15]) have submitted at least one BUR and 50% (10 countries[16]) have submitted at least one NIR.

- As for the National Communications on Climate Change, Uruguay and Mexico are the countries with the largest number of reports submitted to the UNFCCC (6 updates), while the average number of updates for 45%[17] of the countries is 3, followed by 4 for the remaining 30%[18].

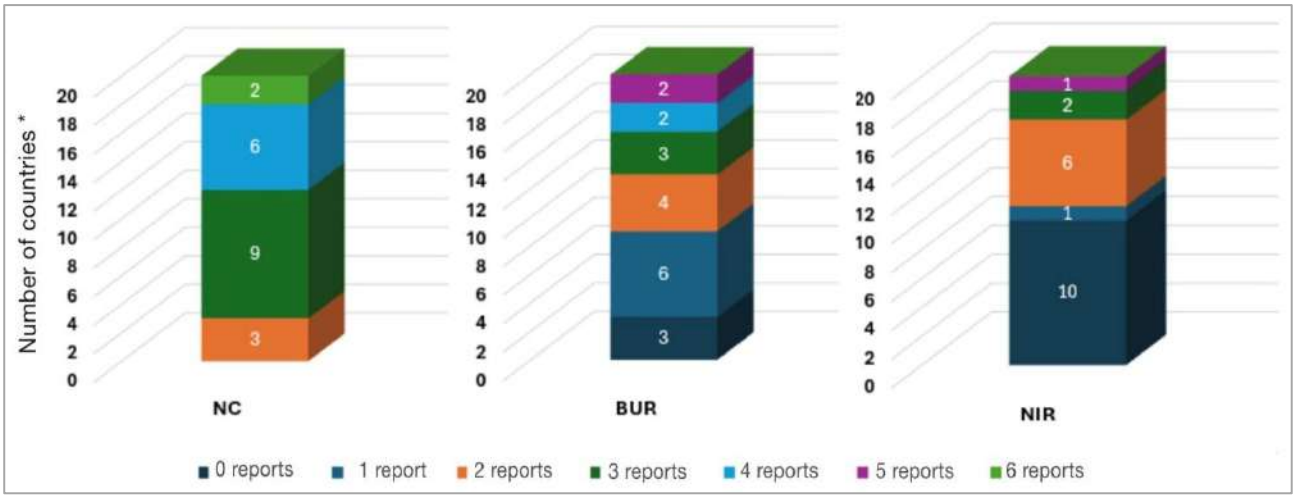
- As for BURs, 30%[19] of the countries have submitted one, while 10% (Argentine and Chile) have submitted 5 updates. The average number of updates submitted is 2.

- As for NIRs, Chile is the only country that has submitted 5 updates of this voluntary report, while 40%[20] of the countries have submitted between 2 and 3 of these voluntary exhaustive reports.

Below, the number of reports submitted to the UNFCCC by countries per type of report is presented:

[14] Available on: https://unfccc.int/BURs and https://unfccc.int/non-annex-I-NCs
[15] Argentina, Brazil, Chile, Colombia, Cuba, Costa Rica, Ecuador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Dominican Republic, Trinidad and Tobago, and Uruguay.
[16] Argentina, Chile, Colombia, Ecuador, Guatemala, Honduras, Mexico, Panama, Paraguay, and Uruguay.
[17] Argentina, Bolivia, Colombia, Cuba, Guyana, Honduras, Jamaica, Dominican Republic, and Trinidad and Tobago.
[18] Brazil, Chile, Costa Rica, Ecuador, Panama, and Paraguay.
[19] Cuba, Guatemala, Guyana, Jamaica, Dominican Republic, and Trinidad and Tobago.
[20] Argentina, Colombia, Ecuador, Honduras, Mexico, Panama, Paraguay, and Uruguay.

Figure 9. Number of reports submitted to the UNFCCC per type and number of countries



Source. Own authorship. This chart was made with information provided available on the UNFCCC BURs and NCs portals.

To analyze the progress made by countries, the most recent report (NC, BUR, NIR) officially submitted by LAC countries to the UNFCCC, with the most updated GHG inventory, has been taken as a reference. Table 1 also specifies the year each of these reports were submitted and the base year of the inventory.

Table 1. Most recent national GHG inventory submitted[21] to the UNFCCC in reports[22]

No	Country	Type of report	Year submitted	Baseline year
1	Argentina	5th BUR & 3rd NIR	2023 and 2024.	2020
2	Bolivia	3rd NC	2020	2006 and 2008
3	Brazil	4th NC and 4th BUR	2020	2016
4	Chile	5th BUR & 4th NIR	2022 and 2023.	2020
5	Colombia	3rd BUR & 2nd NIR	2021 and 2022.	2018
6	Costa Rica	4th NC & NI	2021	2017
7	Cuba	3rd NC & 1st BUR	2020	2016
8	Ecuador	2nd BUR & 2nd NIR	2023	2014 | 2016 | 2018
9	Grenada	2nd NC	2019	2014
10	Guatemala	1st BUR & 1st NIR	2023	2018
11	Guyana	3rd NC & 1st BUR	2024	2022
12	Honduras	2nd BUR & 2nd NIR	2024	2020

[21] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).

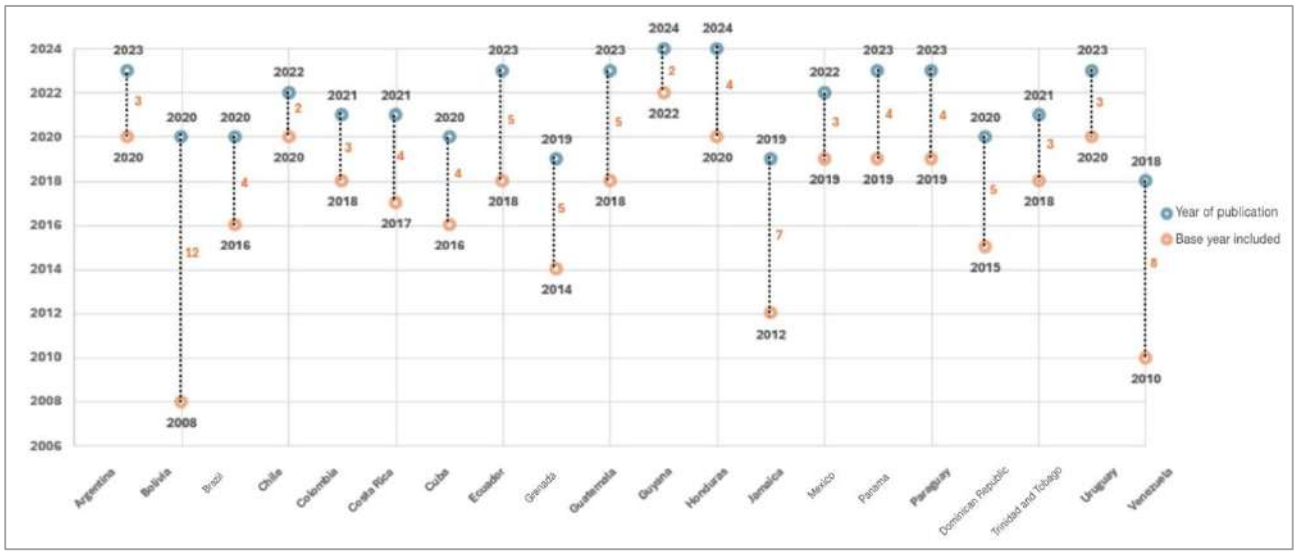
[22] The year included in this table is the year recorded in UNFCCC's web portals for the submission of updates of biennial update reports by Non-Annex I Parties (https://unfccc.int/es/node/17617) and National communications by Non-Annex I Parties (https://unfccc.int/non-annex-I-NCs).

13	Jamaica	3rd NC	2019	2012
14	Mexico	3rd BUR	2022	2019
15	Panama	4th NC & 2nd NIR	2023	2019
16	Paraguay	4th NC & 2nd NIR	2023 and 2024	2019
17	Dominican Republic	1st BUR	2020	2015 recalculation of 2010[23]
18	Trinidad and Tobago	3rd NC and 1st BUR	2021	2018
19	Uruguay	6th NC	2023	2020
20	Venezuela	2nd NC	2018	2010

Source. Own authorship. This table was made using information from the UNFCCC.

On average, the most recent base year of national GHG inventories is 2017. 25%[24] of the countries have a national GHG inventory for 2020 or subsequent years and the remaining 75% have official information published for calendar years before 2020. The following chart shows the difference in years between the year of submission of the latest national GHG inventory (shown in Table 1) and last base year of GHGs emissions estimations reported for each country.

Figure 10. Difference between year of submission and most recent base year



Source. Own authorship - prepared using UNFCCC information.

Taking into account the years and the reporting frequency described in Figure 1 for each type of report, caveats about reporting obligatory and flexibility given to countries based on their particular circumstances, it is possible to state that:

- 65%[25] of the countries submitted their last report providing inventory data for a period not exceeding 4 years before the year of submission. Chile and Guyana are the countries with the

[23] 2010 estimated emissions were recalculated for all categories to ensure consistency with methodological improvements mad to BURs and to make data comparable and consistent.
[24] Argentina, Chile, Guyana, Honduras, and Uruguay.
[25] Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Guyana, Honduras, Mexico, Panama, Paraguay, Trinidad and Tobago, and Uruguay.

smallest difference between the year of submission and the base year of the inventory; and Bolivia, Venezuela, and Jamaica are the ones that present the greatest challenge to fill missing data gaps.

- If we consider 2022 as the last base year of the inventory ideally expected to be included in the BTR that is being prepared by most of the countries to submit it by 2024, the existing time gap with regard to the last year covered in a reported inventory would be of more than 5 years for 40% of the countries, between 2 and 4 years for 35% of the countries, and between 0 and 2 years for the remaining 25%[26] of the countries.

These data, provide a glimpse of the challenges of closing the temporary margins of national GHG inventories in the region, which will be discussed in more detail in the different maturity criteria described below.

4.2 Institutional maturity

4.2.1 Legal framework

As for the degree of integration of national GHG inventories in a country's national legal framework, it is possible to identify three levels of integration and progress towards their regulation in the region.

Firstly, we can state that all LAC countries adopted the United Nations Framework Convention on Climate Change and, therefore, approved or ratified the Paris Agreement by enacting the laws listed later in this report.

Countries in the first level of integration have implicitly or explicitly stated that the communication of the "*national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol*"—including methane—, must be submitted in accordance with the corresponding frequency requirements and make reference to the means of implementation to access financing and capacity building projects to prepare and submit their inventories. (Article 12, UNFCCC, 1992)

In their instruments of ratification of the Paris Agreement, countries in the second level of integration make reference to their ETF implementation obligations, modalities, procedures, and guidelines, the submission of "*reports on the national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases*", quality assurance for the information, technical expert reviews, and means of implementation. (Article 13, The Paris Agreement, 2015)

[26] Argentina, Chile, Guyana, Honduras and Uruguay.

Table 2. Legal instruments of the UNFCCC and the Paris Agreement

No	Country	Adoption of the UNFCCC	Ratification of the PA
1	Argentina	Law No. 24295 (1993)	Law No. 27270 (2016)
2	Bolivia	Law No. 1576 (1994)	Law No. 835 (2016)
3	Brazil	Legislative Resolution No.1 (1994)	Legislative Decree No.140 (2016)
4	Chile	Supreme Decree No.123 (1995)	Supreme Decree No.30 (2017)
5	Colombia	Law No. 164 (1994)	Law No. 1844 (2017)
6	Costa Rica	Law No. 7414 (1994)	Law No. 9405 (2016)
7	Cuba	Decree Law No. 116 (1994)	Decree Law No. 331 (2016)
8	Ecuador	Executive Decree No. 3743 (1993)	Executive Decree No. 739 (2017) Legislative Resolution No. 011-17 (2016)
9	Grenada	Not identified. August 11, 1994.	Not identified. April 22, 2016.
10	Guatemala	Legislative Decree No.15 (1995)	Not identified. January 25, 2017.
11	Guyana	UNFCCC Implementation Law - 1994	PA Ratification Law - 2016
12	Honduras	Decree No. 26 (1995)	Not identified. September 21, 2016.
13	Jamaica	Not identified. January 6, 1995.	Not identified. April 10, 2017.
14	Mexico	Executive Decree dated March 11, 1993	PA Enactment Decree
15	Panama	Law No. 10 (1995)	Law No. 40 (2016)
16	Paraguay	Law No. 251 (1993)	Law No. 5681 (2016)
17	Dominican Republic	Not identified. October 7, 1998	Law No. 231 (2017)
18	Trinidad and Tobago	Not identified. June 24, 1994	Law No. 27 (2016)
19	Uruguay	Law No. 16517 (1994)	Law No.19439 (2016)
20	Venezuela	UNFCCC Adoption Law - 1994	PA Adoption Law - 2017

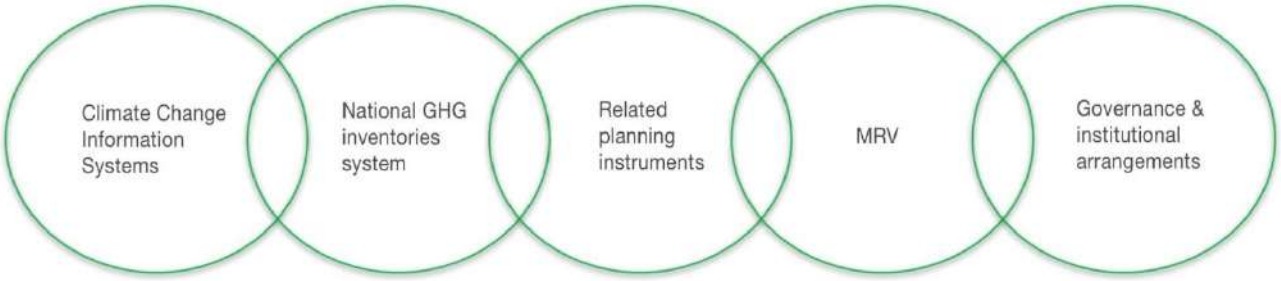
Source. Own authorship

There are different ways in which countries' legal instruments make reference to the ratification. Some mention it in a generic manner, while others include a transcript of the decisions or add further details like information on the entities appointed as focal points for the preparation of the national GHG inventory.

Likewise, 14 countries (i.e., 70%[27] of the countries included in this report) have at least one additional legal instrument with supplementary guidelines on national GHG inventories associated with the following elements and described in more detail in Table 3:

[27] Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico, Panama, Paraguay, Dominican Republic, and Uruguay.

Figure 11. Supplementary elements addressed in legal instruments



Source. Own authorship

Table 3. Supplementary legal instruments[28] on national GHG inventories[29]

No.	Country	Name of legal instrument	Observations
1	Argentina	Law No. 27520 (2019)	Creation of the National System on Climate Change Information. Among others, this system was created to ensure robustness and add transparency to the national GHG inventory and to monitor mitigation measures. (Article 17) Creation of the National Climate Change Adaptation and Mitigation Plan. This plan includes actions to identify the sectors and activities that release more GHG emissions, a system for GHG quantification, and a uniform measurement system consistent with internationally agreed methodologies (Article 19).
2	Bolivia	No regulatory instrument reported and/or identified[30].	
3	Brazil	Decree No. 9172 (2017)	Creation of the National Emissions Registry System (SIRENE, for its Spanish acronym). SIRENE keeps record of the results of the Brazilian Inventory of Anthropogenic Emissions and other accounting initiatives. The Ministry of Science, Technology, Innovation, and Communication is identified as the agency in charge of implementing and managing the system. This decree also specifies the information to be provided to SIRENE and the entities that provide information for the inventory. (Articles 1, 3 and 7).
		Law No.12351 (2010)	This Law applies to the exploration and production of oil, gas and other fluid hydrocarbons and specifies that the terms and conditions of production sharing contracts must include the obligation to publish and submit a GHG inventory on a regular basis and that a copy thereof must be sent to Congress. (Article 29)
4	Chile	Law No. 21455 (2022)	Creation of the National Greenhouse Gases Inventory System for the purposes of preparing and updating the inventory, which is managed by the Ministry of the Environment (Article 28).
		Law No. 21305 (2021)	The Ministry of Energy is appointed as the authority in charge of defining criteria, every 4 years, to determine which companies will be subject to the obligation of reporting their energy consumption and energy intensity for the previous calendar year. (Article 2)

[28] This is not a comprehensive list of all existing legal instruments; rather, we included this list as an example of supplementary instruments on matters related to the preparation of national GHG inventories, MRV, process stages, accountability, reporting cycles, and governance.
[29] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).
[30] Although any supplementary legal instrument has not been identified, Law No. 300 (2012), with the creation of the Live Well in Harmony with Mother Earth Mitigation Mechanism managed by the Plurinational Authority for Mother Earth implicitly and generically includes as part of its duties, conducting monitoring activities for the reduction of GHG emissions and working towards mitigation goals. (Article 55.5)

5	Colombia	Law No. 2294 (2023)	The Ministry of the Environment and Sustainable Development is identified as the agency responsible for regulating the MRV mitigation system (Article 230, amends the Article 175, Law 1753; 2015).
		Resolution No. 1447 (2018)	Regulation of the National MRV Mitigation System, which includes the GHG Inventory System (SINGEI, for its Spanish acronym). The resolution provides detailed information on the structure, functions, components, scope, approach, and principles of national GHG estimations.
		Resolution No. 1383 (2023)	Regulation of the National Climate Change Information System (SNICC, for its Spanish acronym), which includes all GHG inventory information at national, sectoral, and local level. Reference is made to the general obligations of stakeholders, coordination, and information access and availability.
		Resolution No. 40066 (2022)	This resolution specifies the technical information needed from hydrocarbons exploration and operations for the MRV System of GHG emissions of the Ministry of Mines and Energy. (Article 79.2)
6	Costa Rica	Decree No. 41127 (2019)	Creation of the National Climate Change Metrics System (SINAMECC, for its Spanish acronym) under the Climate Change Division of the Ministry of Environment and Energy to facilitate the preparation of reports to be submitted to the UNFCCC and required by the ETF (Article 5.c) and preparing a biennial national GHG inventory consistent with international methodologies. (Article 5.d)
7	Cuba	Law No. 150 (2022)	Regulation of the Environment and Natural Resources System, including the creation of the National Measurement, Reporting, and Verification System under the Ministry of Science, Technology, and Environment to estimate GHG emissions, among others, and the National GHG Inventory to measure, record, and report GHG emissions (Articles 108 and 109).
		Decree No. 86 (2023)	The Decree states that the obligations of the agencies, Central Government agencies, national regulatory bodies, Higher Organizations of Enterprise Direction, governors, and municipal councils and institutions, include supplying data and information, taking part in the process of preparing the Inventory, NC, NDC, and other reports on climate change (Article 4.e).
8	Ecuador	Decree No. 752 (2019)	This Decree states that the information provided by the National Environmental Authority will enable the preparation of the national inventory of anthropogenic GHG emissions by sources and sinks (Article 714.e). The Decree sets forth guidelines for the national MRV system (Art. 717), and, regarding the national GHG inventory, provides a conceptual description on its preparation process, makes official reference to the National Inventories System and specifies reporting frequency and quality requirements for information providers (Articles 723-727).
9	Grenada	No regulatory instrument reported and/or identified.	
10	Guatemala	Decree No. 7 (2013)	Framework law for the reduction of vulnerabilities, mandatory adaptation to climate change effects and GHGs mitigation. The Ministry of Environment and Natural Resources is identified as the agency responsible for the national GHG inventory.
11	Guyana	No regulatory instrument reported and/or identified.	
12	Honduras	Decree No. 297 (2013)	The Climate Change Law states that public and private companies and entities must provide information on climate change, and GHG emissions and reductions through the National Directorate of Climate Change. (Article 21)
13	Jamaica	No regulatory instrument reported and/or identified[31].	
14	Mexico	General Law on Climate Change	This law specifies the due dates for the preparation of the national inventory by the National Institute for Ecology and Climate Change (INECC, for its Spanish acronym) (Art. 74), information requirements for state and municipal competent authorities (Art. 75), and makes reference to the integration of an Information System on Climate Change under the National Institute of Statistics and Geography (INEGI, for its Spanish acronym). (Articles 76 and 77)
15	Panama	Executive Decree No. 100 (2020)	Decree ordering the preparation of national GHG inventories, including: Procedure Manual of the Sustainable System of National GHG Inventories (SSINGEI, for its Spanish acronym), preparation instructions, inventory concepts, MRV principles, the creation of a National Platform for Climate Transparency under the National System of Environmental Information (SINIA, for its Spanish acronym) to manage, monitor, report, and record national initiatives.

[31] However, the National Policy on Climate Change makes reference to the creation of the National Transparency Working Group in 2021 to support the Jamaica's MRV System.

			The Decree specifies that SSINGEI includes all institutional arrangements, procedures, elements, and guidelines to prepare, update, and manage the national inventory (Article 20) (Article 32).
16	Paraguay	Resolution No. 585 (2023)	This resolution authorizes the creation of Industry Roundtables for the National GHG Inventory, including one for the Energy Sector (Article 1). Public and private institutions, legal entities, and the academia are expected to provide data and relevant GHG estimation information (Article 3). Also, details its operation.
17	Dominican Republic	Decree No. 541 (2020)	Creation of the National GHG Emissions System and GHG Inventory Department under the Ministry of Environment and Natural Resources. Creation of the MRV system (Art. 1), integration of the MRV and the Inventory system (Article 2). Detailed information on the relationship between the MRV system and NCs, BURs, and BTRs, (Article 4). Creation of the Inventories System and specification of industries and sectors[32] required to report emissions, reporting frequency, verification and control (Article 5), institutional roles and MRV duties. (Articles. 9 y 10).
18	Trinidad and Tobago	No regulatory instrument reported and/or identified[33].	
19	Uruguay	Decree No. 181 (2020)	Creation of the National Greenhouse Gas Inventory Work Group to manage the National Inventories System and coordinate the preparation of reports to be submitted to the UNFCCC (Article 1). The Group includes the Ministry of Housing, Land Use Planning, and Environment and is chaired by the Ministry of Industry, Energy, and Mining and the Ministry of Livestock, Agriculture, and Fisheries (Article 2). Group duties include, among others, preparing the Inventory, coordinating institutions, and ensuring compliance with MRV principles (Article 3). The National Directorate of Energy of the Ministry of Industry, Energy, and Mining is responsible for collecting data for the estimations, preparing industry reports of GHG emissions, time series, and quality control (Article 5).
20	Venezuela	No regulatory instrument reported and/or identified.	

Source. Own authorship, complementing and taking as a reference information provided by the countries.

Figure 12 shows LAC countries have made progress in the implementation of supplementary regulations to strengthen the preparation of national GHG inventories and other processes related therewith. However, *Table 3. Supplementary legal instruments* shows that there is still a considerable disparity.

Some countries have specified procedures, accountabilities, duties, and/or have regulated inventories and/or their systems with other records on climate information, while other countries have also specified the entities responsible for coordinating and/or supplying Energy sector information under the national GHG inventory.

On the other hand, even though some countries (10%)[34] do not have a supplementary legal instrument, they provide guidelines in national public policy instruments or provide detailed information on institutional arrangements, data sources, MRV, and other aspects in the reports they submit to the UNFCCC, which evidence progress in this area. In 15%[35] of the countries no legal instrument or official document of guideline is reported and/or identified (Figure 12).

[32] As for the Energy sector, it only specifies the inclusion of power generation and transport categories.
[33] As for public policies, however, the National Environmental Policy (2006) includes the commitment to implement regular Inventories and states the need to formalize the inventory with legislation to institutionalize it at a later stage. It indicates that the Environmental Management Authority (EMA) is the regulatory agency in charge of the process.
[34] Jamaica, and Trinidad and Tobago.
[35] Grenada, Guyana, and Venezuela.

Figure 12. Improvements in legislation on national GHG inventories in LAC

Source. Own authorship

Inventory Systems:

45% of the countries[36] have legal instruments with guidelines that address and support the creation of GHG inventory systems and there is another group of countries[37] (15.8%) that, in spite of not having supplementary regulations, have made some progress by including statements on the components, processes, institutional arrangements, methodologies, procedures, and structures needed to gather, analyze, estimate, report, and disclose information related to national GHG inventories.

In addition to this, 25% of the countries have digital public platforms that provide information on their national GHG inventories, offer inputs for knowledge management, and allow users to interact dynamically with the information and, stakeholders to take part in reporting emission factors and activity data.

[36] Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Panama, Dominican Republic, and Uruguay.
[37] Bolivia, Guatemala and Honduras.

Table 4. Characterization of national GHG Inventory Systems per LAC country[38]

No	Country	Has the System been included in a regulatory instrument?	Name given to the Inventory Information System	Observations
1	Argentina	Yes	SNI-GEI-AR | National Greenhouse Gas Inventory System for Argentina	Status: effective. SNI-GEI-AR is also part of the National Climate Change Information System of (SNICC). The National Inventory has a website[39] with an interactive platform and visual elements.
2	Bolivia	No	SMTCC | System of Information and Monitoring of Mother Earth and Climate Change	No evidence of having been included in a regulation. However, SMTCC was validated in 2022 and the latest NC makes reference to its creation.
3	Brazil	Yes	SIRENE | National Emissions Record System	SIRENE is referred to as a computer system[40] that makes National GHG inventory results available and includes documents, charts, publications, and interactive data.
4	Chile	Yes	SNICHILE | National Greenhouse Gas Inventory System of Chile	SNICHILE's website[41] states the intention of keeping citizens informed on the results of national and regional inventories and provides information about the System's structure and operation.
5	Colombia	Yes	SINGEI | National Greenhouse Gas Inventory System	Status: effective. Detailed regulation pending. Digital platform parametrization pending. SINGEI is part of the National Information System on Climate Change (SNICC).
6	Costa Rica	No	-	-
7	Cuba	Yes	SINGEI | National Greenhouse Gas Inventory System	The BUR submitted in 2020 makes reference to an ongoing project aimed at implementing the System.
8	Ecuador	Yes	SINGEI | National Greenhouse Gas Inventory System	SINGEI's website[42] was designed to gather specific information about different sectors and to make inventory results publicly available. It provides information on the preparation cycle, data sources and information from each sector.
9	Grenada	No	-	-
10	Guatemala	No	SNIGT | National Greenhouse Gas Inventory System of Guatemala	The NIR submitted in 2023 states that the Department of Science and Metrics of Climate Change of the Ministry of Environment and Natural Resources is in the process of designing, developing, and implementing the System.
11	Guyana	No	-	-
12	Honduras	No	SINGEI | National Greenhouse Gas Inventory System	The NIR submitted in 2024 states that (the GHG Inventory Technical Team has provided a general outline of SINGEI, which will become a division of the National Climate Change Monitoring System (SNMCC).
13	Jamaica	No	-	-
14	Mexico	No	-	No evidence of a dedicated National GHG Inventory System. However, the National Inventory is referred to as a part of the Climate Change Information System.

[38] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).
[39] Available on: https://inventariogei.ambiente.gob.ar/
[40] Available on: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene
[41] Available on: https://snichile.mma.gob.cl/
[42] Available on: https://singei.ambiente.gob.ec/singei/

15	Panama	Yes	SSINGEI | Sustainable System of National Inventories of Greenhouse Gases	SSINGEI has an interactive website [43] that explains its purpose, structure, legal framework, tools, figures from the National GHG Inventory, and a form to record activity data and emission factors.
16	Paraguay	No	-	-
17	Dominican Republic	Yes	SINGEI | National Greenhouse Gas Inventory System	The 2020 BUR mentions the need to make it effective for continuity purposes and to reduce uncertainty in the estimation of GHG emissions.
18	Trinidad and Tobago	No	-	-
19	Uruguay	Yes	SINGEI | National Greenhouse Gas Inventory System	Inter-institutional system led by the Directorate of Climate Change of the Ministry of Environment under the National Climate Change Response System (SNRCC).
20	Venezuela	No	-	-

Source. Own authorship

4.2.2 Governance

From the broad perspective of climate governance, it can be highlighted, in a more specific approach to the creation of information on GHG emissions, the following:

Except for Jamaica and Costa Rica, in all cases analyzed in this study, the work teams that prepare national GHG inventories and supply consolidated information about the oil and gas industry serve in different national government agencies. In the case of Jamaica and Costa Rica, as part of their institutional arrangements, inventory preparation-related works are performed by the Climate Change Division of the Ministry of Economic Growth and Job Creation and the Climate Change Division of the Ministry of Environment and Energy, respectively.

It is worth highlighting that in 95% of LAC countries, the preparation of national GHG inventories and the reports to be submitted to the UNFCCC fall under the scope of their environmental, natural resources, or climate change agencies and/or their attached entities. In the case of Brazil, however, the process is led by the Ministry of Science, Technology, and Innovation and the environmental agencies under the umbrella of the Ministry of Environment and Climate Change only contribute to the report.

Table 5 shows the coordinating entities in charge of preparing national GHG inventories in LAC countries:

[43] Available on Panama's Climate Transparency Platform: https://transparencia-climatica.miambiente.gob.pa/modulo-ssingei/

Table 5. Coordinating entities for national GHG inventories

No	Country	Name of coordinating entity
1	Argentina	Ministry of the Environment and Sustainable Development
2	Bolivia	Plurinational Authority of Mother Earth – Joint Mitigation and Adaptation Mechanism, Ministry of Environment and Water
3	Brazil	Ministry of Science, Technology, and Innovation (MCTI)
4	Chile	Ministry of the Environment - Climate Change Office
5	Colombia	Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), under the Ministry of Environment and Sustainable Development
6	Costa Rica	Ministry of the Environment and Energy (MINAE)
7	Cuba	Ministry of Science, Technology and Environment and Institute of Meteorology
8	Ecuador	Ministry of Environment, Water and Ecological Transition (MAATE)
9	Grenada	Ministry for Climate Resilience, the Environment and Renewable Energy
10	Guatemala	Ministry of Environment and Natural Resources (MARN)
11	Guyana	Ministry of Natural Resources
12	Honduras	Department of Natural Resources and the Environment - National Climate Change Office
13	Jamaica	Ministry of Economic Growth and Job Creation - Climate Change Division
14	Mexico	National Institute of Ecology and Climate Change (INECC). General Directorate of Climate Action Policies of the Ministry of Environment and National Resources (SEMARNAT)
15	Panama	Ministry of the Environment
16	Paraguay	Ministry of Environment and Sustainable Development (MADES) - National Climate Change Office
17	Dominican Republic	Ministry of Environment and Natural Resources & National Council for Climate Change and Clean Development Mechanisms
18	Trinidad and Tobago	Environmental Management Authority (EMA) of the Ministry of Planning and Development
19	Uruguay	Ministry of the Environment (MA)
20	Venezuela	Ministry of People's Power for Ecosocialism and Water (MINEA) & National Institute of Meteorology and Hydrology (INAMEH)

Source. Own authorship

Most of the countries state that their biggest challenge is coordinating and aligning various stakeholders such as coordinating entities, national government agencies responsible for the mining-energy sector, and other providers of information to be included in the inventories, such as private sector companies, unions, universities, research institutes or centers, and territorial entities.

In some cases, it can infer that the entity in charge of the inventory is the same entity responsible for national policies on climate change. Most of the times, existing regulations do not provide detailed information on reporting methods, entities, roles, frequency, type of information, and other requirements; rather include general statements about existing or planned institutional arrangements within the reports themselves.

Some countries, however, have also:

- defined technical and legal mechanisms to provide information.
- adopted regulations for the development of agreements with private sector entities for them to supply information to be used in the preparation of inventories.

- drafted regulations that explicitly define the parties that must contribute information.
- defined specific legal responsibilities for Mine and Energy agencies in connection with the inventories.

One of the strategies to enhance the maturity of inventories in terms of governance and the engagement and involvement of stakeholders could be to enter into agreements, achieve consensus, and document and/or formalize these agreements in regulatory instruments.

On the other hand, in the guidelines for preparing UNFCCC reports, countries are encouraged to make new institutional arrangements and implement processes to strengthen the national Monitoring, Reporting, and Verification system based on their particular context, existing arrangements, and capacities to ensure the continuity of reporting processes, facilitate and improve communication with national and international policy makers at different levels, support the institutionalization of the reporting process in consultation with national stakeholders, and seek verification by industry experts and endorsement from competent government agencies before submitting their reports. (UNFCCC, 2014)

In this regard, it is possible to observe a considerable progress in the level of definition of the structure of national MRV mitigation systems based on each country's current capacities. However, the analysis of the existing gap in the transition towards the ETF could be subject of further study.

4.2.3 Resources

All the countries included in this report have received financial support from the Global Environment Facility (GEF) to prepare their NCs, BURs or NIRs and enhance their technical and administrative capacities; and technical support from GEF implementing agencies, i.e., UNDP and UNEP.

As for the latest reports submitted to the UNFCCC by each of the countries with the latest update of their GHG inventory, it is possible to observe variations over time in the allocation and source of the resources used for preparing the reports. Countries have made progress towards managing the gaps and limitations they have identified in their regulations by making institutional arrangements, implementing information management systems, and sharing tools and information with other systems used to record national emissions or sectoral-specific activity data.

Countries like Grenada, Jamaica, Trinidad and Tobago, and Venezuela mention lack of finance as the main challenge to update their inventories and fill the time gap between their reports.

On the other hand, countries such as Argentina, Colombia, and Chile rely on several sources of funding for climate actions, including international cooperation projects and countries' own resources. In these countries part of the national government budget is allocated through the relevant agencies to leverage the preparation and reporting cycles of national GHG inventories and the implementation of Climate Change Information Systems and Monitoring, Reporting, and Verification Systems.

However, the entire region continues to express a need for additional, sufficient, regular, not conditioned and readily available funds to improve inventories' effectiveness, frequency, and quality.

Table 6. Source of funding for preparing the most recent national GHG inventory

No	Country	Financing	Technical assistance / supporting / implementing agency
1	Argentina	GEF CBIT Project GEF Umbrella Program NDC Support Project ICAT Project	UNDP UNEP – CBIT
2	Bolivia	GEF	UNDP
3	Brazil	GEF National budget related entities	UNDP
4	Chile	GEF National budget related entities	UNDP
5	Colombia	GEF BioCarbon Fund - World Bank IDEAM budget	PNUD - CBIT Fundación Natura Foundation
6	Costa Rica	GEF National budget	UNDP
7	Cuba	GEF National budget	UNDP
8	Ecuador	GEF National budget	UNDP Global Support Programme Latin American Network of National GHG Inventories (RedINGEI)
9	Grenada	GEF	UNDP UNEP
10	Guatemala	GEF National budget related entities	UNDP
11	Guyana	GGGI	Gauss International Consulting
12	Honduras	Cooperation from Spain NDC Partnership	UNDP
13	Jamaica	GEF National budget	UNDP UNEP
14	Mexico	GEF National budget	UNDP
15	Panama	GEF National budget	UNDP
16	Paraguay	GEF	UNDP
17	Dominican Republic	GEF National budget	UNDP
18	Trinidad and Tobago	GEF	UNDP
19	Uruguay	GEF	UNDP
20	Venezuela	GEF	UNDP

Source. Own authorship

In addition to this, since 2018 and for a temporary period ending in 2026, 15[44] of the 20 countries included in this report have been part of the *Capacity-Building Initiative for Climate Transparency* (CBIT)[45] of the Global Environment Facility (GEF) with an estimated budget of approximately USD 23,351,690 (CBIT-GSP, 2023).

[44] Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, Dominican Republic, Trinidad and Tobago and Uruguay.
[45] Created to enhance the technical and institutional capacities of developing countries for them to meet the requirements of the Enhanced Transparency Framework. (CBIT-GSP, 2023)

Countries set priorities to allocate said resources to different areas of work, such as updating their national, subnational, and corporate inventories of GHG emissions and removals, monitoring the implementation of NDCs, and implementing transparency and MRV systems and mitigation actions.

For these purposes, among others, they have focused on the development of tools and information systems, workshops with stakeholders, capacity building activities, proposals to reach institutional agreements and draft legal instruments, the development of data collection strategies, communication and disclosure, and pilot studies (CBIT-GSP, 2023).

As for the human resources dedicated to national GHG inventories, 55% of the countries consider they have sufficient human resources to prepare the inventory for the oil and gas industry.

The main strengths of these teams include:

- In-house multidisciplinary teams with expertise in the (national and/or international) Energy sector.
- Inter-institutional teams organized under industry-specific arrangements or legal framework.
- In some cases, the same group of people that takes part in preparing the national GHG inventory prepares the National Energy Balance.
- Use of applications, technology tools, and software to make emission projections, models, and simulations.
- Development of tools to ensure information quality, information management processes, and transfer of knowledge to new team members.
- Involvement of Energy sector professionals in national energy policy management.
- Transition for national inventories to be prepared by the national government instead of being outsourced.

The needs and opportunities for improvement identified for work teams, include:

- High or considerable turnover of professionals.
- Difficulties to ensure team continuity.
- Difficulties to build long-term specialized capabilities.
- Need for specialized knowledge about the particular circumstances of the country; the structure of inventories, international guidelines and estimation methodologies, statistics and/or continuous improvement in inventory preparation processes.
- Heavy workload, need for more professionals or dedicated professionals for preparing the inventory.
- Technical support and internet access; limited number of computers.
- Access to the documents, calculation tools, and databases used to prepare previous inventories.

4.3 Methodological maturity

4.3.1 Use of standardized methodology

In accordance with UNFCCC guidelines, all LAC countries have used IPCC standardized methodologies to prepare their national GHG inventories. They have implemented these guidelines in their updates to different extents and based on the decisions made at the Conferences of the Parties.

It especially highlights the use of:

- 2006 IPCC guidelines
- IPCC Good practice guidance (2000).
- 2019 Refinement to the 2006 IPCC Guidelines for greenhouse gas inventories.
- Decision 2/CP.17 Annex III - Guidelines preparation BUR Non-Annex I Parties.
- Decision 17/CP.8 Annex – NC reporting guidelines for Non-Annex I Parties.
- 1996 Revised IPCC guidelines for greenhouse gas inventories (IPCC, 1997).

Likewise, and specifically in the Energy sector, countries rely on the reference or sectoral methods depending on the level of detail of their consolidated data and the chosen approach. A good practice recommended by 2006 IPCC Guidelines is the simultaneous use of two methods for estimating GHG emissions, to provide a basis for comparison.

The range of information shared by LAC countries on their greenhouse emissions for the base year and/or historical series is very wide, ranging from level 2 reports in IPCC categories, i.e. global up to categories *1A Fuel combustion activities* and *1B Fugitive emissions from fossil fuel production*; up to maximum level of disaggregation (Level 6), i.e. reporting very specific emissions up to categories like *1B2aiii1 Exploration*.

Below we indicate the relationship between the methodology used by the countries in their latest report submitted to the UNFCCC with their most updated national GHG inventory and the level of disaggregation achieved in the reports per category for oil and gas activities and methane.

Table 7. Description of the methodology used and estimated level of emissions[46]

No	Country	Report	Methodology	Level of category reported for the oil & gas industry in the Energy sector	Level of category reported for methane in the oil & gas industry
1	Argentina	5th BUR & 3rd NIR	• 2006 IPCC guidelines • 2019 Refinement • Guidelines for BURs for non-Annex I Parties	Level 6	Level 6[47]

[46] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).
[47] These are not representative of the main sources identified.

			• Guidelines for NCs for non-Annex I Parties		
2	Bolivia	3rd NC	• 2006 IPCC Guidelines • IPCC Good Practice Guidance (2000).	Level 2 - reference approach Level 3 - sectoral approach	Level 3[48]
3	Brazil	4th NC and 4th BUR	• 2006 IPCC Guidelines • 1996 Revised IPCC Guidelines • IPCC Good Practice Guidance (2000).	Level 5 for 1A1 Level 5 for 1B2[49]	Level 4
4	Chile	5th BUR & 4th NIR	• 2006 IPCC Guidelines • Guidelines for BURs for non-Annex I Parties • Guidelines for NCs for non-Annex I Parties	Level 4 for 1A1 Level 6 for 1B2	Level 4 for 1A1 Level 6 for 1B2
5	Colombia	3rd BUR & 2nd NIR	• 2006 IPCC Guidelines • 2019 Refinement	Level 5 for 1A1 Level 6 for 1B2	Level 5 for 1A1 Level 6 for 1B2
6	Costa Rica	4th NC & NI	• 2006 IPCC Guidelines • 2019 Refinement	Level 4 for 1A1 Level 5 for 1B2	Level 4 for 1A1 Level 5 for 1B2
7	Cuba	3rd NC & 1stBUR	• 2006 IPCC Guidelines • IPCC Good Practice Guidance (2000). • Guidelines for BURs for non-Annex I Parties • Guidelines for NCs for non-Annex I Parties	Level 3	Level 3
8	Ecuador	2nd BUR & 2nd NIR	• 2006 IPCC Guidelines	Level 4 for 1A1 Level 5 for 1B2	Level 4 for 1A1 Level 5 for 1B2
9	Grenada	2nd NC	• 2006 IPCC Guidelines	Level 4 for 1A1 1B not included	Level 4 for 1A1
10	Guatemala	1st BUR & 1st NIR	• 2006 IPCC Guidelines	Level 3	[50]
11	Guyana	3rd NC & 1st BUR	• 2006 IPCC Guidelines • 2019 Refinement	Level 3 for 1A1 1B2 reported without occurrence	Level 3 for 1A1[51]
12	Honduras	2nd BUR & 2nd NIR	• 2006 IPCC Guidelines • IPCC Good Practice Guidance (2000).	Level 3 for 1A1 1B2 reported without occurrence	Level 3 for 1A1
13	Jamaica	3rd NC	• 2006 IPCC Guidelines	Level 3	Level 2 for 1A[52]
14	Mexico	3rd BUR	• 2006 IPCC Guidelines • 2019 Refinement	Level 4	Level 4
15	Panama	2nd NIR	• 2006 IPCC Guidelines	Level 4 for 1A1 Level 4 for 1B2[53]	Level 4
16	Paraguay	4th NC & 2nd NIR	• 2006 IPCC Guidelines	Level 4	1A1 not reported 1B reported without occurrence
17	Dominican Republic	1st BUR	• 2006 IPCC Guidelines	Level 3	Level 3

[48] The most significant methane emissions in the Energy Sector are fugitive emissions from activities related to oil and natural gas systems.
[49] It states that Petrobras does not have sufficient information to estimate the subcategory to Level 6.
[50] Methane emissions associated to oil and gas are reported at 0.
[51] It includes an estimation of fugitive emissions for oil & gas industry activities in the base year but not in historical records.
[52] Informs 0 emissions for category 1B2 but includes emissions for the historical series of methane and fuel combustion.
[53] Only reported for 2000 from the historical series for 1.a.1.b activity, mentioning the closure of the only refinery in the country. Fugitive emissions are not included due to lack of activity data.

			• Guidelines for BURs for non-Annex I Parties • Guidelines for NCs for non-Annex I Parties		
18	Trinidad and Tobago	3rd NC & 1st BUR	• 2006 IPCC Guidelines	Level 2	Level 2
19	Uruguay	6th NC	• 2006 IPCC guidelines • Guidelines for BURs for non-Annex I Parties • Guidelines for NCs for non-Annex I Parties	Level 4 for 1A1[54]	Level 3 for 1A1 Level 2 for 1B
20	Venezuela	2nd NC	• 2006 IPCC Guidelines • Revised IPCC Guidelines (1996). • IPCC Good Practice Guidance (2000).	Level 5	Level 5[55]

Source. Own authorship - prepared using official information about the countries

Note 1. Category levels reported:

Level 1 | 1. Energy Sector
Level 2 | 1A Fuel combustion activities & 1B Fugitive emissions from fossil fuel production
Level 3 | 1A1 Energy & 1B2 Oil and natural gas industries
Level 4 | 1A1a Electricity and Heat Production as main activities, 1A1b Oil refineries, 1B2a Oil & 1B2b Natural gas
Level 5 | 1A1ai Electricity generation, 1A1aii Combined heat and power generation (CHP), 1A1aiii Power plants, 1B2ai / 1B2bi Venting, 1B2aii / 1B2bii Flaring, 1B2aiii / 1B2biii All others
Level 6 | 1B2aiii1 / 1B2biii1 Exploration, 1B2aiii2 Production and refining, 1B2aiii3 Transport, 1B2aiii4 Refining, 1B2aiii5 Distribution of oil products, 1B2aiii6 / 1B2biii6 Others, 1B2biii2 Production, 1B2biii3 Processing, 1B2biii4 Transmission and storage & 1B2biii5 Distribution.

4.3.2 Use of emission factors

All countries included in this study use default emission factors[56], whether for the Energy sector or for categories that include oil & gas industry-related emissions, and/or for estimating methane emissions. 25% of the countries report national emission factors and 10% do it per type of technology.

As for the global warming potential[57] metric for methane, in their latest reports submitted to the UNFCCC with the most updated version of their GHG inventories, 45% of the countries used the GWP of the 5th Assessment Report (AR5), according to which methane has 28 times the global warming potential of CO_2 over a hypothetic 100-year period; and 30% of the countries used the GWP of the 2nd Assessment Report (AR2), which states that methane's global warming potential over a 100-period is 21 times greater than that of CO_2.

[54] No estimation reported for Category 1B2 due to lack of significance.
[55] These are mainly related to fugitive emissions (93%) from natural gas flaring and venting in oil production processes.
[56] i.e., standard emissions factors provided by the IPCC: global or regional averages generally used when there are no specific data available from research or analysis.
[57] Global warming potential is the metric that measures how much heat a greenhouse gas traps in the atmosphere relative to CO_2 over a specific period, for measurement and standardization purposes.

Table 8. Emission factors per type for the Energy sector[58]

No	Country	Report	Level of detail used to define emission factors in the Energy sector	GWP metric used	Observations
1	Argentina	5th BUR & 3rd NIR	Tier 1 for categories 1A1 and 1B2 Tier 2 for CO_2 in category 1A	AR2 | IPCC 1995	Use of the same EF of BUR4, except for some adjustments, including some in the Energy sector. More than 72% of emissions are estimated with local data and EF[59].
2	Bolivia	3rd NC	Tier 1	AR2 | IPCC 1995	Use of the same EF in the Energy sector and in INGEI 2002 and 2004.
3	Brazil	4th NC and 4th BUR	Tier 1 and 2 per sectoral approach and Tier 1 per reference approach, for category 1A1 Tier 2 and 3 for oil and gas fugitive emissions.	AR2 | IPCC 1995 AR5 | IPCC 2013	Comparison of AR2 and AR5 results. Same methodological references than 3NC for EF.
4	Chile	5th BUR & 4th NIR	Tier 1 for category 1A1 and certain 1B2 categories[60].	AR4 | IPCC 2007	Level mentioned specifically in the report on methane.
5	Colombia	3rd BUR & 2nd NIR	Tier 1 for categories included in 1A1 and 1B2	AR5 | IPCC 2013	Level mentioned specifically in the report on methane.[61]
6	Costa Rica	4th NC & NI	Tier 1 and 2 for category 1A1 and Tier 1 for category 1B2a.	AR1 IPCC 1990	
7	Cuba	3rd NC & 1st BUR	Tier 1 for categories 1A1 and 1B2.	AR2 | IPCC 1995	It does not include natural gas fugitive emissions (1.B.2.b)
8	Ecuador	2nd BUR & 2nd NIR	Tier 1 for categories 1A1 and 1B2.	AR4 | IPCC 2007	Tier 2 is used in categories other than Energy.
9	Grenada	2nd NC	Tier 1 for categories 1A1 and 1B2.	AR1 | IPCC 1990	Specifically mentioned in the sectoral report and the entire inventory.
10	Guatemala	1st BUR & 1st NIR	Tier 1 for categories 1A1 and 1B2	AR4 | IPCC 2007	It does not include fugitive emissions for natural gas (1.B.2.b) and reports oil and gas methane emissions at a level of 0.
11	Guyana	3rd NC & 1st BUR	Tier 1 for categories 1A1 and 1B2	AR5 | IPCC 2013	Mentioned specifically in the report on methane. No EF included for oil refining due to non-occurrence and for the historical series associated with fugitive emissions. EF included for the base year of the inventory.
12	Honduras	2nd BUR & 2nd NIR	Tier 1 for category 1A1.	AR5 | IPCC 2013	No EF included for fugitive emissions for the oil and gas industry or for oil refining due to non-occurrence.
13	Jamaica	3rd NC	Tier 1 for the Energy sector.	AR2 | IPCC 1995	Specifically mentioned in the report for the industry and the entire inventory. Use of values predefined specifically for the region in 2006 IPCC Guidelines for fuel.
14	Mexico	3rd BUR	Tier 1 for categories 1A1 and 1B2.	AR5 | IPCC 2013	Level mentioned specifically in the report on methane.

[58] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).

[59] In the case of natural gas combustion, the comparison of the results of a detailed analysis of a representative sample of gas chromatography measurements provided by oil companies and the National Electricity Regulatory Agency (ENRE) based on data from power plants and IPCC 2006 default EFs was within the uncertainty interval and, therefore, default EF continued to be used.

[60] Methane emissions are not estimated for category 1B2. However, estimations are included for 1.B.2.a.i., 1.B.2.a.ii., 1.B.2.a.iii.2., 1.B.2.a.iii.3.,1.B.2.a.iii.4. as fugitive emissions from the oil industry and for 1.B.2.b.i., 1.B.2.b.ii., 1.B.2.b.iii.2., 1.B.2.b.iii.3., 1.B.2.b.iii.4. for natural gas activities.

[61] For oil systems, fugitive emissions are estimated in exploration, production, transport, and refining; and for gas systems in exploration, production, processing, transport, and distribution. They expect to have their own EF in the medium term.

15	Panama	2nd NIR	Tier 1 for category 1A1	AR5 | IPCC 2013	No EF included for fugitive emissions from the oil & gas industry or for oil refining due to non-occurrence.[62]
16	Paraguay	4th NC & 2nd NIR	Tier 1	AR5 | IPCC 2013	
17	Dominican Republic	1st BUR	Tier 1	AR2 | IPCC 1995	Specifically mentioned in the report for the industry.
18	Trinidad and Tobago	3rd NC & 1st BUR	Tier 1	AR5 | IPCC 2013	
19	Uruguay	6th NC	Tier 1, 2, and 3 for the Energy Sector	AR5 | IPCC 2013	
20	Venezuela	2nd NC	Tier 1	No evidence	Selection of default EF based on the following priorities: EF included in IPCC Inventory Software, 2006 IPCC Guidelines, EF database (IPCC EFDB), and 1996 IPCC Guidelines.

Source. Own authorship using official information from the countries and referenced reports.

4.3.3 Data granularity

All national GHG inventories submitted most recently to the UNFCCC report data aggregated at national level. As evidenced in Table 9, only 20% of the countries also report disaggregated data at subnational scale and 10% report plant-level data.

Almost all countries prepare a National Energy Balance which is the main source of information used to prepare their national GHG inventories for the oil and gas industry, followed by other figures obtained from national statistical systems and information provided by state-owned oil and gas companies and power distribution systems, energy regulatory authorities and committees, and, to different extents, private sector companies involved in different stages of the oil and gas production chain.

In the case of Grenada, they use activity data from the United Nations Energy Statistics Database or from countries with a similar level of activity relying on experts to decide on their relevance and extent of use.

Guyana, on the other hand, uses data consolidated by their Environment Protection Agency (EPA) and supplemented with information generated by OLADE.

Table 9. Characterization of activity data granularity for the Energy sector[63]

No	Country	Report	Spatial granularity
1	Argentina	5th BUR & 3rd NIR	AD aggregated at national level

[62] The use of default EF is informed in the category *Energy industries* associated with power and heat generation as main activities and oil refining. Only the period between 1990 and 2002 is included, since the national refinery closed in 2002.

[63] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).

2	Bolivia	3rd NC	AD aggregated at national level
3	Brazil	4th NC & 4th BUR	AD aggregated at national level and disaggregated at sub-national level
4	Chile	5th BUR & 4th NIR	AD aggregated at national level and disaggregated at sub-national level[64]
5	Colombia	3rd BUR & 2nd NIR	AD aggregated at national level and disaggregated at sub-national level[65] (departmental level)
6	Costa Rica	4th NC & NI	No oil exploration or production in Costa Rica[66]. AD used are aggregated at national level.
7	Cuba	3rd NC & 1st BUR	AD aggregated at national level. 3NC improvements include a reduction in the consumption of crude oil, fuel oil, diesel, and natural gas, in the production of energy, and in fugitive emissions.
8	Ecuador	2nd BUR & 2nd NIR	AD aggregated at national level[67]
9	Grenada	2nd NC	AD aggregated at national level
10	Guatemala	1st BUR & 1st NIR	AD aggregated at national level
11	Guyana	3rd NC & 1st BUR	AD aggregated at national level.
12	Honduras	2nd BUR & 2nd NIR	AD aggregated at national level.
13	Jamaica	3rd NC	AD aggregated at national level, including 10% at subnational level, and 5% at plant level.
14	Mexico	3rd BUR	AD aggregated at national level
15	Panama	2nd NIR	AD aggregated at national level
16	Paraguay	4th NC & 2nd NIR	AD aggregated at national level[68]
17	Dominican Republic	1st BUR	AD aggregated at national level, with approximations at the level of individual plants
18	Trinidad and Tobago	3rd NC & 1st BUR	AD aggregated at national level
19	Uruguay	6th NC	AD aggregated at national level
20	Venezuela	2nd NC	AD aggregated at national level

Source. Own authorship. Table prepared using official information submitted by the countries

[64] Disaggregation of estimations at the level of the 16 administrative regions in the country.
[65] The main source of information is public information about the production of hydrocarbons as reported by the National Hydrocarbon Agency, consolidated for each producing field in the country and information on drilled wells provided by the Directorate of Hydrocarbons of the Ministry of Mines and Energy (disaggregated at departmental level).
[66] Therefore, it only includes AD for the categories oil transport (1.B.2aiii) and oil refining (1.B.2a iv) for the 1990-2011 period, since between 2012 and 2017 oil was neither imported into nor refined in the country.
[67] Taken from production, power plant combustion and electricity producers, gas processing centers, own consumption, and industry sector consumption.
[68] Indicated for all subcategories up to level 6 (1.B.2.a.iii.4 Refining) of the report. Activity data available at plant level for international and domestic flights.

4.4. Data base quality and integrity

4.4.1 Time series

With regard to historical data included in national GHG inventories, countries have made considerable efforts towards consolidating and analyzing data with potential for inclusion, seeking compliance with MRV principles, have been evident.

However, the challenges faced during the preparation of national GHG inventories (i.e., documentation, systematization, information availability, and team continuity) have a profound impact on the quantity and quality of available data and some countries have even decided to recalculate the entire series to provide a basis for comparison and to ensure consistency.

Below, the historical series considered by LAC countries in their latest national GHG inventories and the distribution of time ranges are presented.

Table 10. Historical series included in the most recent national GHG inventory[69]

No.	Country	Report	Time series	Time range included in the series (years)
1	Argentina	5th BUR & 3rd NIR	1990– 2020 Recalculated series	30
2	Bolivia	3rd NC	1990 – 2008[70]	18
3	Brazil	4th NC & 4th BUR	1990– 2016 Recalculated series 1990 - 2010	26
4	Chile	5th BUR & 4th NIR	1990 - 2020	30
5	Colombia	3rd BUR & 2nd NIR	1990 - 2018	28
6	Costa Rica	4th NC & NI	1990– 2017 Recalculated series 1990 - 2016	27
7	Cuba	3rd NC & 1st BUR	1990 - 2016	26
8	Ecuador	2nd BUR & 2nd NIR	1994 - 2018	24
9	Grenada	2nd NC	2000 - 2014	14
10	Guatemala	1st BUR & 1st NIR	1990– 2018	28
11	Guyana	3rd NC & 1st BUR	1990– 2022	32
12	Honduras	2nd BUR & 2nd NIR	2016 - 2020 Recalculated series BUR1: 2005 - 2015	15
13	Jamaica	3rd NC	2006 – 2012[71]	6
14	Mexico	3rd BUR	1990– 2019	29

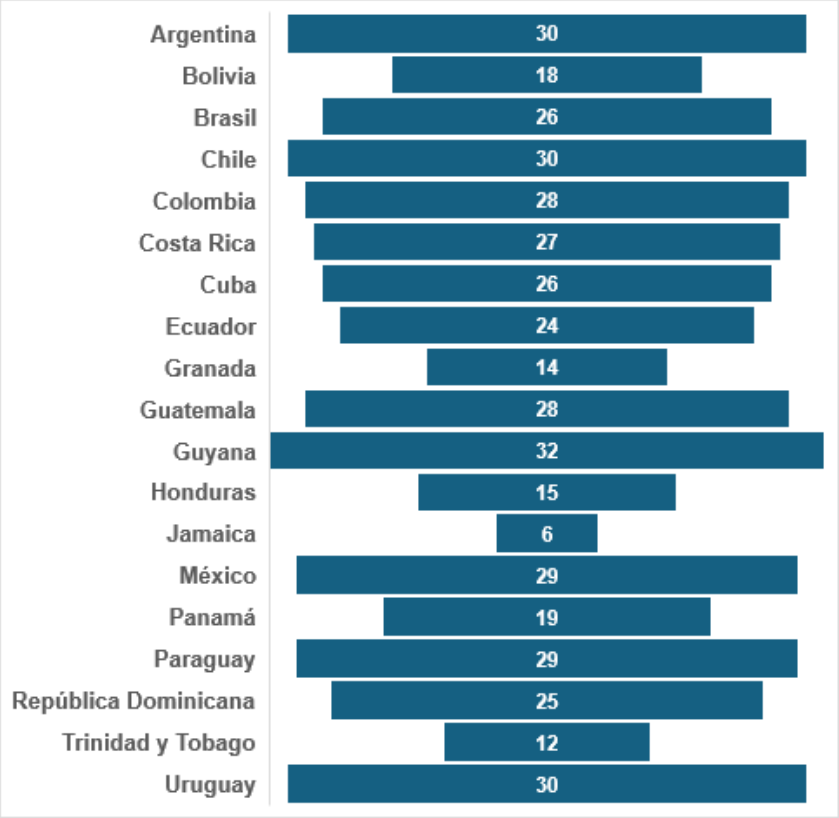
[69] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).
[70] Even-year sequence since 1994.
[71] Information was gathered for the 2000-2005 period, but did not comply with the standards of the referenced series. Therefore, its use is limited and has not been presented. The information of the 3rd NC cannot be compared to that of the 2nd NC.

15	Panama	2nd NIR	2000 – 2019[72]	19
16	Paraguay	4th NC & 2nd NIR	1990– 2019	29
17	Dominican Republic	1st BUR	2010– 2015 1990– 2015	25
18	Trinidad and Tobago	3rd NC and 1st BUR	2006– 2018	12
19	Uruguay	6th NC	1990 – 2020[73]	30
20	Venezuela	2nd NC	Historical series not included	Not applicable

Source. Own authorship. Table prepared using the referenced reports submitted to the UNFCCC.

With regard to the historical data covered in their most recent national GHG inventory, 75% of the countries cover more than 15 years (on average) in their time series, while in the remaining 20% cover 15 years or less. According to their latest NC and their first BUR, Guyana is the country with the longest covered period (32 years), followed by Argentina, Chile, and Uruguay (30 years).

Figure 13. Ranges of historical time series included in the national GHG inventories



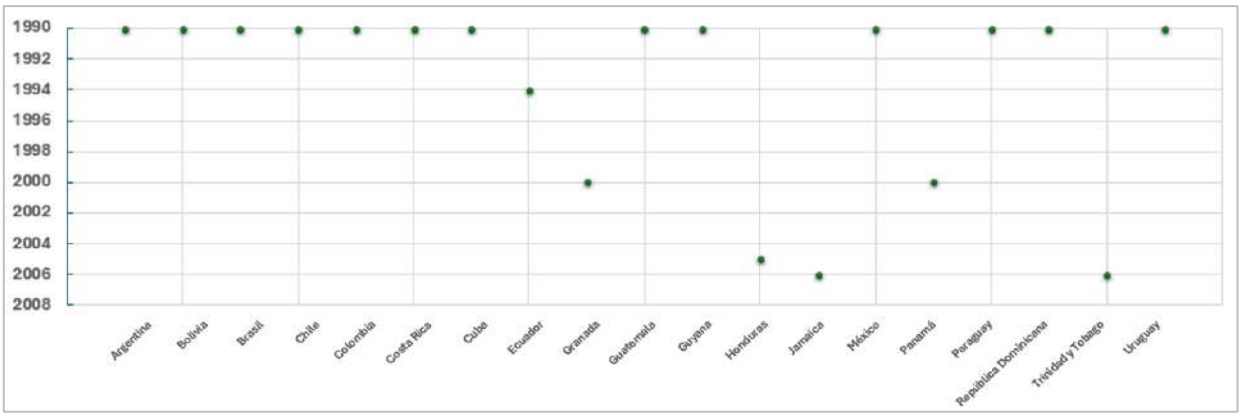
Source. Own authorship. This chart was made using UNFCCC information.

With regard to the start date of the time series, as shown in Figure 14, 65% of the countries have used 1990 as their start year. 1990 was the year initially established by the UNFCCC as the base

[72] The start year of the historical series was redefined in the 4th NC (1994-2017 in the BUR) due to the limitations to access complete information about the AFOLU sector.
[73] It includes the evolution of the estimation for the series 1990, 1994, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2017, 2018, 2019, and 2020.

year or the year of reference for Annex I countries to count and report their GHG emissions. Non-Annex I countries, however, voluntarily decided to use 1990 (to the extent possible based on their capabilities and available information) to facilitate global comparisons and monitoring.

Figure 14. Start dates of the historical series of the national GHG inventories



Source. Own authorship. Plot prepared using UNFCCC information.

4.4.2 Update frequency

As for the frequency with which countries update their GHG inventories for the oil and gas industry, as shown in Table 11, 50% of them make annual updates during the preparation of their National Energy Balance, 30% of them every 2 or 4 years depending on the preparation of the national GHG inventory included in their National Communications or BURs, and 20% have not defined any particular frequency.

Table 11. Update frequency of national GHG inventories in the oil and gas industry[74]

No	Country	Update frequency
1	Argentina	Every 2 years
2	Bolivia	Not defined; Updated to 2008
3	Brazil	Annual
4	Chile	Every 2 years
5	Colombia	Annual for Mining - Energy industry
6	Costa Rica	Annual
7	Cuba	Annual
8	Ecuador	Annual
9	Grenada	Not defined; based on NC updates.

[74] Countries in green are LAC countries classified as small island developing states (SIDS). Readers should take this into consideration when analyzing the information provided in this report because of the special characteristics of these countries (as described in Figure 1).

10	Guatemala	Annual
11	Guyana	Annual
12	Honduras	Annual
13	Jamaica	Every 2 or 4 years depending on NC and BUR updates
14	Mexico	Annual, but published every 2 years
15	Panama	Every 2 years
16	Paraguay	Every 2 or 4 years depending on NC and BUR updates
17	Dominican Republic	Every 4 years
18	Trinidad and Tobago	Not defined; based on NC and BUR updates
19	Uruguay	Annual
20	Venezuela	Not defined; Updated to 2010

Source. Own authorship. Table prepared using information submitted by the countries.

4.5 Maturity in the level of use

4.5.1 Use in decision-making processes

89% of the countries state that they use national GHG inventories as a decision-making tool and to plan national climate change response actions. Below, we include some examples of how this information is used by countries in the design of state planning instruments and/or for the energy sector:

- Argentina: national GHG inventories have been used to draft the National Climate Change Adaptation and Mitigation Plan.

- Chile: national GHG inventories have been used by energy sector for long-term strategic planning, to draft the Energy Sector Climate Change Adaptation and Mitigation Plan, to design long-term climate strategies and NDCs, and to draft regulatory instruments such as the Framework Law on Climate Change and the Energy Efficiency Law, and to define biodiversity services and protected areas under the National System of Protected Areas.

- Colombia: national GHG inventories have been used to update their NDC, to create the carbon budget, and to draft Law No. 2169 (2021), which sets climate goals that supplements the goals included in the NDC for each industry (including the Energy sector).

- Costa Rica: national GHG inventories have been used to draft the National Decarbonization Plan 2019-2050 and to update their 2020 NDC.

- Cuba: national GHG inventories have been used to update their NDC and to draft the Climate Action State Plan known as “Tarea Vida” (Project Life) under the Ministry of Science, Technology, and Environment.

- Ecuador: the information included in national GHG inventories has been used to draft the National Development Plan, the NDC, the Energy Efficiency National Plan (PLANEE), and the Electricity Master Plan (PME).

- Grenada: the information included in national GHG inventories has been used to draft their National Climate Change Policy.

- Jamaica: national GHG inventories have been used to draft an Integrated Resource Plan and policies on electric vehicles and vehicle emissions, and to draft national development plans and different strategies and actions for the Energy sector.

- Panama: national GHG inventories have been used to establish a Green Economy Model taken as a basis for the definition of the Energy Transition Agenda scenarios.

- Paraguay: national GHG inventories have been used in the development of their NDC, the Strategy to Mitigate Climate Change, and the National Climate Change Mitigation Plan.

- Dominican Republic: national GHG inventories have been used to update their NDC and to design emission models for future scenarios.

- Venezuela: national GHG inventories have been used to design the Economic and Social Development Plans.

4.6 Systematization

4.6.1 Information availability

Out of all the countries included in this study, 70% stated that the results of their national GHG inventories are available for review by stakeholders. However, all countries have weaknesses in the way they disclose and present information (e.g., level of detail and clarity, possibility to interact with the information), which creates a common barrier in the region to adequate and thorough understanding, and appropriation of knowledge.

In addition to this, among the obstacles, needs, and gaps identified during the update of their GHG inventories submitted to the UNFCCC, countries highlight the lack of access to the information used for preparing their first GHG inventories. Not having this initial information available in databases, software, spreadsheets, or documents creates difficulties in comparison, understanding, source analysis, form of presentation, estimation and quantification.

In cases such as that of the Dominican Republic, emission estimations have been recalculated for some base years or are presented as non-comparable. They also recommend creating document systematization and management systems and implementing systems to document processes, assumptions, and other relevant criteria.

Similarly, Argentina recalculated their time series based on adjustments in activity data and emission factors to ensure consistency in estimations and to facilitate data analysis.

In the case of Jamaica, even though they had collected data for a larger period, they decided not to include this information in their latest inventory due to lack of compliance with most recent standards. Therefore, the use of this information is very limited and non-comparable.

Panama encountered difficulties in accessing accurate and complete information from various sectors. Therefore, their last national GHG inventory states they decided to redefine the start year of their time series, which will be 2000 instead of 1994.

5. PRIORITIES

Based on the challenges and needs identified and exemplified by each of the countries and those described and analyzed throughout this report, those aspects in which the highest levels of prioritization and technical support are expected have been categorized according to the assessment parameters. These have been analyzed and included in the road map of activities of the Methane Emissions Observatory of Latin American and the Caribbean (OEMLAC) in compliance with its mission.

Table 12. Parameters to be prioritized and addressed

Maturity criteria	Level of priority 1	Level of priority 2
Institutional maturity	Legal instruments requiring the preparation of the national GHG inventory	Human resources capacities and skills
	Having enough financial and material resources	
Methodological maturity	Getting disaggregated activity data	Use of standardized methodology
		Development of national or technology-based emission factors
Maturity in data base quality and integrity	Complete annual time series	Public access to data base
	Years covered by the time series	
Level of maturity in systematization	Systematization formalized in planning or legal instrument	Allocating responsibilities for systematization
	Inventory management process	

Source. Own authorship

For the purposes of focusing Observatory's technical assistance efforts, Figure 15 shows the degree of relevance assigned by countries to specific parameters perceived by them as priorities to improve the maturity of their national GHG inventories for the oil and gas industry and for methane emissions.

Figure 15. Prioritization of parameters to improve the maturity of inventories

Source. Own authorship

6. CONCLUSIONS

After analyzing countries' reports, different levels of identification of needs, gaps and restrictions within the GHG inventory preparation process have been evidenced.

From the perspective of assessment parameters and criteria integrity, the countries with a higher level of maturity in their national GHG inventories are Argentina, Colombia, and Mexico (in the group of medium and large LAC oil and gas producers); Chile (in the group of micro and small producers), and Panama (in the group of importers). Below the main conclusions are shared:

Institutional maturity:

- There is a correlation between the countries that have drafted legal instruments to supplement general UNFCCC and Paris Agreement guidelines and those who have reached a higher level of maturity in the preparation of their national GHG inventories, especially with regard to the definition of roles and responsibilities of public and private stakeholders as information providers, and the identification of improvements for updating cycles and reporting frequencies.

- As for the challenges identified by countries in connection with the transition to the Enhanced Transparency Framework, a window of opportunity has been identified for strengthening the legal frameworks for the preparation of national GHG inventories, and to set out reporting and disclosure guidelines for productive sector parties in charge of providing information to prepare the inventories.

- Regulatory frameworks should be leveraged to formalize inter-institutional arrangements and assign roles and responsibilities within relevant energy and environmental agencies and coordinating entities.

- Interruptions or reductions in international financing could compromise the frequency and quality of the processes for preparing national GHG inventories in countries that depend largely on these funds.

- However, in those countries that have implemented practices such as the early allocation of dedicated resources from the annual budget of coordinating entities and/or other entities that contribute to the preparation of GHG inventories (as a result of international or national cooperation agreements or otherwise), it is possible to observe higher levels of data disaggregation, higher reporting frequencies, and the implementation of information and quality management systems.

- Some countries, like Argentina, Colombia, Panama, and Chile, have also monitored the implementation of general and sectoral-specific improvements mentioned in their previous reports, including, among others, technical cooperation agreements with public and private sector institutions to measure, report, and include emission factors and activity data in the estimations for the oil and gas industry; standardized methodologies to obtain data on a regular basis and to reduce the gap between reporting and occurrence.

- High employee turnover or lack of human resources for the large volume of work involved in preparing national GHG inventories is one of the main challenges faced by LAC countries,

as well as the difficulty to retain trained staff, specialized institutional memory, and the consolidation of document management systems.

Methodological maturity:

- The needs expressed both in the reports submitted by countries to the UNFCCC and in the initial assessment questionnaire regarding the development of national or technology-level emission factors to reduce uncertainty and to add new subcategories non-reported before is closely related to the need for making progress towards institutional arrangements with other stakeholders, such as national, regional or international academic and research centers, and the availability of resources and effective measurement and report technologies.

- Many countries state that it is necessary to explore alternatives to set a minimum level of granularity in the process of collecting activity data for OLADE countries and to build or strengthen the capacity to obtain and include plant-level data to estimate GHG emissions.

- Countries are especially interested in building capacities to estimate fugitive emissions, defining protocols and procedures to obtain data from each production chain process—taking into account their particular circumstances—, and identifying emission volumes estimated with a higher degree of certainty, so as to implement effective mitigation measures and strategies.

Data base quality and integrity:

- All countries with time series of less than 15 years encountered difficulties to ensure the continuity, consistency, and replicability of input data and long-term estimations in their national GHG inventories. These difficulties resulted from long-standing financial, operative, and technical needs or from particular institutional or financial barriers.

  The impact of these difficulties on the periods covered by their time series results in additional obstacles associated with the lack of sufficient information to analyze historical trends for emission sources and compromises the effectiveness of decision-making processes aimed at implementing industry-specific and evidenced-based mitigation actions.

- The development of information quality and management systems is perceived as an advantage (by the countries that already have these systems in place) and as a desirable goal (by those that expect to have these systems in place in the short or midterm) to ensure the transparency and strength of their national GHG inventories, to record historical trends, and to include comparable data in their future inventories, managing uncertainty and designing, implementing and monitoring improvement plans.

Level of use:

- The importance of inventories in the decision-making processes of member countries should encourage improvements in the accuracy of estimations (reduction of uncertainty) for better decisions regarding planning instruments to set mitigation goals for the oil and gas industry and the long-term availability of inventories.

- It is worth highlighting that, in their reports to the UNFCCC, some countries express their interest in implementing engagement, disclosure, and data contribution tools for other stakeholders to contribute in the preparation of future inventories.

Systematization:

- Despite the fact that the use of databases in public websites in the countries that report the use of information systems have been observed, in the rest of the countries the information available is the same information included in the national inventories or in the communications submitted to the UNFCCC. For this reason, all efforts to achieve a higher degree of consolidation of information systems become especially relevant to facilitate the process of entering and accessing activity data and emission estimations, create reports, and consider aggregated information for the region in the future.

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