ASEAN Guidelines on Facility-level GHG Measurement and Reporting

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Contents

Abbreviations

AD	Activity Data
AFOLU	Agriculture, Forestry and Other Land Use
AMS	ASEAN Member States
ASEAN	Association of Southeast Asian Nations
AR	Assessment Report
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CH_4	Methane
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
COP	Conference of the Parties
CPA	Carbon Pricing Act
ECA	Energy Conservation Act
EDMA	Emissions Data Monitoring and Analysis
EF	Emission Factor
ETF	Enhanced Transparency Framework
EU-ETS	European Union Emissions Trading System
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISO	International Organization for Standardization
JCM	Joint Crediting Mechanism
HFC	Hydrofluorocarbon
MOU	Memorandum of Understanding
MPG	Modalities, Procedures and Guidelines
M&R	Measurement & Reporting
MRV	Measurement, Reporting & Verification
NCCS	National Climate Change Secretariat
NDC	Nationally Determined Contributions
NEA	National Environment Agency
NF_3	Nitrous trifluoride
N_2O	Nitrous oxide
PDCA	Plan-Do-Check-Act
PFCs	Perfluorocarbons
QA	Quality Assurance
QC	Quality Control

TACCC	Transparency, Accuracy, Completeness, Comparability, Consistency
TMG	Tokyo Metropolitan Government
UI	User-Interface
UNFCCC	United Nations Framework Convention on Climate Change

I. Background and Objectives

<<For Government and Private Sector>>

1. The Objectives of the Guideline

[Introduction]
The objective of the Guideline is to support the establishment of facility level GHG measurement and reporting systems (hereafter referred to as GHG reporting systems) for ASEAN Member States' governments and private sector stakeholders in the measurement and reporting of facility-level GHG emissions.

Since the use of the term "Measurement, Reporting and Verification (MRV)" in the Bali Action Plan which was adopted by the COP in 2007, the UNFCCC and the Paris Agreement have developed and added guidance on MRV (for example, Decision 1/CP.13 on Bali Action Plan and Decision 21/CP.19 on general guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties). Internationally, "MRV" generally means submission of national reports (e.g., national communications, biennial update reports, or biennial transparency reports) associated with national GHG inventories and the progress of achieving national climate actions. In this context, in addition to the fact that Verification may be required to different degrees for different purposes, the MRV system for GHG emissions at facility level covered by these Guidelines may or may not require Verification, depending on the country. Thus, this Guideline does not provide any steps on how to conduct verification of facility-level GHG emissions. This Guideline refers to the Measurement and Reporting (M&R) system as the common element.

In the context of domestic arena, there are still various types of "M&R" systems. Sectoral-level M&R often refers to tracking the respective emissions of an entire sector, such as energy, IPPU, waste, agriculture, forestry and other land use (AFOLU). The sector-level M&R is often based on statistical data to inform the general trend of emissions, and often to assess the degree of effectiveness of sectoral mitigation policies.

The facility-level M&R is based on GHG emissions of designated facilities such as a power plant or a factory, whereby emitters can revisit their GHG emissions resulting from economic activities and consider possible ways to reduce future emissions. Sometimes, this term has been used with "corporate-level M&R" interchangeably, however, "corporate-level M&R" can involve multiple facilities. The project-level M&R covers GHG emissions within a boundary specific to a project. It is basically used to assess the emission reduction of projects, such as those under the Clean Development Mechanism (CDM) or Joint Crediting Mechanism (JCM) projects, which include issuance of carbon credits for offsetting purposes.

In recent years, organizations tend to assess their carbon footprint voluntarily using different Guidelines such as the GHG Protocol, ISO 14064, IPCC Guidelines, etc., to meet different objectives (e.g., at the request of stock exchanges, shareholders or investors).

M&R of GHG emissions at the facility level, on which this Guideline focuses, will motivate the facilities to contribute to the country NDCs under the Paris Agreement and the carbon markets by applying mitigation actions to reduce their current GHG emissions. However, M&R of GHG emissions at the facility level is subject to various policy considerations. It is therefore up to each country to decide the purposes for which M&R of GHG emissions at facility level will be implemented.

Under the first phase of the PaSTI-JAIF project, the uptake of M&R for preparing GHG inventories was analyzed on three dimensions: i) At national level; ii) At sectoral and policy levels; and iii) At the facility/installation level. The survey showed that ASEAN Member States (AMS) were at different stages of development and levels of readiness for implementing M&R at the facility/installation level, ranging from non-existent to fully implemented. In particular, many AMS have strong willingness to engage the private sector in climate change mitigation while some of them are interested to develop domestic GHG measurement and reporting systems targeting the private sector, together with the need to share relevant knowledge and experiences.

As some countries have not yet started to fully develop their GHG M&R systems, there is a need-to-know the steps to be taken while developing GHG M&R systems, and the possibility to make use of the MRV experiences of other countries. This Guideline sets out the components to be included; and the steps to be followed by administrative officials in AMS when establishing a national mandatory or voluntary GHG M&R system.
Please note that the Guideline is not binding on the current system in any AMS or the GHG M&R system to be established in the future, and those are left to the discretion of each country.

Objectives of the Guideline are as follows:

- ✓ To share standard steps and procedures for developing facility level GHG reporting system for AMS;
- ✓ To provide useful prototypes, formats, and institutional models for a GHG reporting system; and
- ✓ To highlight key elements, including consistency with international standards, robustness of GHG calculation, and scalability for other relevant systems such as carbon pricing mechanisms, while promoting gradual improvement and capacity building.

The Guideline will provide guidance for operating a pilot GHG reporting system for demonstration.
It is expected that those in charge of M&R will be able to use the Guideline in order to establish a facility level M&R system for GHG emissions, and finally be able to implement such a system. In

addition, it is expected to be a guide for the private sector to learn the basics of GHG emissions M&R systems as well as potentially create opportunities for the private sector to be involved in the development of national M&R systems.

2. Key Concept and Structures of the Guideline

This section provides a brief introduction to the chapters in this report.

Chapter 2 introduces the generic image of the facility-level GHG M&R System, including objectives (benefits for the private sector and the governments), institutional structure and essential modality and procedure.

Chapter 3 provides an understanding of the target GHGs, the target sectors that emit GHGs and the methodologies for calculating GHG emissions. The methodology for calculating GHG emissions includes references to various methodologies, including CDM, ISO 14064, GHG protocol, Singapore's carbon tax, Japan's Mandatory GHG Accounting and Reporting System and refers to the philosophy behind the construction of the methodology.

Chapter 4 enhances the understanding of the criteria for entities that emit GHGs, the reporting content, and the documents that serve as a template for reporting. In developing a reporting system, it will also focus on the benefits that can be gained by ensuring consistency with other reporting systems, such as energy use monitoring systems.

Chapter 5 introduces the steps within an administrative body to establish a GHG emission reporting system, such as taking stock of the existing relevant legal and policy framework. These steps include not only the steps to be taken within an administrative body like one ministry, but also the engagement of private entities in the establishment of the system, and the coordination with other relevant ministries.

II. What is the facility-level GHG Reporting System?

<<For Government and Private Sector>>

> [Introduction]
> As a starting point, this chapter introduces the generic image of a facility-level GHG Measurement and Reporting System, including objectives (benefits for the private sector and the governments), institutional structure and essential modality and procedure.

1. The Objectives of the System

The main objective of the facility-level GHG reporting system is to provide transparency on GHG emissions at individual GHG emitting facilities and corporates, and to facilitate the emitters to reduce the GHG emissions caused by their economic activities. The system can be introduced either by the government or as a program by a group of corporates.

Here, the "system" means a set of institutional guidance and procedures of GHG reporting according to which facilities or entities are required to measure and report their GHG emissions to the system owners. The "system" is usually governed by the government based on legal designation or by voluntary system owners (secretariat), which provides facilities with terms and conditions of participation in the voluntary system. The "system" sometimes means an electronic platform where facilities can submit their report to the system owners. In order to differentiate the institutional system and the electronic vehicle, these Guidelines call the latter as "electronic reporting system".

As illustrated in Figure 1, some of the activity data[1] collected to assess the GHG emissions of facilities can be used to prepare the GHG inventory of the country. Country specific/facility-specific emission factors developed under the MRV system may also be used to develop the GHG inventory using higher tier approaches (e.g., modelling). Further, governments may use the emissions of the facilities to create the basis for trading the GHG emission reductions[2] and developing carbon pricing mechanisms, i.e., carbon tax, emissions trading scheme, and others. As these schemes will require foundational data of periodic GHG emissions for imposing obligation, the GHG reporting system creates an enabling environment for the governments to consider such an extended intervention.

If facilities are interested in voluntary corporate reporting systems such as Science-Based Targets (SBT), Carbon Disclosure Project (CDP), etc., the facility-level MRV system will be a great asset to

[1] Part of the information required for GHG inventory preparation can be collected from the M&R system and further information on available data in the M&R system is reported in section 3.1 – Target Sectors

[2] Estimated GHG emissions of facilities can be used to decide the CAP of ETS and tax base of carbon tax when planning and implementing the CPIs.

maintain the sustainability of the reporting system[3]. Also, as an essential aspect of contemporary economic activities, disclosure of GHG emissions is required at various times. These include the disclosure requests to producers and service suppliers in a supply chain, the listing of stocks in a certain market segment of stock exchange, and other occasions.

Moreover, an M&R system provides the inputs to develop climate change policy, energy efficiency policy, GHG reduction strategy, etc. at the facility, sector, and country levels.

[3] Part of the information required for SBT, and CDP can be collected from the M&R system

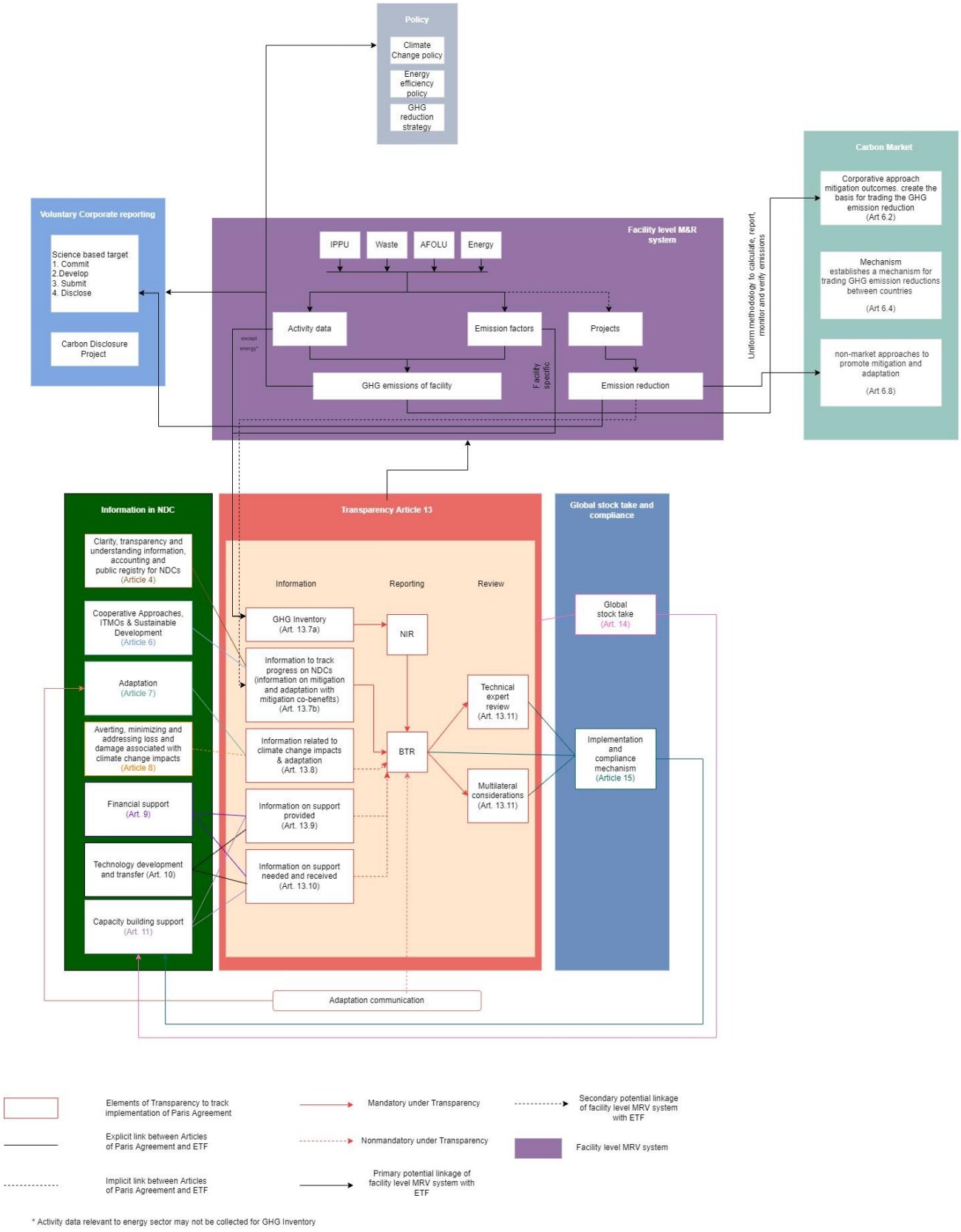


Figure 1: Linkage of proposed Guideline with international and national reporting requirements[4]

4 Activity data relevant to energy sector may not be collected for GHG Inventory.

A) Expected outputs

[For the private sector]

- The facility-level GHG reporting system will provide a Plan-Do-Check-Act (PDCA) cycle for GHG emitters at facility level to understand and revisit their own emissions, with a view to reduce them.
- In the recent trends, by participating in facility-level GHG reporting systems, corporates are meeting requirements in the supply-chain by their business partners, increasing competitiveness, and in some cases, obtaining better access to Environmental, Social and Governance (ESG) investments[5].

[For the governments]

- The facility-level GHG reporting system will provide access to bottom-up data, directly reported by facilities.
- It will help the governments to develop more effective policies and measures targeting specific groups of GHG emitters (Once the data are verified)

Data at the national GHG inventory are based more on statistics, and in many cases, they have a macro-perspective (for example, GHG emissions in the energy sector are based on the amount of imported fuels), and they are not always useful for formulating a policy to lead GHG reduction in a specific economic sector. On the other hand, the facility-level GHG reporting system will provide a breakdown of emissions and historical data of individual facilities, which enables analysis by highlighting trends of certain groups/sub-sectors, identifying root causes of emissions, and formulating potential solutions.

B) Potential benefits, providing foundation for extended schemes with scalability

The facility-level GHG reporting system can provide a foundation for extended interventions, including introducing and linking with other indicated activities such as carbon pricing, disclosure, stock exchange etc.

As the system provides specific data and information, emission standards, incentives and disincentives can be introduced. Also, awareness raising and capacity-building through consultations with emitters may be useful. [See “Column 1” on the case of the Tokyo Metropolitan Government and its GHG reporting system under the Environmental Protection Ordinance]

[5] In some stock markets, sustainability index criteria are introduced, requiring disclosure of corporates’ GHG emission amount. This can be a variation of facility-level GHG reporting, which is closely linked with ESG investments.

Column 1

GHG reporting system under the Global Warming Action Plan

by the Tokyo Metropolitan Ordinance on Environmental Protection

In 2002, the Tokyo Metropolitan Government (TMG) issued the Ordinance on Environmental Protection to oblige corporates to measure and report their GHG emissions and submit their emissions reduction targets. Also in 2005, the TMG strengthened the system by adding its mandate to provide administrative guidance and advice to respective corporates, for the purpose of leading them to develop and implement GHG emissions reduction efforts. For example, reporting corporates are provided information on comparison with other corporates in the same business sector and become aware of the ranking of their carbon intensity per unit of energy consumption. Also, the TMG often organizes demonstration workshops or training by sector (e.g. hotels, retailers, factories, etc.,) for technical staff members of reporting corporates to share and discuss effective ways to reduce GHG emissions. Also, in the reporting system, corporates are required to report not only the GHG quantities but also the equipment specifications and durability. This has enabled the TMG to provide specific recommendations to corporates to consider introducing more energy-efficient equipment along with their equipment updating cycles.

As a result of the series of efforts, the TMG's energy-based GHG emissions gradually decreased as shown in figure 2. Also, based on these practices, the TMG initiated an emissions trading scheme (Cap and Trade system) for mandatory participation by large corporates in 2010, while small and medium sized corporates continued to be under the mandatory reporting system.

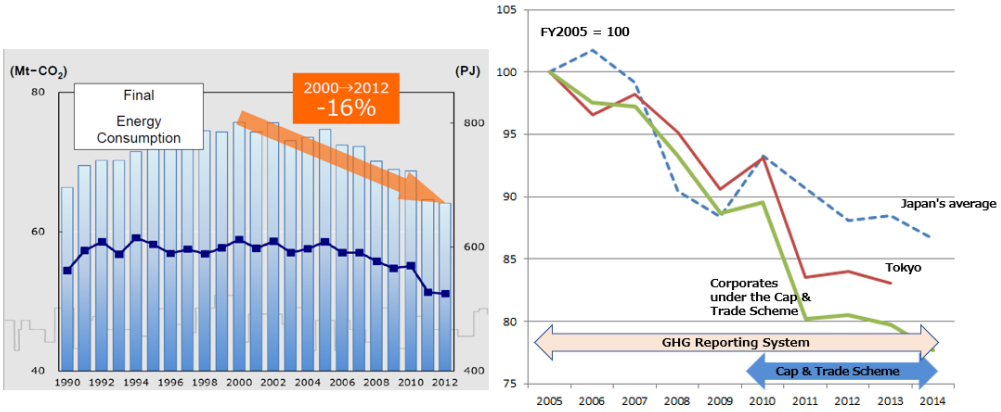


Figure 2:(left)- Changes in the final energy consumption and CO_2 emissions in Tokyo.

Figure 3:(right)- Changes in GHG emissions per unit/floor area in Tokyo and Japan's average

(Source: City-led building energy efficiency Tokyo and Other Cities, Bureau of Environment, TMG)

2. Essential Structure

The essential structure of a GHG reporting system (a case of introducing the system by government legislation) can be as follows:

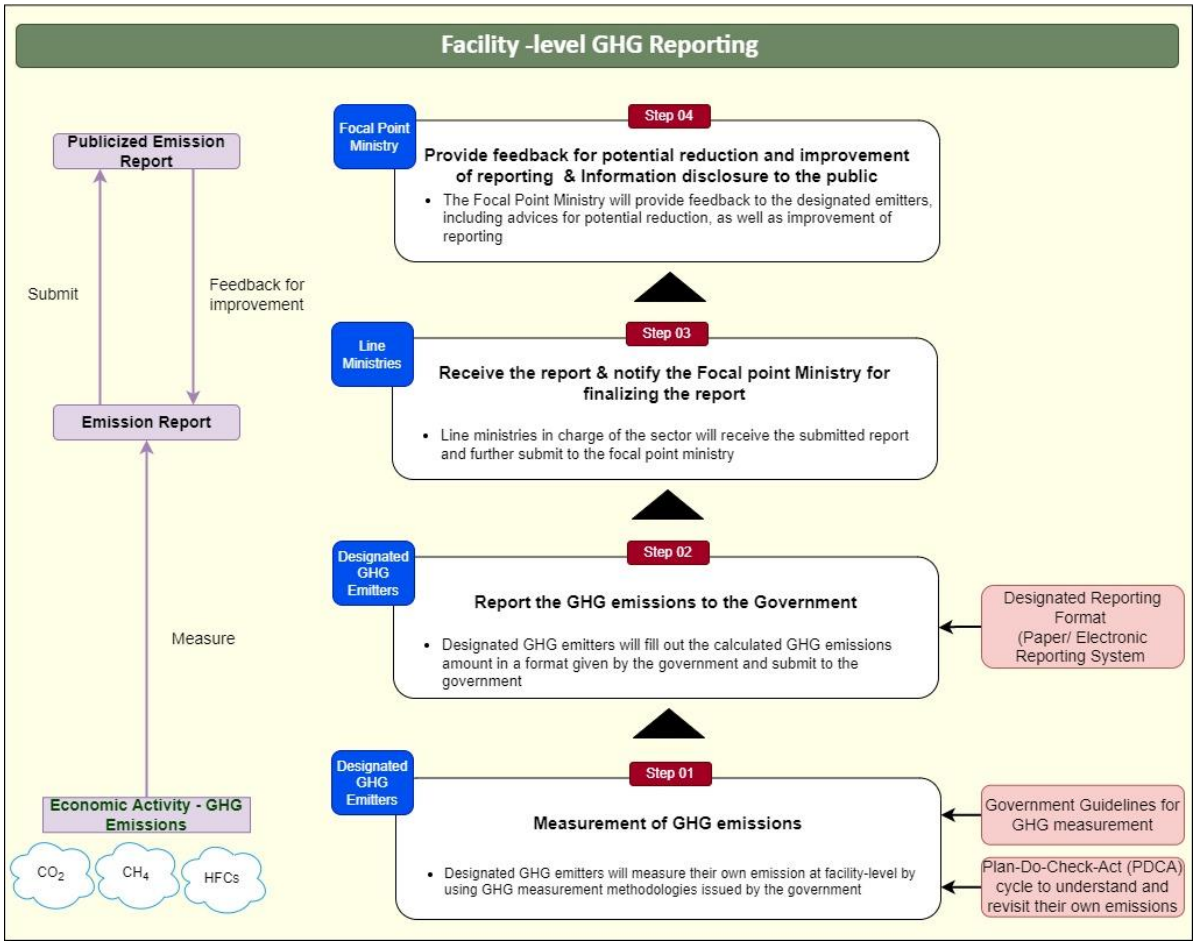


Figure 4: Generic structure and steps for facility-level GHG reporting

As shown in Figure 4, the generic structure of the facility-level GHG reporting is as follows.

- Step 1: Designated GHG emitters will measure their own emissions at facility-level using GHG measurement methodologies issued by the government.
- Step 2: Designated GHG emitters will fill out the calculated GHG emissions amount in a format given by the government and submit the report to the government.
- Step 3: Line ministries in charge of the sector will receive the submitted reports and forward those to the focal point ministry.
- Step 4: The focal point ministry will provide feedback to the designated emitters, including advice for potential reduction, as well as improvement of reporting.

Column 2

Singapore's Carbon Tax

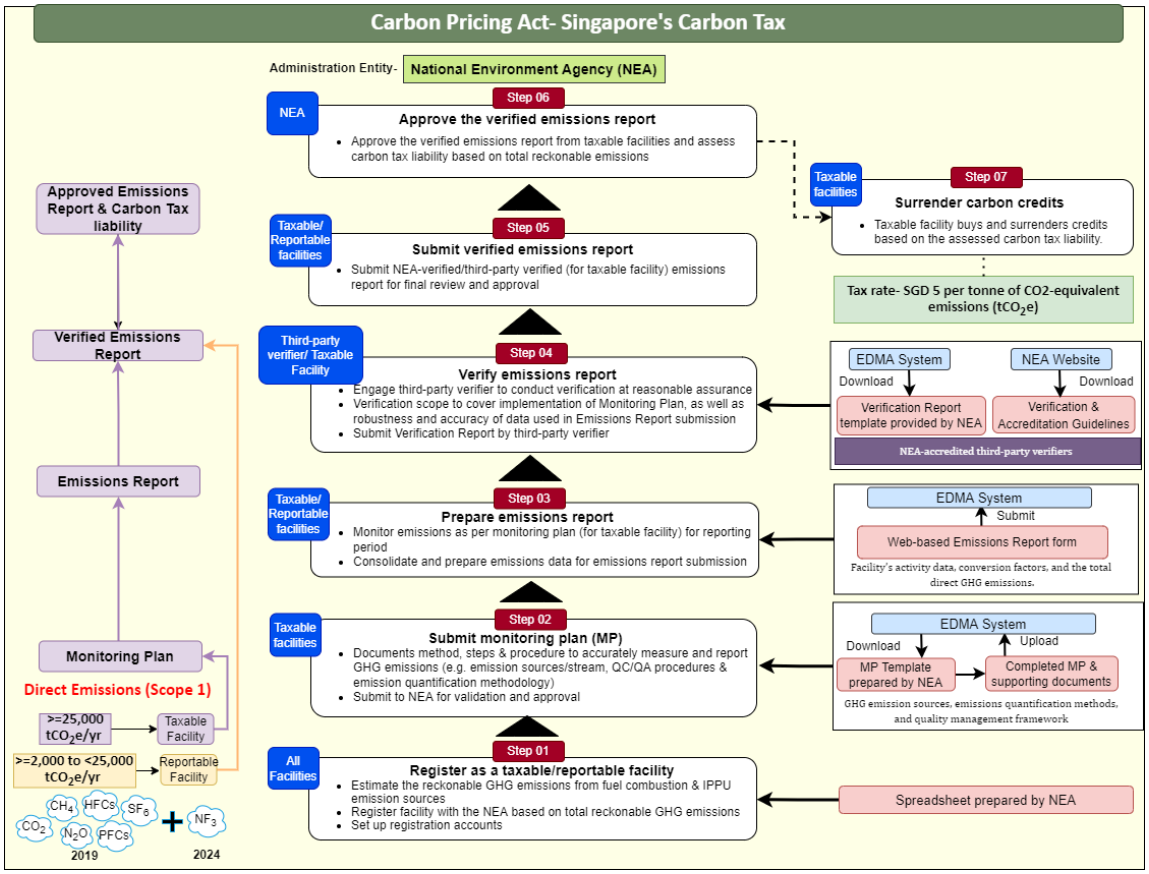


Figure 5: Key steps of Singapore's Carbon tax

*Detailed information on Singapore's Carbon tax is in Annex 01

3. Key considerations of facility-level GHG reporting

The following are the key considerations under this reporting system. They are explained in the next section.

- Methodologies for measurement of GHG emissions (Chapter III)
- Reporting format (Chapter IV)
- Line of reporting in the government (Chapter IV)
- Ways to provide feedback, including publicization (Chapter IV)

Figures 6 and 7 below indicate the process of establishing a voluntary and mandatory M&R system respectively. Relevant chapter numbers are shown in the white circles in the diagram. Further, they are provided quick overview at the beginning of each chapter which is intended for government or private sector.

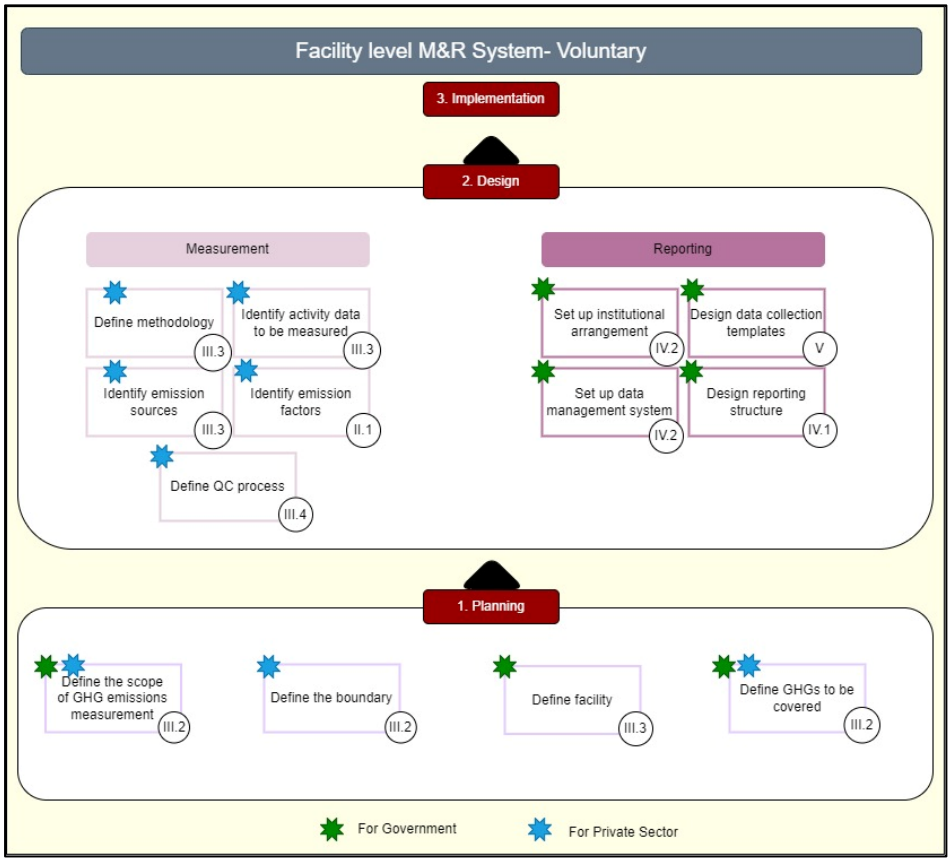


Figure 6: Process of establishing a voluntary M&R system

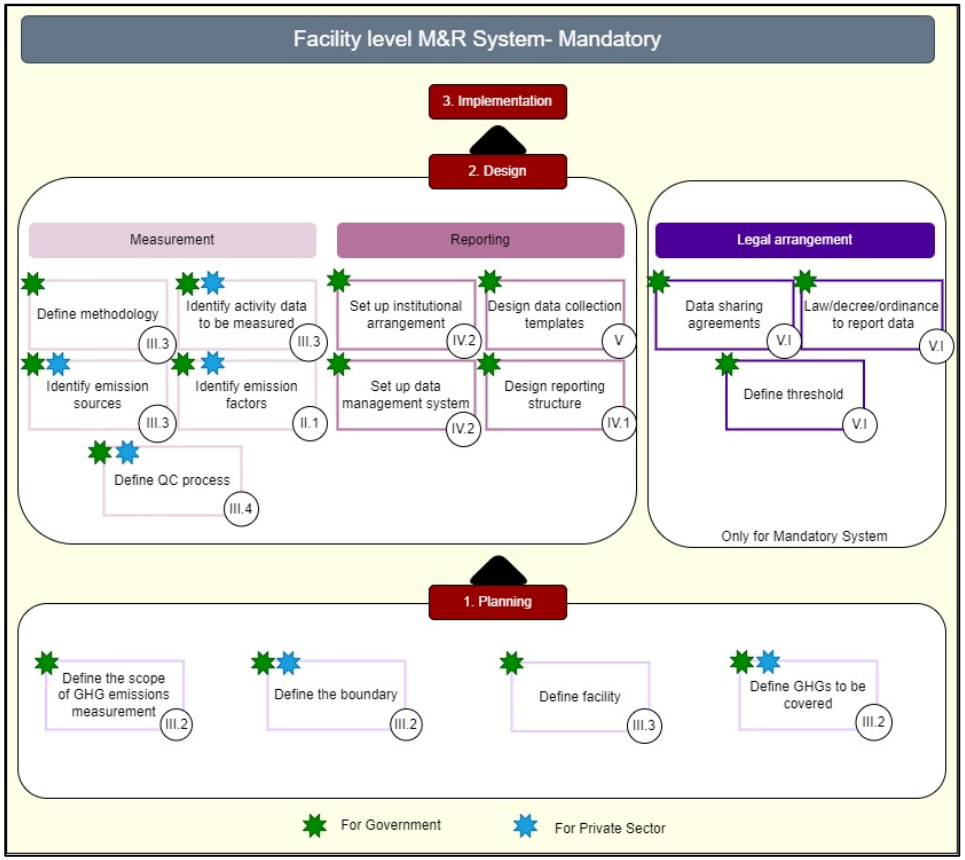


Figure 7: Process of establishing a mandatory M&R system

III. Methodologies for the Measurement of GHG Emissions

<<For Government and Private sectors>>

Introduction: This chapter explains the measurement of GHG emissions using the M&R Guideline. Target sectors, scope of GHG emission measurements, Gases covered, methodologies for GHG emission measurements, and issues related to estimation of GHG emission amounts are explained in detail. Further, it will describe how to maintain the quality of reporting GHG emissions using Transparency, Accuracy, Completeness, Comparability, Consistency (TACCC) principle. The Guideline also addresses the issues of consistency and coordination of the administrative divisions of each country and those based on the classification of national GHG inventories under the IPCC Guidelines or the Enhanced Transparency Framework (ETF) under the Paris Agreement.

1. Target sectors

The English word "sector" can be used in different ways when discussing GHG emissions. In this document, unless other words are used (such as "private sector"), the word "sector" would mean one of the five national GHG inventory sectors (Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), and Waste) as defined in 2006 IPCC Guidelines. Each sector consists of several categories (The term "sub-sector" used in the report "Road Map for Designing Facility Level GHG M&R Guideline for ASEAN region" is equivalent or similar to "category" here).

Figure 8 below shows an example of a hierarchical sector-category-subcategory structure defined for the Energy sector in 2006 IPCC Guidelines. Each country doesn't have to follow this classification; however, it is recommended to develop a set of hierarchical classification of emission categories to reduce risk of double-counting or omission of emissions. Other classification systems may be developed based on, for example, areas of administration of ministries/departments.

Each country must decide on target sectors to be reported. Fuel combustion under energy sector will be covered in all M&R systems. The IPPU sector - cement production in particular, can also be a significant source of GHG emissions. Industrial waste data can be informative for national GHG inventory, while it will pose substantial technical challenges for reporting facilities. Agriculture and Forestry can be significant sectors in AMS. Consideration and consultation are required on whether facility-level reporting is necessary (no other feasible options available), significant (compared to the national total), efficient (workload for reporters and administration is minimized), and technically feasible to cover the sectors for National GHG inventory and/or mitigation monitoring purposes.

When defining the target sectors, existing reporting requirements within the country should be reviewed.

Harmonization of reporting requirements is necessary to minimize the burden on both reporting facilities and administration. In particular, close coordination with energy audit systems is critical.

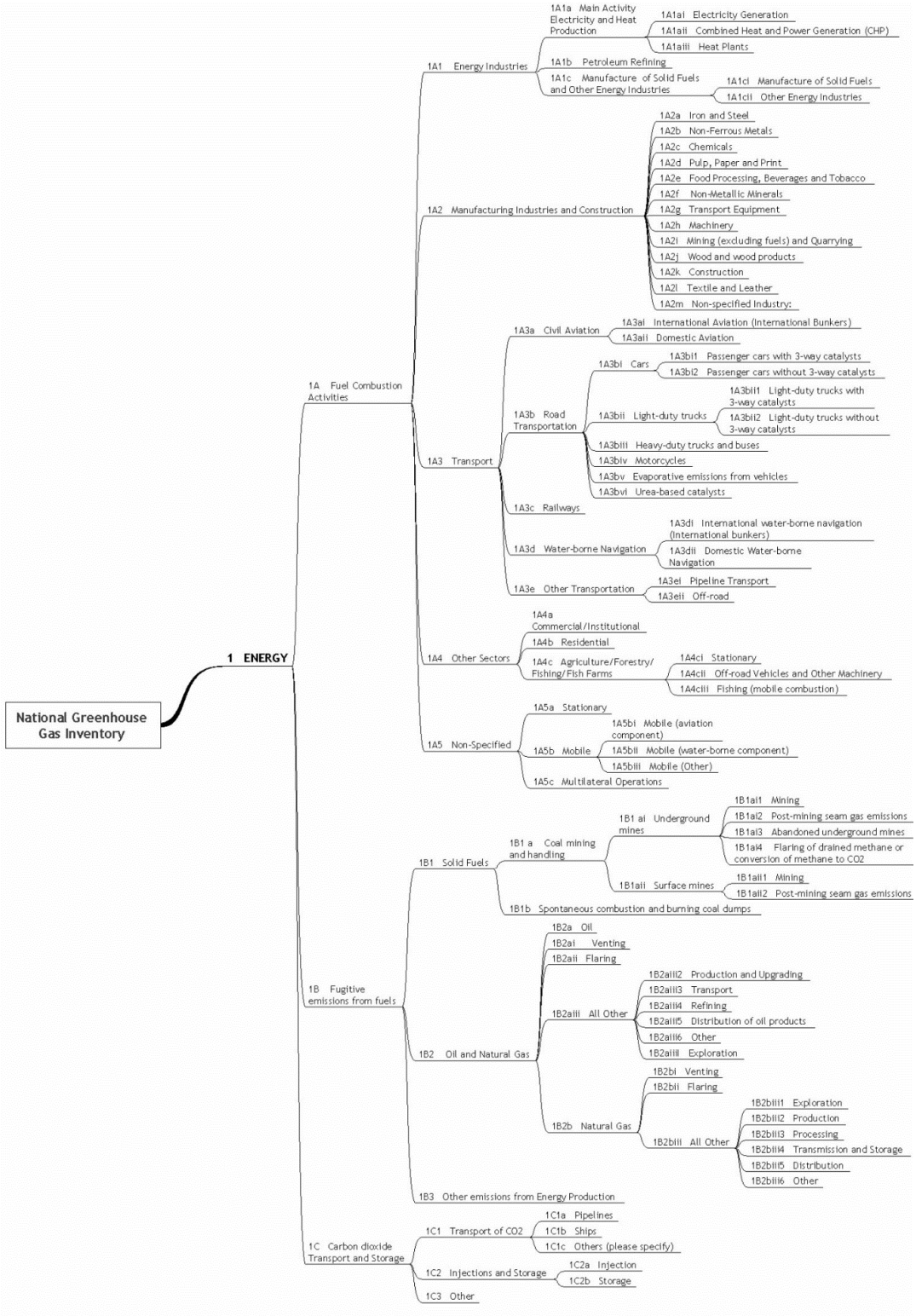


Figure 8: Categorization of GHG emissions in the energy sector, ramified into subsectors (Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories)

2. Scope of GHG emissions measurement

Scope of GHG emissions measurements must be defined, typically into project level, facility level, local and national measurements. Emission inventories of facility, local or national level accounts for all emissions (and removals if appropriate) within the geographical boundary, while project level measurement is interested in emission reduction amount from a series of interventions (e.g. energy saving, gas recovery and so on). This Guideline focuses mainly on facility level inventory. Some readers of these Guidelines may be familiar with the Clean Development Mechanism (CDM) or the Joint Crediting Mechanism (JCM), where project level measurements are performed. It should be noted that emission reduction amount may be reported additionally, however, it will not be discussed further in this Guideline.

When thinking about emissions within the geographical boundary, emissions from burning fuels in the property is a straightforward example. Such emissions are called direct emissions. It is also natural to consider that a facility is responsible for some emissions outside the location, such as consumed grid electricity that are (partially) supplied from power plants. Those are called indirect emissions. For further classification, the idea of scopes 1, 2 and 3 as defined in the GHG protocol has become popular currently (Figure 9). Scope 1 means emissions attributed to sources which are owned or controlled by the organization. According to the Greenhouse Gas Protocol, scope 1 emissions at company level can be summarized as follows:

- Generation of electricity, heat, or steam. These emissions result from combustion of fuels in stationary sources, (e.g., boilers, furnaces, turbines)
- Physical or chemical processing. Most of these emissions result from the manufacture or processing of chemicals and materials, (e.g., cement, aluminum, adipic acid, ammonia manufacture, and waste processing)
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars)
- Fugitive emissions. These emissions result from intentional or unintentional releases, (e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport).

Scope 2 includes some indirect emissions. These are emissions associated with commodities called secondary energy such as electricity or heat used within the facility but the emissions from production of the commodity occur outside the facility. Electricity generation related emissions occur at power companies which are usually direct emitters. GHG emissions from secondary energy productions attributed to energy producers will be considered as scope 1 in National GHG inventories. Scope 3 is also indirect emission even covering production, use and disposal of products, passenger and freight transport conducted for the facility by third parties,

disposal of waste outside facilities and any other activities as far as relevant. For scopes 1 and 2, the facility managers can take measures to reduce the emissions by actions within the facility. For scope 3, addressing emissions is basically beyond the control of the facility managers, except for delegated activities by the facility. Following illustration indicates how emissions are categorized.

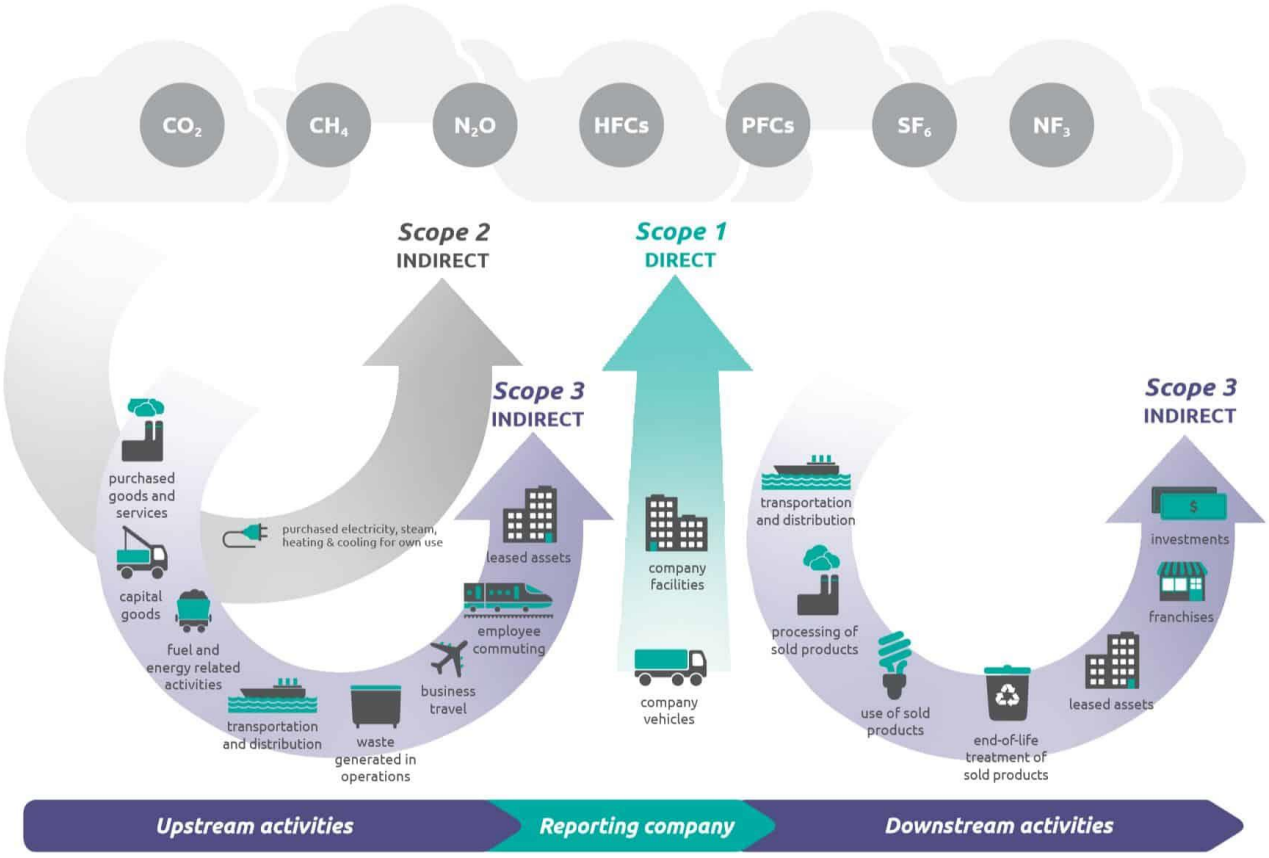


Figure 9: Scopes of GHG emissions (Source: Technical Guidance for Calculating Scope 3 Emissions (version 1.0), Greenhouse gas protocol)

For scope 2, it should be noted that secondary energy providers should deduct emissions from sold energy to avoid double-counting of emissions. In this case, a power company is responsible for its energy consumption and corresponding GHG emissions from the self-consumption (as well as transmission and distribution if transmission is not delegated to another company). Identifying grid emission factors poses another challenge on timelines of reporting. Secondary energy users can't complete estimation unless the grid emission factor is derived from reports from secondary energy providers. Japan applies grid emission factors calculated from data of the previous year, which reduces stringency in estimated emissions. In addition, scope 1 has a larger emission coverage than scope 2 when it comes to facility-level reporting because a certain portion of sold electricity goes to residential and other consumers who are not reporting entities under the scheme. When summing

up total emissions from reporting entities, scopes 1 and 2 will not result in overlap of emissions, while double counting is inevitable for scope 3.

Many carbon reporting systems such as the Carbon Pricing Act of Singapore, are based on scope 1 emissions. The M&R Guidelines recommend at least scope 1 emissions to be subject to mandatory reporting. Scope 2 emissions would be adopted in systems stemming from energy audit purpose or the like, for the interest of reducing overall energy consumption at each facility. Application of scope 2 depends on the specific objectives of the M&R system, institutional arrangement, preparedness of reporting entities and so on. Scope 3 is informative for consumers when choosing products with less emissions, while it may not be necessary for a government to require reporting. Moreover, its estimation method is not as established as scopes 1 or 2. In the case of ISO 14064-1 "Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals", reporting of scope 2/ 3 emissions are required in addition to Scope 1 if they are determined as significant by the reporting entity.

Japan's Mandatory GHG Accounting and Reporting System basically covers scope 1 and 2 emissions from transport of raw material and products by third party transportation providers, and a methodology is also provided for that purpose. Although GHG emissions from such activities are usually classified as scope 3; however, this arrangement could encourage selection of less-emitting transportation by facility side. Such partial scope 3 might be adopted as scope 2 under certain conditions such as: (i) facilities having control of the emissions through selection of the service provider or contract, (ii) such options are available throughout the country, (iii) the system owner has capacity to provide information and guidance on estimation, and (iv) existence of a policy to promote such mitigation action. Disposal of wastes could be another example of such. It is advisable for the system owner to be aware of such modifications in scope 2, if any, for international comparability.

The table below shows indicative choices of scopes against purposes. An M&R system may serve different purposes and require data from a particular scope, provided that reporting formats indicate that explicitly, and reporting burden is minimized. For example, the primary objective of an M&R system may be energy audit thus scope 2 is chosen, while scope 1 emissions are also estimated based on the same data set and used for international carbon trading.

Scope 1	Preparation of national energy statistics and/or GHG inventory (specially for international), carbon pricing mechanisms, calculating grid emission factor, voluntary reporting/disclosure schemes
Scope 2	Energy audit, awareness raising on emissions, (domestic) carbon pricing mechanisms (more detailed design needed), voluntary

	reporting/disclosure schemes
Scope 3	Information for investors, customers and public including voluntary reporting/disclosure schemes, awareness raising on environmental impacts; (expanded scope 2)

Coverage of GHG emissions must be defined. Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are common GHGs. On the contrary, many AMS may not have perfluorocarbons (PFCs) and nitrous trifluoride (NF_3) emissions covered in the system. Hydrofluorocarbons (HFCs) must have been emitted in all AMS while only some countries have reported such emissions due to technical challenges in identifying and monitoring the emission streams. Sulfur hexafluoride (SF_6) may also be the case. According to the Modalities, Procedures and Guidelines (MPG) under the Paris Agreement, national GHG inventories of the additional four gases (HFCs, PFCs, SF_6 and NF_3) must be reported and included in the Party's NDC under Article 4 of the Paris Agreement; covered by an activity under Article 6 of the Paris Agreement; or have been previously reported (para 48, Annex to Decision 18/CMA.1). An M&R system could cover gases that have not been reported in the national GHG inventory to fulfil the requirement, however, a legal basis for doing so may be required in some countries.

For aggregation of emission quantities expressed in CO_2 equivalent, Global Warming Potential (GWP) values have been applied globally. GWP should be in line with the NDC of the country, taking into account that the Enhanced Transparency Framework under the Paris Agreement which designates 100-year time-horizon GWP values from the IPCC's Fifth Assessment Report (AR5) or from a subsequent IPCC assessment report as agreed upon by the CMA for national GHG inventories (para 37, Annex to Decision 18/CMA.1). If the M&R system is designed to also handle HFC data and serve for administration of the Kigali Amendment under the Montreal Protocol, it should be noted that the Kigali Amendment refers to GWP values from AR4.

Under both ISO 14064 and GHG protocol, HFC is considered to assess the organizational Carbon Footprint of Products, therefore, it is important to consider HFC in facility level M&R as well. Further, as all the countries have to report under the ETF, it is recommended to use the GWP values given in the AR5. Data collection by gas species in actual amount, in addition to CO_2 equivalent emissions, is recommended (see para 49, Annex to Decision 18/CMA.1).

However, companies tend to prefer aggregated reporting rather than by gas species for the sake of confidentiality. Consultation with the industry will be necessary.

3. Methodologies for GHG emissions measurements

For the sake of simplicity in measurement, *almost all M&R systems adopt Activity Data (AD) × Emission Factor (EF) method to calculate emissions as the first choice.* UNFCCC requires reporting of GHG emissions caused by human activities, it is straightforward to apply data on activities for calculation.

For example, almost all facilities to be reported under the facility-level GHG measurement and reporting, consume fuels and electricity to implement economic activities. In such a case, the equation is likely to be determined as below:

Emission [Fuel Combustion] = AD [Amount of fuels by fuel type]
× EF [GHG emission amount per consumption of fuels by fuel type]

The combination of AD and EF must be defined for each emission category. Examples of equations can be found in IPCC Guidelines, GHG Protocols and so on. CDM or JCM may also be referred to, keeping in mind that they are project-based methodologies to calculate emission reduction amounts. The following list shows some typical examples. More extensive examples can be found in the Annex.

Activity/category (GHG)	**AD (unit)**	**EF**
Fuel combustion (tCO_{2e})	Consumed amounts of fuels by fuel type (kt, kl, m^3) × Calorific value	Emission factor per calorific value
Grid electricity consumption (tCO_{2e}) [scope 2]	Consumed amount of electricity (kWh)	Grid emission factor (kt-CO_2/kWh)
Freight transport by third party (tCO_{2e}) [scope 3]	Transportation load (tkm) *or* Cumulative distance of transportation (km) *or* Consumed amounts of fuels by fuel type (kt, kl, m^3) × Calorific value	Load-based emission factor (t-CO_2/tkm) *or* Fuel efficiency (t-CO_2/km) *or* Emission factor per calorific value
Cement production (tCO_2)	Amount of clinker produced (kt) *or* Amount of cement produced by cement type (kt) × clinker fraction of cement (± purchased/sold clinker)	Emission factor for clinker (kt-CO_2/kt-clinker)

Enteric fermentation of livestock (tCH_4)	The number of head of livestock species (head)	Emission factor by livestock species ($kg\text{-}CH_4$/head/year)
Wastewater treatment (tCH_4)	COD (Chemical Oxygen Demand) loading of wastewater (kg-COD) *or* Volume of wastewater (m^3) × unit COD loading by industry type ($kg\text{-}COD/m^3\text{-}wastewater$)	Emission factor by treatment type (incl. direct discharge)

Examples of information sources for reporting entities to fill activity data and other relevant information may be indicated as:

- Bills for purchasing fuels, energy commodities and relevant materials
- Stock changes of fuels and relevant materials between the initial and final days of the reporting period.
- Measuring equipment (e.g. air pollutant monitor, electricity meter, flowmeter)
- Records on waste disposal
- Other activity reports

Some categories under IPPU sector of the national GHG inventory consume fossil fuels as feedstock which are not consumed to produce energy (e.g. ammonia production and other petrochemical industries, coke for iron and steel production). One of the reasons for such segregation is for more accurate estimation of CH_4 and N_2O because of differences in oxidation conditions. It should be accounted for in the IPPU Sector as per IPCC Guidelines. However, it is often difficult to separate energy and non-energy uses and poses additional burden for reporting entities. Unless the reporting entity in the country has capabilities to report consumption as a feedstock or fuel, aggregated consumption of such fuels under energy sector may be sufficient. It is always good practice to consult with energy statistics compilers and the industries in the country to make a uniform reporting format in order to avoid lower comparability within the country.

Transportation is a tricky category for estimation. Typical scope 1 emissions include emissions from company-owned vehicles (e.g trucks or commuting buses), even though most of such emissions usually occur outside the geographical boundary of the facility. The approach is proposed by the facility owners. Control approach may be applied for scope 2/3 reporting as mentioned previously. The coverage of transportation for the M&R system should be clearly stated in the definition of facility. Data sources may also be diverse, as vehicles can be fueled at gas stations outside the boundary of the facility. These days, plug-in hybrid and electric vehicles would consume electricity taken from the facility or external recharging stations, which may further complicate calculation of total input energy for transportation.

Column 3

Building a definition of Facility

Physical boundary	Physical property, plant, building, structure, source, or stationary equipment, on contiguous or adjacent properties; in actual physical contact or separated solely by public roadway or other public right of way;
Ownership/control	owned/ controlled by a single person or entity
Operational boundary	Any activity or series of activities (including ancillary activities) that involves the emissions of greenhouse gases
Sector	Energy, Industrial Processes and Product Use (IPPU), Waste, Agriculture, Forestry, and Other Land Use (AFOLU)*

*This guideline can be used in AFOLU if there are appropriate methodologies in the boundaries under the control of the owners

It is important for the authority to define and acknowledge a methodology for every reporting item. In most cases, default EFs in IPCC Guidelines and country specific EFs for national GHG inventories are good information sources. Most EFs may not require frequent updates, but some, grid electricity EF for scope 2 reporting in particular, should be calculated and updated regularly by the relevant authority. Countries with experiences in CDM or JCM can utilize the section which provides grid emission factors every year, and/or this facility-level reporting may replace existing data collection process for the grid emission factor. While national GHG inventory will update EFs for continuous improvement, EFs for M&R system may be kept for a certain period to keep time-series consistency without recalculation (see column below).

On the other hand, the M&R system may be designed to allow application of facility-specific EFs. It is

particularly useful under some conditions such as: 1) For very large emitters of GHG relative to the national total emissions; 2) Have sufficient capacity to do so at facility side; 3) Third-party verification; 4) Such data are informative for the facility side (e.g. for monitoring energy saving or participating in carbon markets). Estimation based on mass balance, direct measurement of exhaust, or modeling (so-called higher tier methods) may also be the case.

Application of facility-level EFs or higher tier method should be encouraged as the first choice, followed by country-specific EFs for national GHG inventories of the country.

Column 4

Time-series consistency, methodological improvement, and simplicity of reporting

- Under the ETF of the Paris Agreement, continuous improvement of reporting is required (Section I.D, Annex to Decision 18/CMA.1). In the case of national GHG inventory, "recalculation", or updating the previously reported numbers by applying the latest methodology throughout the time series, is to be conducted where methodological improvement (such as revision of EFs) occurs in order to foster methodological improvement while keeping time-series consistency (Section II.C.3 Annex to Decision 18/CMA.1).
- Recalculation may not be applicable for M&R systems in many cases in view of additional burden of handling historical data.
  - Where accuracy of the latest emission data is more critical for the reporting system than time-series consistency (e.g. carbon market), EFs should be updated as frequently as applicable.
  - In view of the objective for private sector to stimulate self-checking of emission levels, it may not be worth updating EFs frequently.

Methodology for facility level can be simpler than that of national/local GHG inventories in some cases, in order to minimize burden to businesses. This is especially the case for categories where the activity in previous years affect emissions in this year. Methane emissions from solid waste disposal sites under the waste sector and HFC emissions from recharging refrigerants under IPPU sector are some examples. In Japan's Mandatory GHG Accounting and Reporting System, AD [annual organic waste amount] multiplied by EF is the methodology for facility-level reporting, instead of the complex First Order Decay method which requires cumulative amount of organic waste for more than 20 years. For HFC refrigerants, annually recharged amount is the activity data for annual

emissions instead of refrigerant bank amount, or estimated total amount used in equipment.

4. Quality of reporting and Quality Control activities

On quality of reporting, TACCC principles on GHG inventories and reporting to UNFCCC are well-known, TACCC stands for:

- **T**ransparency: Methodology and results are clearly described so that a third-party can reproduce a result. This includes archiving of historical data for ex-post verification.
- **A**ccuracy: Estimation is based on the best knowledge available at the moment, and systematic under-estimation or over-estimation is minimized.
- **C**ompleteness: All relevant emissions and removals occurring within the boundary are included, minimizing double-counting or omission.
- **C**omparability: Applying the same scope, classification, and methodology as far as appropriate.
- (Time-series) **C**onsistency: Same methodology is applied throughout the time series which allows trend analyses.

These principles are more or less applicable for facility level reporting, with different focuses. Comparability and consistency would be the most important for awareness-raising purposes. Time-series consistency enables observation of trends in GHG emissions from reported data which may reflect mitigation efforts of each facility. Comparability in this context would mean comparability among reporting entities, in particular under a same industry, for benchmarking purpose. Transparency and completeness would be mainly the responsibility of the authority for the design of reporting formats. Reporting entities are encouraged to archive the basis for reporting as a practice on transparency. The required level of accuracy depends on the purposes and preparedness of reports. Accuracy is particularly necessary when the M&R system is linked with any carbon pricing mechanism or other statistical reporting. A pilot reporting period (for a few years at least) should allow reporting entities to be acquainted with reporting practices and improve accuracy.

In order to ensure the quality of reporting and results as far as possible, Quality Control (QC) should be implemented. The QC system is designed to:
(i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness.
(ii) Identify and address errors and omissions; and
(iii) Document and archive inventory material and record all QC activities.

Even though it is impossible to detect all the errors, there may be several possible measures to screen potential issues. For example:

- Detection of blank cells (especially when they are mandatory reporting items) and inappropriate inputs (e.g. sentences in a numerical cell)
- Detection of potential typographical errors in numerical figures: Activities and corresponding GHG emissions tend to be rather stable in the private sector. When there is a difference in numbers from the previous submission over threshold (e.g. ＋5/ -10%), it is worth highlighting the difference to encourage recheck.
- Comparison with default emission factors: Where a facility reports emissions based on facility-level emission factors, whether such emission factors are realistic should be checked. Implied emission factor, i.e., the number derived by dividing the reported emissions by activity data, can be checked against aggregated emissions, direct measurement or any other method to compare with default emission factors. If these numbers are substantially different from default emission factors (e.g., beyond the uncertainty range), this may be highlighted to both reporter and administrator.

These checks may be automated if an electronic reporting system is to be employed.

For reporting entities, normal data QC procedure of their own can be applied (e.g., regular calibration of measuring equipment, sanity check of spreadsheets, random check, calculation by an independent spreadsheet). In addition, archiving of previous submissions and background data at their side is encouraged, or even mandated in some cases, to correct mistakes and improve future reporting as well as facilitate auditing.

Apart from QC, Quality Assurance (QA) can be conducted by a third party on the report before or after its submission. It may be understood as a form of verification. Thus, this Guideline will not explain the details.

5. Relationship with national GHG inventories

The M&R system may be designed to collect data for national GHG inventories. However, technical consideration is critical to make such a bottom-up approach successful. Some important statistical data for GHG inventories are top-down, which means the total amount is segregated to sub-items. This approach tends to result in better overall accuracy, especially when there are many reporting entities. It means that sum of reported values is different from the national total of the relevant statistical item. If bottom-up data are mixed up, errors in GHG estimation is inevitable. Section 2.3, Volume 1 of 2019 Refinement to the IPCC Guidelines gives technical details on this approach.

Energy balance is an example of an accounting framework for compilation of data on all energy

products entering, exiting, and used within the national territory of a given country during a reference period. It is recommended as AD for tier 2 methodology of national GHG inventories. Even in EU where a carbon market mechanism (EU-ETS) has been in place for years, EU member countries usually rely on an energy balance table for a national GHG inventory, with supplemental uses of EU-ETS data such as facility-specific emission factors for some subcategories. On the contrary, local GHG inventories, if they are to be compiled, would take a bottom-up approach for the emissions due to the lack of an energy balance table for their boundary.

Many other statistics are compiled on a bottom-up basis, which means that the sum of reported values becomes the national total. In such a case, the sum of reported emissions can be the national total of the category, and disaggregation into subcategories is also straightforward. For this type of data, it must be ensured that the reported values for this M&R system and other national statistics are identical. For avoiding discrepancy in data and minimizing reporting/compiling burdens, coordination on reporting items across different statistical data is critical. Data on industrial solid waste and wastewater management are some examples of bottom-up data that national GHG inventory compilers in developing countries usually face difficulty in accessing. Direct data collection could contribute to improve estimation of such categories, in addition to fulfilling other sectoral data needs.

Column 5

Confidential data

- Data to be collected under the reporting system should be transparent and are supposed to be publicly available or accessible in general. However, data providers might restrict access to information to prevent inappropriate use of the data, unauthorized commercial exploitation, or sensitivity to possible imperfections in the data. (i) Clear explanation on the intended use of the data; and (ii) written agreement as to the level at which it will be made public; may help coordination of data collection.
- In some cases, the data provider simply does not have the resources required to compile and check confidential data. Offering cooperation and capacity building on measurement could address the issue.
- National Statistical Offices have experience in handling confidential data. They may have already collected the relevant data. It will always be beneficial to consult with them.
- Raw data can be aggregated in a way that protects confidentiality and yet produces useful information for national inventory purposes. In general, if there are 3 or more entities under one item, aggregation can mask individual data. Aggregation before submission (e.g., reporting entity submits emissions amounts without indicating AD nor EF) may also be allowed.
- More technical details can be found in the Section 2.2, Vol. 1, of IPCC 2006 Guidelines and 2019 Refinement.

IV. Essential tools, procedure and institutional arrangements of facility-level GHG Reporting System

<<For Government and Private sectors >>

> [Introduction]
> This section explains essential tools, procedure and institutional arrangements required to operationalize the facility-level GHG reporting system and introduces some examples and prototypes.

1. Reporting format

The reporting format is necessary for submission of GHG reports by the emitters.
It should have an accurate but uncomplicated layout.
The generic elements that are provided by a standard format are as follows.

A) Reporting boundaries

The organization shall establish its reporting boundaries, including the identification of direct and indirect GHG emissions and removals associated with the organization's operations. Grouping of GHG emissions or GHG removals reported within the boundary of facility is called as reporting boundary.

B) Classification by gas

The format provides the kinds of GHGs that reporting facilities are required to report, including the provision of rule documents by GHG reporting systems. The basic reporting may require CO_2 only. However, to the extent possible, other gases, such as CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3 should be included. It is recommended to use GWP values given in the IPCC AR5 for all GHGs.

In the case of CO_2 emissions, it may be useful to differentiate energy derived CO_2 and non-energy derived CO_2. The former covers CO_2 emissions from energy consumption (direct combustion of fuels or electricity consumption from the grid), and the latter covers CO_2 emissions from chemical reactions in industrial processes, such as clinker production in the cement industries. Such differentiation can help identify emissions for reduction efforts.

C) Business categories

In many countries, line ministries have a regular administrative jurisdiction and a deep knowledge

on the nature of business in the respective sectors. For this reason, the format should provide space to identify business categories that reporting facilities belong to. This categorization will facilitate further actions from the reporting system, such as providing feedback or advice to facilities on emissions reduction.

D) Types of fuels, energy commodities and electricity

Identification of types of fuels, energy commodities and electricity are important to the reporting of accurate emissions data, together with their emission factors. In general, the reporting system owners (e.g. government) can check if the emissions calculation is appropriate in certain types of businesses which use specific fuels. Also, when leading reporting facilities reduce GHGs emissions, by switching to low carbon or decarbonized fuels, such as renewable energy, the information, for example types of fuels, energy commodities and electricity, can provide useful information.

E) Emissions by scope 1, 2 (+3)

In general, the facility-level reporting should have scopes 1 and 2 as a basic format. Reporting of scope 3 emissions is useful for facilities to further provide information on their emissions for the purpose of meeting specific standards or carbon disclosure of corporate value. However, data collection and calculation would require more effort, and sometimes is not easy for many facilities. In such cases, scope 3 can be optional.

If significant indirect emissions are excluded from the GHG emission quantification, explanation/ Justification shall be provided in facility level M&R system.

F) Selection of Base year

The facility shall establish a historical base year for GHG emissions and removals for comparative purposes of the GHG M&R system. Base year emissions or removals may be quantified based on a specific period (e.g. a year or part of a year where seasonality is a feature of the organization's activity) or averaged from several periods (e.g. several years). If sufficient information on historical GHG emissions or removals is not available, the organization may use its first facility level GHG M&R period as the base year.

In establishing the base year, the facility:

- shall quantify base-year GHG emissions and removals using data representative of the organization's current reporting boundary, typically single-year data, a consecutive multi-year average or a rolling average
- shall select a base year for which verifiable GHG emissions or removals data are available

- shall explain the selection of the base year
- shall develop a GHG inventory for the base year consistent with the provisions of this document.

The facility may change its base year but shall justify any change to the base year.

G) Uncertainties

Assumptions made in collecting activity data, and uncertainties in GHG emission calculations may be recorded separately. Description of planned actions for reducing uncertainty for the future year may add to respective section

H) Recalculation

If any change is made to the base year or other historical GHG data, recalculation of the base year or other historical year may need to compare the respective year result.

Sample formats are attached as Annex

2. Reporting line

When introducing the reporting system, it is necessary to consider what will be an ideal reporting line. In many cases, the GHG reporting system is introduced by the Environment Ministry or Ministry in charge of climate change. In this case, emitters' businesses do not necessarily need to be under their jurisdiction. Also, in developing GHG emission measurement methodologies, in-depth knowledge of sectors is required.

For this reason, it is important to consider allocation of roles of line ministries (and in some cases local governments), for their effective engagement. This will allow smooth implementation of the systems.

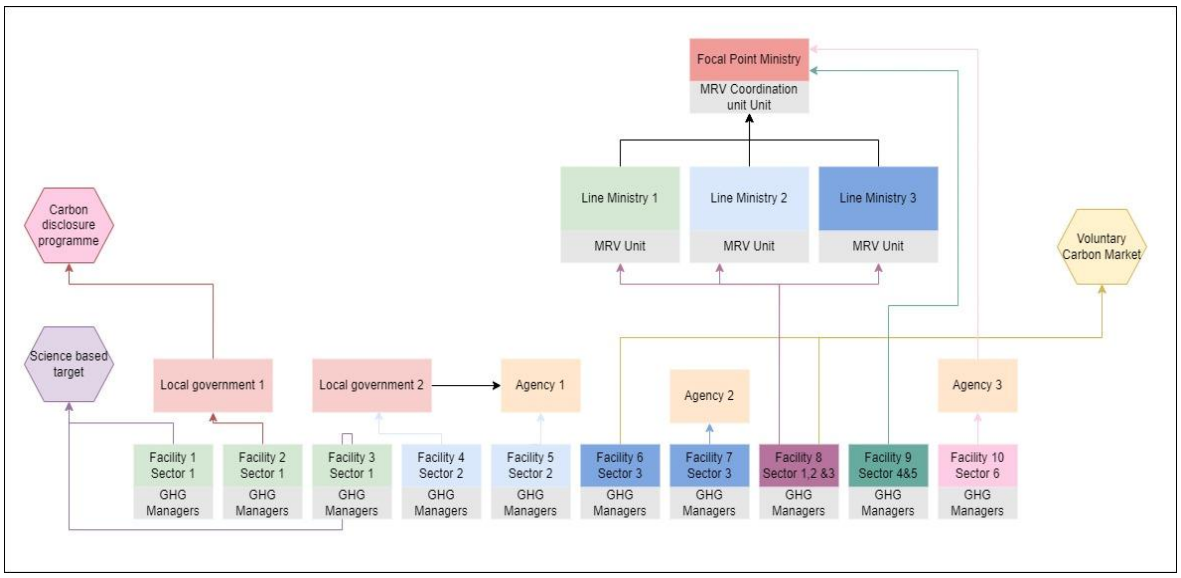


Figure 10: Prototype of the Institutional Arrangement for a facility level reporting system

(A) Roles of the focal point ministry or voluntary system administrator

The focal point ministry designated by law, or the voluntary reporting system administrator plays the role of overseeing the system including developing and executing rules, modalities and procedures; GHG measurement methodologies; making announcements to reporting facilities; and final data collection and storage. Further, the focal point ministry or the system administrator should set principles that line ministries or local governments should follow, and the system provides feedback to reporting facilities.

Key roles-

- Set the rules and oversee the system.
- Establish an MRV coordination unit

(B) Roles of the MRV coordination unit

MRV Coordination unit provides guidance and training to stakeholders on accurate data collection, data recording, data reporting, data analysis, and calculation of GHG emissions.

Key roles-

- Provide technical and financial support

- Establish extensive and effective communication with stakeholders
- Plan and conduct all coordination and consultation activities with governmental and, if appropriate non-governmental stakeholders
- Carry out and keep track of capacity-building efforts, both domestic (unilateral) as well as international
- Conduct an evaluation exercise to identify key lessons learned and areas for improvement
- Incorporate reporting from all line ministries and their regulatory bodies and keep an updated registry
- Establish guidelines for quality control of collected data and develop and oversee the implementation of a quality control strategy for the entire MRV process; and
- Mediate between parties when concerns surface, for example, over a disagreement in terms of responsibilities or a potential conflict of interest.

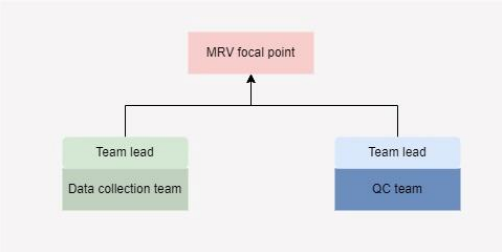
(C) Roles of line ministries

Line ministries can play a role of supporting the system, based on their knowledge and experiences with specific sectors. This includes the development of or providing inputs on GHG measurement methodologies. Facilities can go through specific line ministries in the reporting line to submit reports to the focal point ministries. Line ministries can play an active role in providing feedback, based on the regular relationships with facilities under their sectoral jurisdiction.

Key roles-

- Line ministries and local governments will oversee the implementation of rules established by focal point Ministry
- Establish MRV units at each ministry

(D) Roles of MRV Unit- MRV Focal Point



Key roles-

- Allocate responsibilities for all institutions, ensuring that there is a clear lead for each institution, and establish an institutional level formal approval process
- Develop and monitor a time frame and schedule for preparing and submitting necessary data, including specific dates for the deliverables; and

- Report GHG emissions to MRV coordination unit annually
- Appoint technical, data collection and QC teams

(E) Roles of local governments

In some countries, local governments can play a role as the first entry point for facilities to submit a report. Also, as they may have better access to information of facilities for their geographical region, compared to national government ministry, local governments may provide consultation or advice to facilities when they are having trouble in developing the report, or feedback on their emissions reduction efforts after the reporting.

(F) Roles of the Secretariat/supporting agencies

Sometimes, the focal point ministries find it difficult to accommodate the workload of managing the entire system, and processing the reports submitted by facilities. In some countries, processing and analysis of data are outsourced to supporting agencies or consultants, to ensure a stable workflow.

(G) Roles of the GHG Manager

GHG manager in the facility is responsible for data collation, preparation, and analysis of the emissions reports.
Key roles-

- Assess data collection for the requisite parameters that contribute to GHG emissions
- Document measurement approaches
- Monitor GHG emission sources and their operating parameters on a regular basis
- Measure and report GHG emissions
- Submit the emissions reports in accordance with the MRV requirements; and
- Ensure the emissions reports are, to the best of the knowledge of the GHG manager, complete and accurate

3. Providing feedback

Providing feedback plays a key role in facilitating the recognition of the emitters and encouraging their actions for further emission reductions. There are ways to provide feedback to the emitters, by informing:

- Historical trend of emissions
- Key emission sources and potential reductions

- Ranking in the same sector/subsector
- Potential intervention for reductions, such as change of operation and introducing new technologies

V. Common steps for developing a reporting system

<< For Government >>

[Introduction] The step for developing a reporting system is expected to start with a review of what the competent authorities have already done, the authority they have, and whether they have implemented the components required for the development of the system.

1. Starting the development of a GHG M&R system

A) Useful steps for developing a GHG M&R system

The development of a GHG M&R system is expected to start with a review of what the competent authorities have done already, the authority they have and whether they have implemented the components required for the development of the system, such as previous climate change efforts and mechanisms. This is one of the preparations required not only for the development of GHG M&R systems, but also for the development of various institutional arrangements.

Steps in the work include starting with Category 1 and working through the questions in each category to see whether there is experience that can be used to develop the GHG M&R system. If there is “Yes“ in each category, those experiences gained can also be used to develop the GHG M&R system.

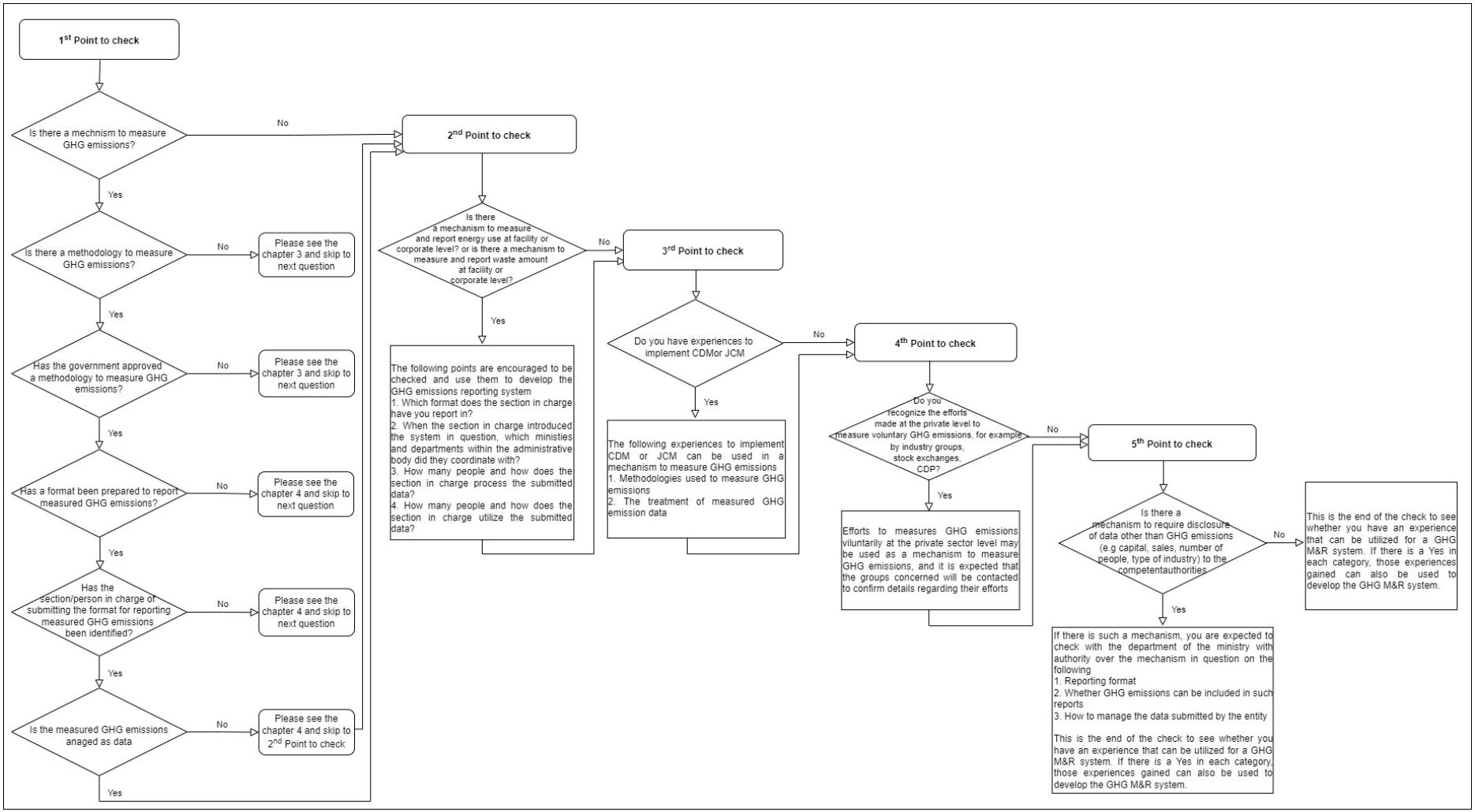


Figure 11: Point to check 1- 5

If there is experience that can be utilized for developing a GHG M&R system, the transition towards developing the system can proceed. However, the process of developing a GHG M&R system may involve relationships with the relevant ministries and require country-specific procedures. For this reason, the following components are considered to be commonly necessary for the development of a system:

1. To consider the need for a GHG M&R system within the ministries and agencies (If necessary, a committee composed of experts and business stakeholders may be set up to consider the issue.)
2. To set up forums for information sharing and consultation with relevant ministries, e.g. through the National Climate Change Commission.
3. To conduct discussions with key stakeholders covered by the system, such as the industrial sector, in parallel with consultations with the relevant ministries and agencies.

B) Legal underpinning of the M&R system

Legal underpinning is an important perspective when developing M&R systems in each ASEAN country. The legal underpinning can be in the form of law, decree or ordinance, in the case of mandatory reporting system, or in the form of a contract in the case of voluntary reporting system.

For example, if private entities may be legally required to report their GHG emissions, it is provided that the formula to be used will be clearly defined in the law. Also, it is expected that the roles of each ministry will be defined, for example, which ministry will receive the calculated GHG emissions.

In the latter case of voluntary reporting system, the contract compels reporting by companies to, for example, the Carbon Disclosure Project (CDP) or stock exchanges. These initiatives can be used as experience for existing entities when enacting legislation, as mentioned above.

C) Mandatory Requirement for facility level M&R System

In introducing a mandatory requirement for facilities, it is necessary to establish a law to define obligation of reporting, definition of terms, reporting cycles, designated formats, protocols and methodologies for reference, as well as legal consequences of non-compliance with the law. Since facilities designated by the law have a legal obligation for submitting reports and relevant data, the government has a stronger basis for ordering appropriate responses from such facilities.

In many cases, such mandates are defined as part of an entire system, and other elements, such as roles of ministries and local governments in the system are also defined in the law. See [Column 6] Viet Nam's revised law on environmental protection law and Decree 06/2022/ND-CP regulations on reduction of greenhouse gas emissions and protection of the ozone layer.

Column 6

et Nam's revised Law on Environmental Protection and the Decree 06/2022/ND-CP regulations on reduction of greenhouse gas emissions and protection of the ozone layer.

In November 2020, the Government of Viet Nam revised the Law on Environmental Protection, which is a basic law for the entire environmental management in Viet Nam. The Government's response to the Paris Agreement, including the implementation of NDC, and relevant MRV have been included in Article 91. In this law, the Government also introduced a framework for mandatory GHG emissions measurement, reporting and verification by designated facilities.

Guided by the Revised Law, the Decree 06/2022/ND-CP regulations on reduction of GHG emissions and protection of the ozone layer in January 2022 stipulates more detailed obligations of facilities, and procedures for MRV.

Framework provided under the Decree 06/2022/ND-CP

GHG mitigation (including Emissions Trading Schemes)
✓ Entities that must carry out GHG mitigation;
✓ Objectives, roadmap and measures to mitigate GHG;
✓ MRV system for GHG mitigation;
✓ GHG inventory at all levels;
✓ Allocation, adjustment and withdrawal of GHG emission quotas;
✓ Plan on GHG mitigation, and expected results;
✓ Requirements for appraisal units;
✓ Responsibility for inspection and supervision of GHG mitigation activities.

2. Inter-ministerial coordination

A) Importance of inter-ministerial coordination

As the flowchart above shows, it may be possible to utilize the experience and efforts of other government agencies to which the officer in charge does not belong. This is not simply a matter of ensuring consistency of mechanisms between government agencies but may also facilitate reporting from the perspective of the private sector entities in the end.

The coordination of such inter-ministerial arrangements may include the following matters.

(a) Coordination between the Environmental Ministry and the Energy Ministry for consistency and avoiding burdens of private sector reporters.
(b) Providing possible co-benefits with administration of other sectors including statistics agency by adding new data reporting.
(c) Providing advice from statistics agency on handling of confidential data
(d) Discussing with the relevant ministries the elements of data to be reported by companies and which of the reported data are to be made public and which are to be kept confidential.
(e) Discussing with the relevant ministries whether the data collected will be used for NDC.
(f) Creating an opportunity to discuss whether amendments to current laws and regulations are sufficient or whether additional legal actions are needed.

Such coordination is expected to be proposed in a committee of relevant ministries and agencies on climate change, such as the National Climate Change Committee, before direct enquiries are made to the relevant agencies by the private sector. Meanwhile, inter-ministerial coordination is recommended as much as possible, as any lack of coordination may make it more difficult for private entities operating in their country to report.

3. Private sector engagement

A) Encouraging the positive attitude of the private sector

In order to promote a positive attitude of private entities, attention is expected to be paid to two phases: 1. The process of establishing the system; and 2. The process of operating the system. Please note that, in principle, the engagement of private entities in these two phases should be decided through discussions between the ministries and private entities, and not necessarily implemented.

To begin with, the engagement of private entities in the process of establishing the system can create opportunities to incorporate the know-how of private entities in the establishment of the system, in addition to the aspect of checking the feasibility of the system from the government's point of view. Private entities are expected to communicate their experiences and views to the ministries and relevant agencies that intend to develop a GHG M&R system.

Sample Format of GHG reporting by Japanese case

No.	Business category	Carbon dioxide equivalent greenhouse gas emissions				
		① Energy-origin CO_2	② Non-energy-origin CO_2 (Excluding ③)	③ Non-energy-origin CO_2 from the use of waste material fuels	④ Methane	⑤ N_2O
		⑥ HFC	⑦ PFC	⑧ SF_6	⑨ NF_3	⑩ Energy-origin CO_2
-	Specified emitter overall	①	②	③	④	⑤
		t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2
		⑥	⑦	⑧	⑨	⑩
		t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2
1	Business name	①	②	③	④	⑤
		t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2
	Sub-classification number	⑥	⑦	⑧	⑨	⑩
	Ministry in charge of business	t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2
2	Business name	①	②	③	④	⑤
		t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2
	Sub-classification number	⑥	⑦	⑧	⑨	⑩
	Ministry in charge of business	t-CO_2	t-CO_2	t-CO_2	t-CO_2	t-CO_2

(2) By types of energy

Type of energy			Unit	FY			
				Amount used		Amount of byproduct energy sold	
				Value	Calories (GJ/TOE)	Value	Calories (GJ/TOE)
Fuel or heat	Crude oil (not including condensate)		kl				
	Condensate part of crude oil (NGL)		kl				
	Volatile oil		kl				
	Naphtha		kl				
	Kerosene		kl				
	Light oil		kl				
	Heavy oil A		kl				
	Heavy oil B, C		kl				
	Petroleum asphalt		t				
	Petroleum coke		t				
	Petroleum gas	Liquefied petroleum gas (LPG)	t				
		Petroleum hydrocarbon gas	1,000 m^3				
	Flammable	Liquefied natural	t				

	natural gas	gas (LNG)					
		Other flammable natural gases	1,000 m^3				
	Coal	Coking coal	t				
		Steam coal	t				
		Anthracite coal	t				
	Coal coke		t				
	Coal tar		t				
	Coke oven gas		1,000 m^3				
	Blast furnace gas		1,000 m^3				
	Converter gas		1,000 m^3				
	Other fuels	Natural gas	1,000 m^3				
	Industrial steam		GJ/TOE				
	Steam other than industrial		GJ/TOE				
	Hot water		GJ/TOE				
	Cold water		GJ/TOE				
	Subtotal		GJ/TOE				

Sample Format of GHG reporting by GHG Protocol

EMISSIONS	TOTAL (mtCO2e)	CO2 (mt)	CH4 (mt)	N2O (mt)	HFCs (mt)	PFCs (mt)	SF6 (mt)
Scope 1							
Scope 2							
Scope 3 (OPTIONAL)							

Emissions disaggregated by source types

Scope 1: Direct Emissions from Owned/Controlled Operations

a. Direct Emissions from Stationary Combustion
b. Direct Emissions from Mobile Combustion
c. Direct Emissions from Process Sources
d. Direct Emissions from Fugitive Sources
e. Direct Emissions from Agricultural Sources

Scope 2: Indirect Emissions from the Use of Purchased Electricity, Steam, Heating and Cooling

a. Indirect Emissions from Purchased/Acquired Electricity
b. Indirect Emissions from Purchased/Acquired Steam
c. Indirect Emissions from Purchased/Acquired Heating
d. Indirect Emissions from Purchased/Acquired Cooling

Content of the report according to the ISO 140064

a) Chapter 1: General description of the organization goals and inventory objectives.
   This chapter includes the description of the reporting organization, persons responsible, purpose of the report, intended users, dissemination policy, reporting period and frequency of reporting, data and information included in the report (list of GHGs taken into account and explained), and statements by the organization about verification.
b) Chapter 2: Organizational boundaries.
   This chapter includes the description and explanation of boundaries and consolidation methodologies.
c) Chapter 3: Reporting boundaries.
   This chapter includes the description and explanation of emissions categories that are considered.
d) Chapter 4: Quantified GHG inventory of emissions and removals.
   This chapter includes the quantified data results by emission or removal category, description of methodologies and activity data used, references and/or explanation and/or documentation of emission and removal factors, uncertainties and accuracy impacts on results (disaggregated by category), and description of planned actions for reducing uncertainty for the future inventory.
e) Chapter 5: GHG reduction initiative and internal performance tracking.
   The organization may report its GHG reduction initiatives and the results of its internal performance tracking

An example of an illustrative template to provide a framework for reporting is given below

Recommended format for consolidated statement of GHG emissions (values shown for illustration only)

	REPORTING COMPANY	NAME											
	Person or Entity responsible for the report	NAME	CONTACT										
	Reporting period covered	From	MM/DD/YYYY	To	MM/DD/YYYY								
	Organizational boundaries	Attached document											
	Reporting boundaries	Attached document											
	EMISSIONS	**Notes**	**20xx CO_2e TOTAL (Tonnes p.a.)**	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrous oxide (N_2O)	Hydrofluoro-carbons (weighted average) (HFCs)	Perfluoro-carbons tonnes (weighted average) (PFCs)	Sulfur hexafluoride (SF_6)	Nitrogen trifluoride (NF_3)	Quantitative uncertainty	Qualitative uncertainty	
			GWP	1	30	265	5 000	4 000	23 500	16 100			
1	**Category 1 : Direct GHG emissions and removals in tonnes CO_2e (1)**		**83 205**	**83 050**	**149**	**6**	**0**	**0**	**0**	**0**			
1.1	Direct emissions from stationary combustion		2 050	2 050	0	0	0	0	0	0	7%		
1.2	Direct emissions from mobile combustion		81 005	81 000	5	0	0	0	0	0	7%		
1.3	Direct process emissions and removals arise from industrial processes		0	0	0	0	0	0	0	0			
1.4	Direct fugitive emissions arise from the release of greenhouse gases in anthropogenic systems		0	0	0	0	0	0	0	0			
1.5	Direct emissions and removals from Land Use, Land Use Change and Forestry		0	0	0	0	0	0	0	0			
	Direct emissions in tonnes of CO_2 from biomass		**718**	718									
	Indirect Emissions in tonnes CO_2e (2)	**S/NS[*]**	**4 157 450**										
2	**Category 2 : Indirect GHG emissions from imported energy (3)**		**70 000**										
2.1	Indirect emissions from imported electricity		60 000								15%		
2.2	Indirect emissions from imported energy		10 000								10%		
3	**Category 3 : Indirect GHG emissions from transportation**		**614 950**										
3.1	Emissions from Upstream transport and distribution for goods		153 200										C
3.2	Emissions from Downstream transport and distribution for goods		320 000										B
3.3	Emissions from Employee commuting includes emissions		12 200										C
3.4	Emissions from Client and visitor transport	NS											
3.5	Emissions from Business travels		129 550										B
4	**Category 4: Indirect GHG emissions from products used by organization**		**3 372 500**										
4.1	Emissions from Purchased goods		3 202 500										D
4.2	Emissions from Capital goods		125 000										D
4.3	Emissions from the disposal of solid and liquid waste		45 000										D
4.4	Emissions from the use of assets	NS											
4.5	Emissions from the use of services that are not described in the above subcategories (consulting, cleaning, maintenance, mail delivery, bank, etc.)	NS											
5	**Category 5: Indirect GHG emissions associated with the use of products from the organization**		**100 000**										
6.1	Emissions or removals from the use stage of the product		100 000										B
6.2	Emissions from downstream leased assets	NS											
6.3	Emissions from end of life stage of the product	NS											
6.4	Emissions from investments	NS											
6	**Category 6: Indirect GHG emissions from other sources**	**NS**											
	REMOVALS (4)												
	Direct removals in tonnes CO_2e		**100**	**100**	**0**	**0**	**0**	**0**	**0**	**0**			C
	STORAGE (5), (6), (7)												
	Total storage as of year end in tonnes CO_2e		**10**	**10**	**0**	**0**	**0**	**0**	**0**	**0**			C
	CARBON FINANCIAL INSTRUMENTS (8)												

				Market based emission factors compliant with ISO 14064-1 Annex E		
Total Renewable Electricity purchased in kWh		**575 000** kWh				
Renewable Electricity purchased in kWh with contractual instruments compliant with ISO 14064-1 Annex E		150 000 kWh		**13** gCO_2e/kWh	1,9 tCO_2e	See attached document
Renewable Electricity purchased in kWh with contractual instruments compliant with ISO 14064-1 Annex E		45 000 kWh		**6** gCO_2e/kWh	0,2 tCO_2e	See attached document
Renewable Electricity purchased in kWh with contractual instruments compliant with ISO 14064-1 Annex E	375 000	180 000 kWh		**15** gCO_2e/kWh	2,7 tCO_2e	See attached document
Renewable Electricity purchased in kWh with contractual instruments not compliant with ISO 14064-1 Annex E criteria		200 000 kWh				
Offsets from GHG Scheme AA in tonnes CO_2e		**95 000** CO_2e				
Credits from GHG Scheme BB in tonnes CO_2e		**125 000** CO_2e				

Other related information

Performance tracking (emissions and removals by metric, e.g. tonnes CO_2e per annual revenue)	See attached document
Base year GHG emissions, removals, and stocks; and adjustments to base year	See attached document
Disclosure of most significant sources, sinks, and reservoirs	See attached document
Statements of emissions (CO_2e) per unit of relevant uniits	See attached document
Statement of emission reduction initiatives	See attached document
Significancy criteria	See attached document
Uncertainty assessment	See attached document

Notes

[*] Significant / Non significant.

Facilities may report activity data and EF as follows

Category/ Emission source	Activity data		Reference/Data source
	Quantity	Unit	

EF	Value	Unit	Reference

Further facilities may use the following notation keys in the tables to indicate the completeness of the data

Notation Key	Definition	Explanation
NE	Not estimated	Emissions and/or removals occur but have not been estimated or reported
IE	Included elsewhere	Emissions and/or removals for this activity or category are estimated and included in the inventory but not presented separately for this category. The category where these emissions and removals are included should be indicated (for example in the documentation box in the correspondent table)
C	Confidential information	Emissions and/or removals are aggregated and included elsewhere in the inventory because reporting at a disaggregated level could lead to the disclosure of confidential information.
NA	Not applicable	The activity or category exists but relevant emissions and removals are considered never to occur. Such cells are normally shaded in the reporting tables.
NO	Not occurring	An activity or process does not exist within a country

Annex 01- Singapore's Carbon Tax

1. Background

Singapore instituted a carbon tax when the Carbon Pricing Act (CPA) and its accompanying Regulations came into operation on 1 Jan 2019. The carbon tax is administered by the National Environment Agency (NEA) and forms part of a comprehensive suite of mitigation measures by providing a broad-based price signal across the economy. The revised carbon tax level and trajectory post-2023 support Singapore's efforts to reach net-zero by 2050. This will also accelerate the economic transformation necessary to transition to a future-ready green economy by enhancing the business case to implement energy efficiency improvements and other emission reduction solutions. This ensures the long-term viability of business investments and activities in a carbon-constrained world.

The tax is applied on facilities that directly emit at least 25,000 tCO_2e of greenhouse gas (GHG) emissions annually, covering the six GHGs that Singapore is currently reporting to the United Nations Framework Convention on Climate Change (UNFCCC), namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). As Singapore will also start reporting a seventh GHG, nitrogen trifluoride (NF_3) by 2024, Singapore will include NF_3 as a taxable GHG from 2024.

In all, the carbon tax currently covers about 80% of total GHG emissions from about 50 facilities in the manufacturing, power, waste, and water sectors. Facilities in other sectors would also indirectly face a carbon price on the electricity they consume as power generation companies are expected to pass on some degree of their tax burden through increased electricity tariffs.

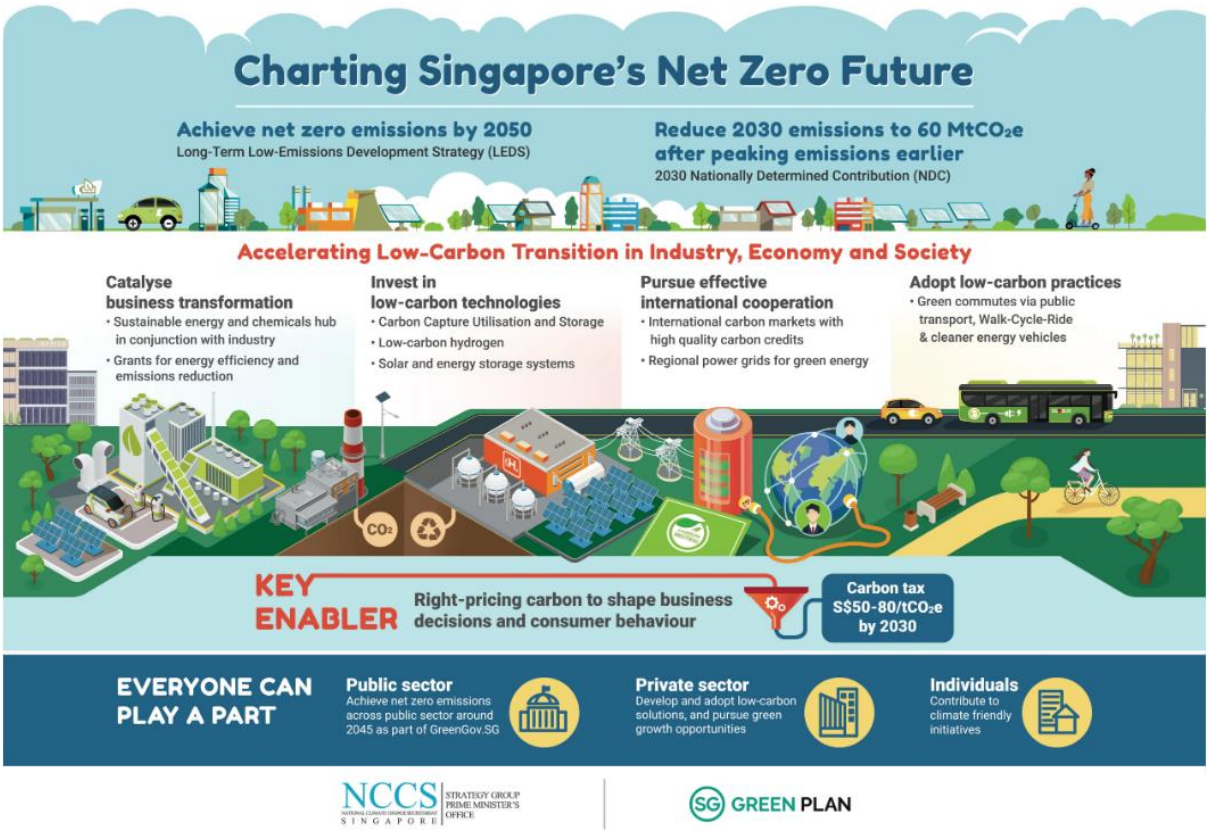


Figure 12: Singapore's climate ambition as of Oct 2022, found at https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/

2. Key Steps

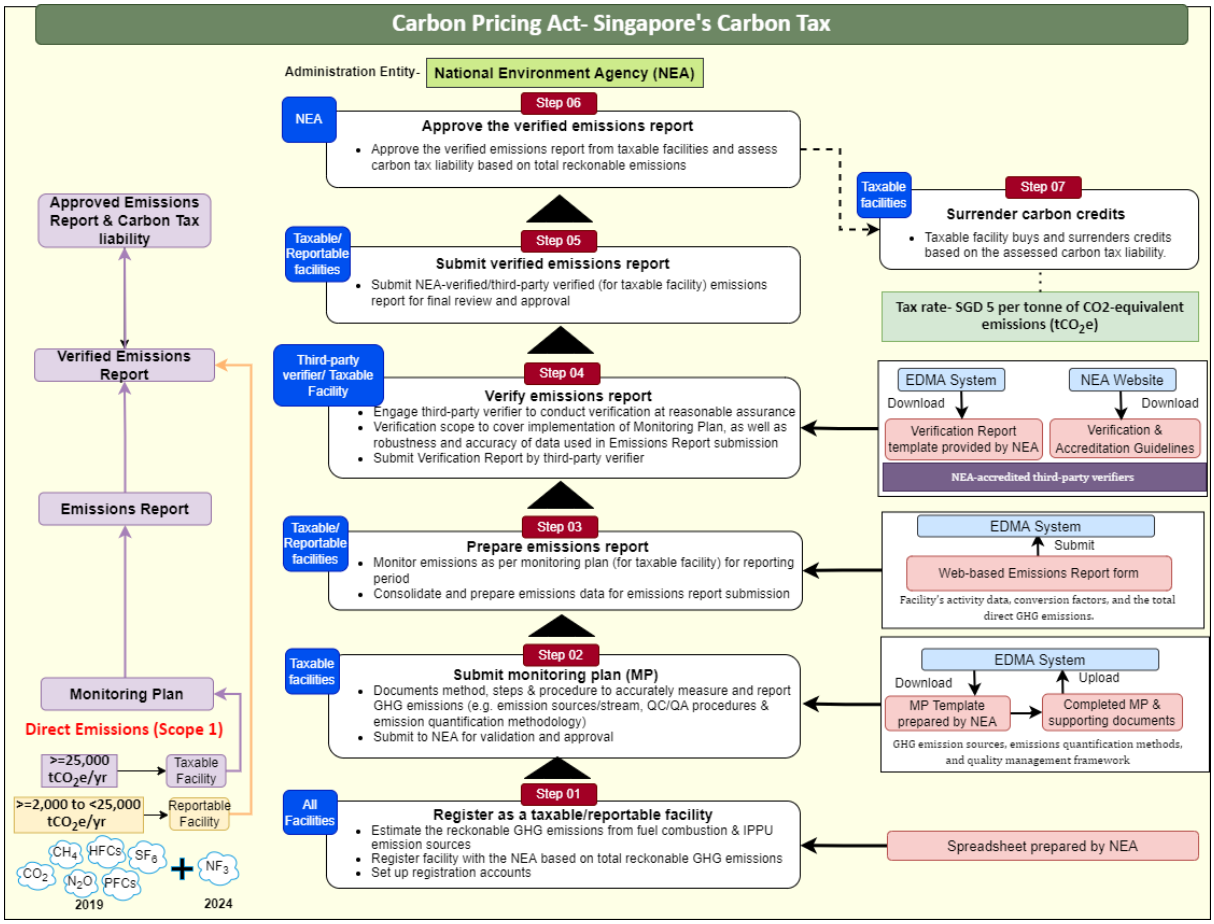


Figure 13: Key steps of Singapore's Carbon tax

- **Step 01- Register as a taxable / reportable facility**

Any industrial facility that emits direct GHG emissions equal to or above 25,000 tCO_2e annually will be required to be registered as a taxable facility, submit a monitoring plan, and a third-party verified Emissions Report and pay a carbon tax.

Also, any other industrial facility that emits direct greenhouse gas (GHG) emissions equal to or above 2,000 tCO_2e annually is required to register as a reportable facility and to submit an Emissions Report annually.

Registration is done via the Emissions Data Monitoring and Analysis (EDMA) System.

- **Step 02- Submit monitoring plan (MP)**

Each taxable facility shall submit a MP, which documents the taxable facility's GHG emission sources and streams, emissions quantification methods, and quality management framework.

The MP will need to be submitted to NEA by 31 Dec of the registration year and approved by NEA before the start of the first reporting period. Each reporting period is a calendar year during which the direct GHG emissions are measured and reported.

The approved MP will apply to all future reporting periods unless there is a change to the MP. The registered corporation shall ensure that the Monitoring Plan remains current and up-to-date, by updating the MP and seeking NEA's approval on the amendments when required.

The taxable facility shall use the Excel-based Monitoring Plan Template provided by NEA to prepare its Monitoring Plan submission, which comprises of completed MP Template and supporting documents and is submitted to NEA via the EDMA system.

- **Step 03, 04 and 05- Monitor emissions, verify emissions report and submit (verified) Emissions Report**

Both reportable and taxable facilities are required to monitor and submit an Emissions Report annually by 30 June of the year following the end of each reporting period. The Emissions Report for each reporting period shall contain information on the facility's activity data, conversion factors such as NCV and emission factors, and the total direct GHG emissions at both emission stream-level and facility-level.

The Emissions Report for reportable facilities will be verified by NEA to ensure that they are accurate, while the Emissions Report for taxable facilities shall be prepared in accordance with the approved Monitoring Plan and verified by an NEA-accredited third-party verifier before submission. The third-party verifiers are required to assess to a reasonable level assurance that i) data reported in the Emissions Report were collected in accordance with the approved MP; ii) data reported in the Emissions Report are complete, reliable, accurate and free from material misstatements, and iii) the

ER complies with the measurement and reporting (M&R) requirements.

The facilities are required to submit the Emissions Reports using a web-based Emissions Report form housed in the EDMA system. This Emissions Report form were designed with the following principles to ensure it is user friendly:

- Aligned to Monitoring Plan and M&R Guidelines. Taxable facilities are required to report activity data and conversion factors for each emission stream based on the quantification methodology approved in the MP
- Built on reporting under the Energy Conservation Act. Emissions Report form was built on the forms and templates used for the reporting of energy use and Industrial Processes and Product Use (IPPU) emissions under the Energy Conservation Act (ECA), which majority of the taxable and reportable facilities were familiar with.
- Streamlined reporting with ECA Energy Use Report (EUR). To avoid duplication of effort and provide consistency in the data reported to NEA under CPA and ECA, verified fuel combustion data reported in the ER are auto populated to the ECA.
- Minimized manual inputs by reportable and taxable facilities. The Emissions Report UI required minimal inputs from facilities by including default emission factors, automate the calculation formulae, and pre-populating the new Emissions Report using previous Emissions Report submissions.

- **Step 06- Approve Verified Emissions Report**

NEA conducts surveillance audits on the accredited third-party verifiers[6] to ensure that the verification is carried out in compliance with CPA and its regulations. Subsequently, NEA will check and approve the verified emissions report submitted by taxable facilities and assess each taxable facility's carbon tax liability based on verified emissions.

- **Step 07- Surrender carbon credits**

Taxable facilities with verified emissions of equal or above 25,000tCO_2e must pay carbon tax in the form of fixed-price carbon credits to be procured and surrendered in the EDMA system by 30 Sep of each year. The carbon tax is set at a rate of S$5 per tonne of GHG emissions (tCO_2e) from 2019 to 2023 (i.e. S$5 per fixed-price carbon credit), and will be raised to S$25/t$CO_2$e in 2024 and 2025, and S$45/t$CO_2$e in 2026 and 2027, with the aim to reach S$50-80/t$CO_2$e by 2030. Companies may utilize high-quality international carbon credits that meet Singapore's requirements, to offset up to 5% of their taxable emissions from 2024 onwards.

[6] The third-party verifiers are accredited by an Accreditation Working Committee (AWC) on a 3-yearly basis and their performance are subject to NEA's annual surveillance checks on their GHG engagement works.

3. Roles and Responsibility of Key Stakeholders

- **Inter-Ministerial Committee on Climate Change**

The Inter -Ministerial Committee on Climate Change enhances Whole-of-Government coordination on climate change policies to ensure that Singapore is prepared for the impacts of climate change. Members comprise Ministers for Sustainability and the Environment, Finance, National Development, Trade and Industry, Transport and Foreign Affairs.

- **National Climate Change Secretariat (NCCS)**

NCCS was established in 2010 under the Prime Minister's Office (PMO) to develop and implement Singapore's domestic and international policies and strategies to tackle climate change. NCCS led the preparatory work in the lead-up to the implementation of the carbon tax in 2018.

- **National Environment Agency (NEA)**

NEA is the administrator of the Carbon Pricing Act. The key administration roles under the CPA include the registration and deregistration of reportable and taxable facilities, the accreditation and surveillance of third-party verifiers, the validation and approval of Monitoring Plan submitted by taxable facilities, the verification of Emissions Report submitted by reportable facilities, the approval of verified Emissions Report and collection of carbon tax from taxable facilities. NEA has developed a suite of guidelines and templates to help the facilities and accredited verifiers to comply with the measurement, reporting, and verification requirements. The Guidelines are available at NEA's website.

- **Accredited third party verification company**

The verification company is required to understand the Verification and Accreditation Guidelines prepared by NEA in detail and internally assess its capabilities to meet the accreditation requirements before making an application to NEA. Accredited third-party verification companies engaged by taxable facilities to conduct verification on their Emissions Report shall complete the verification and submit the verification report to the facility and NEA before 30 June of the year following the end of each reporting period.

- **Taxable Facilities**

Any industrial facility that emits direct GHG emissions equal to or above 25,000 tCO_2e annually are required to:

i) be registered as a taxable facility

ii) appoint a GHG Manager within 30 days from the registration and appoint a Designated

Representative (DR)

iii) submit a Monitoring Plan by 31 December of the registration year, and

iv) submit a verified Emissions Report to NEA annually by 30 June of the year following the end of each reporting period.

The duties and responsibilities of a GHG Manager include, but are not limited to, the list below:

i) Be responsible for data collation, preparation and analysis of the Monitoring Plan and Emissions Report

ii) Assess applicability of the Monitoring Plan and data collection for the requisite parameters that contribute to GHG emissions

iii) Document measurement approaches

iv) Monitor GHG emission sources and their operating parameters on a regular basis

v) Measure and report GHG emissions

vi) Submit the Monitoring Plan and Emissions Report in accordance with the MRV Regulations

vii) Ensure the Monitoring Plan and Emissions Report are, to the best of the knowledge of the GHG manager, complete and accurate.

The duties and responsibilities of the DR include,

i) Submit GIRO application to set up the EDMA credit registry account for each facility of the Corporation

ii) Timely purchase of carbon credits according to the desired GIRO deduction date (the list of GIRO deduction dates for the year is available on the EDMA System)

iii) Ensure sufficient funds in the bank account for the GIRO deduction to take place, for the purchase of carbon credits and other carbon tax related payments

iv) Timely surrender of carbon credits (by the later of 30 September of the year immediately following the reporting period; or 30 days after the date of service of the Notice of Assessment)

v) Submit any application to transfer carbon credits from the registry account of a taxable facility to the registry account of another taxable facility under the same corporation.

- **Reportable Facilities**

Any industrial facility that emits direct GHG emissions equal to or above 2,000 tCO_2e annually are required to be registered as a reportable facility and to submit an Emissions Report to NEA annually. The registration corporation shall also appoint at least one **GHG Manager** for each reportable facility to monitor and report the emissions annually and appoint at least a Designated Representative (DR) to serve as a back-up for the GHG Manager In the event where the registered corporation has multiple reportable facilities, the same GHG Manager could be appointed to be in charge of multiple facilities.

The appointment of external service providers to assist the GHG Manager(s) in the preparation of the Emissions Report is allowed, but service providers shall not be appointed as the GHG Manager. The duties and responsibilities of a GHG Manager include, but are not limited to, the list below:

i) Be responsible for data collation, preparation, and analysis of the Emissions Report
ii) Assess data collection for the requisite parameters that contribute to GHG emissions
iii) Document measurement approaches
iv) Monitor GHG emission sources and their operating parameters on a regular basis
v) Measure and report GHG emissions
vi) Submit the Emissions Report in accordance with the MRV Regulations
vii) Ensure the Emissions Report are, to the best of the knowledge of the GHG manager, complete and accurate.

4. Preparation for carbon pricing implementation

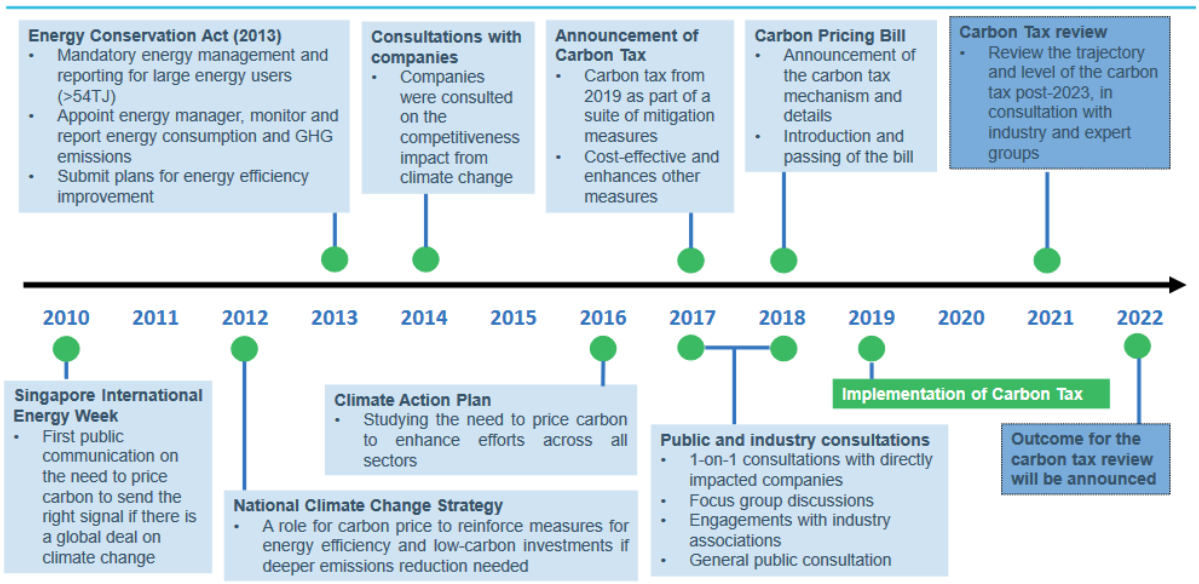


Figure 9: Timeline for carbon tax implementation

5. References

https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax
https://www.thepmr.org/system/files/documents/Presentation%20Jansen%20Toh.pdf
https://www.nea.gov.sg/docs/default-source/our-services/climate-change/ghg-mr_guidelines_part_1a_mr_requirements_reportable_facilities.pdf

Glossary of Terms

Conference of the Parties (COP)	The supreme decision-making body of the UNFCCC. All states that are Parties to the Convention are represented at the COP, where they review the implementation of the Convention and any other legal instruments that the COP adopts and make decisions for the implementation of the Convention, including institutional and administrative arrangements.
Measure or monitor (M)	Data and information on emissions, mitigation actions, and support. This may entail direct physical measurement of GHG emissions, estimating emissions or emissions reductions utilizing activity data and emission factors, calculating changes relevant to sustainable development, and collecting information about support for climate change mitigation
Report (R)	By compiling this information in inventories and other standardized formats to make it accessible to a range of users and facilitate public disclosure of information
Verify (V)	By periodically subjecting the reported information to some form of review or analysis or independent assessment to establish completeness and reliability. Verification helps to ensure accuracy and conformance with any established procedures, and can provide meaningful feedback for future improvement
Facility level MRV	Involves assessing total GHG emissions and removals from all sources within a single facility (e.g., power plant, factory, or waste disposal site), as opposed to an entire organization, to produce a facility-level inventory
Direct emissions	GHG emissions from GHG sources owned or controlled by the organization
Indirect emissions	GHG emissions that are consequences of an organization's operations and activities, but that arise from GHG sources that are not owned or controlled by the organization. These emissions occur generally in the upstream and/or downstream of supply chain

Energy Industry	In energy industries, fossil fuels are both raw materials for the conversion processes, and sources of energy to run these processes. The energy industry comprises three kinds of activities: 1 Primary fuel production (e.g. coal mining and oil and gas extraction); 2 Conversion to secondary or tertiary fossil fuels (e.g. crude oil to petroleum products in refineries, coal to coke and coke oven gas in coke ovens); 3 Conversion to non-fossil energy vectors (e.g. from fossil fuel into electricity and/or heat) Emissions from combustion during production and conversion processes are counted under energy industries.
IPCC	An advisory body that provides governments with the state of current science to inform climate policies. Established in 1988, the IPCC is an organization of governments that are members of the United Nations or the World Meteorological Organization (WMO).
IPPU	Covers greenhouse gas emissions occurring from industrial processes, from the use of greenhouse gases in products, and from non-energy uses of fossil fuel carbon. (IPCC, 2006b)
Greenhouse gas (GHG)	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and clouds. Agriculture contributes methane and nitrous oxide emissions to the atmosphere, as well as carbon dioxide from the soil or biomass and use of energy.
Global warming potential (GWP)	The relative effect of the GHGs on the atmosphere, for the same level of emissions. Defined scientifically as the cumulative radiative forcing effect of a gas over a specified time period resulting from the emission of 1 kilogram of a gas relative to 1 kilogram of a reference gas (e.g., CO2 equivalent). GWP is a relative scale where carbon dioxide equals 1. The GWP changes according to the time horizon used.
Nationally Determined	The plans and goals established by each country in the Paris

Contribution (NDC)	Agreement for actions to reduce their national emissions and adapt to the impacts of climate change. INDCs are a Parties first submission and the NDCs are submitted every 5 years.
National greenhouse gas inventory	Inventories of a country's anthropogenic emissions and removals of GHGs containing transparent documentation and data. The UNFCCC requires all Annex I Parties to submit annual inventories and the IPCC publishes guidelines that provide methodologies for estimating national inventories.
Paris Agreement	An agreement under the UNFCCC, ratified by 189 parties, to make the changes necessary to keep global temperature rise by 2100 below 2 ˚Celsius above the pre-industrial average, with the additional goal of limiting warming to 1.5 ˚Celsius if possible. It requires all parties to put forward an NDC (see NDCs) with the goal of reducing emissions and strengthening the ability of countries to deal with the impacts of climate change.
UNFCCC	A global agreement and the parent treaty of the 2015 Paris Agreement and 1997 Kyoto Protocol. UNFCCC's purpose is to stabilize GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system, in a time frame that allows ecosystems to adapt naturally and enables sustainable development. Entered into force in 1994.