Training on 2006 IPCC Guidelines for preparing National GHG Inventory: General Reporting and Guidelines

Overview on GHG Inventory

Present By:

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Organized by the Capacity Building Initiative for Transparency
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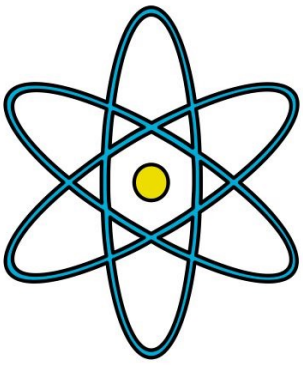
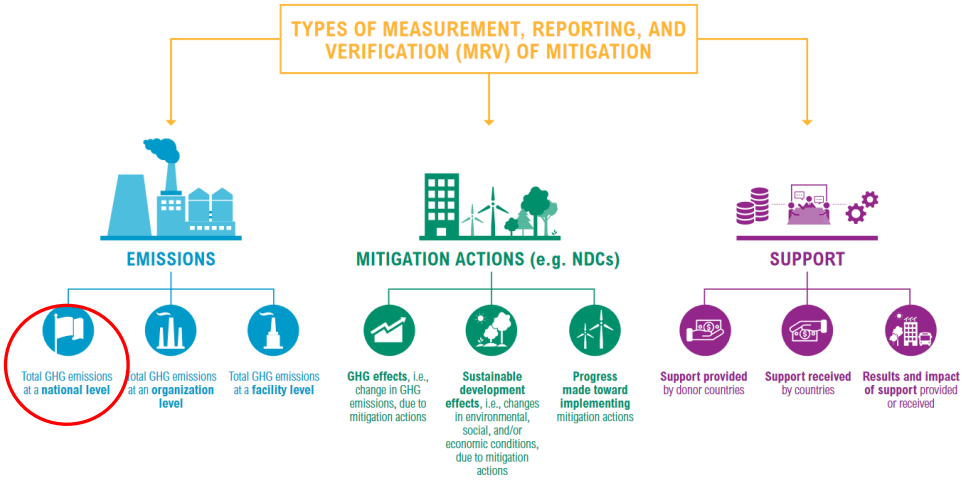


Contents

1. Introduction to GHG inventory

What is GHG Inventory?

- ✓ A national GHG inventory is a key element of the national communication
- ✓ National GHG Inventory is an MRV of GHG emissions. It refers to estimating, reporting, and verifying actual emissions over a defined period of time (one year or number of years).



Reference-https://www.wri.org/data/3-types-measurement-reporting-and-verification-mrv

What is GHG Inventory?

Purpose:

To quantify and understand the sources and sinks of GHGs, providing a comprehensive snapshot of a region's or country's contribution to climate change.

Key Elements **of GHG Inventory:**

1. Tables of annual emission and removal
2. Worksheets (i.e. calculation sheets)
3. For each source, a description of the methodology, the sources of data (e.g. activity data, emission factors (EFs), methodologies), the actual data and a description of uncertainties
4. Other informative background data (e.g. a national energy balance)

Reference- https://unfccc.int/files/national_reports/application/pdf/module_3_national_ghg.pdf

Why do we need a GHG Inventory?

- ✓ To align with the international agreement to limit climate change
- ✓ To set emission limits/ targets/ aims
- ✓ To monitor progress openly and transparently
- ✓ To understand the link between environmental pollution and its effects on the source of pollution
- ✓ To help cost-effective policy development (input to models)

Total GHG emissions-2010 in the Philippines (Million tons of CO_2e)

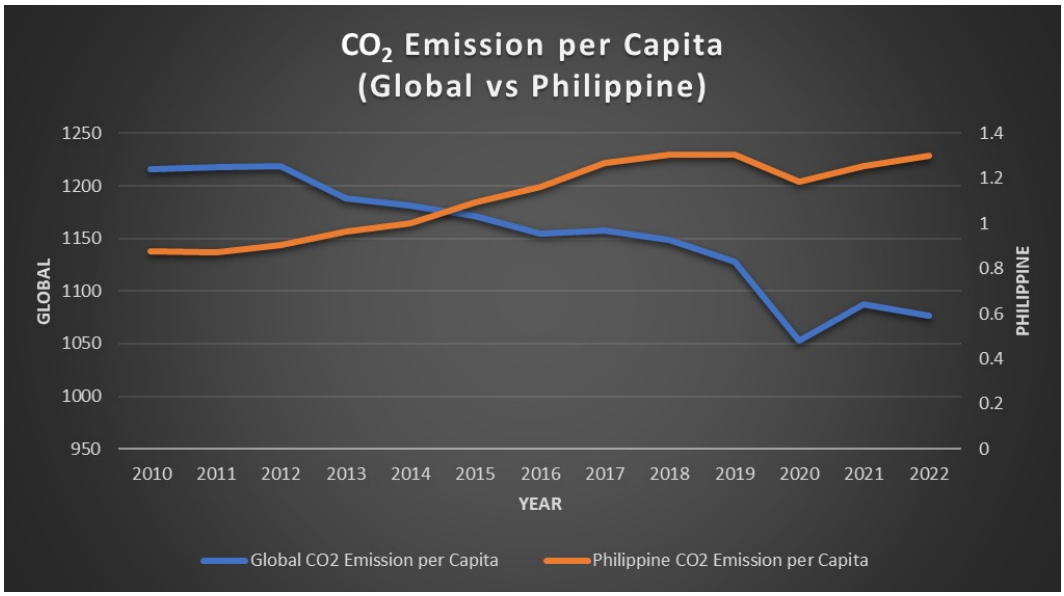
	CO_2	CH_4	N_2O	HFCs	Total
Energy	50.698	1.888	0.519	-	53.105
Agriculture	0.696	33.853	8.604	-	43.152
Transport	23.718	0.125	0.331	-	24.174
Waste	0.015	14.527	1.017	-	15.559
IPPU	7.564	0.009	0.019	0.771	8.363
FOLU	(37.016)	0.007	0.002	-	(37.007)
	TOTAL				107.345

GHG Inventory Report-2010 Philippines

SECTORS & SUB-SECTORS CONSIDERED IN GHG INVENTORY IN THE PHILIPPINES

Sector	Sub-sectors considered for GHG inventory 2010 in Philippines	Sub-sectors not considered for GHG inventory 2010 in Philippines
Energy	Energy Industries, Manufacturing Industries & Construction, Transport, Other Sectors, Fugitive Emissions- Solid fuels, Fugitive Emissions- Oil and Natural Gas	-
IPPU	Mineral products, Chemical Industry, Metal production, Non-energy products from Fuels & Solvent use, Product uses as substitutes for ODS	Other production, Production of halocarbons and Sulphur hexafluoride(Not applicable), Consumption of halocarbons and Sulphur hexafluoride (excluded)
Agriculture	Enteric Fermentation, Manure Management, Rice cultivation, Agriculture soils, prescribed burning of Savannahs, Field burning of Agricultural Residues	-
LUCF	Changes in Forest and Other Woody Biomass Stocks, Forest and Grassland Conversion	Abandonment of managed lands, CO_2 emissions and removals from soil
Waste	Solid waste disposal on land, Waste water handling	Waste incineration (Not applicable)

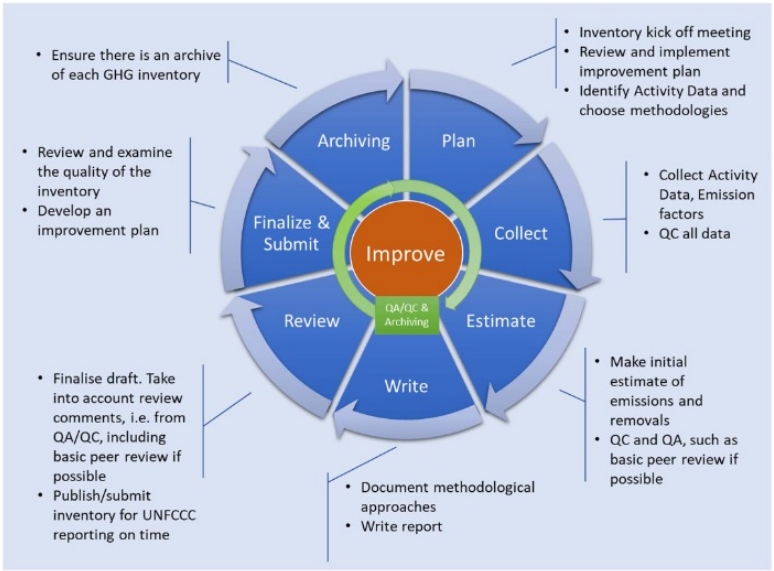
CO_2 Emissions per capita in Philippine vs Global (2010-2022)



Source : [Per capita CO_2 emissions (ourworldindata.org)]

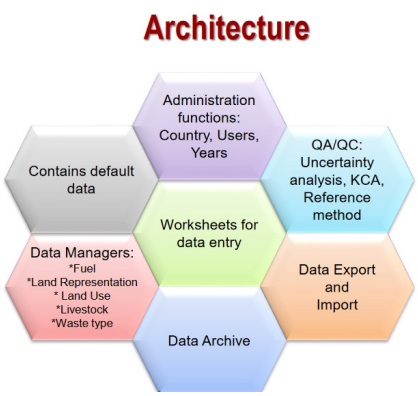
National GHG Inventory Management System

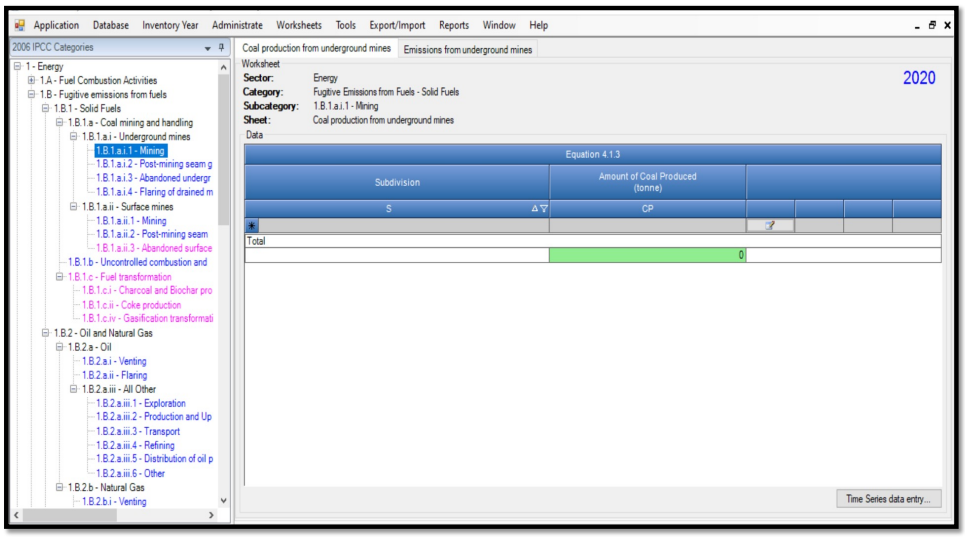
A way to structure all the steps and elements needed to estimate, report, review, archive, and improve estimates of GHG emissions and removal.



National GHG Inventory can be prepared by using

IPCC Inventory Software or web based national GHG inventory systems or calculation worksheets by manually





IPCC Inventory Software

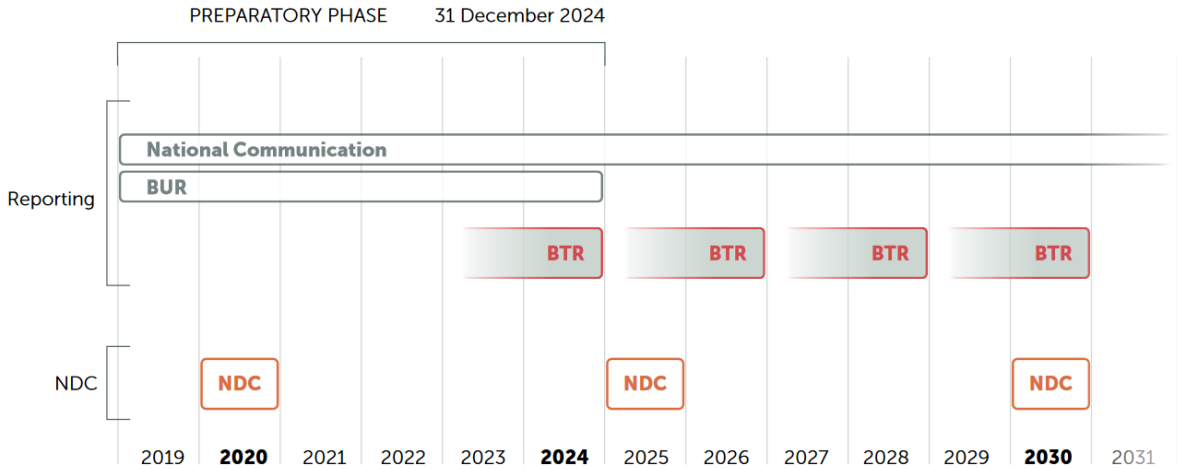
IPCC Inventory Software was first released in 2012. Initially, it was designed to be a simple tool implementing only Tier 1 methods according to the 2006 IPCC Guidelines

The latest version, 2.89, has been released on November 28, 2023, for UNFCCC COP28

- ✓ All Methodological Tiers and approaches according to the 2006 IPCC Guidelines,
- ✓ Calculation of Indirect CO_2 and N_2O emissions according to the 2006 IPCC Guidelines and its 2019 Refinement
- ✓ Interoperability functionality with the UNFCCC CRT Reporting tool (Energy Sector, Waste sector, Agriculture categories)

2. Requirements for GHG inventories for Non-Annex I countries

Timeline for BTR, NDC, NC and BUR



Methodologies and Tiers - Non-Annex I Parties

- IPCC Guidelines for National Greenhouse Gas Inventories.

  ✓Different methods (tiers) - giving priority to methods which provide most accurate estimates, depending on national circumstances and the availability of data.

  ✓National methodologies - which can reflect their national situation, provided that these methodologies are consistent, transparent and well documented

  ✓Default methodologies - which include default emission factors and in some cases default activity data

Information to be included in GHG Inventory

- ✓ Procedures and arrangements for data management
- ✓ Estimates and information of GHG emissions under the UNFCCC
- ✓ Information of other GHGs such as CO, NOx and non-methane volatile organic compounds (NMVOCs) and other gases not controlled by the Montreal Protocol, such as SOx.
- ✓ Any large differences between the sectoral and reference approaches
- ✓ Emissions from international aviation and marine bunker fuels separately
- ✓ Information on methodologies used
- ✓ Brief explanation of the sources of emission factors and activity data
- ✓ The inventory sectoral tables and worksheets of the IPCC, in both electronic and hard copy format
- ✓ Information on the level of uncertainty associated with inventory data and their underlying assumptions, and to describe the methodologies used, if any, for estimating these uncertainties

Reference- https://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/dec17-cp.pdf

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Training on 2006 IPCC Guidelines for preparing National GHG Inventory: General Reporting and Guidelines

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Overview of the IPCC 2006 Guidelines

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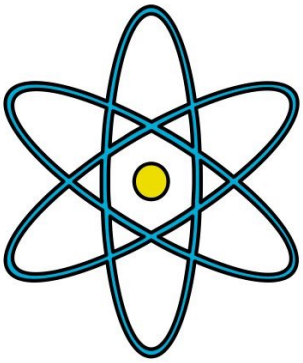

Contents

1. Introduction

Why we need a GHGI Guideline?

- Any international agreement to limit climate change must set emission limits/targets/aims and monitor progress in an open and transparent way

- Currently, most national emissions can only be estimated, not measured and so we need a consensus on the best way of doing this.
  - Cannot measure all sources (e.g. road transport would be impractical; Remote sensing techniques not available)

- To do this we need reliable, generally accepted methods and guidelines

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Benefits of a GHGI Guideline?

Standardization

- ✓Provide a standardized framework for compiling, reporting, and verifying greenhouse gas emissions globally
- ✓Ensures consistency and comparability of data across different countries and regions.

Methodological Consistency

- ✓Ensures consistent methodologies for estimating emissions and removals, fostering reliability and comparability of data.
- ✓Crucial for generating reliable and comparable data, allowing for meaningful analyses and assessments at local, national, and global levels.

International Reporting Obligations

- ✓Serve as the basis for fulfilling these reporting obligations, facilitating the tracking of progress in mitigating climate change.

Quality Assurance and Quality Control (QA/QC)

- ✓Ensure the reliability and accuracy of reported data.
- ✓Includes standardized methods for data collection, validation, and verification, enhancing the overall quality of the inventory.

Transparency and Replicability

- ✓Emphasize transparent documentation of methodologies and data sources.
- ✓This transparency enhances the replicability of inventory processes, allowing stakeholders to understand and reproduce the results, fostering credibility and trust in the reported data.

Policy Development and Decision-Making

- ✓Provides a robust foundation for policymakers to develop effective climate policies, informed by accurate and systematic inventory compilation.

Global Collaboration

- ✓Facilitate international collaboration by creating a common language and methodology for assessing and addressing greenhouse gas emissions, fostering a collective response to a shared challenge.

?

Covered Greenhouse Gases

- The IPCC Guidelines cover a range of significant greenhouse gases that contribute to climate change.

The covered gases include:
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)
- Trifluoromethyl Sulphur pentafluoride (SF_5CF_3)
- Halogenated ethers (e.g., $C_4F_9OC_2H_5$, $CHF_2OCF_2OC_2F_4OCHF_2$, $CHF_2OCF_2OCHF_2$)
- Other halocarbons not covered by the Montreal Protocol including CF_3I, CH_2Br_2, $CHCl_3$, CH_3Cl, CH_2Cl_2.

Global Warming Potentials (GWPs)

- Each covered gas has an associated GWP, indicating its relative impact on global warming compared to CO_2.
- Understanding GWPs is crucial for assessing the overall climate impact of different gases.
- The IPCC Guidelines provide these values to standardize the evaluation of greenhouse gas contributions.

Inclusion of Substitute Gases

- The 2006 Guidelines include methods for gases like $C_3F_7C(O)C_2F_5$, C_7F_{16}, C_4F_6, C_5F_8, and c-C_4F_{80}, for which GWP values were not available before finalization.
- These substitute gases are sometimes used in place of others, and their estimation is encouraged for a comprehensive assessment.

Countries are encouraged to provide estimates for substitute gases to improve the accuracy and completeness of greenhouse gas inventories.

This inclusive approach ensures that the guidelines remain adaptable to evolving scientific knowledge and technological changes.

Covered Greenhouse Gases
Philippines

The 2010 Philippines Greenhouse Gas Inventory comprehensively addressed the range of significant greenhouse gases specified in the 2006 IPCC Guidelines.

Sector	Greenhouse gases covered
IPPU	CO_2, CH_4, N_2O, HFCs, SF_6, NOx, NMVOCs, CO, SO_2, PFCs, HCFC-22, Halogenated ethers, Halocarbons
Energy	CO_2, CH_4, N_2O, CO, NOX, NMVOCs
Agriculture	CH_4, N_2O
LUCF	CO_2
Waste	CH_4, N_2O, CO_2

HALOCARBON	RELATIVE COMPOSITION
HCFC-22	HCFC-22
HCFC-123	HCFC-123
HCFC-141B	HCFC-141B
HFC-134A	HFC-134A
R-404A	HFC-125/HFC-134A/HFC-143A (44/4/52)
R-401A	HCFC-22/HCFC-124/HFC-152A (53/34/13)
R-401B	HCFC-22/HCFC-124/HFC-152A (61/28/11)
R-402B	HCFC-22/HFC-125/PROPANE (38/60/2)
R407C	HFC-32/HFC-125/HFC-134A (23/25/52)
R410A	HFC 32/HFC-125 (50/50)
R-507A	HFC-125/ /HFC-143A (50/50)
R-508B	HFC-23/PFC-116 (46/54)

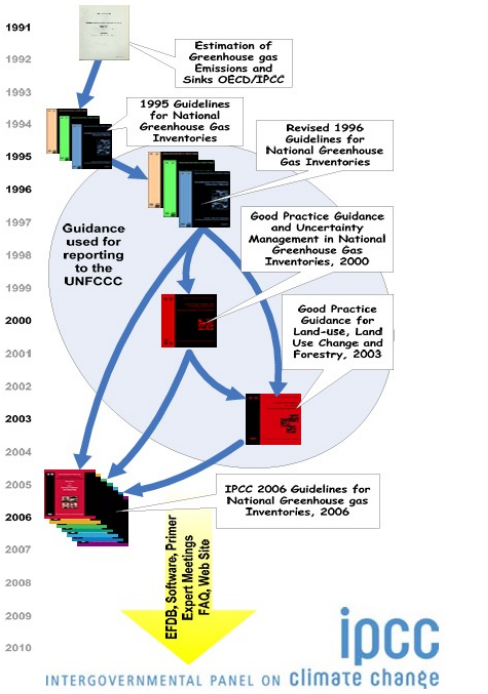
Source: EMB Ozone Desk, 2000

Halocarbons used in the Philippines

Source - Community-level Greenhouse Gas Inventory -GHG-.pdf (climate.gov.ph)

History/ Evolution of IPCC Guidelines

- Process started in 1991
- Revised 1996 Guidelines
  - ✓ Land-Use Change and Forestry (LUCF) identifies major land use processes ---→ More details
- 2000 Good Practice Guidance and Uncertainty Management
  - ✓ Defines GPG for sectors except LUCF
- 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF)
  - ✓ Expanded guidance covering all pools--→ More details
  - ✓ Land-based not process-based
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
  - ✓ Now only 4 main sectors: Energy, IPPU (Industrial Processes and Product Use), AFOLU (Agriculture, Forestry and Other Land Use) and Waste



2. Contents of 2006 IPCC Guidelines

Introduction to the IPCC 2006 Guidelines

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) provide methodologies for estimating national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases.

The 2006 IPCC Guidelines are in five volumes

Volume 1 General Guidance and Reporting

Volume 2 Energy

Volume 4 Agriculture, Forestry and Other Land Use

Volume 3 Industrial Processes and Product Use

Volume 5 Waste

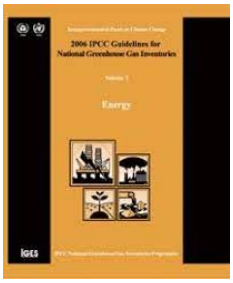
Volume 1: General Guidance and Reporting

Volume 1 describes the basic steps in inventory development and offers the general guidance in greenhouse gas emissions and removals estimates based on the understanding of accumulated experiences of countries over the period since the late 1980s.

Contents of the volume includes,

1. Approaches to Data Collection
2. Uncertainties
3. Methodological Choice and Identification of Key Categories
4. Time Series Consistency
5. Quality Assurance/Quality Control and Verification
6. Precursors and Indirect Emissions
7. Reporting Guidance and Tables

Volume 2: Energy



- Energy systems are for most economies largely driven by the combustion of fossil fuels
- Energy sector typically contributes over 50 percent of the total greenhouse gas emissions in the Philippines.

The energy sector emissions mainly comprises:

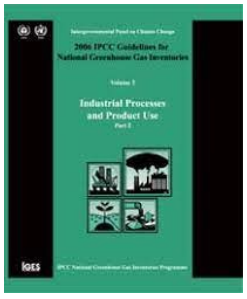
- ✓ exploration and exploitation of primary energy sources,
- ✓ conversion of primary energy sources into more useable energy forms in refineries and power plants
- ✓ transmission and distribution of fuels
- ✓ use of fuels in stationary and mobile applications

Emissions arise from these activities by combustion and as fugitive emissions or escape without combustion.

This volume includes chapters on **energy sub-categories** and reference approach to estimate emissions,

1. Stationary Combustion
2. Mobile Combustion
3. Fugitive Emissions
4. CO_2 Transport, Injection and Geological Storage
5. Reference Approach

Volume 3: Industrial Processes and Product Use (IPPU)



- Volume 3 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.
- Greenhouse gas emissions are produced from a wide variety of industrial activities.
- During these processes, many different greenhouse gases, including CO2, CH4, N2O, HFCs and PFCs can be produced.

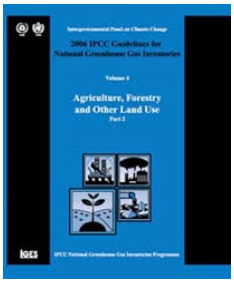
The IPPU sector emissions mainly comprises:

- ✓ **Industrial Processes:** Processes that chemically or physically transform materials releasing GHG
- ✓ **Product Use:** GHGs are used in products such as refrigerators, foams or aerosol cans

This volume includes different chapters on key **industrial sub-categories**,

1. Mineral Industry Emissions
2. Chemical Industry Emissions
3. Metal Industry Emissions
4. Non-Energy Products from Fuels and Solvent Use
5. Electronics Industry Emissions
6. Emissions of Fluorinated Substitutes for Ozone Depleting Substances
7. Other Product Manufacture and Use

Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)



- Volume 4 provides guidance for preparing annual greenhouse gas inventories in the Agriculture, Forestry and Other Land Use (AFOLU) Sector.
- The factors governing emissions and removals can be both natural and anthropogenic

- There are many processes leading to emissions and removals of greenhouse gases, which can be widely dispersed in space and highly variable in time.
- Due to the complexity, inventory methods need to be practical and operational

This volume includes different chapters on key **emission source categories under FOLU Sector**,

1. Generic Methodologies Applicable to Multiple Land-use Categories
2. Consistent Representation of Lands
3. Forest Land
4. Cropland
5. Grassland
6. Wetlands
7. Settlements
8. Other Land
9. Emissions from Livestock and Manure Management
10. N_2O Emissions from Managed Soils
11. CO_2 Emissions from Lime and Urea Application
12. Harvested Wood Products

Volume 5: Waste

- Volume 5 provides methodological guidance for estimation of CO_2, CH_4 and N_2O emissions from Waste sector.
- Typically, CH_4 emissions from solid waste disposal sites (SWDSs) are the largest source in Waste sector

- Biogenic CO_2 emissions are not included in Waste sector
- All greenhouse gas (GHG) emissions from waste-to-energy should be estimated and reported under Energy sector

This volume includes different chapters on **waste data** and **key emission source categories of Waste**,

1. Waste Generation, Composition and Management Data
2. Solid Waste Disposal
3. Biological Treatment of Solid Waste
4. Incineration and Open Burning of Waste
5. Wastewater Treatment and Discharge

3. Changes between the 1996 and 2006 IPCC Guidelines

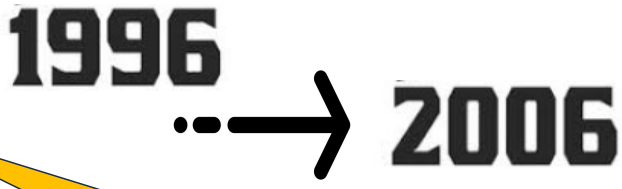
Main changes to the volumes

A new volume **"General Guidance and Reporting"** was included providing an overview of greenhouse gas inventories and the steps needed to prepare an inventory for the first time

"Industrial Processes" and "Solvent and Other Product Use" Sectors in the 1996 Guidelines are combined into "IPPU"

"Agriculture" and "(Land Use,) Land-Use Change and Forestry" Sectors in the 1996 Guidelines are combined into "AFOLU"

Although the number of sectors in the 2006 Guidelines has been reduced from six to four, this is not accompanied by any great changes in methodological approaches at the individual category level except for land categories in AFOLU



Steps to prepare an GHG inventory

1. Identify the key categories for the inventory
2. Identify the appropriate method for estimation for each category
3. Data collection
4. Estimation of emissions and removals
5. Uncertainty analysis
6. Key category analysis
7. QA & QC/ Verification
8. Reporting the inventory

Main changes to the volumes CONT…

Cover more greenhouse gases and give methods for more sectors

1996 → 2006

GHGs covered in 2006 Guideline

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)
- nitrogen trifluoride (NF_3)
- trifluoromethyl sulphur pentafluoride (SF_5CF_3)
- halogenated ethers (e.g., $C_4F_9OC_2H_5$, $CHF_2OCF_2OC_2F_4OCHF_2$, $CHF_2OCF_2OCHF_2$)
- and other halocarbons not covered by the Montreal Protocol including CF_3I, CH_2Br_2 $CHCl_3$, CH_3Cl, CH_2Cl_2 [4]

GHGs covered in 1996 Guideline

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Ozone and aerosol precursors (CO, NMVOCs, NO_x and SO_2)

Main changes to the volumes CONT…

The 2006 Guidelines maintain the methods of earlier guidelines and integrate Good practice guidance for clarity and ease of use

Have improved methods and default data

1996 → 2006

1996

TABLE 1-7
CH_4 DEFAULT (UNCONTROLLED) EMISSION FACTORS (IN KG/TJ)

			Coal[a]	Natural Gas	Oil	Wood/ Wood Waste	Charcoal	Other Biomass and Wastes[c]
Energy Industries			1	1	3	30[b]	200[b]	30
Manufacturing Industries and Construction			10	5	2	30	200	30
Transport	Aviation[d]				0.5			
	Road			50	Gasoline 20[e] / Diesel 5			
	Railways		10		5			
	Navigation		10		5			
Other Sectors	Commercial/Institutional		10	5	10	300	200	300
	Residential		300	5	10	300	200	300
	Agriculture/ Forestry/ Fishing	Stationary	300	5	10	300	200	300
		Mobile		5	5			

2006

TABLE 2.2
DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
(kg of greenhouse gas per TJ on a Net Calorific Basis)

Fuel		CO_2 Default Emission Factor	CO_2 Lower	CO_2 Upper	CH_4 Default Emission Factor	CH_4 Lower	CH_4 Upper	N_2O Default Emission Factor	N_2O Lower	N_2O Upper
Crude Oil		73 300	71 100	75 500	r 3	1	10	0.6	0.2	2
Orimulsion		r 77 000	69 300	85 400	r 3	1	10	0.6	0.2	2
Natural Gas Liquids		r 64 200	58 300	70 400	r 3	1	10	0.6	0.2	2
Gasoline	Motor Gasoline	r 69 300	67 500	73 000	r 3	1	10	0.6	0.2	2
	Aviation Gasoline	r 70 000	67 500	73 000	r 3	1	10	0.6	0.2	2
	Jet Gasoline	r 70 000	67 500	73 000	r 3	1	10	0.6	0.2	2
Jet Kerosene		r 71 500	69 700	74 400	r 3	1	10	0.6	0.2	2
Other Kerosene		71 900	70 800	73 700	r 3	1	10	0.6	0.2	2
Shale Oil		73 300	67 800	79 200	r 3	1	10	0.6	0.2	2
Gas/Diesel Oil		74 100	72 600	74 800	r 3	1	10	0.6	0.2	2
Residual Fuel Oil		77 400	75 500	78 800	r 3	1	10	0.6	0.2	2
Liquefied Petroleum Gases		63 100	61 600	65 600	r 1	0.3	3	0.1	0.03	0.3
Ethane		61 600	56 500	68 600	r 1	0.3	3	0.1	0.03	0.3
Naphtha		73 300	69 300	76 300	r 3	1	10	0.6	0.2	2
Bitumen		80 700	73 000	89 900	r 3	1	10	0.6	0.2	2
Lubricants		73 300	71 900	75 200	r 3	1	10	0.6	0.2	2
Petroleum Coke		r 97 500	82 900	115 000	r 3	1	10	0.6	0.2	2
Refinery Feedstocks		73 300	68 900	76 600	r 3	1	10	0.6	0.2	2
Refinery Gas		r 57 600	48 200	69 000	r 1	0.3	3	0.1	0.03	0.3

General Guidance

- Elaborated general guidance has been included which is applicable to all sectors and helps overall inventory management, such as:
  - ✓ Extended advice on data collection
  - ✓ Uncertainty analysis
  - ✓ Key category analysis
  - ✓ Time series consistency
  - ✓ Quality assurance and quality control (QA/QC)

  → Updated from GPG2000/ GPG-LULUCF
- The general guidance enables continuous improvement across inventory quality (e.g. transparency, accuracy, completeness, consistency, etc.) through a systematic inventory development cycle.
- Inventory compilers using GPG2000/GPG-LULUCF are expected to be already familiar with most of the elements of general guidance

Includes instructions for…

Gathering existing data

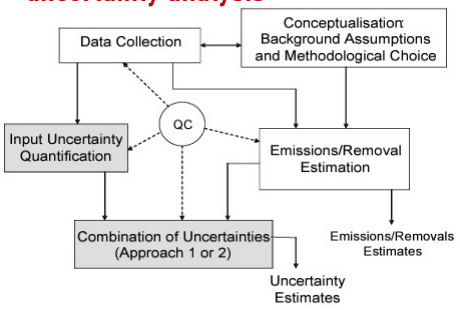
Generating new data

Adapting data for inventory use

Emission factors and direct measurement of emissions

Activity data

Overall structure of a generic uncertainty analysis



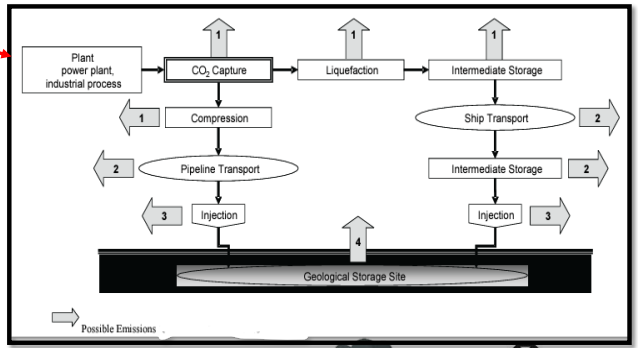
Energy Sector

The changes from 1996 Guidelines are minimal.

- Two new sources have been added:
  - ✓ Urea-Based Catalysts (Road Transport)
  - ✓ Carbon Dioxide Transport, Injection and Geological Storage
- More details have been provided particularly for:
  - ✓ Fuel Combustion Activities –Manufacturing Industries and Construction
  - ✓ Fugitive Emissions from Fuels –Oil and Natural Gas

Urea consumption for catalytic converters in vehicles is directly related to the vehicle fuel consumption and technology.

Possible emissions from carbon capture and storage process



More Info

- *Page 10 of Overview Chapter of the 2006 IPCC Guidelines*
- *Page 18 of the Primer to the 2006 IPCC Guidelines*

IPPU Sector

- **The whole sector has been restructured:** Industrial Processes and Solvent and Other Product Use Sectors have been combined
- **There are categories (e.g. chemical, metal and product use) that were <u>not</u> present in the Revised 1996 IPCC Guidelines:** some were previously included in other categories while for the others new guidance is provided.
- Emissions from the Non-Energy Use of fuels are allocated to this Sector rather than in the Energy Sector.

Categories explicit added…

- *Caprolactam, glyoxaland glyoxylic acid production*
- *Titanium dioxide production*
- *Petrochemical and carbon black production*
- *Lead production*
- *Zinc production*
- *Thin-film-transistor flat panel displays, photovoltaic and heat transfer fluid*
- *Sulfur Hexafluoride and per-fluorocarbons from other product use (Military applications and accelerators)*

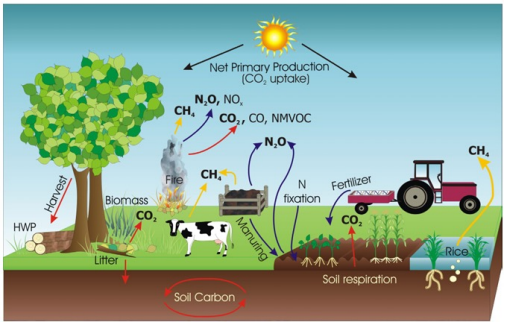
Etc.

More Info

- *Page 11 of Overview Chapter of the 2006 IPCC Guidelines*
- *Page 18 of the Primer to the 2006 IPCC Guidelines*
- *Annex 3 to Vol.3 of the 2006 IPCC Guidelines ("Improvements since 1996")*

AFOLU Sector

- The GPG-LULUCF (2003) introduced a new approach for the "Land Use, Land-Use Change and Forestry" (LULUCF) Sector with a new classification of these categories. (It is based on land use types rather than activities.)
- The 2006 IPCC Guidelines maintain the same structure as GPG-LULUCF for land categories. Therefore, inventory compilers already using the GPGLULUCF should have no any problems.
- More detailed guidance has been added for various categories, including livestock categories, harvested wood products (HWP), etc.



More Info

- *Page 11 of Overview Chapter of the 2006 IPCC Guidelines*
- *Page 19 of the Primer to the 2006 IPCC Guidelines*
- *Chapter 1 of Vol.4 of the 2006 IPCC Guidelines ("Introduction")*

Waste Sector

- The scope is similar to the earlier guidelines (Revised 1996 IPCC Guidelines and GPG2000).
- Revised methodology for methane from landfills
- Guidance on carbon accumulation in landfills
- Guidance on biological treatment and open burning of waste

EQUATION 3A1.24
DEGRADABLE ORGANIC CARBON ACCUMULATED DURING A YEAR

$$DDOCma(i+1) = a \bullet DDOCma(i) + b \bullet DDOCmd(i-1) + c \bullet DDOCmd(i)$$

Where:

DDOCma (i) = DDOCm stock in the SWDS at the beginning of year *i*, Gg C

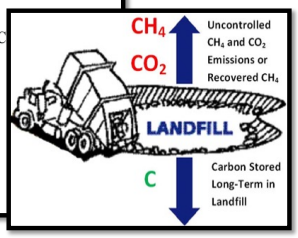
DDOCmd (i) = DDOCm disposed during year *i*, Gg C

a = e^{-k} (constant)

b = $1/k \bullet (e^{-k(1-\Delta)} - e^{-k}) - \Delta \bullet e^{-k}$ (constant)

c = $1/k \bullet (1 - e^{-k(1-\Delta)}) + \Delta$ (constant)

Δ = delay constant, in years (between 0 and 1 years)



Guidance on estimation of emissions from composting and biogas facilities has been included to ensure a more complete coverage of sources.

More Info

- *Pages 11-12 of Overview Chapter of the 2006 IPCC Guidelines*
- *Page 20 of the Primer to the 2006 IPCC Guidelines*

4. 2019 Refinement to the 2006 IPCC Guidelines

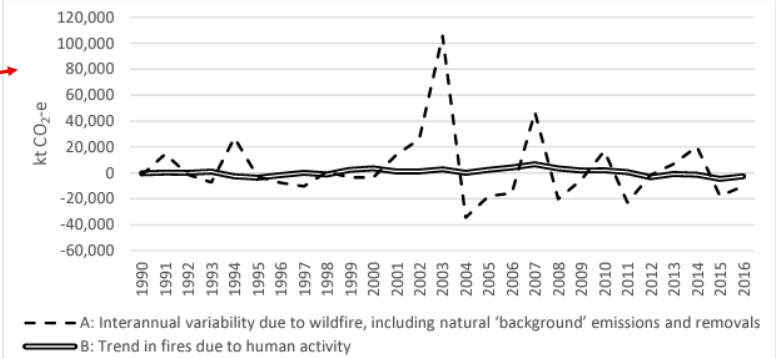
Specific Developments in the 2019 Refinement

Volume 1: General Guidance and Reporting

Chapter 1 "Introduction to National GHG Inventories"

- New guidance on implementation of a national inventory management system
- **Updated concept of "anthropogenic emissions and removals" related to new optional approach for disaggregation of emissions and removals by human and natural components** in Chapter 2 of Volume 4
- Elaborated guidance on the treatment of CO_2, CH_4 and N_2O emissions from combustion of biomass or biomass-based products

Example of the disaggregation of wildfire emissions in Australia into 'natural disturbance' emissions and removals and the emissions and removals from fires due to human activity.



Specific Developments in the 2019 Refinement

Volume 1: General Guidance and Reporting CONT…

Chapter 2 "Approaches to data collection"

- New guidance for the development of Country Specific emission factors
- New guidance for data collection
- New guidance on the integration of emissions reported from facilities into national GHG inventories

Chapter 3 "Uncertainties"

- Updated guidance on uncertainty by providing more default values, calculation examples and best practices

Chapter 4 "Methodological Choice and Identification of Key Categories" and Chapter 5 "Time series consistency"

- Updated guidance on Key category analysis
- Elaborated guidance on time series consistency

Chapter 6 "QA/QC and Verification"

- Elaborated definitions of QA/QC and verification
- Updated guidance on comparisons with atmospheric measurements
- New guidance on the use and reporting of models

Specific Developments in the 2019 Refinement

Volume 1: General Guidance and Reporting CONT…

Chapter 7 "Precursors and indirect emissions"

- Elaborated guidance on indirect CO_2 inputs to the atmosphere from emissions of carbon-containing compounds

Chapter 8 "Reporting Guidance and Tables"

- Updated to reflect refinements made in other Volumes (although it was not explicitly included in the original scope of refinements) , including:
  - ✓ Reporting guidance
  - ✓ List of GHGs
  - ✓ List of IPCC categories and their definitions
  - ✓ Reporting Tables

Specific Developments in the 2019 Refinement

Volume 2: Energy

Overview to the refinement

Chapter 2. Stationary Combustion
- *Link to issue related to biomass combustion and methodologies for Harvested Wood Products (HWP)*

Chapter 4. Fugitive Emissions
- 4.1 Fugitive emissions from mining, processing, storage and transportation of coal
  - Elaborate chapter to include guidance on emissions from exploration and CO_2 emissions (Underground coal mines, Surface coal mining)
  - Include new section on abandoned surface coal mines
- 4.2 Fugitive emissions from oil and natural gas systems
  - Update chapter including update/inclusion of EFs representative for current practice. Additional guidance for unconventional oil and gas production and abandoned wells.
- 4.3 Fuel transformation *[New]*

Note. All methodological updates made in the *2019 Refinement* are in the fugitive emissions categories. No methodological updates were made for stationary combustion, mobile combustion, or other sources other than fugitives.

New guidance on Fugitive Emissions from Fuel Transformation (Volume 2, Chapter 4)

TABLE 4.3.1 (NEW)
DETAILED SECTOR SPLIT FOR EMISSIONS FROM FUEL TRANSFORMATION

IPCC code	Category/subcategory	Definition
1 B 1 c	*Fuel transformation*	Fugitive emissions arising during the manufacture of secondary and tertiary products from fuels.
1 B 1 c i	*Charcoal and Biochar Production*	Fugitive emissions arising d of charcoal and biochar.
1 B 1 c ii	*Coke Production*	Fugitive emissions arising d of coke.
1 B 1 c iii	*Solid to Solid Fuel Production*	Fugitive emissions arising d of wood pellets.
1 B 1 c iv	*Gasification Transformation*	Fugitive emissions from the biomass, coal or natural gas composed by H_2, CO, CO_2 into a liquid hydrocarbons f

Emission sources for future methodological developments (Volume 2, Chapter 4)

Appendix 4A.1 Fugitive emissions from mining, processing, storage and transportation of coal: Basis for Future Methodological Development

Based on the current state of research and data availability, methodologies for estimating emissions from abandoned surface mining and from coal exploration have not yet been able to be developed. However, general methodological issues for abandoned surface mine emissions, and a more detailed draft of elements of a methodology for coal exploration are below for countries to consider as a basis for future methodological development.

Appendix 4A.1.1 Abandoned Surface Mines

Closed, or abandoned, surface coal mines may continue to be a source of greenhouse gas emissions for some time after the mines have been closed or decommissioned. For the purpose of the emissions inventory compilation, a first critical step is to ensure that each mine is classified in one and only one inventory database (e.g., active or abandoned).

It is also important to consider sub-category allocation issues - to separate any emissions from abandoned surface mines from those of uncontrolled combustion and burning of coal deposits, to avoid double counting. CO_2 emissions can arise from both low-temperature oxidation of exposed coal-bearing rocks and uncontrolled combustion. The CO_2 emissions from uncontrolled combustion should be reported under *1.B.1.b Uncontrolled Combustion and Burning Coal Dumps*

Specific Developments in the 2019 Refinement

Volume 3: IPPU

Overview to the refinement

- Chapter 3
  - Nitric acid production
  - Fluorochemical production
  - Hydrogen production *[New]*
- Chapter 4
  - Iron and Steel
  - Primary aluminium production and Alumina production *[New]*
  - Rare Earths elements *[New]*
- Chapter 6
  - Electronics Industry
- Chapter 7
  - Refrigeration and air conditioning
- Chapter 8
  - Use of SF_6 and PFCs in Textile Industry and for Water-proofing of electronic circuit boards *[New]*

Specific Developments in the 2019 Refinement

Volume 3: IPPU CONT…

Only particular categories were refined, where there is a need to update emission factors and methodological guidance and to provide new information

More complete coverage of sources and gases, some of categories are minor ones in terms of emissions

Structure of categories is practically the same. Main categories are already covered in 2006 IPCC Guidelines

- F-gases emissions are evolving all the time (a challenge for developing emission factors)
- IPCC guidelines provide with default emission factors, countries can use their own factors

Specific Developments in the 2019 Refinement

Volume 4: AFOLU

Overview to the refinement

- The main changes for the AFOLU sector are related to the following:
  - ✓ Provision of New Guidance
  - ✓ Provision of updated default emission factors
  - ✓ Provision of new default emission factors
  - ✓ Better and more complete coverage of sections
- Volume 4 contains annexes:
  - ✓ Annex 1 (Mapping tables)
  - ✓ Annex 2 (Worksheets)

Specific Developments in the 2019 Refinement

Volume 5: Waste

Overview to the refinement

Refinements are made in the following chapters:

- Chapter 2: Waste generation, composition and management data
- Chapter 3: Solid waste disposal
- Chapter 5: Incineration and open burning of waste
- Chapter 6: Wastewater treatment and discharge

Volume 5 contains annexes:

- Annex 1 (Mapping tables)
- Annex 2 (Worksheets)

IPCC Waste Model for estimation of methane (CH_4) emissions from solid waste disposal site (SWDS) has been updated reflecting the refinements made in relevant chapters.

The refinements are made to include new and updated default data as well as new and up-to-date information and guidance, among others.

Specific Developments in the 2019 Refinement

Volume 5: Waste CONT…

Updated and elaborated guidance (e.g., new types of managed solid waste disposal sites; CH_4 and N_2O emissions from gasification and pyrolysis of waste; CH4 and N_2O emissions from wastewater)

- Better understanding of emissions/ sources and clearer guidance (e.g., clarification to the existing guidance)

New and updated default data (e.g., waste generation and composition; parameters of domestic and industrial sludge; CH_4 and N_2O emissions from domestic and industrial wastewater treatment and discharge)

- Improved accuracy

New guidance (e.g.,N_2O emissions from industrial wastewater)

- Improved completeness

- Introduction to Methodology for GHG Inventory Estimation

How ?

- Make estimates based on parameters associated with emission rates
  - CO_2 from fuel depends on carbon in fuel
  - CO_2 proportional to amount of fuel burnt
  - Changes on stocks of carbon in forests give emissions (or removals) of CO_2

$$E = EF * AD$$

Where:

- E = Emission
- EF = Emission Factor
- AD = Activity Data

Calculation of National Total Emissions

- The total emissions for a country are calculated by summing up the individual emissions and removals across all sectors, categories, and sub-categories.
- The summation process ensures a comprehensive assessment of the nation's overall greenhouse gas impact.

Calculation of National Total Emissions

Energy Sector

HC $\xrightarrow{\text{Combustion}}$ H,C $\xrightarrow{\text{Energy released}}$ H_2O, CO_2, CO

There are two ways to estimate CO_2 emissions from fuel combustion: the top-down or reference approach, and the bottom-up or sectoral approach. In both methods, the general formula used to compute for CO_2 emissions is:

CO_2 Emissions (t CO_2) = $\sum$ [fuel consumption (TJ) x carbon emission factor (t C/TJ) – carbon stored (t C) x fraction of carbon oxidized x 44/12]

where:
- t CO_2 = tonnes (1000 kg) CO_2
- TJ = Terajoules (1 TJ is 1,000,000,000,000 or 1 x 1012 joules)
- 44/12 = ratio of the molecular weight of CO_2 (44 grams/mole) to the molecular weight of C (12 grams/mole) and is used to convert from C to CO_2

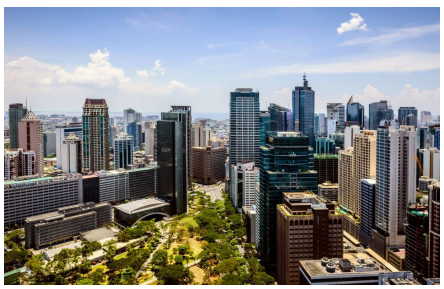
Calculation of National Total Emissions

Industry Sector

The Revised 2006 IPCC Guidelines recommends estimation of GHG emissions from industrial processes based on the amount of material produced or consumed.

The recommended general estimation method follows the following equation, and this has been used in 2000 GHG Inventory.

$$T_{ij} = A_{ij} \times EF_{ij}$$



Where:

T_{ij} = the emission of gas *i* formed from industrial process, *j*

A_j = the amount of activity or production of process materialin industry, *j*

EF_{ij} = the emission factor (EF) of gas i per unit of activity in industrial sector, j.

Calculation of National Total Emissions

Agriculture Sector

Methane from enteric fermentation

$$Ch_4\ Enteric_a = Pop_a \times EF\_enteric_a \times 10^{-3}$$

where:

- $Ch_4\ Enteric_a$ = Methane emission from enteric fermentation for animal type "a" (Gg/yr)
- Pop_a = Population of animal type "a" (x 1000 heads)
- $EF\_enteric_a$ = Emission factor for enteric fermentation for animal type "a" (kg CH_4/head/yr)
- 10^{-3} = Conversion factor (to Gg)

Nitrous Oxide From Manure Management

$$N_2O_{D(mm)} = \left[\sum_S \left[\sum_T \left(N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}\right)\right] \bullet EF_{3(S)}\right] \bullet \frac{44}{28}$$

where:

- $N_2O_{D(mm)}$ = direct N_2O emissions from Manure Management, kg N_2O yr-1
- $N_{(T)}$ = number of head of livestock species/category T
- $Nex_{(T)}$ = annual average N excretion per head of species/category T, kg N animal-1 yr-1
- $MS_{(T,S)}$ = fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S, dimensionless
- $EF3_{(S)}$ = emission factor for direct N_2O emissions from manure management system S, kg N_2O-N/kg N in manure management system S
- S = manure management system
- T = species/category of livestock
- 44/28 = conversion of (N_2O-N)(mm) emissions to N_2O(mm) emissions

Calculation of National Total Emissions

Agriculture Sector

Rice Paddy Cultivation

$$CH_{4\ Rice} = \sum_{i,j,k} (EF_{i,j,k} \bullet t_{i,j,k} \bullet A_{i,j,k} \bullet 10^{-6})$$

where:

- $CH_{4\ Rice}$ = annual methane emissions from rice cultivation, Gg CH_4/yr
- EF_{ijk} = a daily emission factor for *i*, *j*, and *k* conditions, kg CH_4/ha day
- t_{ijk} = cultivation period of rice for *i*, *j*, and *k* conditions, day
- A_{ijk} = annual harvested area of rice for *i*, *j*, and *k* conditions, ha/yr
- *i, j, and k* = represent different ecosystems, water regimes, type and amount of organic amendments, and other conditions under which CH_4 emissions from rice may vary

Calculation of National Total Emissions

LUCF Sector

The annual uptake of carbon due to biomass growth is determined using the following equation:

$$G = A \times B \times C \times 1000$$

G – Annual carbon uptake due to biomass growth
A – Land area covered by a particular land use
B – Annual biomass growth rate
C – Percent carbon contained in the biomass which is valued at 45
1000 – factor to convert MtC to kt C

Table 6. Summary of 2010 FOLU sector emissions, per subsector and per gas (values in Mt CO_2e)

	CO_2	CH_4	N_2O	Total
Biomass Carbon Stock Silvopasture	(51.252)	-	-	(51.252)
Biomass Carbon Stock	11.084	-	-	11.084
Biomass Carbon Stock Deforestation	16.125	-	-	16.125
Biomass Carbon Stock Agroforestry/Perennial Crop	(12.973)	-	-	(12.973)
Biomass Burning - Forests	-	0.007	0.002	0.009
	TOTAL			*(37.007)*

Calculation of National Total Emissions

Waste Sector

Solid waste disposal

$$DOC = \Sigma_i = (DOC_i * W_i)$$

Where,

DOC = fraction of degradable organic carbon in bulk waste, Gg C/Gg waste

DOC_i = fraction of degradable organic carbon in waste type I

W_i = fraction of waste type i by waste category

Calculation of National Total Emissions

Biological Treatment of Solid Waste

CH4 emissions from biological treatment

$$CH_4 \text{ Emissions} = \Sigma_i = (M_i * EF_i) * 10^{-3} - R$$

Where,

CH4 Emissions = total CH4 emissions in inventory year, Gg CH4

M_i = mass of organic waste treated by biological treatment type i, Gg

EF = emission factor for treatment i, g CH4/kg waste treated

i = composting or anaerobic digestion

R = total amount of CH4 recovered in inventory year, Gg CH4

N2O emissions from biological treatment

$$N_2O \text{ Emissions} = \Sigma_i = (M_i * EF_i) * 10^{-3}$$

Where,

N_2O Emissions = total N2O emissions in inventory year, Gg N2O

M_i = mass of organic waste treated by biological treatment type i, Gg

EF = emission factor for treatment i, g N2O/kg waste treated

i = composting or anaerobic digestion

Calculation of National Total Emissions

Wastewater

$$CH_4 \text{ Emissions} = \left[\sum_{i,j}\left(U_i \bullet T_{i,j} \bullet EF_j\right)\right](TOW - S) - R$$

Where:

CH_4 Emissions = CH_4 emissions in inventory year, kg CH_4/yr

TOW = total organics in wastewater in inventory year, kg BOD/yr

S = organic component removed as sludge in inventory year, kg BOD/yr

U_i = fraction of population in income group *i* in inventory year, See Table 6.5.

$T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i* in inventory year, See Table 6.5.

i = income group: rural, urban high income and urban low income

j = each treatment/discharge pathway or system

EF_j = emission factor, kg CH_4 / kg BOD

R = amount of CH_4 recovered in inventory year, kg CH_4/yr

Total Emission = CH4 Emission x GWP_CH4 + N2O Emission x GWP_N20

N_2O EMISSIONS FROM WASTEWATER EFFLUENT

$$N_2O \text{ Emissions} = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

Where:

N_2O emissions = N_2O emissions in inventory year, kg N_2O/yr

$N_{EFFLUENT}$ = nitrogen in the effluent discharged to aquatic environments, kg N/yr

$EF_{EFFLUENT}$ = emission factor for N_2O emissions from discharged to wastewater, kg N_2O-N/kg N

The factor 44/28 is the conversion of kg N_2O-N into kg N_2O.

TOTAL NITROGEN IN THE EFFLUENT

$$N_{EFFLUENT} = (P \bullet Protein \bullet F_{NPR} \bullet F_{NON-CON} \bullet F_{IND-COM}) - N_{SLUDGE}$$

Where:

$N_{EFFLUENT}$ = total annual amount of nitrogen in the wastewater effluent, kg N/yr

P = human population

Protein = annual per capita protein consumption, kg/person/yr

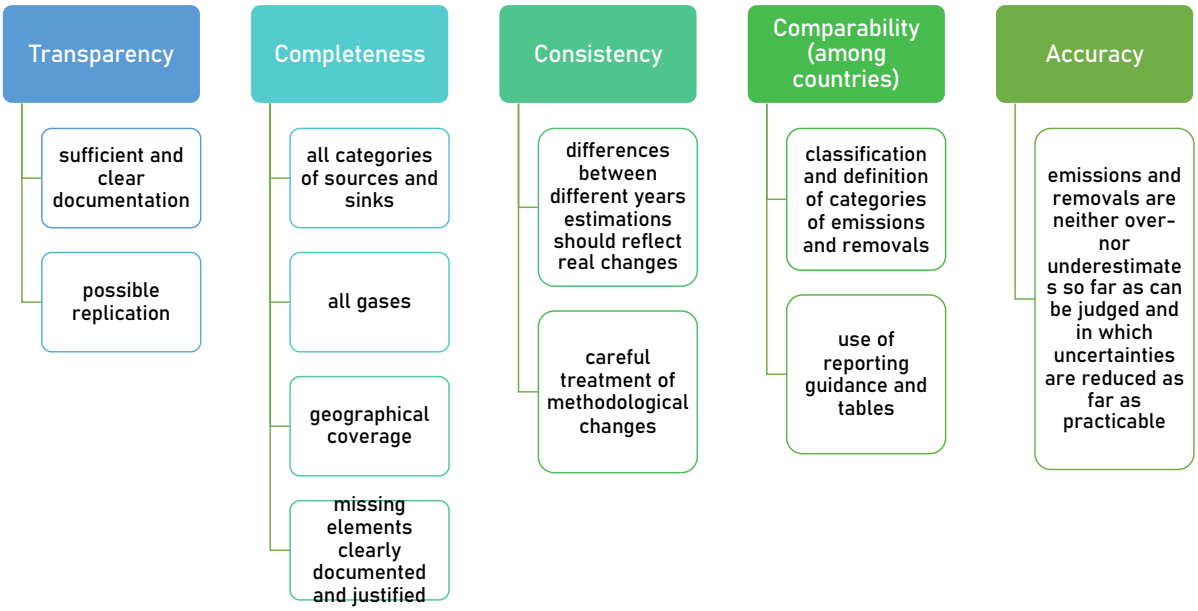
F_{NPR} = fraction of nitrogen in protein, default = 0.16, kg N/kg protein

$F_{NON-CON}$ = factor for non-consumed protein added to the wastewater

$F_{IND-COM}$ = factor for industrial and commercial co-discharged protein into the sewer system

N_{SLUDGE} = nitrogen removed with sludge (default = zero), kg N/yr

Inventory Quality – Good Practice



Estimation Methods

Tiers

✓Methods are presented in 3 tiers

- Tier 1 – Basic method using available national and international statistics and default emission factors
- Tier 2 – Intermediate method using country specific data
- Tier 3 – Higher complexity methods with more demanding data requirements and generally more accurate

Key categories approach

✓used to identify categories that have a significant influence on a country's GHG inventory in terms of level, trend or uncertainty of emissions and removals

Decision trees

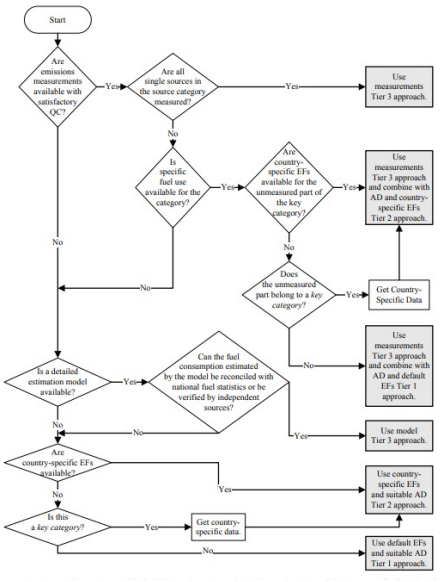
✓help in selection of appropriate tiered methodology based on assessment of key categories

Decision trees

Decision trees become essential in the complex GHG inventory processes, which involve key choices about methodology, emission variables, and activity data.

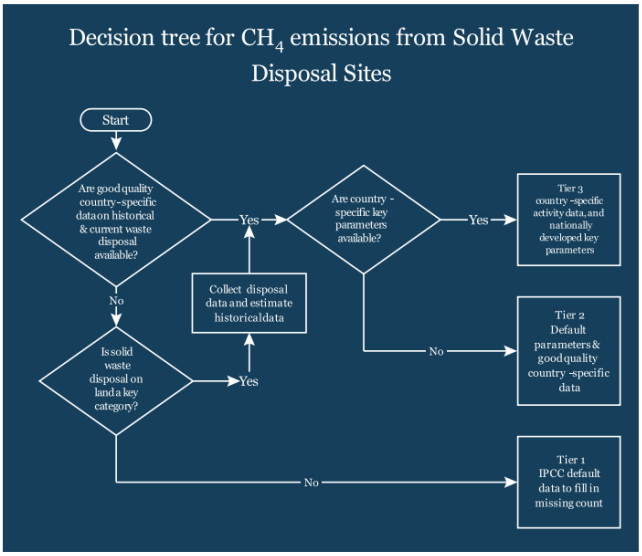
The following are the main factors driving decision tree adoption in the Philippines:

- Simplifying Complexity
- Guiding Methodological Choices
- Enhancing Transparency
- Documentation and Training



Decision tree for estimating fuel combustion

Decision tree used for tier selection Philippines



Decision tree for CH_4 emissions from solid waste disposal sites in Philippines

Data management system under GHG Inventory

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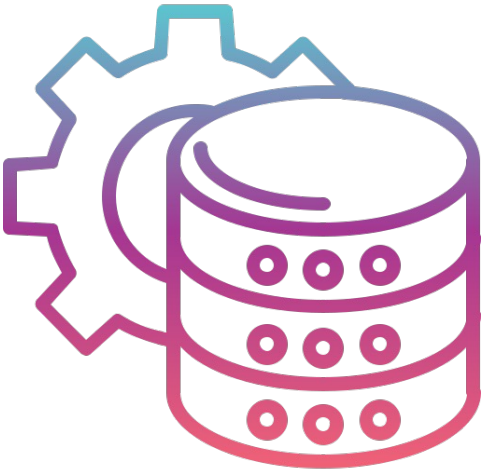
Global Support Programme (CBIT-GSP)

ipcc
INTERGOVERNMENTAL PANEL ON Climate change
WMO UNEP

Data Management



Data Management for Greenhouse Gas Inventories

Introduction:

Effective data management is crucial for accurate and reliable greenhouse gas (GHG) inventories.

Various components contribute to the comprehensive data management process.

Importance:

Reliable data management ensures the accuracy and credibility of GHG inventories.

Supports the development of effective climate change mitigation and adaptation strategies.

References:

IPCC Guidelines for National Greenhouse Gas Inventories.

Key topics within the realm of Data Management for Greenhouse Gas Inventories

1. Gathering Existing Data:

- Collection of pre-existing information relevant to GHG sources and sinks.

2. Generating New Data:

- Involves activities such as field measurements, surveys, and experiments to obtain specific data.

3. Adapting Data for Inventory Use

- Modifying existing data to align with inventory requirements and standards.

4. Emission Factors and Direct Measurement of Emissions:

- Determining the factors influencing emissions and directly measuring emissions from various sources.

5. Activity Data:

- Information on the processes or activities that result in GHG emissions or removals.

Data Management for Greenhouse Gas Inventories Cont.

Maintaining supply of inventory data - It is a good practice to engage data suppliers in the process of inventory compilation and improvement by involving them in activities such as;

Offering an initial estimate for the category, pointing out the potentially high uncertainties and inviting potential data suppliers to collaborate in improving estimates,

Scientific or statistical workshops on the inventory inputs and outputs,

Specific contracts or agreements for regular data supply,

Regular/annual informal updates on the methods that use their data,

Establishment of terms of reference or memoranda of understanding for government and/or trade organizations providing data to clarify what is needed for the inventory, how it is derived and provided to the inventory compiler and when.

Handling Restricted Data and Confidentiality in GHG Inventories

Introduction:

Data providers may restrict access to information due to confidentiality, unpublished status, or ongoing validation.

Ensuring confidentiality is crucial for data providers, especially national statistical agencies (NSAs).

Challenges:

Mechanisms for data protection include preventing inappropriate use, unauthorized commercial exploitation, and addressing imperfections.

Limited resources in organizations may also contribute to data restriction.

Cooperation Strategies:

Explaining Intended Use:

- Clearly articulate how the data will be used for greenhouse gas inventory purposes.

Agreeing on Public Disclosure:

- Establish a written agreement on the level at which the data will be made public.

Emphasizing Increased Accuracy:

- Highlight the enhanced accuracy gained through data use in inventories.

Mutually Acceptable Data Sets:

- Offer cooperation to derive data sets that address concerns.

Credit/Acknowledgment:

- Provide credit or acknowledgment in the inventory to the data provider.

Handling Restricted Data and Confidentiality in GHG Inventories Cont.

Confidentiality Principles:

NSAs are committed to safeguarding confidential information to maintain the quality of collected data.

Individual data is treated and aggregated to extract essential information without compromising confidentiality.

Masking Data for Access:

Investigate the possibility of masking data for researchers while preserving confidentiality.

Consider collaboration with NSAs or relevant statistical services for effective and long-term solutions.

Utilizing Administrative Data:

Ancillary data collected for various purposes (business registration, taxation, etc.) may have confidentiality clauses.

Work with NSAs or relevant statistical services to leverage administrative data, ensuring compliance with confidentiality rules.

Recommendation:

Collaborate with NSAs or relevant statistical services for reprocessing existing data to protect confidentiality and achieve cost savings.

Potential Sources of Country-Specific Data

Although the list is not exhaustive, it provides a starting point for possible sources of country specific data:

- National Statistics Agencies
- Sectoral experts, stakeholder organizations
- Other national experts
- IPCC Emission Factor Database
- Other international experts
- International organizations publishing statistics e.g., United Nations, Eurostat or the International Energy Agency, OECD and the IMF (which maintains international activity as well as economic data)
- Reference libraries (National Libraries)

Choosing Between Published National and International Data

Preference for National Data:	International Data Considerations:	Potential Advantages of International Data:	Encouragement for National Data Development:	Caution:
• National data is generally preferable. • More up-to-date and better links to data originators.	• Many international datasets rely on nationally-derived data. • Data from reputable international bodies may be more accessible and applicable.	• Some international bodies may have country-specific datasets not held by national organizations. • International data may undergo additional checking and verification. • Adjustments for consistency, though not always leading to improved estimates.	• Countries encouraged to develop and improve national data sources. • Cross-checking national and international data helps assess completeness and identify potential issues.	• Reliance on international data should be balanced with efforts to strengthen national data sources.

Generating New Data for Emission Estimation

Need for New Data:	Types of New Data Generation:	Expertise and Resource Considerations:	Optimizing Resource Use:	Considerations for Key Categories:
• When representative emission factors, activity data, or estimation parameters are unavailable. • Existing sources cannot provide the required data.	• Measurement programs for industrial process or energy-related emissions. • Sampling of fuels for carbon content. • Land-use change and forestry sampling activities. • New census or surveys for activity data.	• Tasks best undertaken by experts with appropriate expertise. • Resource-intensive activities that require competent organizations and calibrated equipment.	• Recommend generating data from extensions of existing programs rather than initiating entirely new ones.	• Particularly relevant when the emission category is crucial, and alternatives are limited.

Strategies for Addressing Data Gaps in Greenhouse Gas Inventories

- **Introduction:**
  - Greenhouse gas inventories demand consistent estimates across time series and categories.
  - Challenges arise when data are missing or do not align with required temporal or national coverage.

Strategies for Addressing Data Gaps in Greenhouse Gas Inventories

Filling Gaps in Periodic Data:	Time Series Revision:	Incorporating Improved Data:	Compensating for Deteriorating Data:	Incomplete Coverage:
• Examples: Infrequent surveys (e.g., national forest inventories). • Methods: Inference, splicing, extrapolation (Chapter 5: Time Series Consistency).	• Use of modeling and assumptions by statistical organizations for the most recent year. • Refinement in the following year with further data processing. • Integration of revised data into the inventory	• Challenges when recent data improvements are not suitable for earlier years. • Addressing inconsistencies in time series with detailed new data (e.g., emission factors for modern vs. older plants). • Stratification using expert judgment or surrogate data	• Use of splicing techniques for managing deteriorating data sets. • Deterioration due to changing priorities, economic restructuring, or diminishing resources. • Consideration of international data sources for relevant activity data	• Usage of available data even when incomplete (e.g., measurements for a subset of plants or partial survey data). • Combination with other data sets for calculating national estimates. • Recommendations for expert judgment and data combination with considerations for time series consistency.

Emission factors and direct measurement of emissions

LITERATURE SOURCES

IPCC EMISSION FACTOR DATABASE

IPCC EF DB

DATA OBTAINED BY MEASUREMENTS

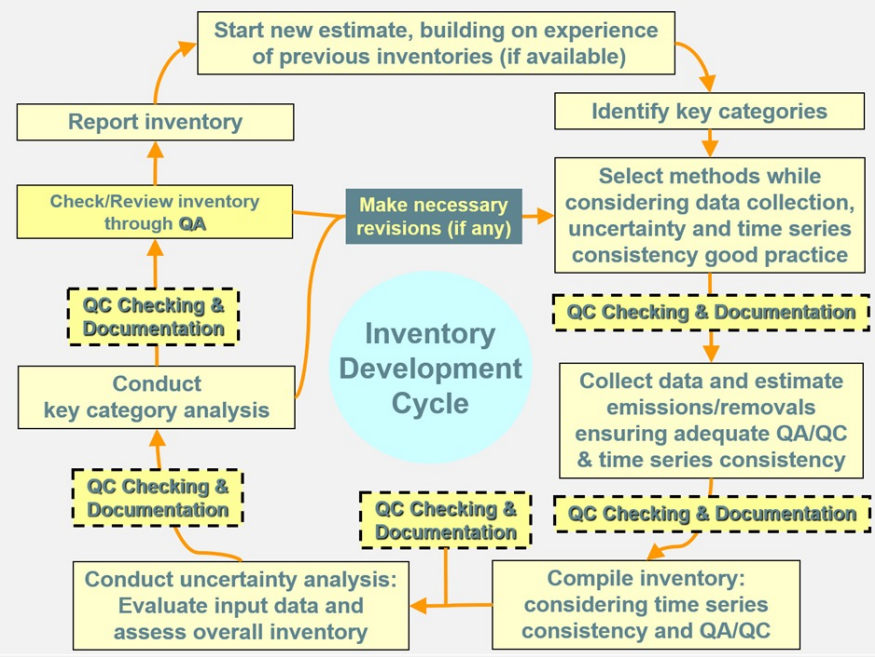
Data Sources

National and International Literature

Surveys & Census information

QA/QC

- Importance of QA/QC in each stage of the inventory cycle.



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