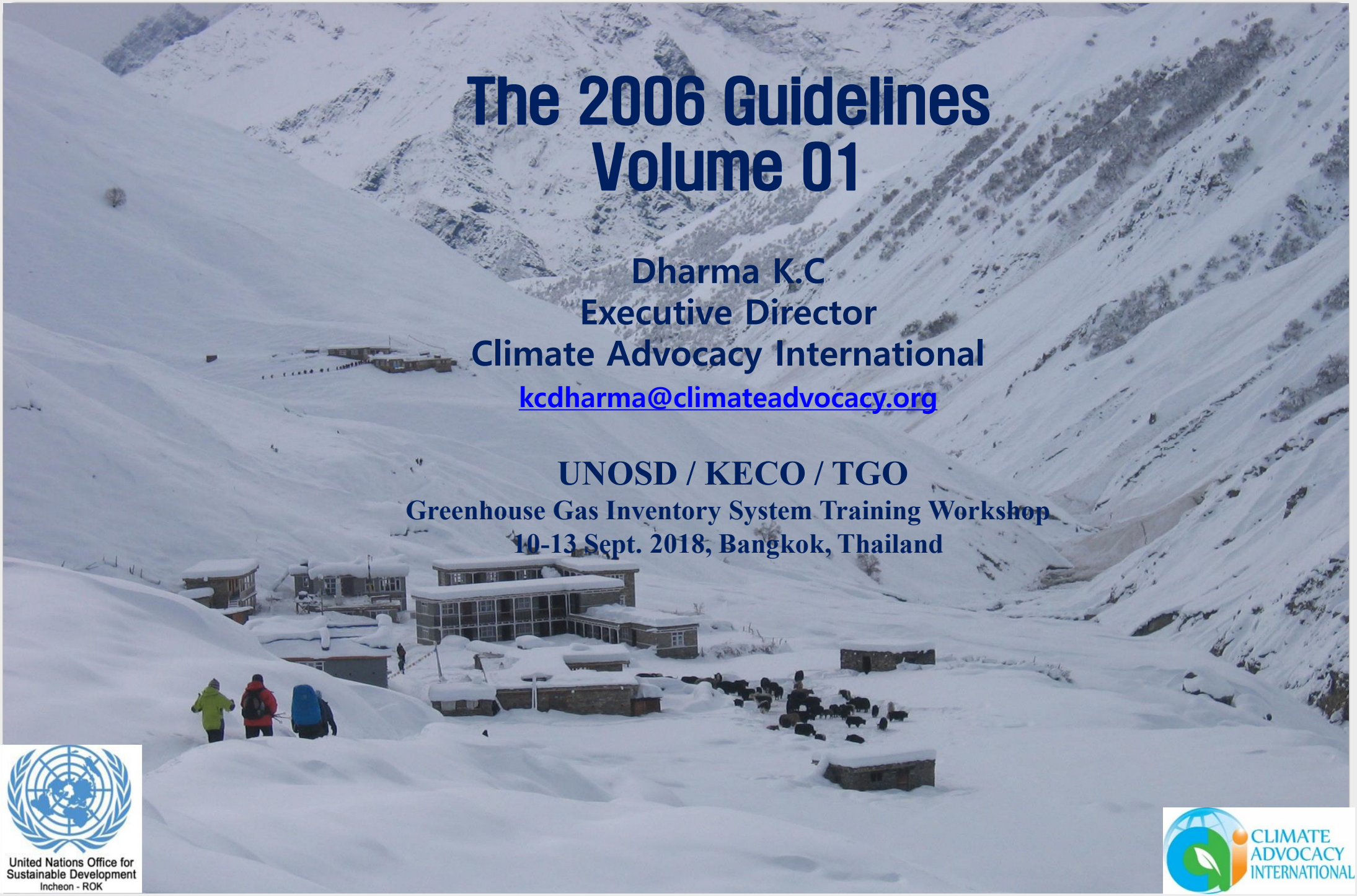

The 2006 Guidelines Volume 01

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UNOSD / KECO / TGO

Greenhouse Gas Inventory System Training Workshop
10-13 Sept. 2018, Bangkok, Thailand

United Nations Office for Sustainable Development
Incheon - ROK

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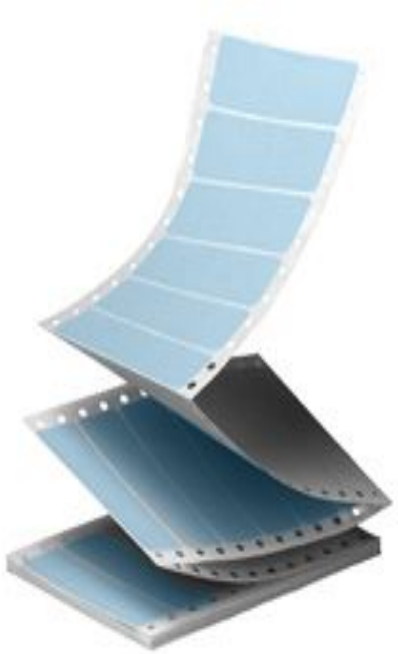

1. Introduction

2. Changes in the 2006 Guidelines

3. Highlights of the 2006 Guidelines

4. Chapter wise information

5. Examples – calculation

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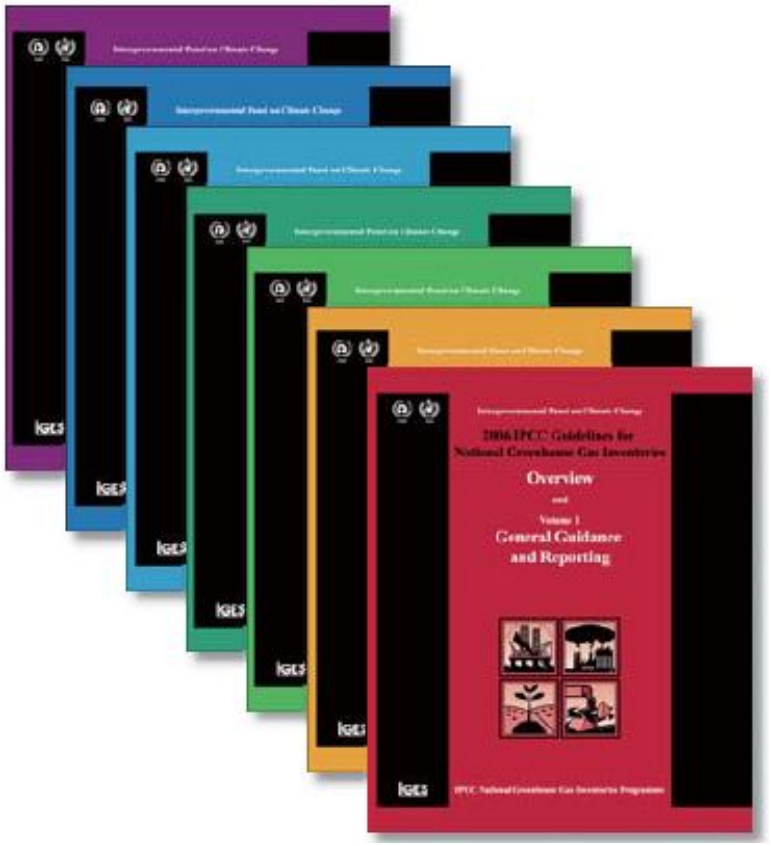
Background Information

1. The 2006 Guidelines are a significant step forward in the production of high quality national estimates of emissions and removals of GHGs.
2. It is a revised 1996 Guideline together with two volumes on inventory good practice.
3. More than 250 authors worked over 2 years and it has been extensively peer-reviewed.



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Emission Inventories

Definition & importance:

1. National Greenhouse Gas Inventories are complete estimates of the anthropogenic annual emissions and removals of greenhouse gases from a country developed source-by source and sink-by-sink.
2. It is very important for policy makers as well
3. Assists on developing the scientific understanding of Climate Change.

Good knowledge of GHGs inventory;

- enables to develop cost effective reduction policies
- allows different policy options to be compared
- provides a simple monitoring mechanism to monitor implementation of these policies
- are a key input to scientific studies of many environmental issues

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Good Practice Guidance

Good practice is a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over- nor underestimates so far as can be judged, and that uncertainties are reduced so far as possible.

Good practice inventories are:

Transparent + Complete + Internally Consistent + Comparable between Countries + Accurate

"*Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*" and "*Good Practice Guidance for Land Use, Land-Use Change and Forestry*" are updated and merged into the 2006 Guidelines.

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What has been included in 2006 Guideline

Vol. 1

- **General Guidance and Reporting**
- Gives general information on inventory compilation, QA/QC, uncertainty and guidance on the choice of methods

Vol. 2

- **Energy**
- Covers the use, production and transport of energy. Includes coverage of carbon dioxide capture and storage

Vol. 3

- **Industrial Processes and Product Use (IPPU)**
- covers industrial processes such as metal production, petrochemicals and other chemical production. Also covers
- the use of products including fl uorinated gases.

Vol. 4

- **Agriculture, Forestry and Other Land Use (AFOLU)**
- integrates agriculture with all other land uses and changes in land use. Covers agricultural sources such as livestock, manure management and fertilizer use as well as emissions and removals of greenhouse gases from differing land uses such as forestry, grasslands and settlements.

Vol. 5

- **Waste**
- covers the collection, treatment and disposal of wastes including solid wastes, landfi lls and waste water treatment.

Consistency

- The approach adopted is consistent with the remainder of the 2006 guidelines,
  - in particular a fundamental principle that the inventory methods reflect the estimated actual emissions in the year in which they occur;
  - emissions are reported where they occur;
  - and in line with the approach used for the treatment of biogenic material.

- The methods in the 2006 Guidelines are compatible with the revised 1996 IPCC guidelines and subsequent good practice guidance.

Gases included

① Carbon Dioxide CO_2

② Methane CH_4

③ Nitrous Oxide N_2O

④ Hydroflurocarbons HFC

⑤ Perflurocarbons PFC

⑥ Sulphur Hexaflouride SF_6

⑦ Nitrogen Trifluoride NF_3

⑧ Trifluoromethyl Sulphur Pentafluoride SF_5CF_3

⑨ Ethers and Halogenated Ethers (e.g., HFE-7200, H-Galden 1040x, HG-10, HG-01)

Changes in 2006 Guideline: Additional Inclusion

① F gases

② Non-energy product uses of fossil fuels

③ All defaults and emission factors reviewed

④ Carbon capture and storage

⑤ Harvested wood products

⑥ Wetlands

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New Sources

- ✓ Carbon Capture and Storage
- ✓ Closed Coal Mines
- ✓ Lead and zinc production,
- ✓ Titanium dioxide production,
- ✓ Various sources of SF_6 (Accelerators, etc),
- ✓ Liquid crystal display (LCD) manufacturing
- ✓ Settlements

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Categories added

Fuel Combustion

- CO_2 - Transport and Storage
- Urea-based Catalysts (Road Transport)

Fugitive Emissions from Fuels

- Abandoned Underground Mines

Mineral Industry

- Glass Production
- Ceramics
- Non Metallurgical Magnesia Production

Chemical Industry

- Caprolactam, Glyoxal & Glyoxylic Acid Production
- Titanium Dioxide Production
- Petrochemical and Carbon Black Production

Metal Industry

- Lead Production
- Zinc Production

Electronics Industries

- Integrated Circuit or Semiconductor
- TFT Flat Panel Display
- Photovoltaics
- Heat Transfer Fluid

Other Uses of Fluorinated Gases

- Electrical Equipment
- Military Applications
- Accelerators
- Medical Applications
- Propellant for Pressure and Aerosol Products

Ozone Depleting Substances Substitutes

Land Use

- Complete, consistent treatment of fires
- Liming
- Urea Application
- Indirect N_2O Emissions from Manure Management
- Harvested Wood Products (methods now provided)

Waste

- Biological Treatment of Solid Waste
- Open Burning of Waste

Other

- Indirect N_2O Emissions from the Atmospheric Deposition of NO_x and NH_3 (excluding agricultural sources)

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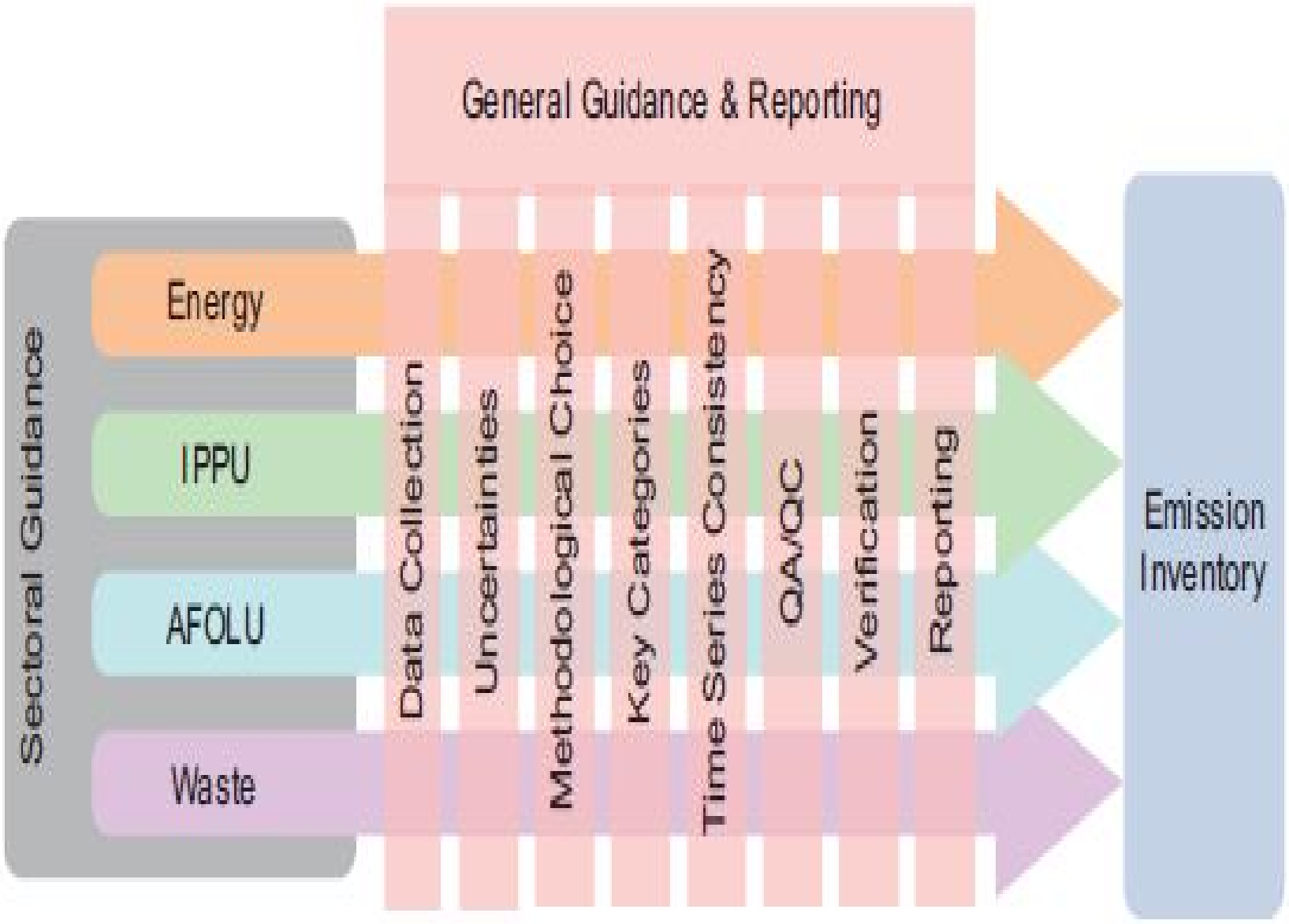
Relationship – General and Sectoral Guidance



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Chapters in Vol. 1

Chapter 1	Introduction
Chapter 2	Approaches to Data Collection
Chapter 3	Uncertainties
Chapter 4	Methodological Choice and Identification of Key Categories
Chapter 5	Time Series Consistency
Chapter 6	QA, QC & Verification
Chapter 7	Precursors and Indirect Emissions
Chapter 8	Reporting Guidance and Tables

Chapter 1: Introduction

Estimation Method:

Emissions = AD × EF

Concepts:

- Good Practice
- Tires
- Default data
- Key categories

Inventory quality:

- Transparency
- Completeness
- Consistency
- Comparability
- Accuracy

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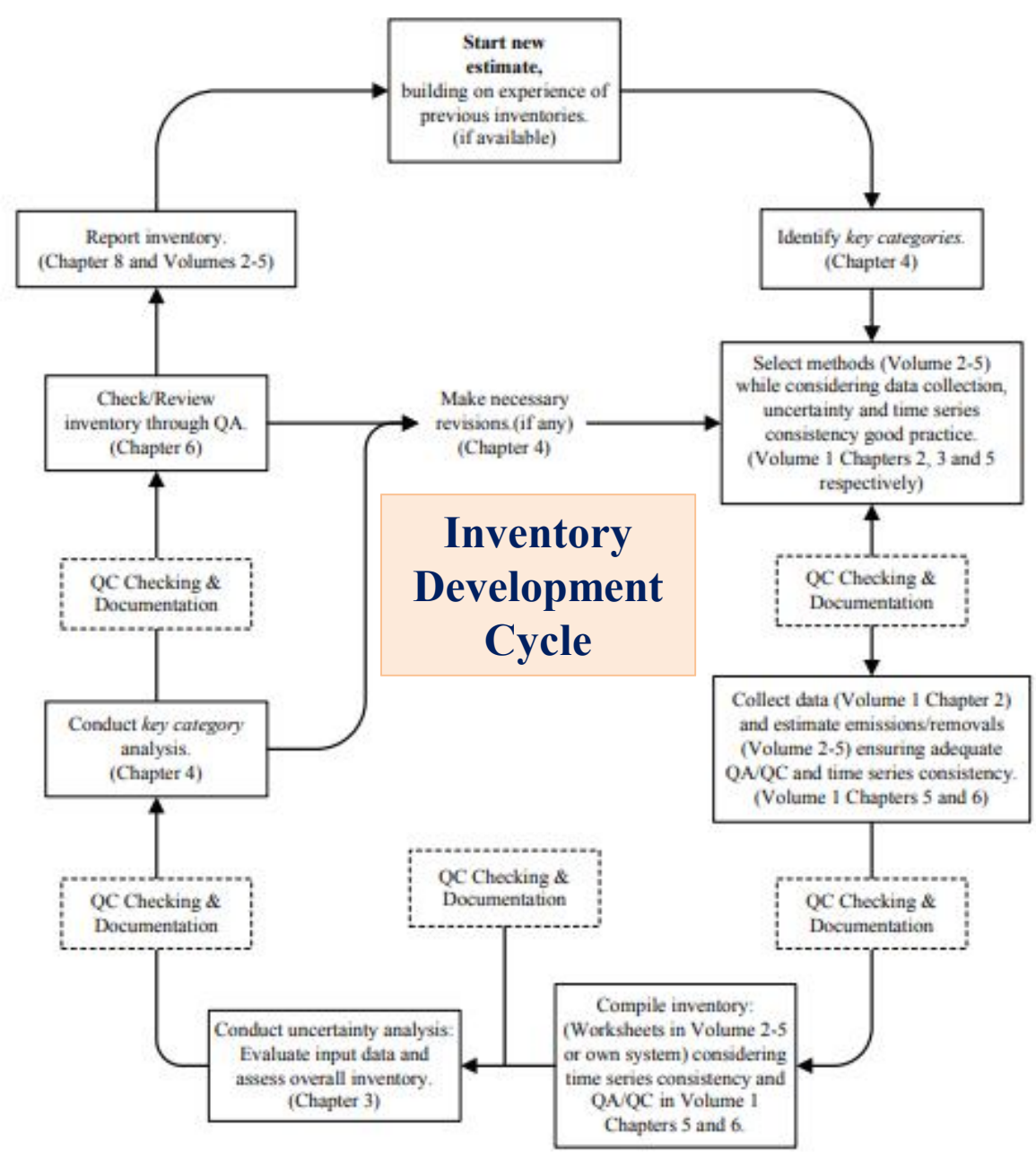
Chapter 1: Introduction



Chapter 2: Approaches to Data Collection

Data and data processing

- Existing data
- New data
- Adapting data for inventory use
- EF and direct measurement of emissions
- Activity data

Data survey

- Energy surveys
- Industries surveys
- Agricultural surveys and censuses
- Forest surveys
- Waste surveys

National grid emission factor?

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_2_Ch2_DataCollection.pdf

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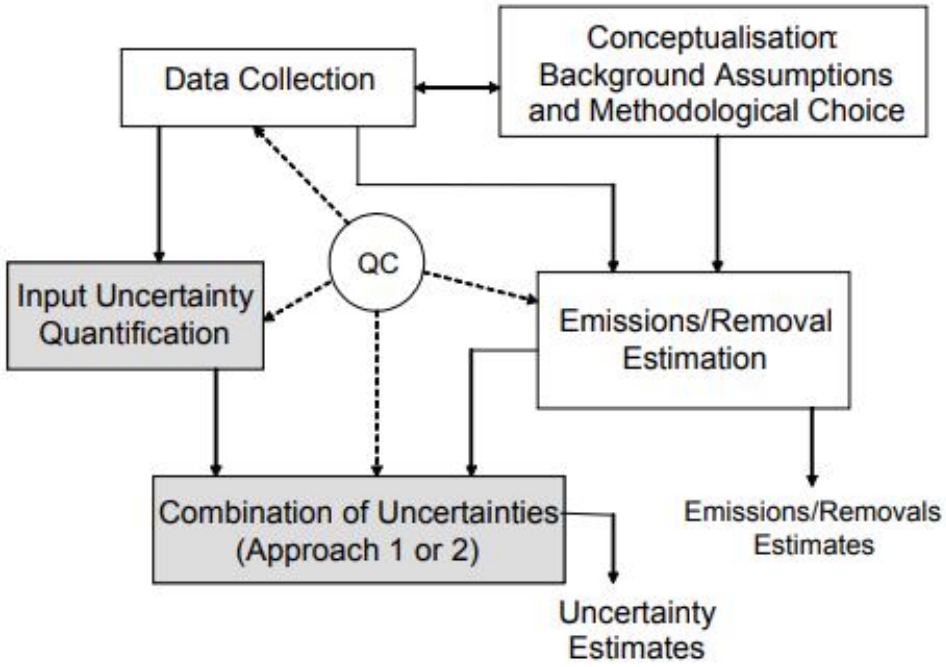
Chapter 3: Uncertainties



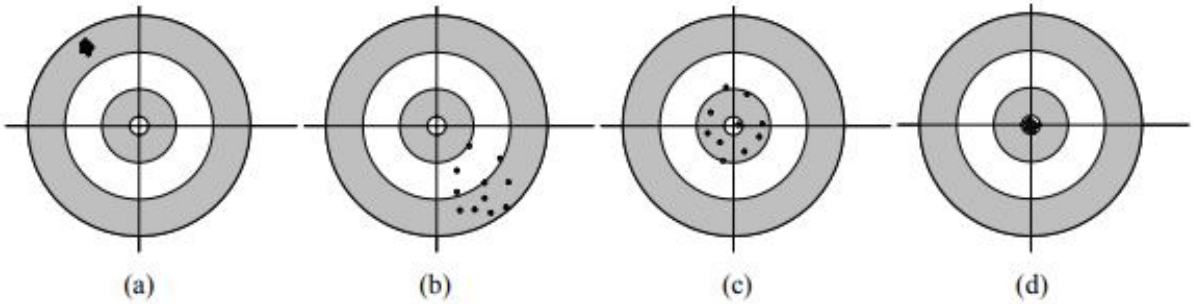
Generic uncertainty analysis

Uncertainty reduction

- Improving conceptualization
- Improving models
- Improving representativeness
- Using more precise measurement methods
- Collecting more measured data
- Eliminating known risks of bias
- Improving states of knowledge

Data accuracy and precision

(a) inaccurate but precise; (b) inaccurate and imprecise; (c) accurate but imprecise; and (d) precise and accurate



https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_3_Ch3_Uncertainties.pdf

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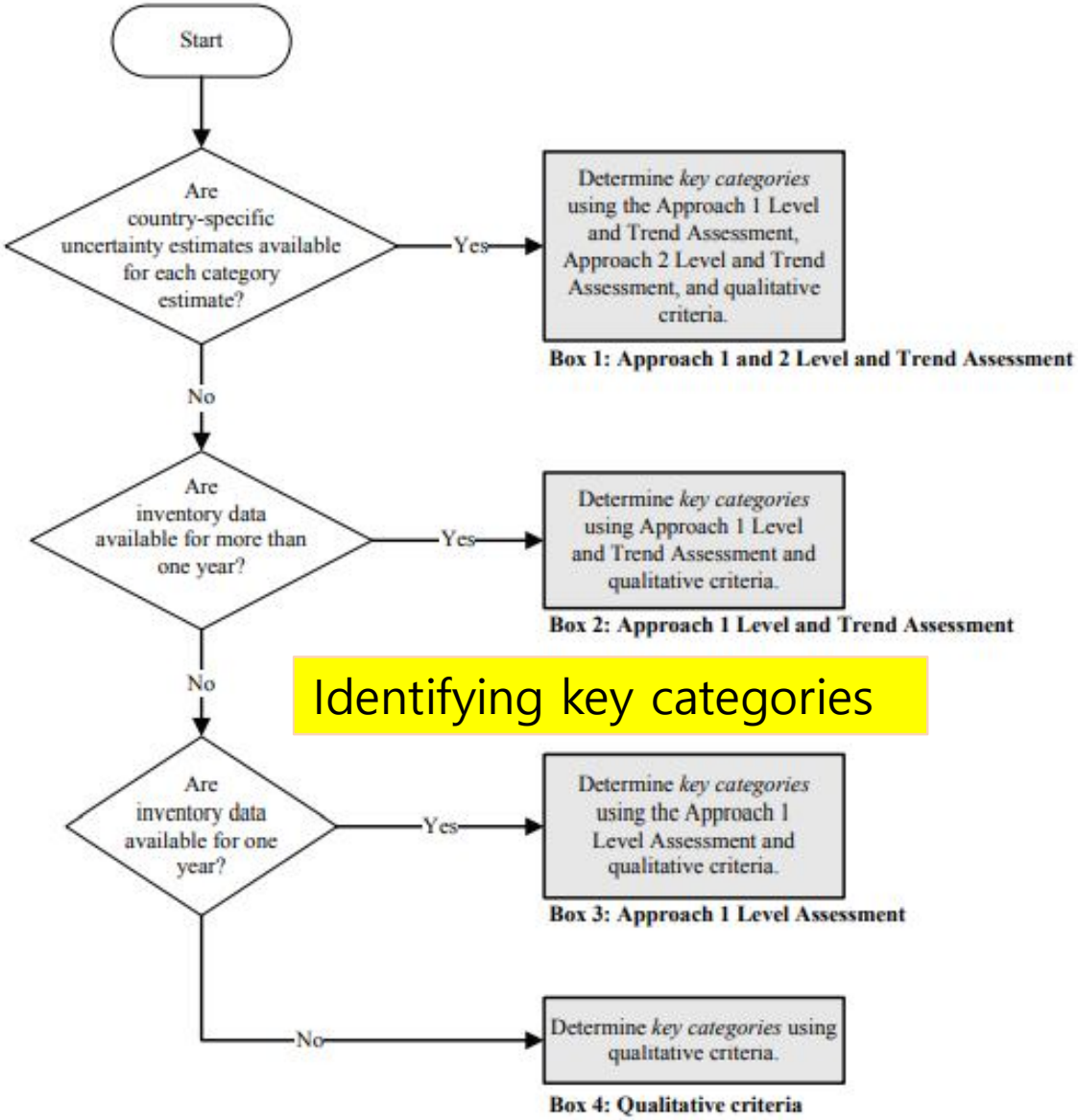
Chapter 4: Methodological Choice and Identification of Key Categories

Key Category

It is the one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals. Includes both sources and sink categories.



Identifying key categories

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf

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Chapter 5: Time Series Consistency

Why it is important?
Because it provides information on historical emissions trends and tracks the effects of strategies to reduce emissions at the national level.

How to ensure time series consistency?

- Recalculations due to methodological changes and refinements
- Adding new categories
- Tracking increases and decreases due to technological change and other factors

Reporting and documentation of trend information

CATEGORY-SPECIFIC DOCUMENTATION OF RECALCULATIONS

Category/Gas	Emissions and Removals (Gg)										
Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Previous Data (PD)											
Latest Data (LD)											
Difference in percent =100•[(LD–PD)/PD]											
Documentation (reason for recalculation):											

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_5_Ch5_Timeseries.pdf

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Chapter 6: QA, QC & Verification

Definition – Quality Control, Quality Assurance & Verification?

Elements of QA/QC and Verification system

- Participation of an inventory compiler
- A QA/QC plan
- General QC procedures that apply to all inventory categories
- Category-specific QC procedures
- QA and review procedures
- QA/QC system interaction with uncertainty analyses
- Verification activities
- Reporting, documentation, and archiving procedures

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_6_Ch6_QA_QC.pdf

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Chapter 7: Precursors and Indirect Emissions

Precursors emissions and indirect emissions & its importance in inventory

Inventory of precursors emissions in each sectors

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_7_Ch7_Precursors_Indirect.pdf

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Chapter 8: Reporting Guidance and Tables

Reporting Guidance

- Coverage
- Gases included
- Time frame of reporting
- Sectors and categories
- Notation keys and completeness information
- Unites and digits
- Time series
- Indirect N2O

Inventory reporting table

- Summary and short summary table
- Sectoral and background table
- Cross-sectoral table
- Emission trend table by gas
- Uncertainty and key categories table

Summary Table

Categories	Net CO_2 (1) (2)	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion factors[3]	Other halogenated gases without CO_2 equivalent conversion factors [4]	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
Total National Emissions and Removals												
1 ENERGY												
1A Fuel Combustion Activities												
1A1 Energy Industries												
1A2 Manufacturing Industries and Construction												
1A3 Transport												
1A4 Other Sectors												
1A5 Non-Specified												
1B Fugitive Emissions from Fuels												
1B1 Solid Fuels												
1B2 Oil and Natural Gas												
1B3 Other Emissions from Energy Production												
1C Carbon Dioxide Transport and Storage												
1C1 Transport of CO_2												
1C2 Injection and Storage												

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_8_Ch8_Reporting_Guidance.pdf

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Example calculations

https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf

Fuel combustion emission factors - solid fuels and certain coal based products

Fuel combusted	Energy content factor GJ/t	Emission factor kg CO_2-e/GJ (relevant oxidation factors incorporated)		
		CO_2	CH_4	N_2O
Bituminous coal	27.0	90	0.03	0.2
Sub-bituminous coal	21.0	90	0.03	0.2
Anthracite	29.0	90	0.03	0.2
Brown coal	10.2	93.5	0.02	0.4
Coking coal	30.0	91.8	0.02	0.2
Coal briquettes	22.1	95	0.07	0.3
Coal coke	27.0	107	0.04	0.2
Coal tar	37.5	81.8	0.03	0.2
Solid fossil fuels other than those mentioned in the items above	22.1	95	0.07	0.3
Industrial materials and tyres that are derived from fossil fuels, if recycled and combusted to produce heat or electricity	26.3	81.6	0.02	0.2
Non-biomass municipal materials, if recycled and combusted to produce heat or electricity	10.5	87.1	0.7	1.1
Dry wood	16.2	0	0.1	1.2
Green and air dried wood	10.4	0	0.1	1.2
Sulphite lyes	12.4	0	0.07	0.6
Bagasse	9.6	0	0.2	1.2
Biomass municipal and industrial materials, if recycled and combusted to produce heat or electricity	12.2	0	0.7	1.1
Charcoal	31.1	0	4.8	1.1
Primary solid biomass fuels other than those mentioned in the items above	12.2	0	0.7	1.1

Source: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1)

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Example calculations

Example: calculation of emissions from black coal consumption

A facility consumes 20,000 tonnes of bituminous coal for a purpose other than for the production of electricity or to produce coke.

Emissions of greenhouse gases (carbon dioxide, methane and nitrous oxide) in tonnes of CO_2-e are estimated as follows:

Emissions of carbon dioxide:

= (20,000 x 27.0 x 90)/1,000

= 48,600 t CO_2-e

Emissions of methane:

= (20,000 x 27.0 x 0.03)/1,000

= 16 t CO_2-e

Emissions of nitrous oxide:

= (20,000 x 27.0 x 0.2)/1,000

= 108 t CO_2-e

Total scope 1 GHG emissions = 48,600 + 16 + 108

= 48,724 t CO_2-e

Example: calculation of emissions from transport fuels consumed

A freight company consumes 10000 kL of automotive diesel for transport purposes. Emissions of greenhouse gases (carbon dioxide, methane and nitrous oxide) in tonnes of CO_2-e are estimated as follows;

Emissions of carbon dioxide:

= (10,000 x 38.6 x 69.9)/1,000

= 26,981 t CO_2-e

Emissions of methane:

= (10,000 x 38.6 x 0.1)/1,000

= 39 t CO_2-e

Emissions of nitrous oxide:

= (10,000 x 38.6 x 0.5)/1,000

= 193 t CO_2-e

Total scope 1 GHG emissions = 26981 + 39 + 193

= 27,213 t CO_2-e

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Example calculations

Indirect (scope 2) emission factors for consumption of purchased electricity or loss of electricity from the grid

State or Territory	Emission factor kg CO_2-e/kWh
New South Wales and Australian Capital Territory	0.83
Victoria	1.08
Queensland	0.79
South Australia	0.49
South West Interconnected System (SWIS) in Western Australia	0.70
North Western Interconnected System (NWIS) in Western Australia	0.62
Darwin Katherine Interconnected System (DKIS) in the Northern Territory	0.59
Tasmania	0.14
Northern Territory	0.64

Sources: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1) and Department of the Environment and Energy.

Example: calculation of emissions from electricity consumption

A company in New South Wales consumes 100,000 kWh of purchased electricity from the grid.

Emissions of greenhouse gases (scope 2) in tonnes of CO_2-e are estimated as follows:

= 100,000 x (0.83 /1000)

= 83 tonnes.

Total scope 2 GHG emissions = 83 tonnes CO_2-e

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Example calculations

Cement clinker production

$$E_{ij} = \left(EF_{ij} + EF_{toc,j}\right) \times \left(A_i + A_{ckd} \times F_{ckd}\right)$$

where:

E_{ij} is the emissions of CO_2 released from the production of cement clinker (CO_2 -e tonnes)

EF_{ij} is the emission factor for cement clinker (tonnes of CO_2 emissions per tonne of clinker produced). See Table 18.

A_i is the quantity of cement clinker produced (tonnes)

A_{ckd} is the quantity of cement kiln dust (CKD) produced (tonnes)

$EF_{toc,j}$ is the emission factor for carbon-bearing non-fuel raw material (tonnes of CO_2 emissions per tonne of clinker produced). See Table 18.

F_{ckd} is the degree of calcination of cement kiln dust (range from 0% to 100%). If the information is not available the degree is assumed to be 100%, that F_{ckd} =1

Clinker production emission factors

Source	Emission factor (tonnes CO_2-e per tonne)
	CO_2
EF_{ij}	0.534
$EF_{toc,j}$	0.010

Source: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Se

Example: Calculation of emissions generated from cement clinker production

A company produces 20,000 tonnes of cement clinker and 300 tonnes of cement kiln dust per year. The degree of calcination of the cement dust is not known. The GHG emissions are calculated as follows:

= (0.534 + 0.01) x (20,000 + 300 x 1)

= 11,043 tonnes CO_2-e

Total scope 1 GHG emissions = 11,043 tonnes CO_2-e

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Courtesy and source of information

Sources of Information:
IPCC webpage
http://www.ipcc.ch/pdf/activity/2006gls-brochure.pdf
Presentation by Simon Eggleston, IPCC, Technical Support Unit
National Greenhouse Accounts Factors, Australian national greenhouse accounts
Commonwealth of Australia 2017

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THANK YOU

United Nations Office for Sustainable Development
Incheon - ROK

P.C.: P. Pokhrel

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