The 2006 Guidelines
Volume 01

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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
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.
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
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.
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 fluorinated 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, landfills and waste water treatment.
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 CO₂

② Methane CH₄

③ Nitrous Oxide N₂O

④ Hydroflurocarbons HFC

⑤ Perfluorocarbons PFC

⑥ Sulphur Hexaflouride SF₆

⑦ Nitrogen Trifluoride NF₃

⑧ Trifluoromethyl Sulphur Pentafluoride SF₅CF₃

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
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
## Categories added

<table>
<thead>
<tr>
<th>Fuel Combustion</th>
<th>Other Uses of Fluorinated Gases</th>
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<tr>
<td>CO₂ - Transport and Storage</td>
<td>Electrical Equipment</td>
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<td>Urea-based Catalysts (Road Transport)</td>
<td>Military Applications</td>
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<td><strong>Fugitive Emissions from Fuels</strong></td>
<td>Accelerators</td>
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<td>Abandoned Underground Mines</td>
<td>Medical Applications</td>
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<td>Propellant for Pressure and Aerosol Products</td>
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<tr>
<td><strong>Mineral Industry</strong></td>
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<tr>
<td>Glass Production</td>
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<td>Ceramics</td>
<td></td>
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<td>Non Metallurgical Magnesia Production</td>
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<tr>
<td><strong>Chemical Industry</strong></td>
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<tr>
<td>Caprolactam, Glyoxal &amp; Glyoxylic Acid Production</td>
<td></td>
</tr>
<tr>
<td>Titanium Dioxide Production</td>
<td></td>
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<tr>
<td>Petrochemical and Carbon Black Production</td>
<td></td>
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<tr>
<td><strong>Metal Industry</strong></td>
<td></td>
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<tr>
<td>Lead Production</td>
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<td>Zinc Production</td>
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<tr>
<td><strong>Electronics Industries</strong></td>
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<tr>
<td>Integrated Circuit or Semiconductor</td>
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<td>TFT Flat Panel Display</td>
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<tr>
<td>Photovoltaics</td>
<td></td>
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<td>Heat Transfer Fluid</td>
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<tr>
<td><strong>Ozone Depleting Substances Substitutes</strong></td>
<td></td>
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<tr>
<td><strong>Land Use</strong></td>
<td></td>
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<tr>
<td>Complete, consistent treatment of fires</td>
<td></td>
</tr>
<tr>
<td>Liming</td>
<td></td>
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<tr>
<td>Urea Application</td>
<td></td>
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<td>Indirect N₂O Emissions from Manure Management</td>
<td></td>
</tr>
<tr>
<td>Harvested Wood Products (methods now provided)</td>
<td></td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td></td>
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<tr>
<td>Biological Treatment of Solid Waste</td>
<td></td>
</tr>
<tr>
<td>Open Burning of Waste</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
</tr>
<tr>
<td>Indirect N₂O Emissions from the Atmospheric Deposition of NOₓ and NH₃ (excluding agricultural sources)</td>
<td></td>
</tr>
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</table>
Relationship – General and Sectoral Guidance
# Chapters in Vol. 1

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<th>Introduction</th>
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<td>Chapter 5</td>
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<td>Precursors and Indirect Emissions</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Reporting Guidance and Tables</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

Estimation Method:
Emissions = AD \times EF

Concepts:
- Good Practice
- Tires
- Default data
- Key categories

Inventory quality:
- Transparency
- Completeness
- Consistency
- Comparability
- Accuracy
Chapter 1: Introduction

Inventory Development Cycle
## Chapter 2: Approaches to Data Collection

<table>
<thead>
<tr>
<th>Data and data processing</th>
<th>Data survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Existing data</td>
<td>• Energy surveys</td>
</tr>
<tr>
<td>• New data</td>
<td>• Industries surveys</td>
</tr>
<tr>
<td>• Adapting data for inventory use</td>
<td>• Agricultural surveys and censuses</td>
</tr>
<tr>
<td>• EF and direct measurement of emissions</td>
<td>• Forest surveys</td>
</tr>
<tr>
<td>• Activity data</td>
<td>• Waste surveys</td>
</tr>
</tbody>
</table>

National grid emission factor?

Chapter 3: Uncertainties

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

Generic uncertainty analysis

Data accuracy and precision

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

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

<table>
<thead>
<tr>
<th>Category/Gas</th>
<th>Emissions and Removals (Gg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td></td>
</tr>
<tr>
<td>Previous Data (PD)</td>
<td></td>
</tr>
<tr>
<td>Latest Data (LD)</td>
<td></td>
</tr>
<tr>
<td>Difference in percent</td>
<td></td>
</tr>
<tr>
<td>=100*[(LD–PD)/PD]</td>
<td></td>
</tr>
<tr>
<td>Documentation (reason for recalculation):</td>
<td></td>
</tr>
</tbody>
</table>

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

Chapter 7: Precursors and Indirect Emissions

Precursors emissions and indirect emissions & its importance in inventory

Inventory of precursors emissions in each sectors
Chapter 8: Reporting Guidance and Tables

Reporting Guidance
- Coverage
- Gases included
- Time frame of reporting
- Sectors and categories
- Notation keys and completeness information
- Units 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

## Example calculations

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

<table>
<thead>
<tr>
<th>Fuel combusted</th>
<th>Energy content factor GJ/t</th>
<th>Emission factor kg CO₂-e/GJ</th>
<th>(relevant oxidation factors incorporated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bituminous coal</td>
<td>27.0</td>
<td>90</td>
<td>0.03</td>
</tr>
<tr>
<td>Sub-bituminous coal</td>
<td>21.0</td>
<td>90</td>
<td>0.03</td>
</tr>
<tr>
<td>Anthracite</td>
<td>25.0</td>
<td>90</td>
<td>0.03</td>
</tr>
<tr>
<td>Brown coal</td>
<td>10.2</td>
<td>93.5</td>
<td>0.02</td>
</tr>
<tr>
<td>Coking coal</td>
<td>30.0</td>
<td>91.8</td>
<td>0.02</td>
</tr>
<tr>
<td>Coal briquettes</td>
<td>22.1</td>
<td>95</td>
<td>0.07</td>
</tr>
<tr>
<td>Coal coke</td>
<td>27.0</td>
<td>107</td>
<td>0.04</td>
</tr>
<tr>
<td>Coal tar</td>
<td>37.5</td>
<td>81.8</td>
<td>0.03</td>
</tr>
<tr>
<td>Solid fossil fuels other than those mentioned in the items above</td>
<td>22.1</td>
<td>95</td>
<td>0.07</td>
</tr>
<tr>
<td>Industrial materials and tyres that are derived from fossil fuels, if recycled and combusted to produce heat or electricity</td>
<td>26.3</td>
<td>81.6</td>
<td>0.02</td>
</tr>
<tr>
<td>Non-biomass municipal materials, if recycled and combusted to produce heat or electricity</td>
<td>10.5</td>
<td>87.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Dry wood</td>
<td>16.2</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>Green and air dried wood</td>
<td>10.4</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>Sulphite eyes</td>
<td>12.4</td>
<td>0</td>
<td>0.07</td>
</tr>
<tr>
<td>Bagasse</td>
<td>9.6</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>Biomass municipal and industrial materials, if recycled and combusted to produce heat or electricity</td>
<td>12.2</td>
<td>0</td>
<td>0.7</td>
</tr>
<tr>
<td>Charcoal</td>
<td>31.1</td>
<td>0</td>
<td>4.8</td>
</tr>
<tr>
<td>Primary solid biomass fuels other than those mentioned in the items above</td>
<td>12.2</td>
<td>0</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Source: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1)
**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:**
  \[
  = (20,000 \times 27.0 \times 0.90)/1,000
  \]
  \[= 48,600 \text{ t CO}_2\text{-e} \]

- **Emissions of methane:**
  \[
  = (20,000 \times 27.0 \times 0.03)/1,000
  \]
  \[= 15 \text{ t CO}_2\text{-e} \]

- **Emissions of nitrous oxide:**
  \[
  = (20,000 \times 27.0 \times 0.2)/1,000
  \]
  \[= 108 \text{ t CO}_2\text{-e} \]

**Total scope 1 GHG emissions**

\[= 48,600 + 15 + 108 \]
\[= 48,724 \text{ t CO}_2\text{-e} \]

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**Example: calculation of emissions from transport fuels consumed**

A freight company consumes 10,000 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:**
  \[
  = (10,000 \times 38.6 \times 69.9)/1,000
  \]
  \[= 26,981 \text{ t CO}_2\text{-e} \]

- **Emissions of methane:**
  \[
  = (10,000 \times 38.6 \times 0.1)/1,000
  \]
  \[= 39 \text{ t CO}_2\text{-e} \]

- **Emissions of nitrous oxide:**
  \[
  = (10,000 \times 38.6 \times 0.5)/1,000
  \]
  \[= 193 \text{ t CO}_2\text{-e} \]

**Total scope 1 GHG emissions**

\[= 26,981 + 39 + 193 \]
\[= 27,213 \text{ t CO}_2\text{-e} \]
Example calculations

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

<table>
<thead>
<tr>
<th>State or Territory</th>
<th>Emission factor kg CO₂-e/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>New South Wales and Australian Capital Territory</td>
<td>0.83</td>
</tr>
<tr>
<td>Victoria</td>
<td>1.08</td>
</tr>
<tr>
<td>Queensland</td>
<td>0.79</td>
</tr>
<tr>
<td>South Australia</td>
<td>0.49</td>
</tr>
<tr>
<td>South West Interconnected System (SWIS) in Western Australia</td>
<td>0.70</td>
</tr>
<tr>
<td>North Western Interconnected System (NWIS) in Western Australia</td>
<td>0.62</td>
</tr>
<tr>
<td>Darwin Katherine Interconnected System (DKIS) in the Northern Territory</td>
<td>0.59</td>
</tr>
<tr>
<td>Tasmania</td>
<td>0.14</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>0.64</td>
</tr>
</tbody>
</table>

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 CO₂-e are estimated as follows:

\[
= 100,000 \times (0.83 / 1000) \\
= 83 \text{ tonnes.}
\]

Total scope 2 GHG emissions = 83 tonnes CO₂-e
Cement clinker production

\[ E_{ij} = \left( EF_{ij} + EF_{loc,i} \right) \times \left( A_i + A_{ckd} \times F_{ckd} \right) \]

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)
- \( EF_{loc,i} \) 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

<table>
<thead>
<tr>
<th>Source</th>
<th>Emission factor (tonnes CO(_2)-e per tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( EF_{ij} )</td>
<td>0.534</td>
</tr>
<tr>
<td>( EF_{loc,i} )</td>
<td>0.010</td>
</tr>
</tbody>
</table>

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

### 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:

\[ (0.534 + 0.01) \times (20,000 + 300 \times 1) \]

\[ = 11,043 \text{ tonnes CO}_2\text{-e} \]

Total scope 1 GHG emissions = 11,043 tonnes CO\(_2\)-e
Sources of Information:
IPCC webpage
Presentation by Simon Eggleston, IPCC, Technical Support Unit
National Greenhouse Accounts Factors, Australian national greenhouse accounts
Commonwealth of Australia 2017