IPCC’s Guidelines and Tools for the National GHG Inventory

United Nations Statistical Commission
Towards the Global Set of Climate Change Statistics and Indicators - Virtual event
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IPCC TFI TSU
Develop and refine the internationally-agreed methodology to estimate GHG emissions and removals at national level. Encourage the widespread use of this.
What are National GHG Inventories?

- **Time series of national statistics** of all emissions and removals of greenhouse gases (GHG) from given sources and sinks (i.e. GHG Inventory categories) from a defined territory in a specific period of time associated with human activities.

- **National statistics**:
  - Anthropogenic Greenhouse Gases fluxes,
  - Occurring within a year, in a series across years
  - Across the entire National Territory
Why do we need inventory guidelines?

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

• Currently, most emissions/removals can only be estimated at national scale, not measured, and so consensus on the best way of doing this is needed.

• To do this we need reliable, generally accepted methods and guidelines.
IPCC Guidelines and Paris Agreement

• “Katowice Climate Package” to operationalize the PA. UNFCCC COP24/CMA.1, December 2018.

• Each Party shall use the **2006 IPCC Guidelines**, and shall use any subsequent version or refinement of the IPCC guidelines agreed upon by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA).
Infer emissions based on parameters (EF) associated with activities (AD). For example:

- Amount of fuel burnt (AD)
- Carbon content in fuel determines the amount of CO$_2$ emitted from a unit of fuel burnt (EF)
- CO$_2$ proportional to amount of fuel burnt (E)

\[ E_{GHG} = AD \times EF_{GHG} \]

Where: E = Emission; AD = Activity Data; EF = Emission Factor

95% CI of AD, EF, and Estimates is to be calculated
Data Collection

• In establishing routine, formalised, data collection use should be made of existing statistical organisations…
  (e.g., waste statistics for the estimation of methane emissions)

• It is good practice to engage data suppliers in the process of inventory compilation and improvement by involving in activities as:
  – …
    – Scientific or statistical workshops on the inventory inputs and outputs

• Census vs Survey/Sampling

• Accuracy & Precision

• Uncertainty Analysis
  – Uncertainty in the mean vs Uncertainty in the individual
  – Standard error vs Standard deviation

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
Fuel Combustion – Activity Data [Gg (TJ)]

➢ For each source category, **fuel consumption/sales** of fuel:

✓ LIQUID FOSSIL FUELS (*Crude oil and petroleum products*)
✓ SOLID FOSSIL FUELS (*Coal and coal products*)
✓ GAS FOSSIL FUELS (*Natural Gas*)
✓ OTHER FOSSIL FUELS (*e.g. waste*)
✓ PEAT (*CO₂ adds to the Energy sector total*)
✓ BIOMASS (*bioliquid, biosolid and biogas fuels, waste bio-fraction; CO₂ does NOT add to the Energy sector total*)

➢ In statistics data on fuels consumption/sale are in physical units, e.g. in tonnes or cubic metres
To convert AD to energy units requires calorific values.

IPCC Guidelines use the net calorific values (NCVs), expressed in SI units.

Some statistical offices use gross calorific values (GCVs).

The difference between NCV and GCV is the latent heat of vaporisation of the water produced during fuel combustion.

Calorific value is fuel specific and thus independent of combustion technology.
Default assumption is that all carbon contained in the fuel is oxidised to CO₂ (this in practice includes the indirect CO₂ emissions caused by the subsequent oxidation in atmosphere of non-CO₂ carbon emissions). Thus,

✓ CO₂ EFs are based on the C-content of the fossil fuel

✓ Since independent of combustion technology, same fuel-specific default CO₂ EF is applicable to all combustion processes

CH₄ and N₂O emissions are strongly dependent on the technology applied in both stationary and mobile combustions, thus EFs vary accordingly.
The Reference Approach is based on the principle of mass conservation, and it is used for CO₂ only.

C brought into a national economy in the form of a fuel, it is either released into the atmosphere as GHG, or it is diverted (e.g., increased fuel stocks, feedstocks, stored in products, left unutilised in ash) and does not enter the atmosphere.

It is *good practice* to apply both a sectoral approach and the reference approach to estimate a country’s CO₂ emissions from fuel combustion and to compare the results of these two independent estimates. Significant differences may indicate possible problems with AD, NCVs, carbon content, excluded carbon calculation, etc.
Energy Balance

CO₂ Estimation

Reference Approach (QC)

\[ E = \sum_{\text{allfuels}} \left( (\text{ApparentConsumption}_{\text{fuel}} - \text{ExcludedCarbon}_{\text{fuel}}) \times \text{COF}_{\text{fuel}} \right) \times \frac{44}{12} \]

✓ ApparentConsumption =
Production (primary fuels) + Imports − Exports − International bunkers − Stock change (in CC)

✓ ExcludedCarbon = CC in feedstocks and non-energy use excluded from combustion

✓ COF = C oxidised fraction. By default = 1 (complete oxidation). Lower values used to count for C retained indefinitely in ash or soot

✓ CC = Carbon Content
### Excluded Carbon/Non-Energy Use of Fuels

#### Table 1.2
Types of Use and Examples of Fuels Used for Non-Energy Applications

<table>
<thead>
<tr>
<th>Type of use</th>
<th>Example of fuel types</th>
<th>Product/process</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstock</td>
<td>natural gas, oils, coal</td>
<td>ammonia</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>naphtha, natural gas, ethane, propane, butane, gas oil, fuel oils</td>
<td>methanol, olefins (ethylene, propylene), carbon black</td>
<td>3.9</td>
</tr>
<tr>
<td>Reductant</td>
<td>petroleum coke</td>
<td>carbides</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>coal, petroleum coke</td>
<td>titanium dioxide</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>metallurgical cokes, pulverised coal, natural gas</td>
<td>iron and steel (primary)</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>metallurgical cokes</td>
<td>ferroalloys</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>petroleum coke, pitch (anodes)</td>
<td>aluminium&lt;sup&gt;1&lt;/sup&gt;</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>metallurgical coke, coal</td>
<td>lead</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>metallurgical coke, coal</td>
<td>zinc</td>
<td>4.7</td>
</tr>
<tr>
<td>Non-energy product</td>
<td>lubricants</td>
<td>lubricating properties</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>paraffin waxes</td>
<td>misc. (e.g., candles, coating)</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>bitumen (asphalt)</td>
<td>road paving and roofing</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>white spirit&lt;sup&gt;2&lt;/sup&gt;, some aromatics</td>
<td>as solvent (paint, dry cleaning)</td>
<td>5.5</td>
</tr>
</tbody>
</table>

<sup>1</sup> Also used in secondary steel production (in electric arc furnaces) (see Chapter 4.2).

<sup>2</sup> Also known as mineral turpentine, petroleum spirits, industrial spirit ("SBP").
Figure 3-2: 2018 U.S. Fossil Carbon Flows (MMT CO₂ Eq.)

Note: Tracking Carbon in Fuel (!!)

Source: US NIR 2019
Various Tools – Supporting Materials

- Emission Factor Database (EFDB)
  https://www.ipcc-nggip.iges.or.jp/EFDB/

- IPCC Inventory Software
  https://www.ipcc-nggip.iges.or.jp/software/index.html

- Primer for 2006 IPCC Guidelines
  https://www.ipcc-nggip.iges.or.jp/support/support.html

- Reports of Expert Meetings
  https://www.ipcc-nggip.iges.or.jp/meeting/meeting.html

- Frequently Asked Questions
  https://www.ipcc-nggip.iges.or.jp/meeting/meeting.html
EFDB

- Library of emission factors and other parameters (*with background documentation and technical references*) that can be used for estimation of GHG emissions and removals in Inventories

- Data collected:
  - Default values from IPCC Guidelines
  - Data from peer-reviewed papers
  - Data from other publications (e.g., national reports)

- It evolves across time

The EFDB is not intended for authorization of use of specific EFs by countries and it has not been subject to formal IPCC review processes. It serves as a library where inventory compilers can find EFs suitable to their countries by their own judgement.
Defaults -> EFDB

Data Provider

Data Meeting

Editorial Board (EB)

• Initial check of data proposals
• Collection of new data and data proposals

TSU
Web application

Search options (e.g. Basic search)
Specify gas, type of parameters etc.
Status of search
To narrow down search results
Details of data
Results can be exported in Excel

https://www.ipcc-nggip.iges.or.jp/EFDB/main.php
IPCC Inventory Software

- Administration functions: Country, Users, Years
- Contains default data
- Worksheets for data entry
- Data Managers: Land Types and Livestock
- QA/QC: Uncertainty analysis, KCA, Reference Approach
- Data Export and Import
- Data Archive

https://www.ipcc-nggip.iges.or.jp/software/index.html
Data Quality & Data Gaps

Data quality (chapter 2 Volume 1 IPCC Guidelines) is to be checked as:

- Completeness (territory, population, calendar year)
- Uncertainty (2.5 & 97.5% percentile, PDF’s shape)
- Method for data collection
- Time series completeness and consistency

Data availability gaps are identified as

- Entire time series missing:
  ✓ designing a new data collection system
  ✓ as interim expert judgment is allowed

- Data missing in the time series (chapter 5 Volume 1 IPCC Guidelines):
  ✓ Splicing techniques as: overlap, surrogate data, interpolation/extrapolation
Conclusions

• Quality and completeness of the inventories depend on the underlying activity data produced primarily by national statistical offices, as well as other relevant institutions, including the national climate reporting authorities to the UNFCCC.

• Close working arrangements with existing systems will make best use of national expertise, minimize duplication, and increase efficiency.

• It is important to engage both data producers and users at an early stage to ensure clear understanding and assessment of the quality of data collected as well as of the availability of data needed.

• Cooperation between inventory compilers and data collectors is key to enhance national data statistics to ensure full correspondence with inventories requirements.
Questions

• Is your National GHG Inventory part of the National statistical System?

• Is your national statistical office working in cooperation with your National GHG Inventory in assessing its data needs?

• Is your national statistical system integrating emerging data needs for estimating GHG emissions and removals from human activities? *(new variables to be monitored/ changes in the data collection procedure for relevant variables)*
Thank you

https://www.ipcc-nggip.iges.or.jp/index.html
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