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Introduction to national inventories and inventory review

1st Autumn School of the International Partnership on Mitigation and MRV

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Content

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1. Overview on national GHG inventories
2. National systems for GHG inventories
3. QA/QC of inventories
4. Review process of GHG inventories under the UNFCCC

GHG inventories

- **Annex I inventory**: consists of National Inventory report (NIR) & Common Reporting Format tables (CRF)
- **Non-Annex I inventories**: voluntary reporting tables/ software, IPCC Worksheets, summary table in national communication, no methodological report required
- Reporting guidelines under the UNFCCC define sectors of emissions and removals in GHG inventories:
  - Energy
  - Industrial processes
  - Agriculture
  - LULUCF
  - Waste

Inventory principles

- **Transparency:** assumptions and methodologies clearly explained to facilitate replication and assessment of the inventory by users
- **Consistency:** same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks.
- **Comparability:** estimates of emissions and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. Annex I Parties should use the methodologies and formats agreed by the COP
- **Completeness:** inventory covers all sources and sinks, as well as all gases
- **Accuracy:** Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, uncertainties reduced as far as practicable.

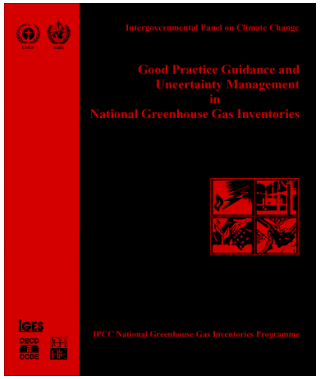
GHG inventories

Guidance for compilation of GHG inventories:

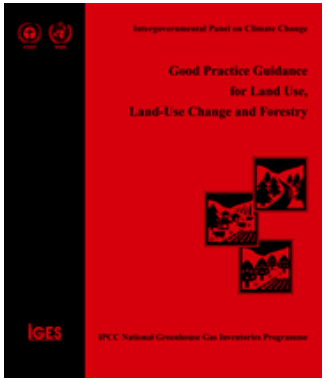
available at: http://www.ipcc-nggip.iges.or.jp/public/index.html

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories



Good Practice Guidance for Land Use,Land-Use Change and Forestry



2006 IPCC Guidelines for National Greenhouse Gas Inventories (1: General guidance and reporting, 2: Energy, 3: Industrial processes and Product Use, 4: AFOLU, 5: Waste)

General principles

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General methodological approach:

Emissions = Emission Factor x Activity Data

- Some sectors use mass balance approach
- Land Use assumes that C stock changes ⇒ Emissions/Removals

IPCC Guidelines usually provide different methodological tiers

Tier = level of methodological complexity

1. **Tier 1 method**: basic method using default EFs – should be feasible for all countries
2. **Tier 2 method**: country-specific EFs and other parameters
3. **Tier 3 method**: detailed emission models, measurements, plant-specific data

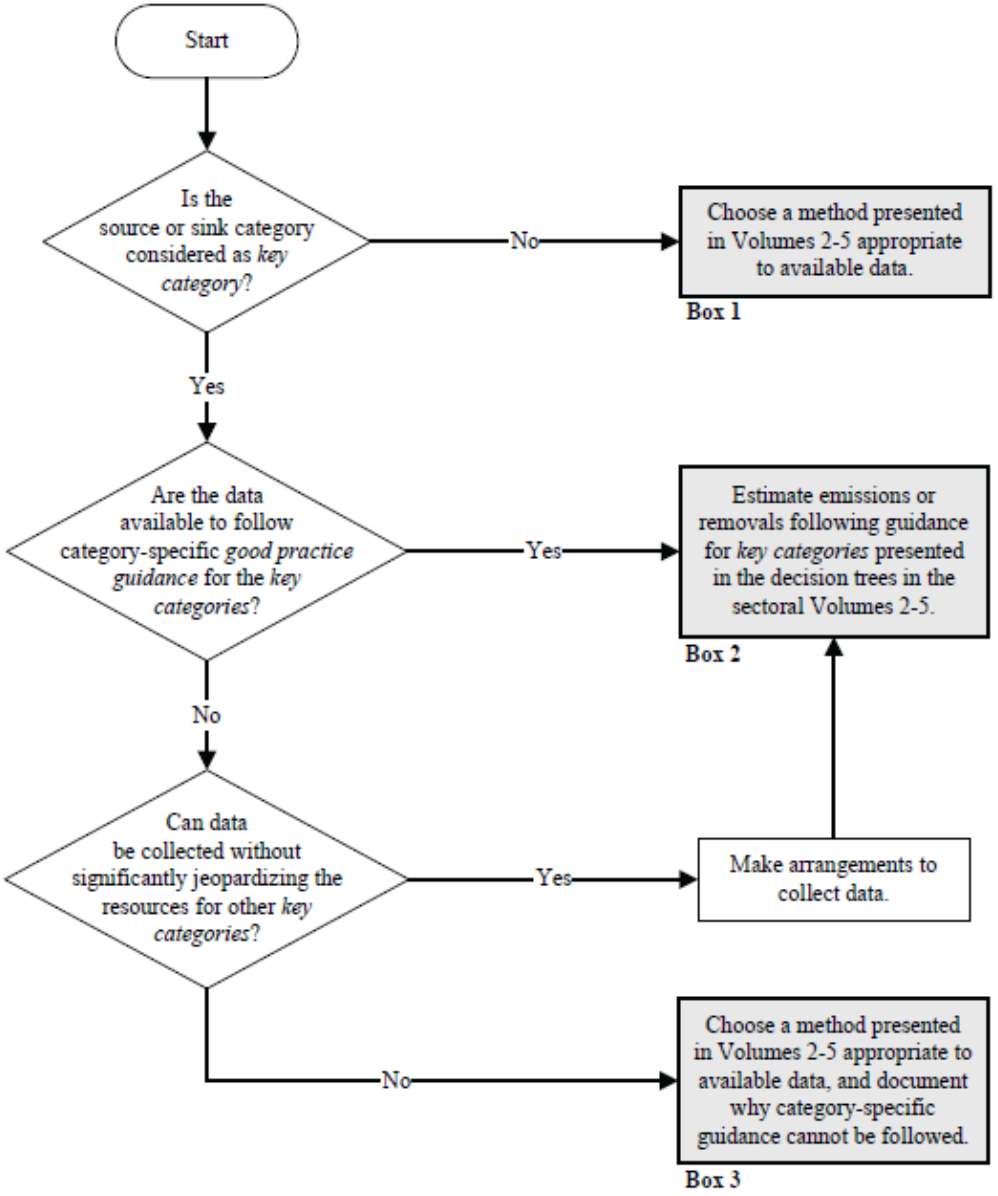
Key category analysis

Key category analysis

- identifies the categories that have a significant influence
  - on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals,
  - on the trend in emissions and removals, or uncertainty in emissions and removals.
- **Key Categories**: priority for resource allocation for data collection, methodological choice, QA/QC
- **Good practice:** a collection of methodological principals, actions and procedures that define high quality national greenhouse gas inventories

Decision trees

- Decision trees for each category help to navigate through the guidance
- select the appropriate tiered methodology for the national circumstances
- good practice to use higher tier methods for key categories, unless the resource requirements to do so are prohibitive.



IPCC guidelines

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What is the difference between the different IPCC guidelines documents?

- more recent guidance documents include updated emission factors and other parameters
- Good practice guidance documents include the concept of key categories for the methodological choice
- 2006 IPCC Guidelines:
  - more complete in terms of methodologies for source categories and gases
  - additional efforts to provide methodologies for specific sources in developing countries, e.g. open burning of waste
  - good practice guidance incorporated
- Different allocation of emission sources to sectors

Industry & Solvent Classification

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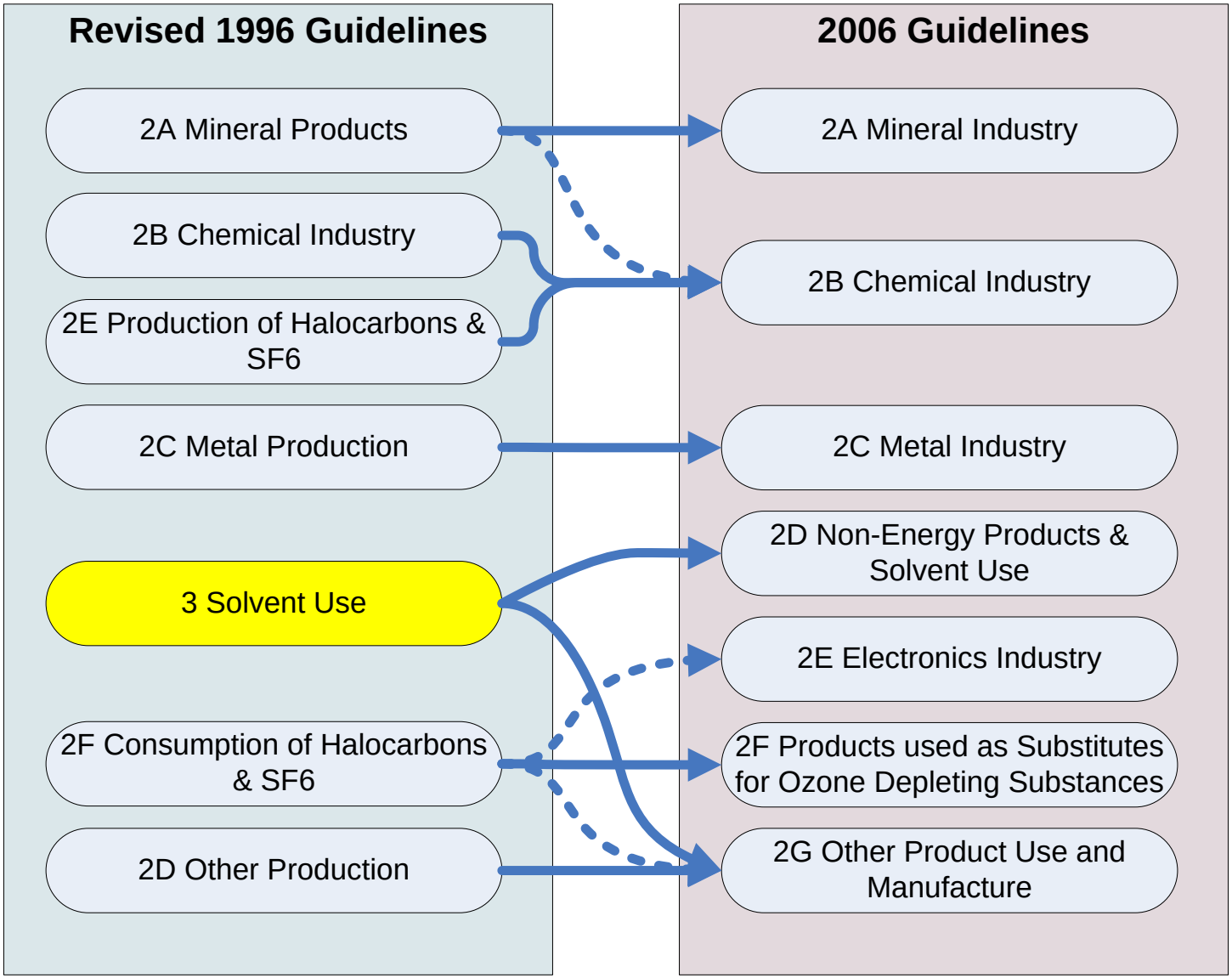

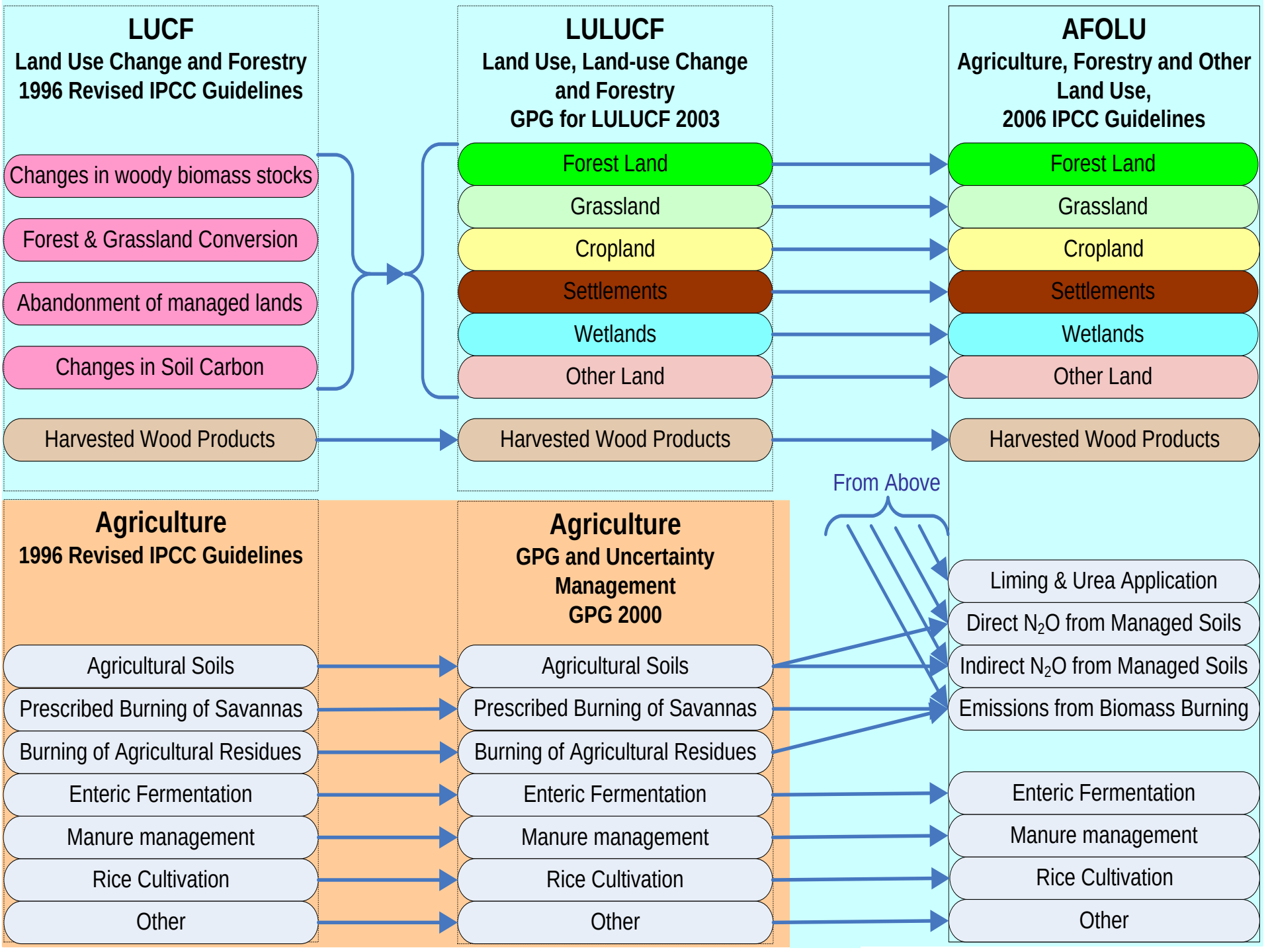
LUCF
Land Use Change and Forestry
1996 Revised IPCC Guidelines
LULUCF
Land Use, Land-use Change and Forestry
GPG for LULUCF 2003
AFOLU
Agriculture, Forestry and Other Land Use,
2006 IPCC Guidelines
Changes in woody biomass stocks
Forest & Grassland Conversion
Abandonment of managed lands
Changes in Soil Carbon
Harvested Wood Products
Forest Land
Grassland
Cropland
Settlements
Wetlands
Other Land
Harvested Wood Products
Forest Land
Grassland
Cropland
Settlements
Wetlands
Other Land
Harvested Wood Products
From Above
Agriculture
1996 Revised IPCC Guidelines
Agriculture
GPG and Uncertainty Management
GPG 2000
Agricultural Soils
Prescribed Burning of Savannas
Burning of Agricultural Residues
Enteric Fermentation
Manure management
Rice Cultivation
Other
Agricultural Soils
Prescribed Burning of Savannas
Burning of Agricultural Residues
Enteric Fermentation
Manure management
Rice Cultivation
Other
Liming & Urea Application
Direct N2O from Managed Soils
Indirect N2O from Managed Soils
Emissions from Biomass Burning
Enteric Fermentation
Manure management
Rice Cultivation
Other

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1.A Emissions from fuel combustion

- Sectoral approach: bottom-up methodology to estimate CO_2 emissions
- Reference approach: Top-down method for CO_2 based on fuel supply statistics
  - not suitable for all subcategories in inventory, e.g. transport
  - differences due to the non-energy fuel use and feedstock uses, non standard fuel categories, uncertainties in statistics
- Energy Industries
  - Public electricity and Heat Production
  - Petroleum refinig
  - Manufacture of solid fuels and other energy Industries
- Manufacturing Industries and Construction

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1.A Emissions from fuel combustion

- Transport:
  - domestic aviation
  - road transport
  - railways
  - national navigation
    - international aviation and marine emissions
- Other sectors:
  - Commercial institutional
  - Residential
  - Agriculture/ Forestry/ Fishing

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1.B Fugitive emissions from coal, oil and gas

- 1.B.1 Solid fuel:
  - Coal mining:
- 1.B.2 Oil and natural gas:
  - venting and flaring
  - production, refining and distribution
  - exploration and drilling
  - transmission and storage
- 2006 IPCC GL:
  - CO2 transport and storage

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Industrial processes

- Mineral products
  - Cement Production
  - Lime Production
  - Limestone and Dolomite Use
  - Soda Ash production and Use
- Chemical industry
  - Ammonia production
  - Nitic acid production
  - Adipic Acid production
  - Carbide Production
- Metal production
  - Iron & steel production
  - Ferroalloys production
  - Aluminium production

Industrial processes / Agriculture

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Industrial processes

- Other Production
  - Pulp and paper
  - Food and drink
- Production of Halocarbons and SF6
- Consumption of halocarbons and SF6

Agriculture

- Enteric fermentation
- Manure management
- Rice cultivation
- Agricultural soils
- Field burning of agricultural residues

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LULUCF

A. Forest Land
1. Forest Land remaining Forest Land
2. Land converted to Forest Land
B. Cropland
1. Cropland remaining Cropland
2. Land converted to Cropland
C. Grassland
1. Grassland remaining Grassland
2. Land converted to Grassland
D. Wetlands
1. Wetlands remaining Wetlands (3)
2. Land converted to Wetlands
E. Settlements
1. Settlements remaining Settlements (3)
2. Land converted to Settlements
F. Other Land
1. Other Land remaining Other Land (4)
2. Land converted to Other Land
G. Other *(please specify)* (5)
Harvested Wood Products (6)

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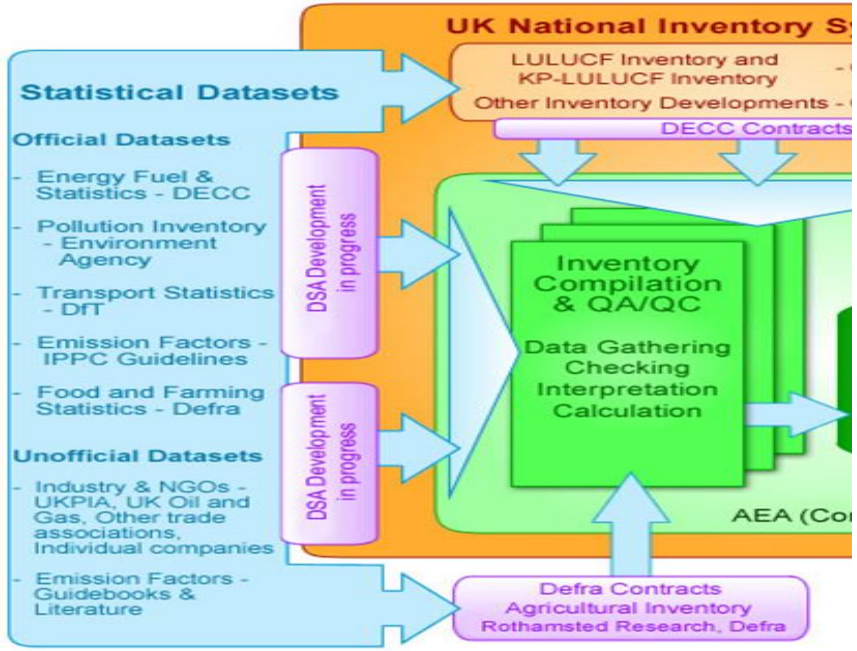
Waste

A. Solid Waste Disposal on Land
1. Managed Waste Disposal on Land
2. Unmanaged Waste Disposal Sites
3. Other *(as specified in table 6.A)*
B. Waste Water Handling
1. Industrial Wastewater
2. Domestic and Commercial Waste Water
3. Other *(as specified in table 6.B)*
C. Waste Incineration
D. Other *(please specify)*
Compost production

National inventory system



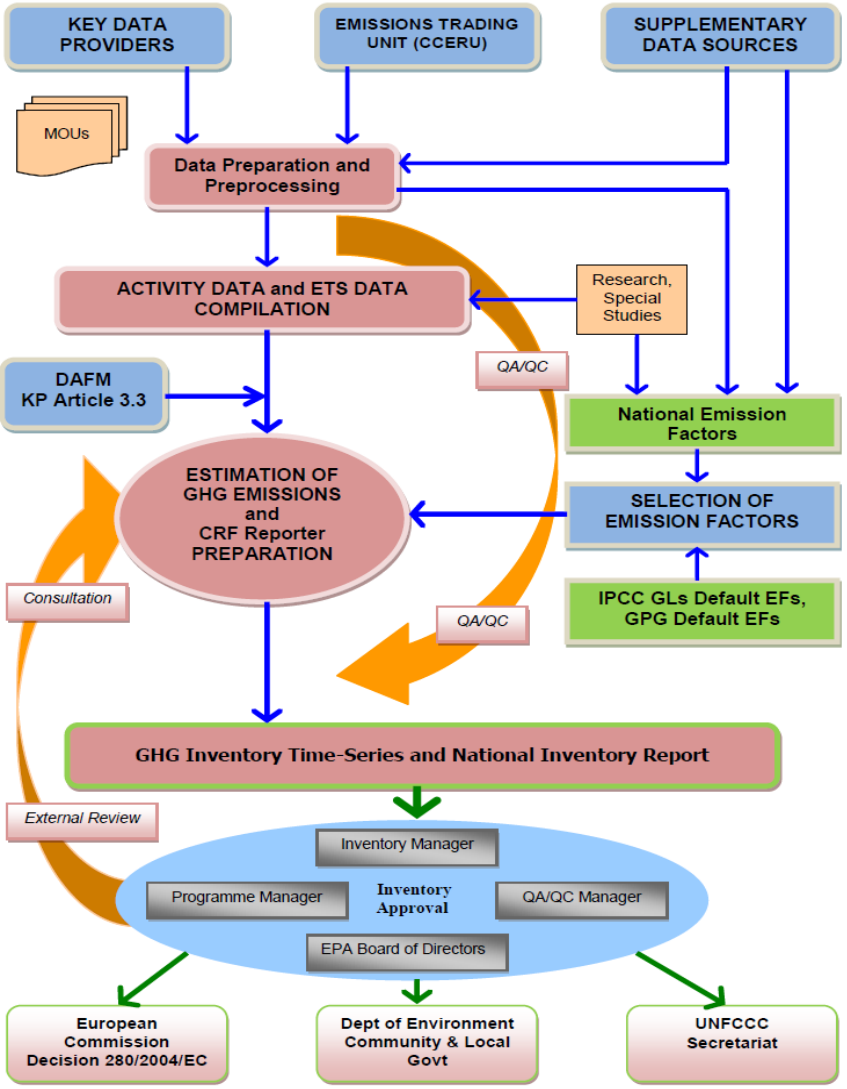


Figure 1.1. National Inventory System Overview

National system

Definition of national inventory system

- all institutional, legal and procedural arrangements made for estimating anthropogenic emissions by sources and removals by sinks of all GHG
- Set set of relations between people and institutions to ensure:
  - i) the sustainability of the inventory preparation in the country
  - ii) consistency of reported emissions,
  - iii) standard quality of results
- General functions of the national system
  - establish and maintain institutional, legal and procedural arrangements
  - ensure capacity for timely performance of functions
  - single national entity with overall responsibility

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Definition of national inventory system

- Specific functions of the national system
  - inventory planning
  - inventory preparation
  - inventory management
- Define and allocate specific responsibilities in the inventory development process, including those relating to choice of methods, data collection, particularly activity data and emission factors

National system

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Many different examples of institutional arrangements

Government agencies

- Statistical agencies
- Consultants

Cross-cutting nature

- GHG inventory only one task, also preparation of air pollution inventories and other reports for which same or similar data is needed
- Also production of other tasks (e.g. projections, sectoral mechanism)

National system

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Different ways to data access

- cooperation with data providers without formal specification of cooperation
- memorandum of understanding
- specific legal act enforces all institutional, legal and procedural arrangements
- Workshops with stakeholders
- own surveys, in addition to surveys for statistical data

Documentation and archiving

- guidance in IPCC and UNFCCC guidelines
- important if experts are contracted only for a specific period

National system

- Documentation falls into two categories:
- 1. Inventory documents describing:
  - what was calculated,
  - how was it calculated, and
  - what does it mean.
- 2. Documents “around” the inventory describing
  - how to make an inventory (e.g., workplans, manual of procedures, inventory improvement strategy, legal and organisational bases, responsibilities, reporting obligations, etc).

Quality assurance and quality control

QA/QC

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- Task in guidelines for national systems of Annex I Parties
- Specific guidance in IPCC Good Practice guidance
  - preparation of QA/QC plan and start its implementation
  - Tier 1 Q/C checks
  - Tier 2 QC checks
    - compare different data sources if available
    - compare with other countries
    - peer review of inventories between parties
  - Data handling:
    - cross-check with colleagues, 4-eye principle
    - ensure use of the same EFs across all sectors
    - ensure use of consistent AD
    - use of software tools

QA/QC

- Documentation of data, method and parameters
  - NIR is very important for this function
  - NIR No mandatory requirement for Non-Annex I Parties, but extremely helpful
- Continuous improvement of GHG inventory
  - elaboration of improvement plan
  - priorities on key categories

Tasks for inventory preparation

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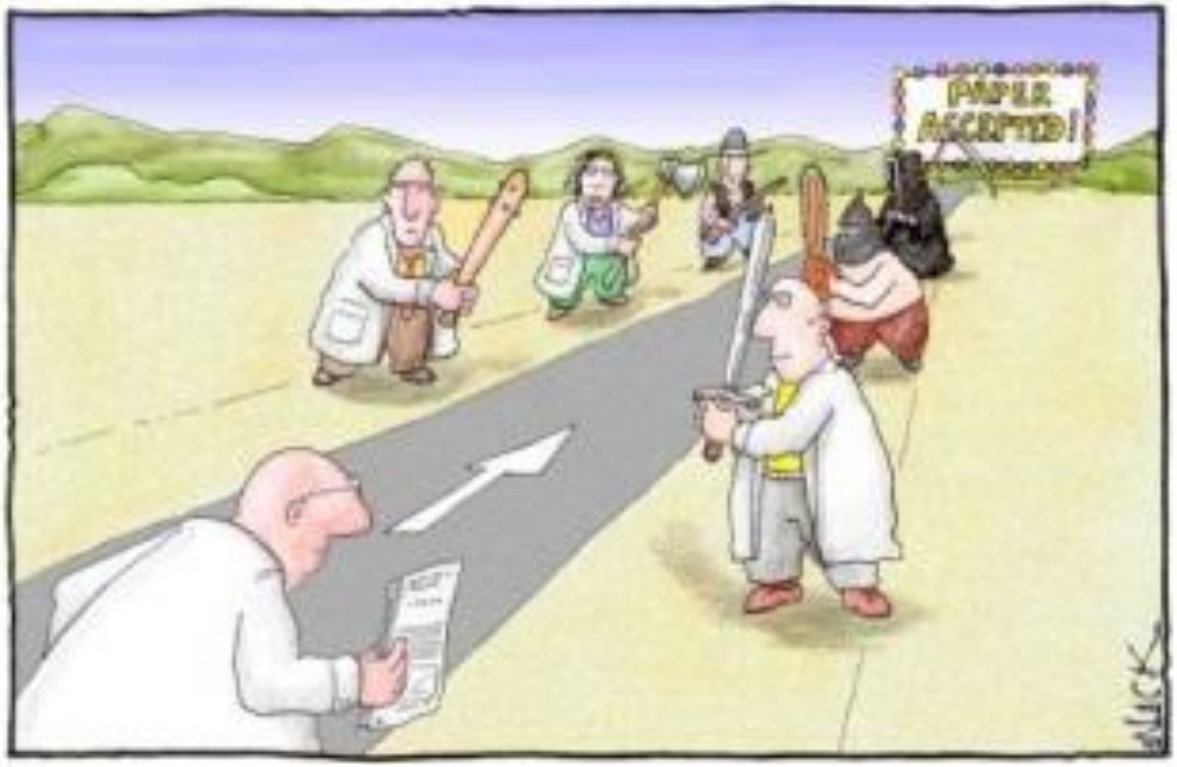
1. Determine Data Availability and Quality;
2. Determine Methods and Compile Data;
3. Conduct Emission Calculations and Complete Text Sections;
4. Complete Quality Assurance/Quality Control Procedures;
5. Undertake Key Source Analysis;
7. Complete Reporting;
8. Complete Documentation and Archiving;
9. Complete Inventory Improvement Strategy

Relationship inventories - NAMAs

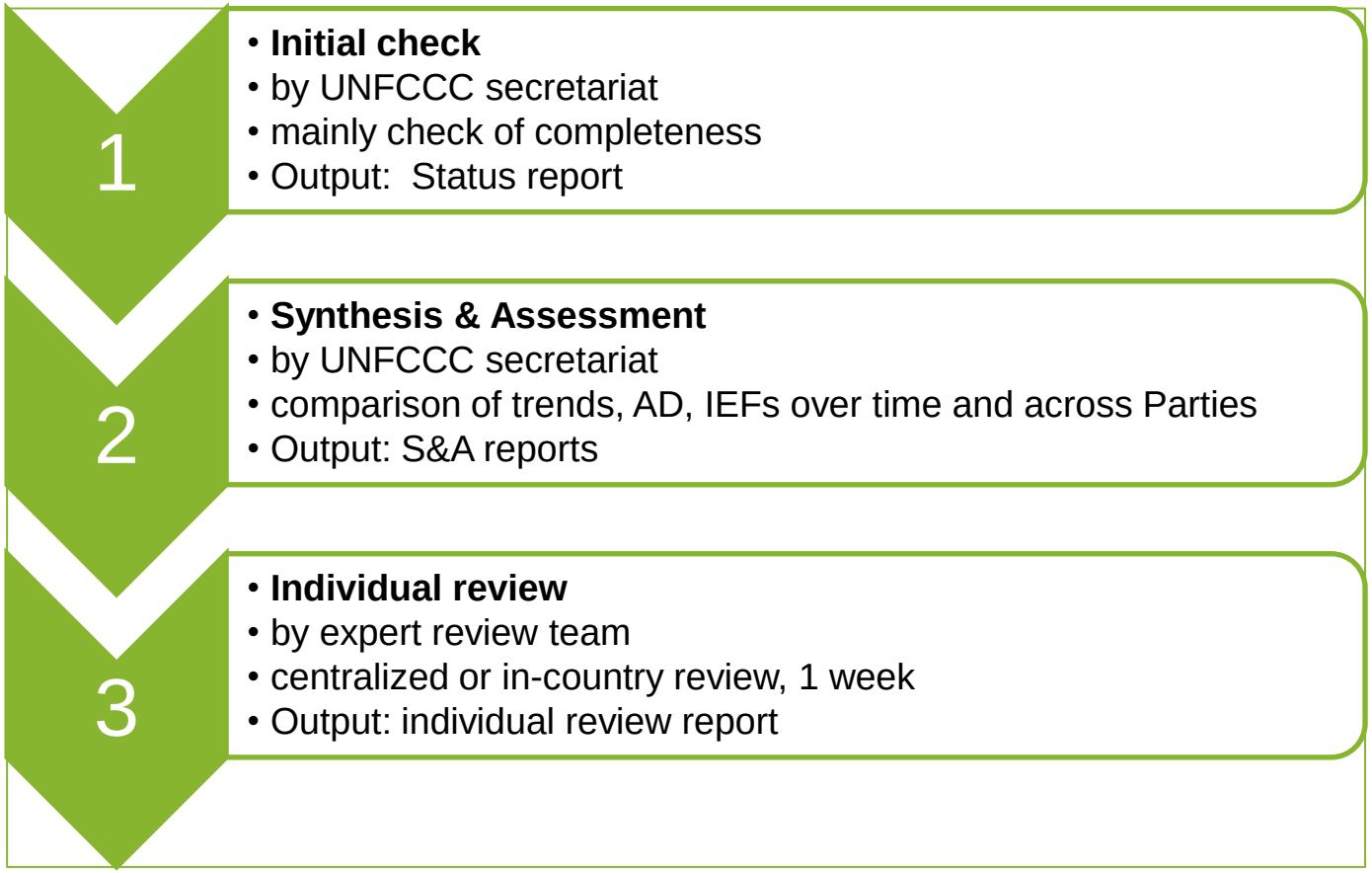
- Is the inventory work useful for the MRV of NAMAs?
- Depends on the scope of NAMA
  - example 1: NAMA addressing EFs for buses, higher tier approach with country-specific EFs used in inventories could also assess this NAMA
  - example 2: replacement of energy-efficient lighting in residential sector: much more detailed than national inventory
- Inventory and key category analysis provide a good overview of the important sectors and gases that contribute to the total emissions and removals of a country and can therefore provide important guidance for the design of NAMAs

Inventory review process



Inventory review process (Annex I)

- Annual review of Annex I GHG inventories became mandatory in 2003 (decision 19/CMP.8)
- Review comprises three stages



Expert Review Teams (ERT)

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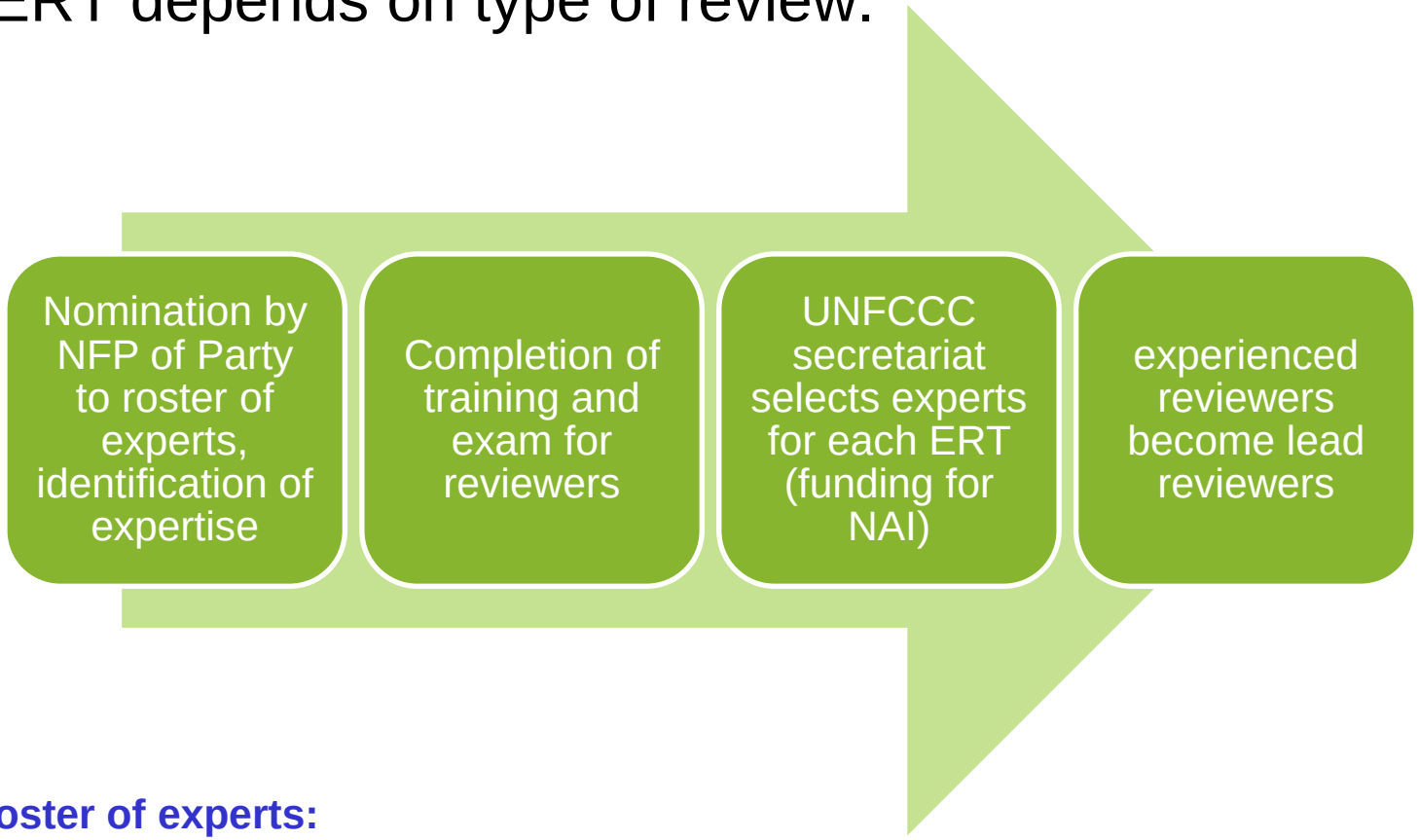
- Annual inventory review process requires the participation of over 120 skilled experts per year. Members of expert review teams are selected by the secretariat. Size of ERT depends on type of review.



Roster of experts:
http://unfccc.int/parties_and_observers/roster_of_experts/items/534.php

Inventory Review Training

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- Basic course:
  - Overview of UNFCCC Review Process and General IPCC Inventory Guidance
  - Modules for each of the five sectors
- mandatory for each new expert
- Each trainee required to study the general module and one sector-specific module.
- Allocated to sector-specific modules based on previous experience in national GHG inventories, and the needs of the inventory review process.
- Courses offered through the Internet for a 1.5 - 2 month period each year.
- Instructors are available during this period to answer questions on the course content and to monitor the individual performance of trainees throughout the study period.
- Trainees are able to study the e-learning courses at their own pace and to interact with course instructors on-line.
- The working language for the training is English.

Inventory Review Training

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- Closing seminar for trainees upon completion of the on-line course
  - simulated inventory review
  - mandatory examination
- Online courses are available all year round, other arrangements for examinations can be made with the UNFCCC secretariat, provided that this does not require additional resources
- Trainees who passed the exam are qualified to study the courses specific to the Kyoto Protocol (adjustments, LULUCF activities)
- After successful completion, new experts can be invited to participate in an review, usually work together with experienced experts
- Other courses:
  - Review of complex models and higher tier methods
  - Improving communication and building consensus in expert review teams
  - Refresher seminar for experienced GHG inventory review experts

Useful data sources and overviews

Inventory software

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UNFCCC inventory software

- Software for Non-Annex I Parties available at UNFCCC website

  http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm

- Annex I Parties use CRF reporter software

IPCC inventory software

- Standalone software that does not require any additional software or internet access
- Covers all inventory categories but can also be used for management of specific sectors
- Allows different parts of the inventory to be developed simultaneously
- Data entry in worksheets following 2006 IPCC Guidelines for ease-of-use
- Implements Tier 1 approaches
- Provides default data from 2006 IPCC Guidelines but gives users the flexibility to use their own country-specific information
- http://www.ipcc-nggip.iges.or.jp/software/new.html

EFDB

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- **IPCC emission factor database (EFDB)**
  - recognised library, where users can find emission factors and other parameters with background documentation or technical references
  - The responsibility of using this information appropriately will always remain with the users themselves
  - EFDB at present contains only the IPCC default data (default data presented in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories).
  - It also contains the data from CORINAIR94, but please note that these data records may be renewed in due course in accordance with the latest version of CORINAIR data set
  - http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

EDGAR

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- **Emissions Database for Global Atmospheric Research (EDGAR)**
- http://edgar.jrc.es.europa.eu/index.php
- Global past and present day anthropogenic emissions of greenhouse gases and air pollutants by country and on spatial grid.
- Joint project of the European Commission JRC Joint Research Centre and the Netherlands Environmental Assessment Agency (PBL).
- Emissions are calculated for the following substances:
- Direct greenhouse gases: CO2 , Methane CH4, Nitrous Oxide (N2O), HFCs, PFCs, SF6, NF3 and Sulfuryl Fluoride (SO2F2).
- Ozone precursor gases: Carbon Monoxide (CO), Nitrogen Oxides (NOx), Non-Methane Volatile Organic Compounds (NMVOC) and Methane (CH4).
- Acidifying gases: Ammonia (NH3), Nitrogen oxides (NOx) and Sulfur Dioxide (SO2).
- Primary particulates: Fine Particulate Matter (PM10) - Carbonaceous speciation (BC , OC) is under progress.
- Stratospheric Ozone Depleting Substances

EDGAR

- **Emissions Database for Global Atmospheric Research (EDGAR)**
- Countries: Emissions in EDGARv4 are calculated by individual countries using country-specific information. The countries are organized in different world regions. Emissions of some small countries are presented together with other countries (e.g. Monaco with France) depending on country definition and availability of activity statistics.
- Time coverage: 1990 – 2008
- downloads in Excel available

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IPCC code	Source name	Comment
1. Energy: Fuel Combustion (1A) and Fugitive emissions from fuel (1B)		
1A1a	Public electricity and heat production	Including autoproducers of electricity and heat
1A1bc	Other energy industries	
1A2	Manufacturing industries and construction	
1A3a	Domestic aviation	
1A3b	Road transportation	
1A3c	Rail transportation	
1A3d	Domestic navigation	
1A3e	Other transportation	
1A4	Residential and other sectors	
1B1	Fugitive emissions from solid fuels	
1B2	Fugitive emissions from oil and gas	Including venting and flaring
1C1	Memo: International aviation	
1C2	Memo: International navigation	

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2. Industrial Processes (non-combustion) and 3. Product Use		
2A	Production of minerals	
2B	Production of chemicals	
2C	Production of metals	
2D	Production of pulp/paper/food/drink	
2E	Production of halocarbons and SF_6	
2F1	Refrigeration and air conditioning	
2F2	Foam blowing	
2F3	Fire extinguishers	
2F4	Aerosols	
2F5	F-gas as solvent	
2F7	Semiconductor/electronics manufacture	Including FPDs and PV cells
2F8	Electrical equipment	
2F9	Other F-gas use	
2G	Non-energy use of lubricants/waxes (CO_2)	
3	Solvent and other product use	

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4. Agriculture (including Savanna burning)		
4A	Enteric fermentation	
4B	Manure management	
4C	Rice cultivation	
4D1	Direct soil emissions	
4D2	Manure in pasture/range/paddock	
4D3	Indirect N_2O from leaching/runoff in agriculture	
4D4	Other direct soil emissions	Including CO_2 from urea application and soil liming
4E	Savanna burning	
4F	Agricultural waste burning	

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5. Land Use Change and Forestry		
5A	Forest fires	Including peat fires
5C	Grassland fires	
5D	Decay of wetlands/peatlands	Included in 5F2 Post-burn decay
5F	Other vegetation fires	
5F2	Forest Fires-Post burn decay	Incl. decomposition of peatlands due to drainage

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6. Waste		
6A	Solid waste disposal on land	
6B	Wastewater handling	
6C	Waste incineration	
6D	Other waste handling	
7. Other anthropogenic sources		
7A	Fossil fuel fires	Includes underground coal fires and Kuwait oil fires
7B	Indirect N_2O from non-agricultural NO_x	
7C	Indirect N_2O from non-agricultural NH_3	
7D	Other anthropogenic sources	

COPERT 4

COPERT 4:

COmputer Programme to Calculate Emissions from Road Transport

- MS Windows software tool for the estimation of emissions from road transport.
    - The emissions estimated include all major pollutants (CO, NOx, VOC, PM, NH3, SO2, heavy metals) as well as greenhouse gases (CO2, N2O, CH4). The programme also provides speciation for NO/NO2, elemental carbon and organic matter of PM and non-methane VOCs, including PAHs and POPs.
- The technical development of COPERT4 is developed by the European Topic Centre on Air and Climate Change (by Aristotle University of Thessaloniki) and is supported by the European Environment Agency (EEA). The European Commission's Joint Research Centre (JRC) coordinates the scientific development of the model.
- http://www.emisia.com/copert/

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Thank you for your attention!

Vielen Dank für Ihre Aufmerksamkeit!

Muchas gracias para su attención!

Merci beaucoup!

Obrigado!

谢谢