Overview of IPCC GHG's Inventory Guidance

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IPCC GHG's Inventory Guidance

PURPOSE AND FOCUS

- Help countries **estimate** and **report GHG emissions** reliably.
- Provide **methods** and **tools** for consistently **compiling GHG inventories.**

OUT OF SCOPE

- The guidelines **don't assess** the **potential** of **emission reduction** **measures** or **mitigation strategies**.
- **Not focused** on **policy** recommendations

MAIN APPLICATION

- Used by compilers to create GHG inventories for **international reporting** (e.g., to the UNFCCC).

IPCC GHG's Inventory Guidance

HOW THE 2006 IPCC GUIDELINES ACHIEVE THEIR PURPOSE

- The **2006 IPCC Guidelines** offer **practical guidance** to help compilers **estimate greenhouse gas emissions**.
- Through a **structured approach**, the guidelines ensure the development of **accurate** and **consistent** GHG inventories.

Good Practice

Guidance are provided as **Good Practice**, rather than standardized rules.

Flexible guidance
Adapts to each country's national circumstances.

Encourages continuous improvement
Promotes gradual refinement of methods over time.

Builds trust through transparency
Clear documentation of methods, data, and assumptions.

Focuses on practicality
Aims for minimizing uncertainties rather than perfection

Global comparability
Ensures that inventories are comparable, even with different data levels

Using the 2006 IPCC Guidelines:

Estimating emissions from a specific source

- *Understanding the emission sources*
- *Choosing the right approach*
- *Ensuring quality*

Using the 2006 IPCC Guidelines

When estimating emissions from a specific source, compilers turn to the guidelines to **find answers** to **key questions**

Identifying and Understanding **Sources of Emissions**

- *What is the source of the emissions?*
- *How are these emissions being produced?*

Choosing the Right **Approach**

- *Which calculation method and emission factor should I use?*
- *What data do I need for this calculation?*

Ensuring **Completeness**, **Consistency**, and **Accuracy**

- *How do I ensure all emission sources are included?*
- *Is the calculation consistent and accurate?*
- *How should I report and communicate the results?*

Understanding the Emission Sources

The chapters of the 2006 IPCC guidelines offer detailed sections like **overview**, **introduction**, and **source descriptions** to help identify emission sources.

- Clear definitions of **emission sources** by sector.
- Explanation of **how** emissions are produced (combustion, chemical, biological, etc.).
- Identification of expected **GHGs** for each source.
- Sector splits and activity **breakdowns** for accurate categorization.
- Cross-references to other sectors to prevent double-counting.
- Examples to illustrate common emission sources and processes.

Choosing the Right Approach

The guidelines provide **flexibility** through the **Tiered Approach**, with detailed sections offering methods for different data availability levels:

- **Tier 1**: Basic methods using default data.
- **Tier 2**: Intermediate methods with more specific national data.
- **Tier 3**: Detailed, country-specific methods using complex models and datasets.

- **Decision trees** guide compilers in selecting the appropriate tier based on data quality and availability

Completeness, Consistency, and Accuracy

To ensure reliability and transparency, the 2006 IPCC Guidelines provide the following tools and procedures for GHG's Inventory compilers:

- **Tools for identifying** all emission sources, sectors and gases, and **cross-checks** to avoid **omissions** or **double-counting.**
- **Methods** for **ensuring consistent data** and **recalculating** past years when methods or data change.
- **Guidelines** for **quantifying uncertainties** in activity data and emission factors, improving reliability.
- **Structured QA/QC procedures**, including **checklists** for data reviews and external validations.
- **Templates and guidance** for **documenting** methodologies, assumptions, and recalculations for transparency.

Examples from 2006 IPCC Guidelines

- *Estimating emissions from a Coal-fired power station*

Description of Sources

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CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

The guidelines provide clear **definitions of the activities**, with detailed and adjusted levels of disaggregation for transparent reporting and accurate estimation.

1.A.1.a.i – Electricity Generation

Compromises emissions from all fuels use for electricity generation from main activity produces except those from combine heat and power plants

TABLE 2.1
DETAILED SECTOR SPLIT FOR STATIONARY COMBUSTION[2]

Code number and name				Definitions
1 ENERGY				All GHG emissions arising from combustion and fugitive releases of fuels. Emissions from the non-energy uses of fuels are generally not included here, but reported under Industrial Processes and Product Use.
1 A Fuel Combustion Activities				Emissions from the intentional oxidation of materials within an apparatus that is designed to raise heat and provide it either as heat or as mechanical work to a process or for use away from the apparatus.
1 A 1	*Energy Industries*			Comprises emissions from fuels combusted by the fuel extraction or energy-producing industries.
1 A 1	a	Main Activity Electricity and Heat Production		Sum of emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (formerly known as public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) should be assigned to the sector where they were generated and not under 1 A 1 a. Autoproducers may be in public or private ownership.
1 A 1	a	*i*	*Electricity Generation*	Comprises emissions from all fuel use for electricity generation from main activity producers except those from combined heat and power plants.

Choice of Method

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CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

When choosing a method, in addition to the equations and explanations of the approach, the requirements for applying each Tier Approach are also clearly stated.

Tier 1 Approach – Requirements

- Data on the amount of fuel combusted in the source category
- A default emission factor

2.3.1.1 TIER 1 APPROACH

Applying a Tier 1 emission estimate requires the following for each source category and fuel:

- Data on the amount of fuel combusted in the source category
- A default emission factor

Emission factors come from the default values provided together with associated uncertainty range in Section 2.3.2.1. The following equation is used:

EQUATION 2.1
GREENHOUSE GAS EMISSIONS FROM STATIONARY COMBUSTION

$$Emissions_{GHG,\,fuel} = Fuel\ \ Consumption_{fuel} \bullet Emission\ \ Factor_{GHG,\,fuel}$$

Where:

$Emissions_{GHG\,,fuel}$ = emissions of a given GHG by type of fuel (kg GHG)

$Fuel\ Consumption_{fuel}$ = amount of fuel combusted (TJ)

$Emission\ Factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ). For CO_2, it includes the carbon oxidation factor, assumed to be 1.

To calculate the total emissions by gas from the source category, the emissions as calculated in Equation 2.1 are summed over all fuels:

EQUATION 2.2
TOTAL EMISSIONS BY GREENHOUSE GAS

$$Emissions_{GHG} = \sum_{fuels} Emissions_{GHG,\,fuel}$$

Choice of Method

CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

When choosing a method, in addition to the equations and explanations of the approach, the requirements for applying each Tier Approach are also clearly stated.

Tier 2 Approach – Requirements

- Data on the amount of fuel combusted in the source category
- A country-specific emission factor for the source category and fuel for each gas

2.3.1.2 TIER 2 APPROACH

Applying a Tier 2 approach requires:

- Data on the amount of fuel combusted in the source category;
- A country-specific emission factor for the source category and fuel for each gas.

Under Tier 2, the Tier 1 default emission factors in Equation 2.1 are replaced by country-specific emission factors. Country-specific emission factors can be developed by taking into account country-specific data, for example carbon contents of the fuels used, carbon oxidation factors, fuel quality and (for non-CO_2 gases in particular) the state of technological development. The emission factors may vary over time and, for solid fuels, should take into account the amount of carbon retained in the ash, which may also vary with time. It is *good practice* to compare any country-specific emission factor with the default ones given in Tables 2.2 to 2.5. If such country-specific emission factors are outside the 95 percent confidence intervals, given for the default values, an explanation should be sought and provided on why the value is significantly different from the default value.

A country-specific emission factor can be identical to the default one, or it may differ. Since the country-specific value should be more applicable to a given country's situation, it is expected that the uncertainty range associated with a country-specific value will be smaller than the uncertainty range of the default emission factor. This expectation should mean that a Tier 2 estimate provides an emission estimate with lower uncertainty than a Tier 1 estimate.

Emissions can be also estimated as the product of fuel consumption on a mass or volume basis, and an emission factor expressed on a compatible basis. For example, the use of activity data expressed in mass unit is relevant when the Tier 2 approach described in Chapter 5 of Volume 5 is used alternatively to estimate emissions that arise when waste is incinerated for energy purposes.

Choice of Method

CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

When choosing a method, in addition to the equations and explanations of the approach, the requirements for applying each Tier Approach are also clearly stated.

Tier 3 Approach – Requirements

- Data on the amount of fuel combusted in the source category for each relevant technology.
- A specific emission factor for each technology.
- Facility level measurements can also be used when available.

2.3.1.3 TIER 3 APPROACH

In a Tier 3 approach this is taken into account by splitting the fuel combustion statistics over the different possibilities and using emission factors that are dependent upon these differences. In Equation 2.3, this is indicated by making the variables and parameters technology dependent. Technology here stands for any device, combustion process or fuel property that might influence the emissions.

EQUATION 2.3
GREENHOUSE GAS EMISSIONS BY TECHNOLOGY

$$Emissions_{GHG,\,fuel,technology} = Fuel\ Consumption_{fuel,technology} \bullet Emission\ Factor_{GHG,\,fuel,technology}$$

Where:

$Emissions_{GHG\ gas,fuel,\ technology}$ = emissions of a given GHG by type of fuel and technology (kg GHG)

$Fuel\ Consumption_{fuel,\ technology}$ = amount[7] of fuel combusted per type of technology (TJ)

$Emission\ Factor_{GHG\ gas,fuel,technology}$ = emission factor of a given GHG by fuel and technology type (kg GHG/TJ)

When the amount of fuel combusted for a certain technology is not directly known, it can be estimated by means of models. For example, a simple model for this is based on the penetration of the technology into the source category.

EQUATION 2.4
FUEL CONSUMPTION ESTIMATES BASED ON TECHNOLOGY PENETRATION

$$Fuel\ Consumption_{fuel,technology} = Fuel\ Consumption_{fuel} \bullet Penetration_{technology}$$

Where:

$Penetration_{technology}$ = the fraction of the full source category occupied by a given technology. This fraction can be determined on the basis of output data such as electricity generated which would ensure that appropriate allowance was made for differences in utilisation between technologies.

To calculate the emissions of a gas for a source category, the result of Equation 2.3 must be summed over all technologies applied in the source category.

EQUATION 2.5
TECHNOLOGY-BASED EMISSION ESTIMATION

$$Emissions_{GHG,\,fuel} = \sum_{technologies} Fuel\ Consumption_{fuel,technology} \bullet Emission\ Factor_{GHG,\,fuel,technology}$$

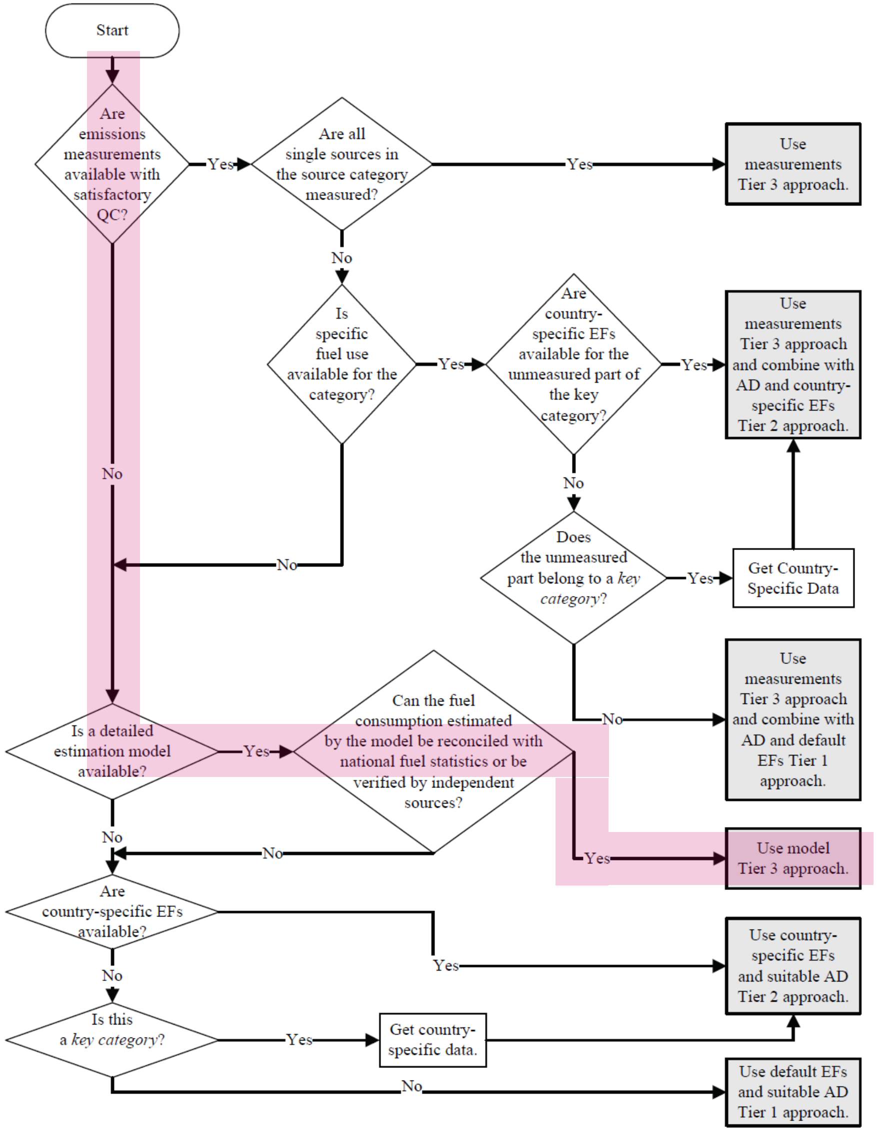
Total emissions are again calculated by summing over all fuels (Equation 2.2).

Application of a Tier 3 emission estimation approach requires:

- Data on the amount of fuel combusted in the source category for each relevant technology (fuel type used, combustion technology, operating conditions, control technology, and maintenance and age of the equipment).
- A specific emission factor for each technology (fuel type used, combustion technology, operating conditions, control technology, oxidation factor, and maintenance and age of the equipment).
- Facility level measurements can also be used when available.

Choice of Method

Figure 2.1 Generalised decision tree for estimating emissions from stationary combustion



CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

The **decision trees** help the Inventory compiler choose between approaches Tier 1, 2, or 3 based on data availability

The user goes through the decision tree, answering **Yes or No questions** until reaching the recommended approach.

Example

Q: Are Emission Measurements available with satisfactory QC?

Answer – No

Q: Is a detailed estimation model available?

Answer – Yes

Q: Can the fuel consumption estimated by the model be reconciled with national fuel statistics or be verified by independent sources?

Answer – Yes

Terminal Node: Use model Tier 3 approach

Choice of Emission Factors

CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

The guidelines provide a comprehensive list of fuels with **clear definitions**, helping inventory compilers identify the fuel that best matches the one used in their country and select the appropriate emission factor from the **default values table**.

Sub-Bituminous Coal
Non-agglomerating coals with a gross calorific value between 17 435 kJ/kg (4 165 kcal/kg) and 23 865 kJ/kg (5 700 kcal/kg) containing more than 31 percent volatile matter on a dry mineral matter free basis.

TABLE 1.1 (CONTINUED)
DEFINITIONS OF FUEL TYPES USED IN THE *2006 IPCC GUIDELINES*

English Description	Comments
SOLID (Coal and coal products)	
Anthracite	Anthracite is a high rank coal used for industrial and residential applications. It has generally less than 10 percent volatile matter and a high carbon content (about 90 percent fixed carbon). Its gross calorific value is greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Coking Coal	Coking coal refers to bituminous coal with a quality that allows the production of a coke suitable to support a blast furnace charge. Its gross calorific value is greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Other Bituminous Coal	Other bituminous coal is used for steam raising purposes and includes all bituminous coal that is not included under coking coal. It is characterized by higher volatile matter than anthracite (more than 10 percent) and lower carbon content (less than 90 percent fixed carbon). Its gross calorific value is greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Sub-Bituminous Coal	Non-agglomerating coals with a gross calorific value between 17 435 kJ/kg (4 165 kcal/kg) and 23 865 kJ/kg (5 700 kcal/kg) containing more than 31 percent volatile matter on a dry mineral matter free basis.

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			CH_4			N_2O		
		Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	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
Gasoline	Aviation Gasoline	r 70 000	67 500	73 000	r 3	1	10	0.6	0.2	2
Gasoline	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
Other Oil	Refinery Gas	n 57 600	48 200	69 000	r 1	0.3	3	0.1	0.03	0.3
Other Oil	Paraffin Waxes	73 300	72 200	74 400	r 3	1	10	0.6	0.2	2
Other Oil	White Spirit and SBP	73 300	72 200	74 400	r 3	1	10	0.6	0.2	2
Other Oil	Other Petroleum Products	73 300	72 200	74 400	r 3	1	10	0.6	0.2	2
	Anthracite	98 300	94 600	101 000	1	0.3	3	r 1.5	0.5	5
	Coking Coal	94 600	87 300	101 000	1	0.3	3	r 1.5	0.5	5
	Other Bituminous Coal	94 600	89 500	99 700	1	0.3	3	r 1.5	0.5	5
	Sub-Bituminous Coal	96 100	92 800	100 000	1	0.3	3	r 1.5	0.5	5

Choice of Activity Data

CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

The guidelines indicate which **activity data is relevant** for each of the approaches, as well as a **list of possible data sources**.

Activity Data:

- Amounts and types of fuel combusted

List of possible data sources:

- national energy statistics agencies
- reports provided by enterprises to energy statistics agencies
- reports provided by enterprises to regulatory agencies
- suppliers of fuels

2.3.3 Choice of activity data

For Stationary Combustion, the activity data for all tiers are the amounts and types of fuel combusted. Most fuels consumers (enterprises, small commercial consumers, or households) normally pay for the solid, liquid and gaseous fuels they consume. Therefore, the masses or volumes of fuels they consume are measured or metered. Quantities of carbon dioxide can normally be easily calculated from fuel consumption data and the carbon contents of the fuels, taking into account the fraction of carbon unoxidised.

The quantities of non-CO_2 greenhouse gases formed during combustion depend on the combustion technology used, and therefore detailed statistics on fuel combustion technology are needed to rigorously estimate emissions of non-CO_2 greenhouse gases.

The amount and types of fuel combusted are obtained from one, or a combination, of the sources in the list below:

- national energy statistics agencies (national energy statistics agencies may collect data on the amount and types of fuel combusted from individual enterprises that consume fuels)
- reports provided by enterprises to national energy statistics agencies (these reports are most likely to be produced by the operators or owners of large combustion plants)
- reports provided by enterprises to regulatory agencies (for example, reports produced to demonstrate how enterprises are complying with emission control regulations)
- individuals within the enterprise responsible for the combustion equipment
- periodic surveys, by statistical agencies, of the types and quantities of fuels consumed by a sample of enterprises
- suppliers of fuels (who may record the quantities of fuels delivered to their customers, and may also record the identity of their customers usually as an economic activity code).

Uncertainties – Activity data

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CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

The guidelines provide **methods to assess uncertainty** in activity data and emission factors. Also provide **reference data** so and inventory compiler can infer uncertainty levels of the activity data and the emission factor.

TABLE 2.15
LEVEL OF UNCERTAINTY ASSOCIATED WITH STATIONARY COMBUSTION ACTIVITY DATA

Sector	Well developed statistical systems		Less developed statistical systems	
	Surveys	Extrapolation	Surveys	Extrapolation
Main activity electricity and heat production	Less than 1%	3-5%	1-2%	5-10%
Commercial, institutional, residential combustion	3-5%	5-10%	10-15%	15-25%
Industrial combustion (Energy intensive industries)	2-3%	3-5%	2-3%	5-10%
Industrial combustion (others)	3-5%	5-10%	10-15%	15-20%
Biomass in small sources	10-30%	20-40%	30-60%	60-100%

The inventory compiler should judge which type of statistical system best describes their national circumstances.
Source: IPCC *Good Practice Guidance* and Uncertainty Management in National Greenhouse Gas Inventories (2000)

2.4.2 Activity data uncertainties

Statistics of fuel combusted at large sources obtained from direct measurement or obligatory reporting are likely to be within 3 percent of the central estimate. For some energy intensive industries, combustion data are likely to be more accurate. It is *good practice* to estimate the uncertainties in fuel consumption for the main sub-categories in consultation with the sample survey designers, because the uncertainties depend on the quality of the survey design and the size of sample used.

In addition to any systematic bias in the activity data as a result of incomplete coverage of consumption of fuels, the activity data will be subject to random errors in the data collection that will vary from year to year. Countries with good data collection systems, including data quality control, may be expected to keep the random error in total recorded energy use to about 2-3 percent of the annual figure. This range reflects the implicit confidence limits on total energy demand seen in models using historical energy data and relating energy demand to economic factors. Percentage errors for individual energy use activities can be much larger.

Overall uncertainty in activity data is a combination of both systematic and random errors. Most developed countries prepare balances of fuel supply and deliveries and this provides a check on systematic errors. In these circumstances, overall systematic errors are likely to be small. Experts believe that the uncertainty resulting from the two errors combined is probably in the range of ±5 percent for most developed countries. For countries with less well-developed energy data systems, this could be considerably larger, probably about ±10 percent. Informal activities may increase the uncertainty up to as much as 50 percent in some sectors for some countries.

Uncertainty ranges for stationary combustion activity data are shown in Table 2.15. This information may be used when reporting uncertainties. It is *good practice* for inventory compilers to develop, if possible, country-specific uncertainties using expert judgement and/or statistical analysis.

Uncertainties – Emission Factor

2.4.1 Emission factor uncertainties

For fossil fuel combustion, uncertainties in CO_2 emission factors are relatively low. These emission factors are determined by the carbon content of the fuel and thus there are physical constraints on the magnitude of their uncertainty. However, it is important to note there are likely to be intrinsic differences in the uncertainties of CO_2 emission factors of petroleum products, coal and natural gas. Petroleum products typically conform to fairly tight specifications which limit the possible range of carbon content and calorific value, and are also sourced from a relatively small number of refineries and/or import terminals. Coal by contrast may be sourced from mines producing coals with a very wide range of carbon contents and calorific values and is mostly supplied under contract to users who adapt their equipment to match the characteristics of the particular coal. Hence at the national level, the single energy commodity "black coal" can have a range of CO_2 emission factors.

Emission factors for CH_4 and especially N_2O are highly uncertain. High uncertainties in emission factors may be ascribed to lack of relevant measurements and subsequent generalisations, uncertainties in measurements, or an insufficient understanding of the emission generating process. Furthermore, due to stochastic variations in process conditions, a high variability of the real time emission factors for these gases might also occur (Pulles and Heslinga, 2004). Such variability obviously will also contribute to the uncertainty in the emission estimates. The uncertainties of emission factors are seldom known or accessible from empirical data. Consequently, uncertainties are customarily derived from indirect sources or by means of expert judgements. The *IPCC 1996 Guidelines* (Table A1-1, Vol. I, p. A1.4) suggest an overall uncertainty value of 7 per cent for the CO_2 emission factors of Energy.

The default uncertainties shown in Table 2.12 derived from the EMEP/CORINAIR Guidebook ratings (EMEP/CORINAIR, 1999) may be used in the absence of country-specific estimates.

TABLE 2.12
DEFAULT UNCERTAINTY ESTIMATES FOR STATIONARY COMBUSTION EMISSION FACTORS

Sector	CH_4	N_2O
Public Power, co-generation and district heating	50-150%	Order of magnitude*
Commercial, Institutional and Residential combustion	50-150%	Order of magnitude
Industrial combustion	50-150%	Order of magnitude

* i.e. having an uncertainty range from one-tenth of the mean value to ten times the mean value.
Source: IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000)

TABLE 2.13
SUMMARY OF UNCERTAINTY ASSESSMENT OF CO_2 EMISSION FACTORS FOR STATIONARY COMBUSTION SOURCES OF SELECTED COUNTRIES

Country	95% confidence interval[1]	Distribution	2003 GHG inventory submission[2]		References
			Approach[3]	Emission factor[4]	
Oil					
Austria	± 0.5	Normal	C	CS	Winiwarter and Rypdal, 2001
Norway	± 3	Normal	C	CS	Rypdal, 1999
The Netherlands	± 2	-	T2, CS	CS, PS	Van Amstel *et al.*, 2000
UK	± 2	Normal	T2	CS	Baggott *et al.*, 2005
USA	± 2	-	T1	CS	EIA, 1999
Coal, coke, gas					
Austria	± 0.5	Normal	C	CS	Winiwarter and Rypdal, 2001
Norway	± 7	Normal	C	CS	Rypdal, 1999
The Netherlands	± 1-10	-	T2, CS	CS, PS	Van Amstel et al., 2000
UK	± 1-6	Normal	T2	CS	Baggott et al., (2005)
USA	± 0-1	-	T1	CS	EIA, 1999
Other fuels (mainly peat)					
Finland	± 5	Normal	T2, CS	D, CS, PS	Monni et al., 2004

[1] Data are given as upper and lower bounds of the 95 percent confidence interval, and expressed as percent relative to the mean value.
[2] The information in the columns is based on the 2003 National Greenhouse Gas Inventory submissions from Annex I Parties to the UNFCCC.
[3] Notation keys that specify the approach applied: T1 (IPCC Tier 1), T2 (IPCC Tier 2), T3 (IPCC Tier 3), C (CORINAIR), CS (Country-specific).
[4] Notation keys that specify the emission factor used: D (IPCC default), C (CORINAIR), CS (Country-specific), PS (Plant Specific).

QA/QC Procedures

CHAPTER 2. VOLUME 2. – STATIONARY COMBUSTION

For stationary sources, the following **procedures** are described:

- Comparison of emissions estimates using different approaches (Reference Approach, Tier 1)
- Activity data check
- Emission factors check and review
- Evaluation of direct measurements
- CO_2 capture
- External review

2.5 INVENTORY QUALITY ASSURANCE/QUALITY CONTROL QA/QC

Specific QA/QC procedures to optimise the quality of estimates of emissions from stationary combustion are given in Table 2.16.

TABLE 2.17
QA/QC PROCEDURES FOR STATIONARY SOURCES

Activity	Calculations of CO_2 emissions from stationary combustion	Calculations of non- CO_2 emissions from stationary combustion
Comparison of emission estimates using different approaches	• The inventory compiler should compare estimates of CO_2 emissions from fuel combustion prepared using the Sectoral Approach with the Reference Approach, and account for any difference greater than or equal to 5 percent. In this comparative analysis, emissions from fuels other than by combustion, that are accounted for in other sections of a GHG inventory, should be subtracted from the Reference Approach.	• If a Tier 2 approach with country-specific factors is used, the inventory compiler should compare the result to emissions calculated using the Tier 1 approach with default IPCC factors. This type of comparison may require aggregating Tier 2 emissions to the same sector and fuel groupings as the Tier 1 approach. The approach should be documented and any discrepancies investigated. • If possible, the inventory compiler should compare the consistency of the calculations in relation to the maximum carbon content of fuels that are combusted by stationary sources. Anticipated carbon balances should be maintained throughout the combustion sectors.
Activity data check	• The national agency in charge of energy statistics should construct, if resources permit, national commodity balances expressed in mass units, and construct mass balances of fuel conversion industries. The time series of statistical differences should be checked for systematic effects (indicated by the differences persistently having the same sign) and these effects eliminated where possible. • The national agency in charge of energy statistics should also construct, if resources permit, national energy balances expressed in energy units and energy balances of fuel conversion industries. The time series of statistical differences should be checked, and the calorific values cross-checked with the default values given in the Introduction chapter. This step will only be of value where different calorific values for a particular fuel (for example, coal) are applied to different headings in the balance (such as production, imports, coke ovens and households). Statistical differences that change in magnitude or sign significantly from the corresponding mass values provide evidence of incorrect calorific values. • The inventory compiler should confirm that gross carbon supply in the Reference Approach has been adjusted for fossil fuel carbon from imported or exported non-fuel materials in countries where this is expected to be significant. • Energy statistics should be compared with those provided to international organisations to identify inconsistencies. • There may be routine collections of emissions and fuel combustion statistics at large combustion plants for pollution legislation purposes. If possible, the inventory compiler can use these plant-level data to cross-check national energy statistics for representativeness. • If secondary data from national organisations are used, the inventory compiler should ensure that these organisations have appropriate QA/QC programmes in place.	
Emission factors check and review	• The inventory compiler should construct national energy balances expressed in carbon units and carbon balances of fuel conversion industries. The time series of statistical differences should be checked. Statistical differences that change in magnitude or sign significantly from the corresponding mass values provide evidence of incorrect carbon content. • Monitoring systems at large combustion plants may be used to check the emission and oxidation factors in use at the plant. • Some countries estimate emissions from fuel consumed and the carbon contents of those fuels. In this case, the carbon contents of the fuels should be regularly reviewed.	• If country-specific emission factors are used, the inventory compiler should compare them to the IPCC defaults, and explain and document differences. • The inventory compiler should compare the emission factors used with site or plant level factors, if these are available. This type of comparison provides an indication of how reasonable and representative the national factor is.
Evaluation of direct measurements	• The inventory compiler should evaluate the quality control associated with facility-level fuel measurements that have been used to calculate site-specific emission and oxidation factors. If it is established that there is insufficient quality control associated with the measurements and analysis used to derive the factor, continued use of the factor may be questioned.	• If direct measurements are used, the inventory compiler should ensure that they are made according to good measurement practices including appropriate QA/QC procedures. Direct measurements should be compared to the results derived from using IPCC default factors.
CO_2 capture	• CO_2 capture should be reported only when linked with long-term storage. The captured amounts should be checked with amount of CO_2 stored. The reported CO_2 captured should not exceed the amount of stored CO_2 plus reported fugitive emissions from the measure. The amount of stored CO_2 should be based on measurements of the amount injected to storage.	Not applicable
External review	• The inventory compiler should carry out a review involving national experts and stakeholders in the different fields related to emissions from stationary sources, such as: energy statistics, combustion efficiencies for different sectors and equipment types, fuel use and pollution controls. In developing countries, expert review of emissions from biomass combustion is particularly important.	

CDR & CCUS Methodology Report

- *What future authors will need to produce*

CDR & CCUS Methodology Report

WHAT FUTURE AUTHORS WILL NEED TO PRODUCE FOR EACH CDR/CCUS TECHNOLOGY

Context and Scope: Definitions, background, and scope of the CDR technology.

Key Definitions: Clear definitions of emission sources, activity data, and expected GHG types.

Method Selection: Detailed methods for each tier (Tier 1, Tier 2, Tier 3), including default factors and decision trees to select the best approach.

Completeness and Consistency: Guidelines for ensuring data completeness, time-series consistency, uncertainty assessments, and QA/QC.

Reporting: Clear templates for reporting emissions, methods, data, and recalculations.

THANK YOU

FOR YOUR ATTENTION

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