



Use of the IPCC Inventory Software for the Energy sector

Training for the African Region

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INTERGOVERNMENTAL PANEL ON climate change



Content

- **Sector overview**
- **Subcategories/Worksheets**
- **Methodological Approaches**
- **Reporting**
- **Activity data**
- **Conversion factors**
- **Sector specific**
- **Exercises**

Energy sector



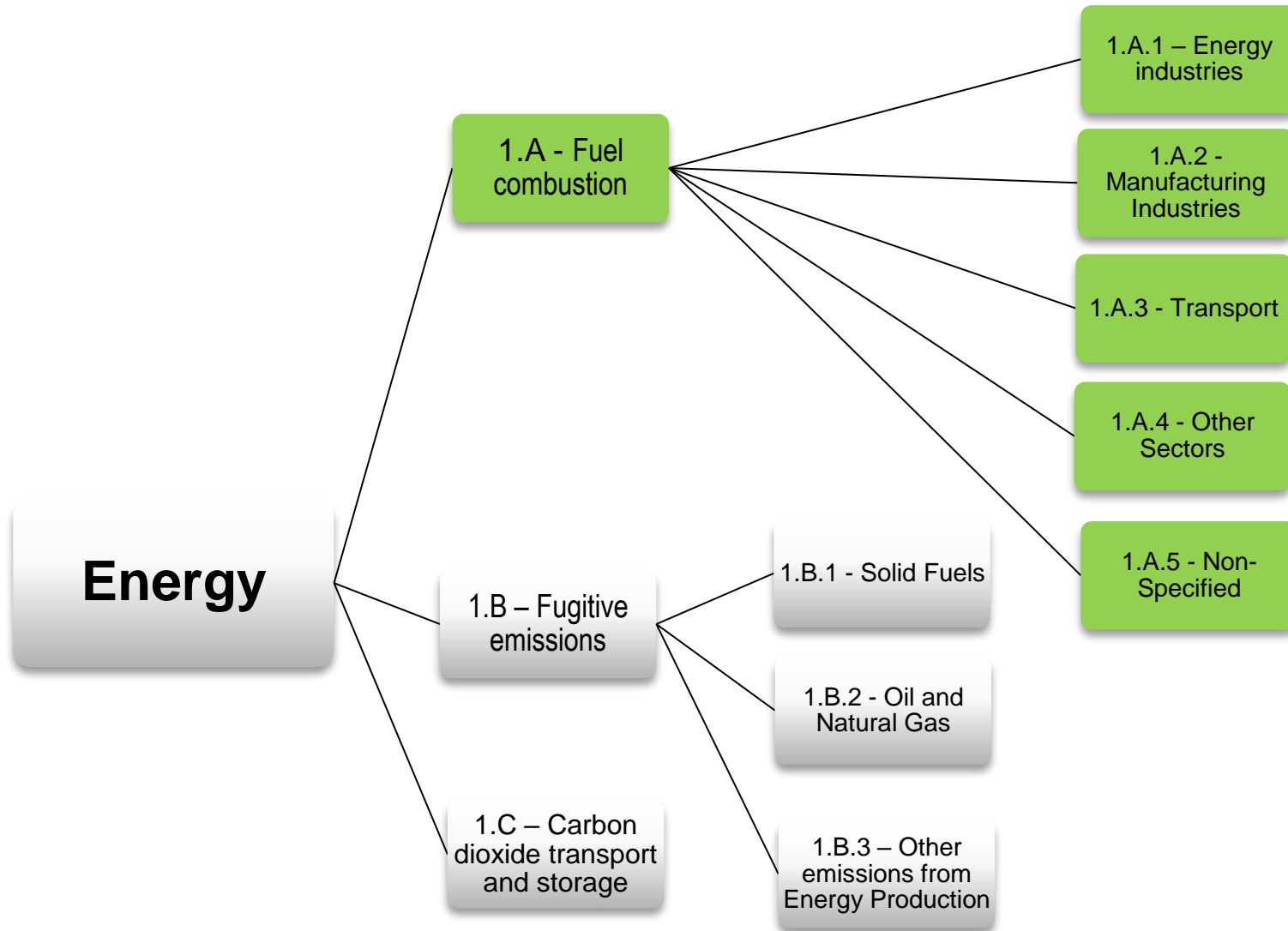
Exploration
and
exploitation of
primary
energy
sources

Conversion of
primary energy
sources into more
useable energy
forms in refineries
and power plants

Transmission
and
distribution of
fuels

Use of fuels
in stationary
and mobile
applications

Sector structure



Worksheets

IPCC Inventory Software - user - [Worksheets]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

2006 IPCC Categories

- 1 - Energy
 - 1.A - Fuel Combustion Activities
 - 1.A.1 - Energy Industries
 - 1.A.1.a - Main Activity Electricity and Heat Production
 - 1.A.1.b - Petroleum Refining
 - 1.A.1.c - Manufacture of Solid Fuels
 - 1.A.1.c.i - Manufacture of Solid Fuels in Blast Furnaces
 - 1.A.1.c.ii - Other Energy Industries
 - 1.A.2 - Manufacturing Industries and Construction
 - 1.A.3 - Transport
 - 1.A.3.a - Civil Aviation
 - 1.A.3.b - Road Transportation
 - 1.A.3.c - Railways
 - 1.A.3.d - Water-borne Navigation
 - 1.A.3.e - Other Transportation
 - 1.A.3.e.i - Pipeline Transportation
 - 1.A.3.e.ii - Off-road
 - 1.A.4 - Other Sectors
 - 1.A.5 - Non-Specified
 - 1.B - Fugitive emissions from fuels
 - 1.B.1 - Solid Fuels
 - 1.B.2 - Oil and Natural Gas
 - 1.B.3 - Other emissions from Energy Conversion
 - 1.C - Carbon dioxide Transport and Storage

2006 IPCC Guidelines

Fuel Combustion Activities

Worksheet: Energy
 Sector: Fuel Combustion Activities
 Category: 1.A.1.b - Petroleum Refining
 Subcategory: CO2, CH4 and N2O from fuel combustion by source categories - Tier 1
 Sheet:

Data

Fuel Type: (All fuels)

Conversion Factor Type: NCV GCV

Fuel	Energy Consumption			CO2		CH4		N2O		
	A Consumption (Mass, Volume or Energy Unit)	B Conversion Factor (TJ/Unit) (NCV)	C Consumption (TJ) (C=A*B)	D CO2 Emission Factor (kg CO2/TJ)	Z Amount Captured (Gg CO2)	E CO2 Emission s (Gg CO2) E=C*D/1 0^6-Z	F CH4 Emission Factor (kg CH4/TJ)	G CH4 Emissions (Gg CH4) G=C*F/10 ^6	H N2O Emission Factor (kg N2O/TJ)	I N2O Emissions (Gg N2O) I=C*H/10^ 6
Crude Oil	Gg		0			0		0		0
Orimulsion			0			0		0		0
Natural Gas Liquids										
Motor Gasoline										
Aviation Gasoline										
Jet Gasoline										
Jet Kerosene										
Other Kerosene										

Time Series data entry... Delete selected rows...

Worksheet remarks

1.A.1.b - Time Series

CARBON DIOXIDE (CO2) Emissions (Gg CO2 Equivalents)

* Base year for assessment of uncertainty in trend: 1990

Gas: CARBON DIOXIDE (CO2)

Country/Territory: Georgia | Inventory Year: 1990 | Base year for assessment of uncertainty in trend: 1990 | CO2 Equivalents: SAR GWPs (100 year time horizon) | Database file: (C:\ProgramData\IPCC2006Software\ipcc2006_blank_v270.mdb)

Methodological approaches

Sectoral approach - bottom-up methodology

Tier 1 (default)

Default calorific values, default emission factors

Tier 2 (country-specific)

Country-specific factors

Tier 3 (technology-specific, measurements)

Combustion technology, operating conditions, control technology, quality of maintenance, age of the equipment, equipment-specific EFs (measurements)

Reference approach - top-down approach, first-order estimate of CO₂ emissions, verification cross-check for Sectoral approach outcomes

Reporting

- **Short Summary** – all sectors, leveled on the first categories (1.A, 1.B,...)
- **Summary** – all sectors, breakdown on subsector level (1.A.1, 1.A.3,...)
- **Energy Sectoral Tables** – only sectoral emissions, lowest level of detail (1.A.3.b.ii.1)
- **Energy Background Tables** – sectoral activity data, lowest level of detail, sectoral emissions divided by fuel type, Reference approach results

The screenshot shows the IPCC Inventory Software interface. The 'Reports' menu is open, showing options for 'Summary', 'Short Summary', 'Energy', 'IPPU', 'AFOLU', 'Waste', and 'Table 7a - Uncertainties'. The 'Energy' option is selected, and a sub-menu is open showing 'Sectoral' and 'Background'. The 'Sectoral' option is selected. The main window displays a data table for the year 1990, with columns for Biomass, Energy consumption, CO2, CH4, and N2O. The table shows zero values for all categories.

Biomass		Energy consumption			CO ₂		CH ₄		N ₂ O	
Fuel	A Consumption (Mass, Volume or Energy Unit)	B Conversion Factor (TJ/Unit) (NCV)	C Consumption (TJ) (C=A*B)	D CO ₂ Emission Factor (kg CO ₂ /TJ)	Z Amount Captured (Gg CO ₂)	E CO ₂ Emissions (Gg CO ₂) E=C*D/10 ⁶ 6-Z	F CH ₄ Emission Factor (kg CH ₄ /TJ)	G CH ₄ Emissions (Gg CH ₄) G=C*F/10 ⁶ 6	H N ₂ O Emission Factor (kg N ₂ O/TJ)	I N ₂ O Emissions (Gg N ₂ O) I=C*H/10 ⁶
Total			0			0		0		0

Activity data sources

National sources

- Energy balance
- Statistical reports
- Utility providers' reports
- Customs services report
- Surveys

International sources

- International Energy Agency
- UN Stat

Data units

- Consumption data can be presented in physical (Gg, m3) and/or energy units (TJ)
- Default calorific values are provided in Table 1.2 of Volume 2: Energy, 2006 IPCC Guidelines for National Greenhouse Gas Inventories

IPCC Inventory Software - user - [Worksheets]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

2006 IPCC Categories

Fuel Combustion Activities

Worksheet

Sector: Energy

Category: Fuel Combustion Activities

Subcategory: 1.A.1.a.i - Electricity Generation

Sheet: CO2, CH4 and N2O from fuel combustion by source categories - Tier 1

Data

Fuel Type (All fuels)

Conversion Factor Type NCV GCV

(All fuels)	Energy Consumption			CO2			CH4		N2O				
Fuel	A Consumption (Mass, Volume or Energy Unit)	B Conversion Factor (TJ/Unit) (NCV)	C Consumption (TJ) (C=A*B)	D CO2 Emission Factor (kg CO2/TJ)	Z Amount Captured (Gg CO2)	E CO2 Emissions (Gg CO2) E=C*D/10 ⁶ 6-Z	F CH4 Emission Factor (kg CH4/TJ)	G CH4 Emissions (Gg CH4) G=C*F/10 ⁶ 6	H N2O Emission Factor (kg N2O/TJ)	I N2O Emissions (Gg N2O) I=C*H/10 ⁶			
Crude Oil	100	TJ	1	73300		7.33	3	0.0003	0.6	0.000			
Crude Oil	100	Gg	42.3	73300		310.0	3	0.012	0.6	0.002			
*		Gg											
Total			4330			317.389		0.01299		0.00254			

1.A - Fuel combustion

Sectoral approach - Tier 1

Default CO₂ emission factors assume that 100% of the fuel carbon is oxidized to CO₂

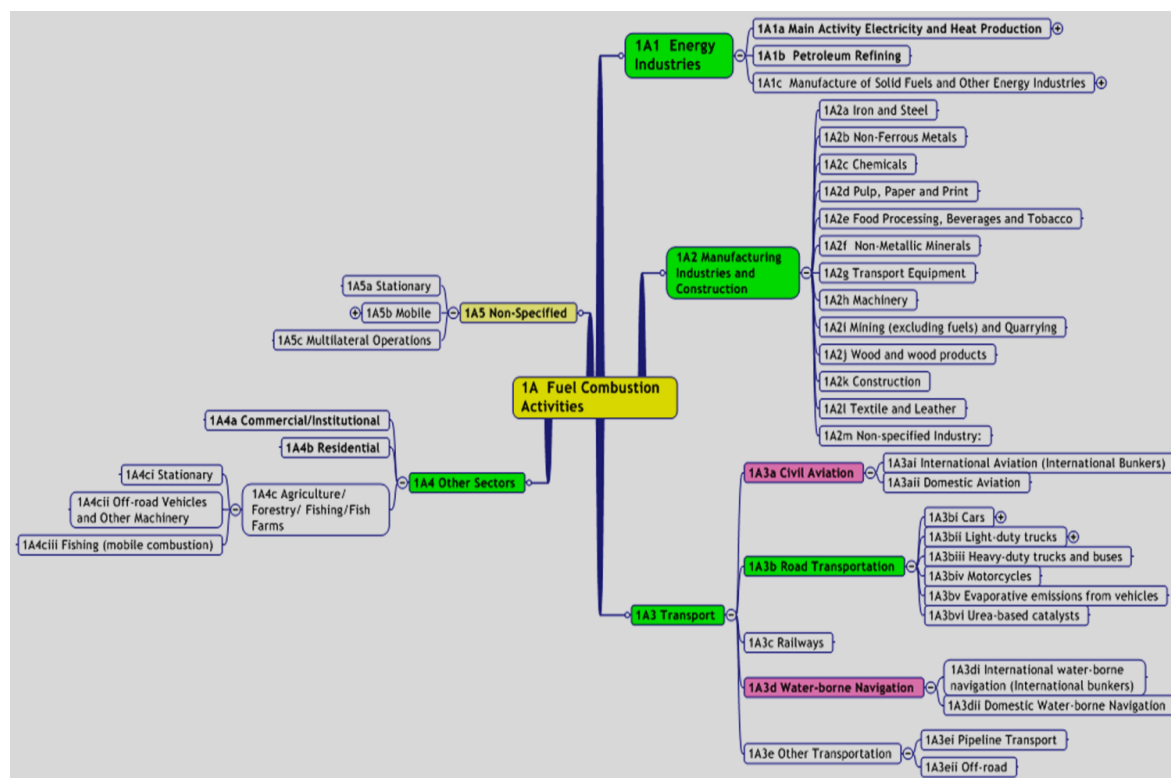
Sectoral approach - Tier 2

Country-specific emission factors

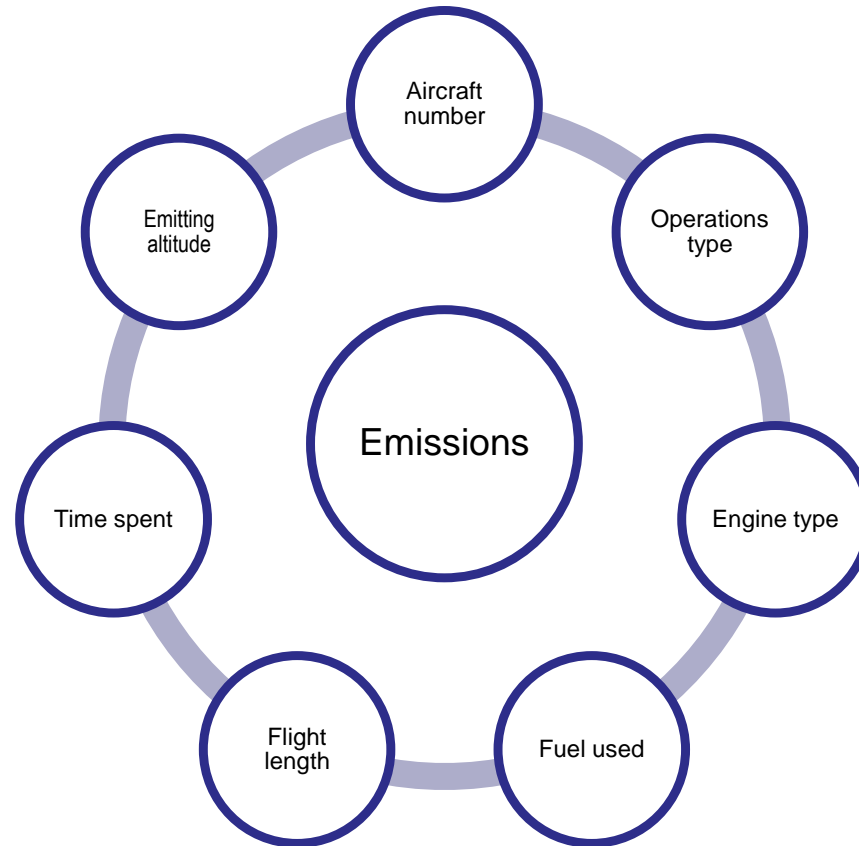
EQUATION 2.1

GREENHOUSE GAS EMISSIONS FROM STATIONARY COMBUSTION

$$\text{Emissions}_{GHG, fuel} = \text{Fuel Consumption}_{fuel} \cdot \text{Emission Factor}_{GHG, fuel}$$



Aviation



Aircraft operations

- Landing/Take-Off (LTO) cycle
- Cruise (around 90% of emissions)

Aviation

Tier 1

Total fuel consumed during all the operations

EQUATION 3.6.1

(AVIATION EQUATION 1)

Emissions = Fuel Consumption • Emission Factor

Tier 2

Breakdown by operations

Total Emissions = Emissions(LTO) + Emissions(Cruise)

$$E_{LTO} = N_{LTO} * EF_{LTO}$$

$$E_{cruise} = (F_{total} - F_{LTO}) * EF_{cruise}$$

Aviation

IPCC Inventory Software - user - [Worksheets]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

2006 IPCC Categories

- 1.A. 1.A.2.a - Iron and Steel
- 1.A. 1.A.2.b - Non-Ferrous Metals
- 1.A. 1.A.2.c - Chemicals
- 1.A. 1.A.2.d - Pulp, Paper and Print
- 1.A. 1.A.2.e - Food Processing, Beverage
- 1.A. 1.A.2.f - Non-Metallic Minerals
- 1.A. 1.A.2.g - Transport Equipment
- 1.A. 1.A.2.h - Machinery
- 1.A. 1.A.2.i - Mining (excluding fuels)
- 1.A. 1.A.2.j - Wood and wood product
- 1.A. 1.A.2.k - Construction
- 1.A. 1.A.2.l - Textile and Leather
- 1.A. 1.A.2.m - Non-specified Industry
- 1.A.3 - Transport
 - 1.A.3.a - Civil Aviation
 - 1.A.3.a.i - International Aviation
 - 1.A.3.a.ii - Domestic Aviation
 - 1.A.3.b - Road Transportation
 - 1.A.3.b.i - Cars
 - 1.A.3.b.i.1 - Passenger cars
 - 1.A.3.b.i.2 - Passenger cars
 - 1.A.3.b.ii - Light-duty trucks
 - 1.A.3.b.ii.1 - Light-duty trucks
 - 1.A.3.b.ii.2 - Light-duty trucks
 - 1.A.3.b.iii - Heavy-duty trucks

Tier 2

LTO Fuel consumption and LTO emissions - Tier 2 Cruise emissions - Tier 2 Emissions from use of other fuels

Worksheet

Sector: Energy

Category: Fuel Combustion Activities

Subcategory: 1.A.3.a.ii - Domestic Aviation

Sheet: Cruise emissions - Tier 2

Data

Gas: CARBON DIOXIDE (CO2)

Fuel	Number of LTOs	Fuel consumption for LTO (kg)	Conversion Factor (TJ/kg)	Fuel consumption for LTO (TJ)	Total Fuel Consumption (TJ)	Fuel Consumption for Cruise (TJ)	Emission Factor for Cruise (kg/TJ)	Cruise Emissions (Gg)	LTO Emissions (Gg)	Total Emissions (Gg)
Jet Ga...	1000	3210000	0.00004	142.203	300	157.797	69300	10.93533	10.14	21.07533
Total	1000	3210000		142.203	300	157.797		10.93533	10.14	21.07533

Time Series data entry...

Worksheet remarks

1.A.3.a.ii - Time Series

* Base year for assessment of uncertainty in trend: 1990

Gas: CARBON DIOXIDE (CO2)

Country/Territory: Georgia | Inventory Year: 1990 | Base year for assessment of uncertainty in trend: 1990 | CO2 Equivalents: SAR GWPs (100 year time horizon) | Database file: (C:\ProgramData\IPCC2006Software\ipcc2006_blank_v270.mdb)

International bunker

Aviation and water-borne navigation

Domestic

- depart and arrive in the same country
- emissions from these activities are reported in the national total

International

- depart in one country and arrive in a different country
- international aviation and water-borne navigation emissions are reported separately from domestic, and **not** included in the national total

Biomass

- CO₂ emissions from biomass burning for energy purposes are not included in the sectoral or national total, instead they are reported separately as an *information item*.
- Non-CO₂ emissions from biomass burning for energy purposes should be reported in the sectoral and national total

IPCC Inventory Software - user - [Energy Sectoral Table]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

Table 1 Energy Sectoral Table Memo and Information Items

Categories	Emissions (Gg)						
	CO2	CH4	N2O	NOx	CO	NMVOcs	SO2
1 - Energy	0.000	0.035	0.005	0.000	0.000	0.000	0.000
1.A - Fuel Combustion Activities	0.000	0.035	0.005	0.000	0.000	0.000	0.000
1.A.1 IPCC Inventory Software - user - [Energy Sectoral Table]	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Table 1 Energy Sectoral Table Memo and Information Items	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Categories	CO2	CH4	N2O	NOx	CO	NMVOcs	SO2
1.A.1 Memo Items (3)							
1.A.1 International Bunkers				0.000	0.000	0.000	0.000
1.A.1 1.A.3.a.i - International Aviation (International Bunkers) (1)				0.000	0.000	0.000	0.000
1.A.1 1.A.3.d.i - International water-borne navigation (International bunkers) (1)				0.000	0.000	0.000	0.000
1.A.1 1.A.5.c - Multilateral Operations (1)(2)				0.000	0.000	0.000	0.000
1.A.1 Information Items							
1.A.1 CO2 from Biomass Combustion for Energy Production	116.000						
1.A.1 1.A.2.e - Food Processing, Beverages and Tobacco					0.000	0.000	0.000
1.A.1 1.A.2.f - Non-Metallic Minerals					0.000	0.000	0.000
1.A.1 1.A.2.g - Transport Equipment					0.000	0.000	0.000

Number of decimal places: 3 Zero padding

Version Factor Type: N2O

H	I
CO Emission Factor (g N2O/TJ)	N2O Emissions (Gg N2O) I=C*H/10 ⁶
4	0.00...
	0.00464

Reference approach

- Reference Approach is a top-down approach using a country's energy supply data to calculate the emissions of CO₂ from fuel combustion
- Easily available energy supply statistics
- Comparison with the sectoral approach results

EQUATION 6.1

CO₂ EMISSIONS FROM FUEL COMBUSTION USING THE REFERENCE APPROACH

$$CO_2 \text{ Emissions} = \sum_{\text{all fuels}} \left[\left(\text{Apparent Consumption}_{\text{fuel}} \cdot \text{Conv Factor}_{\text{fuel}} \cdot CC_{\text{fuel}} \right) \cdot 10^{-3} \right. \\ \left. - \text{Excluded Carbon}_{\text{fuel}} \right) \cdot COF_{\text{fuel}} \cdot 44/12$$

Primary fuels

Apparent consumption = Production + Import - Export - International bunker - Stock change

Apparent consumption of crude oil already contains the carbon from which gasoline would be refined

Stocks increase → positive stock change

Excluded Carbon - carbon in feedstocks and non-energy use

Reference approach

IPCC Inventory Software - user - [1.A - Reference Approach]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

Reference Approach Data Estimating Excluded Carbon Comparison

Sector: Energy
 Category: IPCC Inventory Software - user - [1.A - Reference Approach]
 Category code: 1.A
 Sheet: 1 of 1 - Comparison of CO2 Emissions from Fuel Combustion

Fuel Types	Reference Approach				Sectoral Approach		Difference	
	Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO2 Emissions (Gg)	Energy Consumption (TJ)	CO2 Emissions (Gg)	Energy Consumption (%)	CO2 Emissions (%)
Liquid Fuels: 22 item(s)	300	0	300	19.305	300	21.45	0	-10
Solid Fuels: 11 item(s)	0	0	0	0	0	0	0	0
Gaseous Fuels: 1 item(s)	0	0	0	0	0	0	0	0
Other Fossil Fuels: 3 item(s)	0	0	0	0	0	0	0	0
Peat: 1 item(s)	0	0	0	0	0	0	0	0
Total	300	0	300	19.305	300	21.45	0	-10

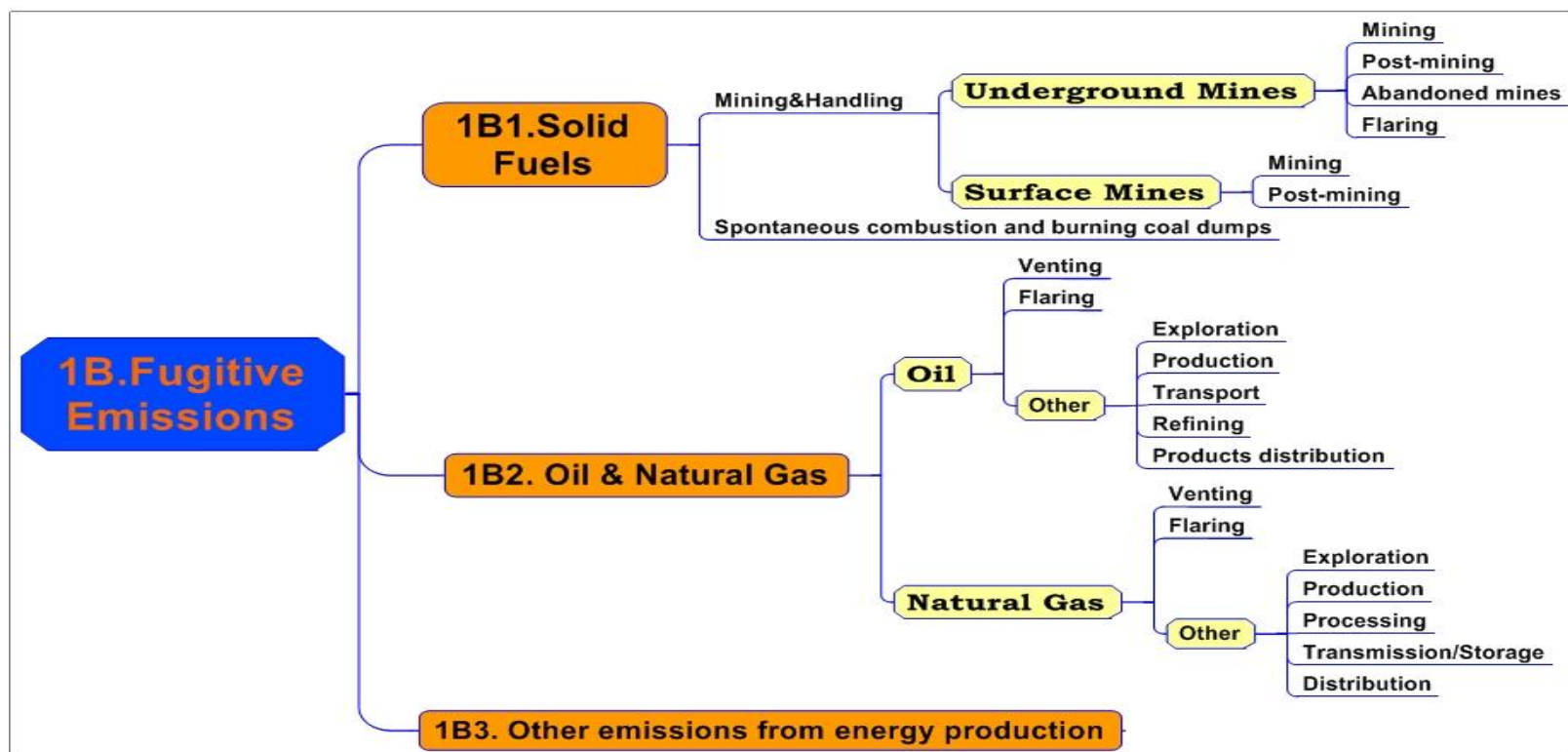
Export to Excel Import from Excel

Country/Territory: Georgia Inventory Year: 1990 Base year for assessment of uncertainty in trend: 1990 CO2 Equivalents: SAR GWPs (100 year time horizon) Database file: (C:\ProgramData\IPCC2006Software\ipcc2006_blank_v270.mdb)



1.B - Fugitive emissions

Intentional or unintentional release of greenhouse gases during the extraction, processing and delivery of fossil fuels to the point of final use



1.B - Fugitive emissions

IPCC Inventory Software - user - [Worksheets]

Application Database Inventory Year Worksheets Reports Tools Export/Import Administrate Window Help

2006 IPCC Categories

Oil and Natural Gas

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil and Natural Gas

Subcategory: 1.B.2.a.ii.4 - Transmission and Storage

Sheet: CO2, CH4 and N2O from fugitive emissions from fuels by source categories - Tier 1

1990

Industry Segment	Subcategory	Activity	Unit for AD	CO2		CH4		Emission Source	
				Emission Factor (Gg CO2/Unit for AD)	CO2 Emissions (Gg CO2)	Emission Factor (Gg CH4/Unit for AD)	CH4 Emissions (Gg CH4)		
					C=A*B		E=A*D		
* Gas Transmission & S...	Transmission	1000	10 ⁶ Sm ³	0	0.00144	0.000633	0.273		
				Country/Territory	Value	Unit	Lower limit	Upper limit	Emission Source
Total				Developed Countries	0.000273	Gg per 10 ⁶ m ³ ...	0	0.000546	Fugitives
				Developing/Transition Countries	0.000633	Gg per 10 ⁶ m ³ ...	0.0003798	0.002155	Fugitives

Uncertainties Time Series data entry... Delete selected rows...

Worksheet remarks

B.2.b.iii.4 - Time Series

* Base year for assessment of uncertainty in trend: 1990

Gas CARBON DIOXIDE (CO2)

Country/Territory: Gec Country/Territory: Georgia Inventory Year: 1990 Base year for assessment of uncertainty in trend: 1990 CO2 Equivalents: SAR GWPs (100 year time horizon) Database file: (C:\ProgramData\IPCC2006Software\ipcc2006_blank_v270.mdb)

1.C - CO2 Transport, Injection and Geological Storage

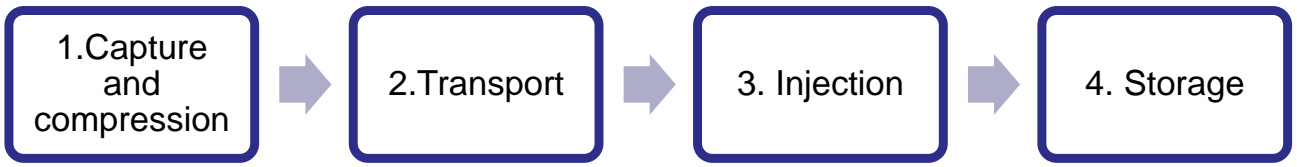
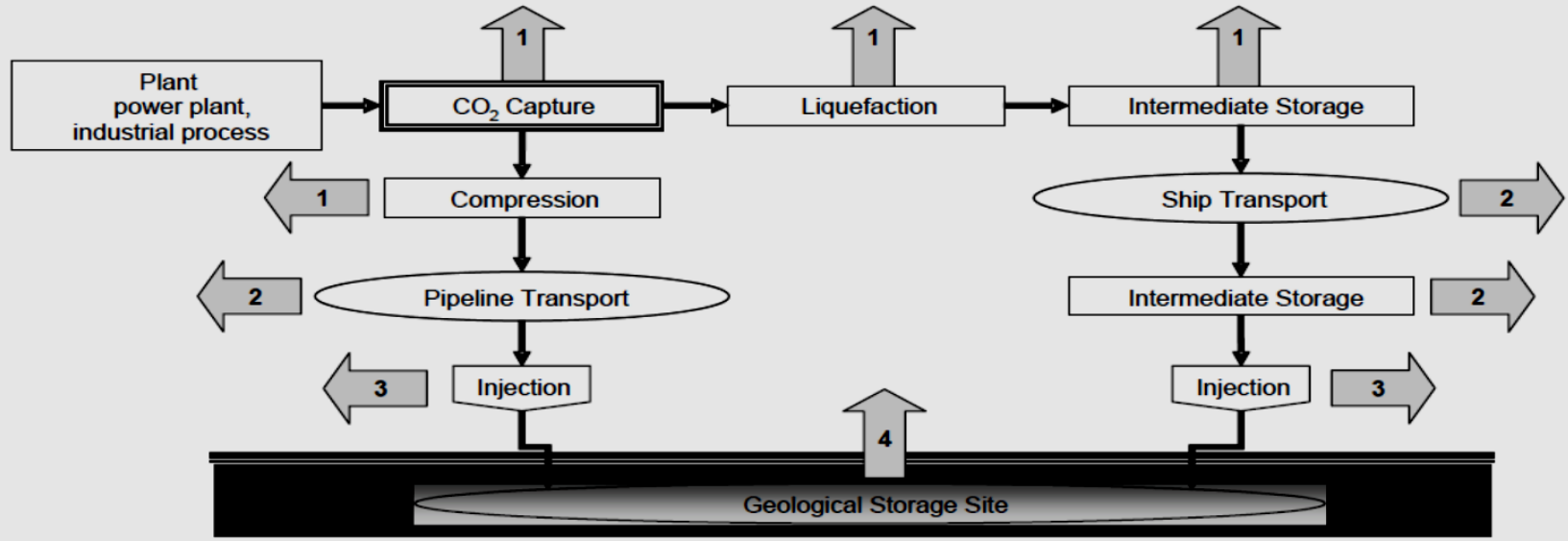


Figure 5.1 Schematic representation of the carbon capture and storage process with numbering linked to systems discussion above.



Capture + Imports = Injection + Leakage + Exports

Practical Exercises

1. Tier 1. Sectoral approach - Stationary combustion
2. Tier 1. Sectoral approach – Mobile combustion
3. Reference Approach
4. Tier 2. Sectoral approach - Stationary combustion
5. Tier 2. Sectoral approach – Mobile combustion (Aviation)

Thank you!

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