GHG Inventory – Fugitive Emissions

Training on 2006 IPCC Guidelines for preparing National GHG Inventory:

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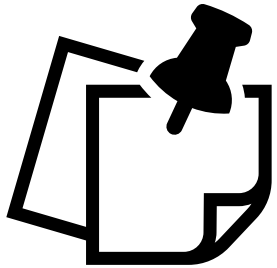
Organized by the Capacity Building Initiative for Transparency
Global Support Programme (CBIT-GSP)



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Reference: UNFCCC CGE Training material

Energy Sector: Scope

1. **Exploration and exploitation of primary energy sources**

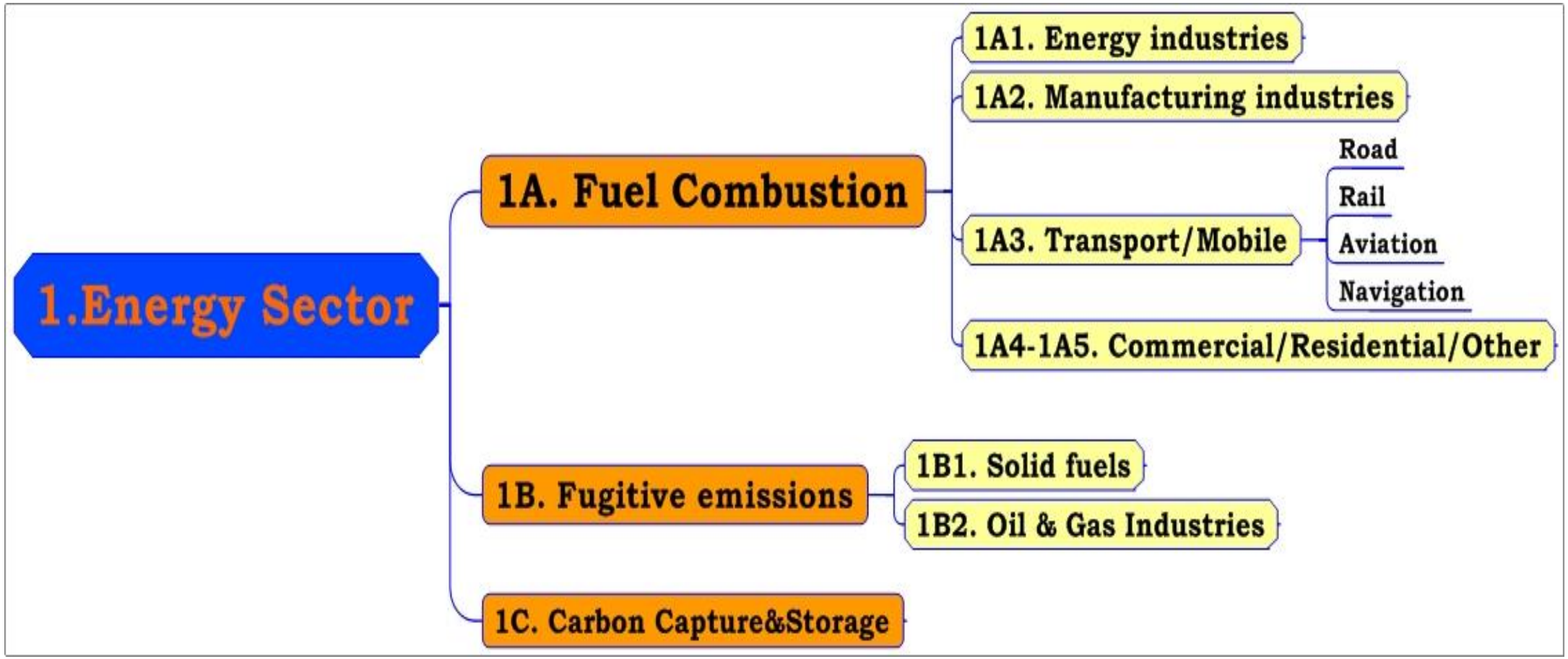
2. **Conversion of primary energy sources into more useable energy forms in refineries and power plants**

3. **Transmission and distribution of fuels**

4. **Use of fuels in stationary and mobile applications**

Reference: UNFCCC CGE Training material

Energy Sector

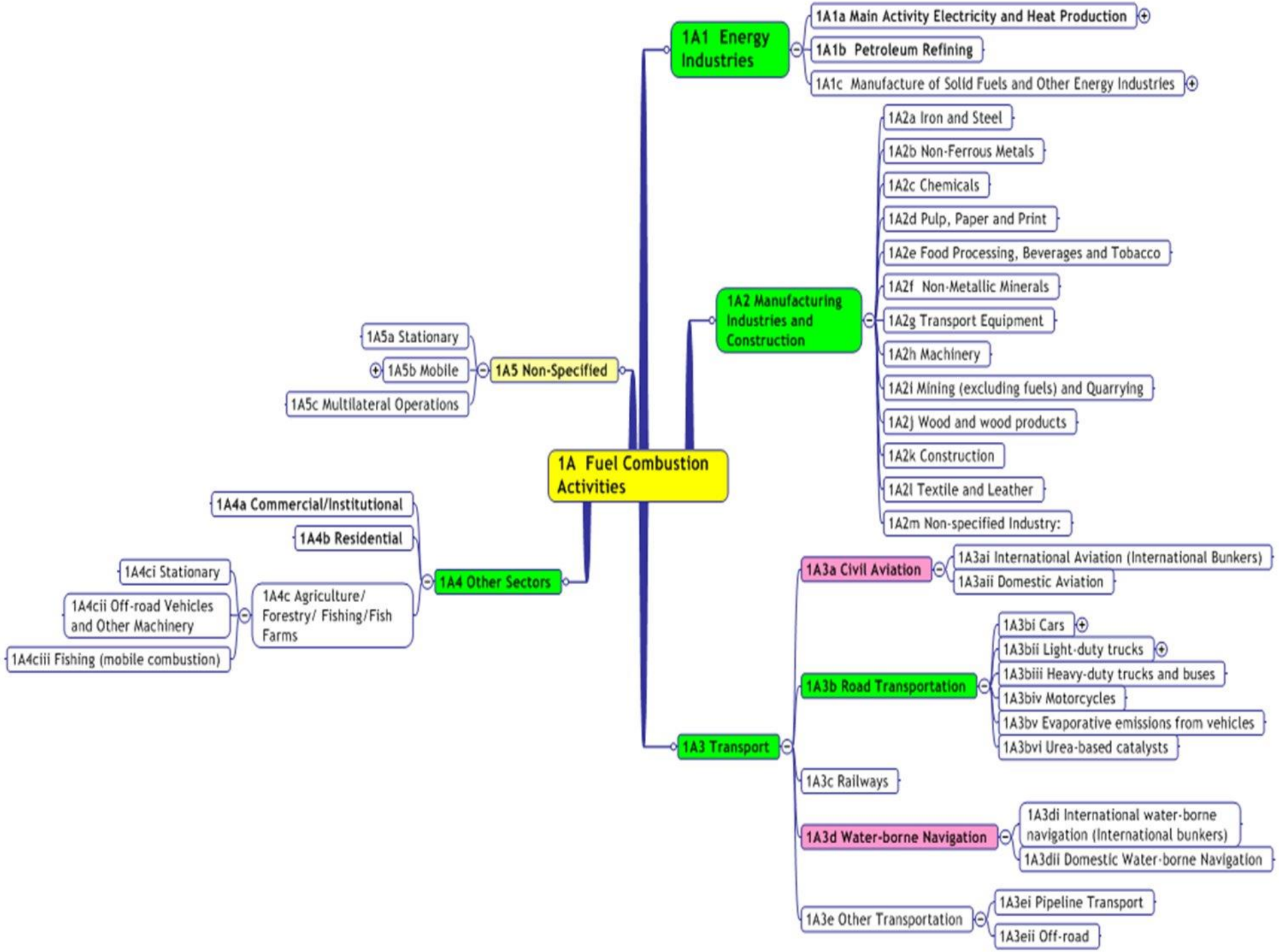


Reference: UNFCCC CGE Training material

Total GHG emissions–2010 in the Philippines (Million tons of CO_2e)

	CO_2	CH_4	N_2O	HFCs	Total
Energy	50.698	1.888	0.519	-	53.105
Agriculture	0.696	33.853	8.604	-	43.152
Transport	23.718	0.125	0.331	-	24.174
Waste	0.015	14.527	1.017	-	15.559
IPPU	7.564	0.009	0.019	0.771	8.363
FOLU	(37.016)	0.007	0.002	-	(37.007)
	TOTAL				107.345

GHG Inventory Report-2010 Philippines


1A Fuel Combustion Activities
1A1 Energy Industries
1A1a Main Activity Electricity and Heat Production
1A1b Petroleum Refining
1A1c Manufacture of Solid Fuels and Other Energy Industries
1A2 Manufacturing Industries and Construction
1A2a Iron and Steel
1A2b Non-Ferrous Metals
1A2c Chemicals
1A2d Pulp, Paper and Print
1A2e Food Processing, Beverages and Tobacco
1A2f Non-Metallic Minerals
1A2g Transport Equipment
1A2h Machinery
1A2i Mining (excluding fuels) and Quarrying
1A2j Wood and wood products
1A2k Construction
1A2l Textile and Leather
1A2m Non-specified Industry:
1A3 Transport
1A3a Civil Aviation
1A3ai International Aviation (International Bunkers)
1A3aii Domestic Aviation
1A3b Road Transportation
1A3bi Cars
1A3bii Light-duty trucks
1A3biii Heavy-duty trucks and buses
1A3biv Motorcycles
1A3bv Evaporative emissions from vehicles
1A3bvi Urea-based catalysts
1A3c Railways
1A3d Water-borne Navigation
1A3di International water-borne navigation (International bunkers)
1A3dii Domestic Water-borne Navigation
1A3e Other Transportation
1A3ei Pipeline Transport
1A3eii Off-road
1A4 Other Sectors
1A4a Commercial/Institutional
1A4b Residential
1A4c Agriculture/ Forestry/ Fishing/Fish Farms
1A4ci Stationary
1A4cii Off-road Vehicles and Other Machinery
1A4ciii Fishing (mobile combustion)
1A5 Non-Specified
1A5a Stationary
1A5b Mobile
1A5c Multilateral Operations

1A. Fuel Combustion

For inventory purposes, *fuel combustion* may be defined as the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus

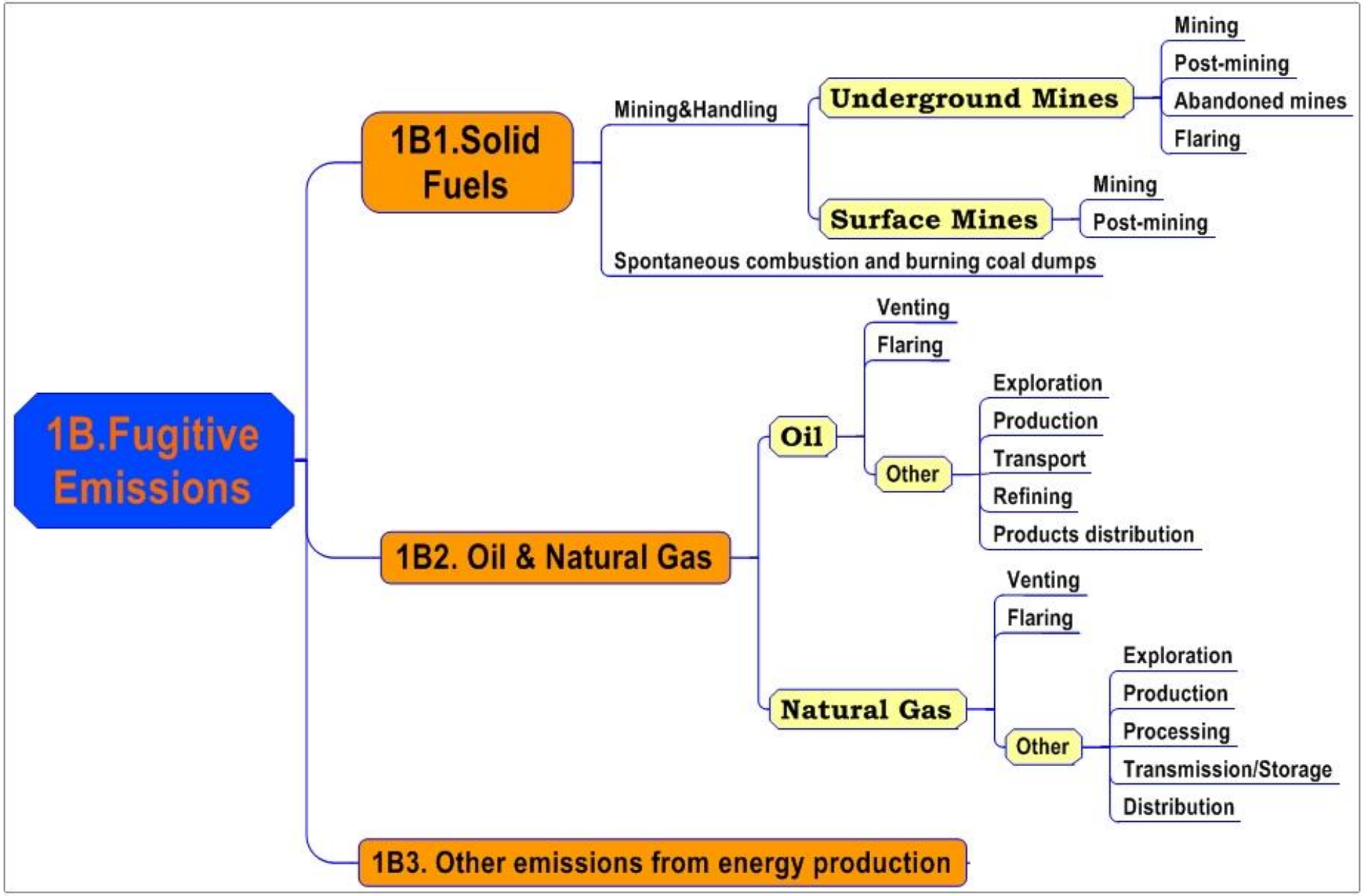
✓ ***Not* Energy Sector:**

- **waste incineration without energy recovery → Waste**
- **use of fossil fuels as a feedstock in the Industrial Sector** (e.g., coke in Iron&Steel) → **IPPU**
- **biomass fires/open burning → AFOLU**

✓ ***Coal mines fires, Gas flaring are in Fugitive Emissions***

Reference: UNFCCC CGE Training material

1B. Fugitive Emissions



1B. Fugitive Emissions

Fugitive emissions **are emissions of gases or vapour from equipment due to leaks and other unintended or irregular releases of gases, mostly from activities associated with the production and distribution of fossil fuels. It includes leaks from pressurised equipment, evaporation and displacement of vapour, and accidental releases**

- **Significant CH_4 emissions from:**
  - Coal mines
  - Refinery leaks
  - Gas distribution pipelines

- **Simple Emission Factor methods at Tier 1. Higher Tiers need more details on technologies and age of plant/mines etc.**

Reference: UNFCCC CGE Training material

Coal Mines

CH_4 is the major GHG emitted from coal mining and handling. CO_2 may also be present in some coal seams. The major stages for the GHG emissions for both underground and surface coal mines are:

- Mining emissions - gas liberated by fracturing coal during mining. This may be collected (for safety) and flared or used for energy. Emission can continue after mine closure
- Post-mining emissions - emissions during processing, handling and distribution
- Low temperature oxidation - coal slowly oxidises to CO_2 when exposed to the air
- Uncontrolled combustion - oxidation may lead to an active fire in coal storage or exposed coal seams with a rapid CO_2 formation. This can occur naturally

✓ ***Simple emission factors are provided for Tier 1, country-specific data is required for better estimates***

Reference: UNFCCC CGE Training material

Oil and Gas

- **Oil & Gas fugitive emissions include all emissions from oil and gas systems <u>except</u> those for the use of oil and gas for energy purpose or as a feedstock**

- **It covers everything from an oil well to a consumer:**
  - Exploration and Production
  - Processing and Refining
  - Distribution and Delivery

- **Includes equipment leaks, evaporation loses, venting, flaring and accidental releases**

Reference: UNFCCC CGE Training material

Oil and Gas. Fugitive GHGs

- **CO_2 may be contained in the oil or gas as extracted from the reservoir**
- **CH_4 can be released directly** (e.g. leaks of natural gas)
- **CO_2, CH_4 and N_2O can also be formed in non-useful energy combustion** (e.g. flaring)
- **General Tier 1 EFs** (for developing and developed countries) **are available**
- **At higher tiers detailed knowledge of the system is needed. Country-specific EFs will need to be developed based on measurements**

Reference: UNFCCC CGE Training material

Oil and Gas. AD and EFs

Tier 1:

- **The available Tier 1 default EFs are presented in the 2006 IPCC Guidelines. All of the presented EFs are expressed in units of mass emissions per unit volume of oil or gas throughput**

- **While some types of fugitive emissions correlate poorly with, or are unrelated to, throughput on an individual source basis (e.g., fugitive equipment leaks), the correlations with throughput become more reasonable when large populations of sources are considered**

- **Furthermore, throughput statistics are the most consistently available AD for use in Tier 1 calculations**

Reference: UNFCCC CGE Training material

Oil and Gas. Default EFs

TABLE 4.2.5
TIER 1 EMISSION FACTORS FOR FUGITIVE EMISSIONS (INCLUDING VENTING AND FLARING) FROM OIL AND GAS OPERATIONS IN DEVELOPING COUNTRIES AND COUNTRIES WITH ECONOMIES IN TRANSITION[a,b]

Category	Sub-category[c]	Emission source	IPCC Code	CH_4		CO_2[i]		NMVOC		N_2O		Units of measure
				Value	Uncertainty (% of value)	Value	Uncertainty (% of value)	Value	Uncertainty (% of Value)	Value	Uncertainty (% of value)	
Well Drilling	All	Flaring and Venting	1.B.2.a.ii or 1.B.2.b.ii	3.3E-05 to 5.6E-04	-12.5 to +800%	1.0E-04 to 1.7E-03	-12.5 to +800%	8.7E-07 to 1.5E-05	-12.5 to +800%	ND	ND	Gg per 10^3 m^3 total oil production
Well Testing	All	Flaring and Venting	1.B.2.a.ii or 1.B.2.b.ii	5.1E-05 8.5E-04	-12.5 to +800%	9.0E-03 to 1.5E-01	-12.5 to +800%	1.2E-05 to 2.0E-04	-12.5 to +800%	6.8E-08 to 1.1E-06	-10 to +1000%	Gg per 10^3 m^3 total oil production
Well Servicing	All	Flaring and Venting	1.B.2.a.ii or 1.B.2.b.ii	1.1E-04 to 1.8E-03	-12.5 to + 800%	1.9E-06 to 3.2E-05	-12.5 to +800%	1.7E-05 to 2.8E-04	-12.5 to +800%	ND	ND	Gg per 10^3 m^3 total oil production
Gas Production	All	Fugitives[d]	1.B.2.b.iii.2	3.8E-04 to 2.4E-02	-40 to +250%	1.4E-05 to 1.8E-04	-40 to +250%	9.1E-05 to 1.2E-03	-40 to +250%	NA	NA	Gg per 10^6 m^3 gas production
		Flaring[e]	1.B.2.b.ii	7.6E-07 to 1.0E-06	±75%	1.2E-03 to 1.6E-03	±75%	6.2E-07 to 8.5E-07	±75%	2.1E-08 to 2.9E-08	-10 to +1000%	Gg per 10^6 m^3 gas production
Gas Processing	Sweet Gas Plants	Fugitives	1.B.2.b.iii.3	4.8E-04 to 1.1E-03	-40 to +250%	1.5E-04 to 3.5E-04	-40 to +250%	2.2E-04 to 5.1E-04	-40 to +250%	NA	NA	Gg per 10^6 m^3 raw gas feed
		Flaring	1.B.2.b.ii	1.2E-06 to 1.6E-06	±75%	1.8E-03 to 2.5E-03	±75%	9.6E-07 to 1.3E-06	±75%	2.5E-08 to 3.4E-08	-10 to +1000%	Gg per 10^6 m^3 raw gas feed
	Sour Gas Plants	Fugitives	1.B.2.b.iii.3	9.7E-05 to 2.2E-04	-40 to +250%	7.9E-06 to 1.8E-05	-40 to +250%	6.8E-05 to 1.6E-04	-40 to +250%	NA	NA	Gg per 10^6 m^3 raw gas feed

Reference: UNFCCC CGE Training material

2. Analysis of 2006 IPCC Guidelines and 2019 Refinement

According to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, there are mainly 3 changes for fugitive emissions

For emissions from mining, processing, storage and transportation of coal, the 2019 Refinement includes guidance on emissions of carbon dioxide (CO_2) emissions from underground and surface mines

For emissions from oil and natural gas systems, the 2019 Refinement includes emission factors representative of current practice, including for unconventional oil and gas exploration, and methods and emission factors for abandoned wells.

For fuel transformation, the 2019 Refinement includes a new section on fugitive emissions from fuel transformation, including methods for fugitive emissions from charcoal production, coke production, coal to liquids and gas to liquids

3. Fugitive emissions coverage in 2006 IPCC guideline

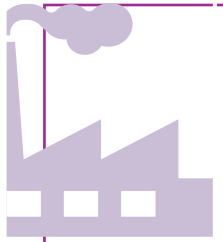
- According to the 2006 IPCC Guidelines it includes emissions from,
  - Mining, Processing, Storage and Transportation of Coal
    - Underground mining
    - Surface coal mining
    - Abandoned underground coal mining

  - Oil and Natural Gas Systems
    - Crude oil production
    - Natural gas systems

Avoiding Double Counting Activity Data With Other Sectors

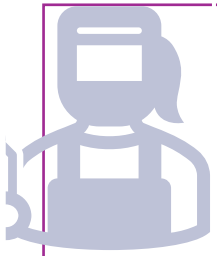
Fuel Combustion Sector:

- Use fuel combustion statistics instead of fuel delivery statistics.
- Be cautious about incomplete combustion data and potential double counting.
- Coordinate estimates between stationary source categories to avoid inaccuracies.



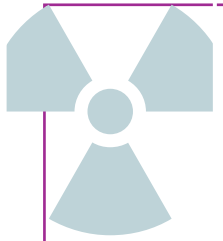
Industrial Processes and Product Use (IPPU) Sector:

- Account for emissions from synthesis gas production in IGCC under fuel combustion.
- Consider emissions from carbide production, especially when using carbon-rich fuels.



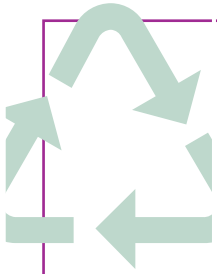
Metal Production (IPPU and AFOLU Sectors):

- Include emissions from the use of coal, coke, natural gas, and by-product fuels in metal production.
- Differentiate between fossil carbon materials and biogenic content for wood chips and charcoal.



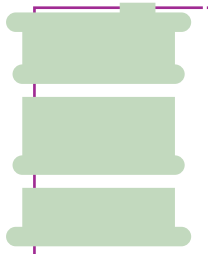
Energy and Waste Sectors:

- Ensure consistency between stationary combustion and fugitive emissions accounting for methane from coal mine waste, landfill gas, and sewage gas.
- Report emissions from waste incineration with energy recovery in the Energy sector.



Waste Sector (Incineration):

- Distinguish between waste incineration with and without energy recovery.
- Assess and differentiate between fossil-carbon and biogenic content for accurate emissions reporting.



Waste Sector (Used Oils):

- Coordinate with those recovering used oils to assess the extent of burning.
- Estimate and report emissions in the Energy sector if used oils are used as fuel.

4. Fugitive emissions in GHGI 2010

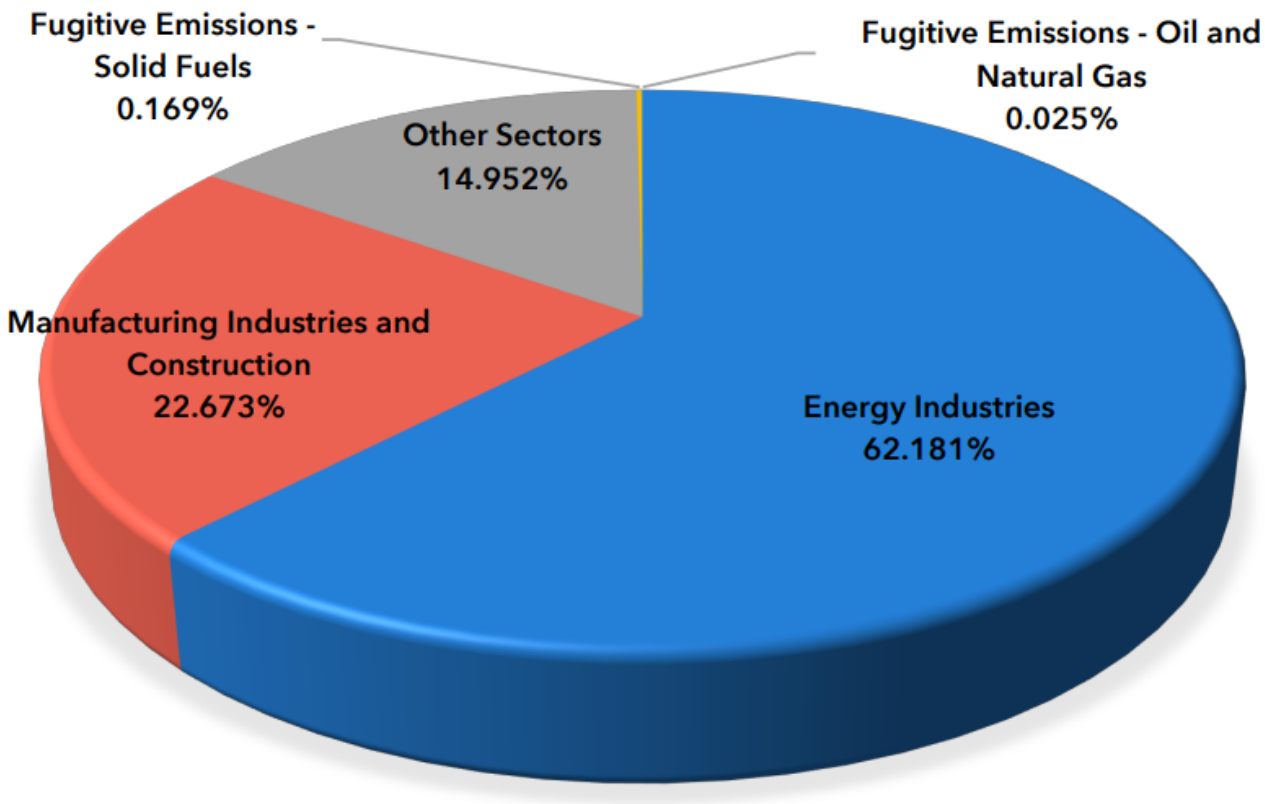
2010 Philippine Greenhouse Gas Inventory Report

Executive Summary

- In 2010, 87% of the total came from coal mining at 0.090 Mt CO_2e and the remaining 13% coming from oil and natural gas exploration at 0.013 Mt CO_2e.

	CO_2	CH_4	N_2O	Total
Energy Industries	32.803	0.049	0.168	33.020
Manufacturing Industries and Construction	11.887	0.055	0.095	12.040
Other Sectors	5.995	1.692	0.257	7.940
Fugitive Emissions – Solid Fuels	-	0.090	-	0.090
Fugitive Emissions – Oil and Natural Gas	0.012	0.001	0.000	0.013
TOTAL				*53.103*

Source : Microsoft Word - [Lay-out] 2010 National GHGI Figures ver 3.docx (climate.gov.ph)



Emission shares of energy subsectors, including fugitive emissions in 2010 national GHGI

Approaches to data collection

Institutional Sources

- ❑ Overall Energy Balance Sheet maintained by the Energy Policy Formulation and Research Division - Energy Policy and Planning Bureau.
- ❑ Coal and Mining Division - DOE
- ❑ Natural Gas Management Division - DOE
- ❑ Petroleum Resource Development Division - DOE
- ❑ Oil and Gas Division – DOE

Literature Sources

- ❑ IPCC

5. Calculation examples and exercises – Manually & using IPCC inventory tool

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES

GLOBAL AVERAGE METHOD – UNDERGROUND MINING- TIER 01

CH_4 emissions = CH_4 Emission from Underground mining+ Post-mining emission of CH_4

NOTE : If there is any CH_4 recovered and utilized for energy production or flared, it can be subtracted from the final answer to adjust the CH_4 emissions.

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES

Step 02 : Estimating the underground mining emissions of CH4 using the equation below

TIER 1: GLOBAL AVERAGE METHOD – UNDERGROUND MINES

Methane emissions = CH_4 Emission Factor * Underground Coal Production * Conversion Factor

Step 03 : Estimating the Post mining emissions of CH4 using the equation below

TIER 1: GLOBAL AVERAGE METHOD – POST MINING EMISSIONS – UNDERGROUND MINES

Methane emissions = CH_4 Emission Factor * Underground Coal Production * Conversion Factor

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES –TIER 01

A: Selection of the Emission Factor for the Underground mining emissions of CH_4

Among these 3 types of emission factors, the appropriate emission factor can be selected according to the mining depth as gas content of coal usually increases with depth.

Mining Depth	Lower limit	Upper limit	Emission factor
Low (below 200m)	5	20	10 m^3/tonne
Average(200-400m)	9	36	18 m^3/tonne
High (Above 400m)	12	50	25 m^3/tonne

Reference for the default emission factor: IPCC 2006 guidelines

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES-TIER 01

B: Selection of CH_4 Emission Factor for the Post Mining Emissions –Underground mines

Among these 3 types of emission factors, the appropriate emission factor can be selected according to the mining depth.

Mining Depth	Lower limit	Upper limit	Emission factor
Low	0.3	2.7	0.9 m^3/tonne
Average	0.8	7.5	2.5 m^3/tonne
High	1.3	12	4 m^3/tonne

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES-TIER 01

C: Getting the Activity Data (Underground Coal Production)

The activity data required for Tiers 1 are raw coal production

D: Getting the Unit Conversion Factor

- This is the density of CH_4
- It converts volume of CH_4 to mass of CH_4
- The density is taken at 20˚C and 1 atmosphere pressure

EXAMPLE OF ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 01

Parameter	Value	Source
Raw coal production	0.046 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	18 m^3 $tonne^{-1}$ (Average CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

EXAMPLE OF ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

CH4 emissions = Raw coal production * Emission Factor * Units conversion factor

CH4 emissions = 0.046 million tonnes/year * 18 m^3 $tonne^{-1}$ * 0.67 * 10^{-6} Gg m^{-3}

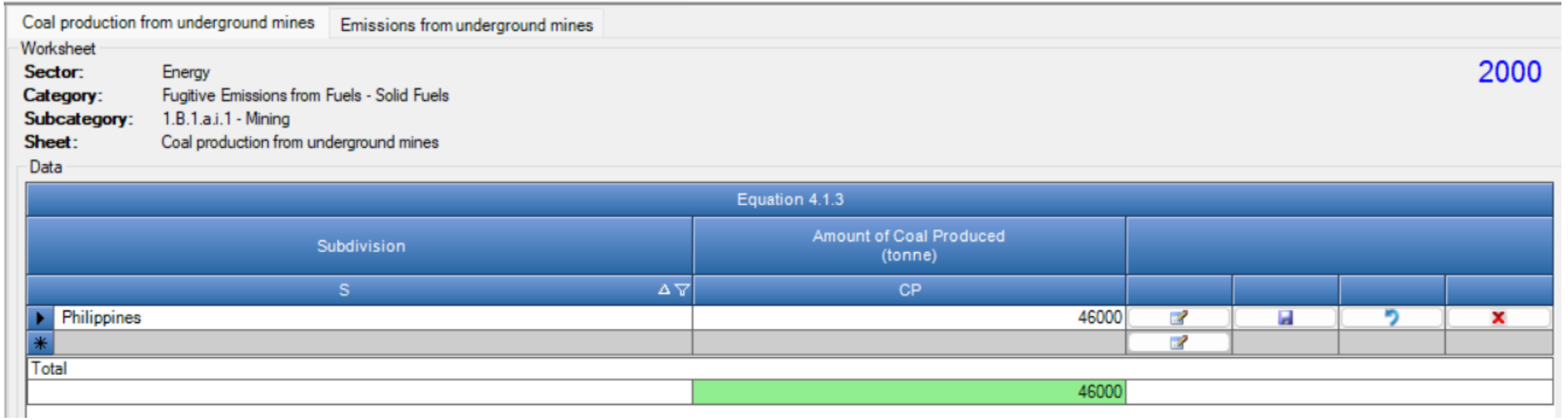
= 0.55 Gg/year

ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software and choose the required inventory year

Step 02 : Select the “1.B.1.a.i.1 – Mining” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Underground Mines”.



ESTIMATING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT.

Step 04 : Save the entries using the save icon

Step 05 : Enter the "CH_4 Emission Factor in the sheet "Emissions from underground mines". Conversion factor will be automatically entered.

Step 06 : If there is any recovered methane, add it to "Methane recovered" in the same sheet.

Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.1 - Mining

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.3

Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R
Philippines	46000	18	828000	0.00000067		0.55476
Total						
	46000		828000			0.55476

EXAMPLE OF ESTIMATING EMISSIONS FROM POST MINING OF UNDERGROUND COAL MINES FOR TIER 1

Parameter	Value	Source
Raw coal production	0.046 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	2.5 m^3 $tonne^{-1}$ (Average CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

EXAMPLE OF ESTIMATING EMISSIONS FROM POST MINING OF UNDERGROUND COAL MINES FOR TIER 1

TIER 1: GLOBAL AVERAGE METHOD – POST MINING EMISSIONS – UNDERGROUND MINES

Methane emissions = CH_4 Emission Factor * Underground Coal Production * Conversion Factor

Methane emissions = CH_4 Emission Factor * Underground Coal Production * Conversion Factor

Methane emissions = 0.046 million tonnes/year * 2.5 m^3 $tonne^{-1}$ * 0.67 * 10^{-6} Gg m^{-3}

= 0.077 Gg/year

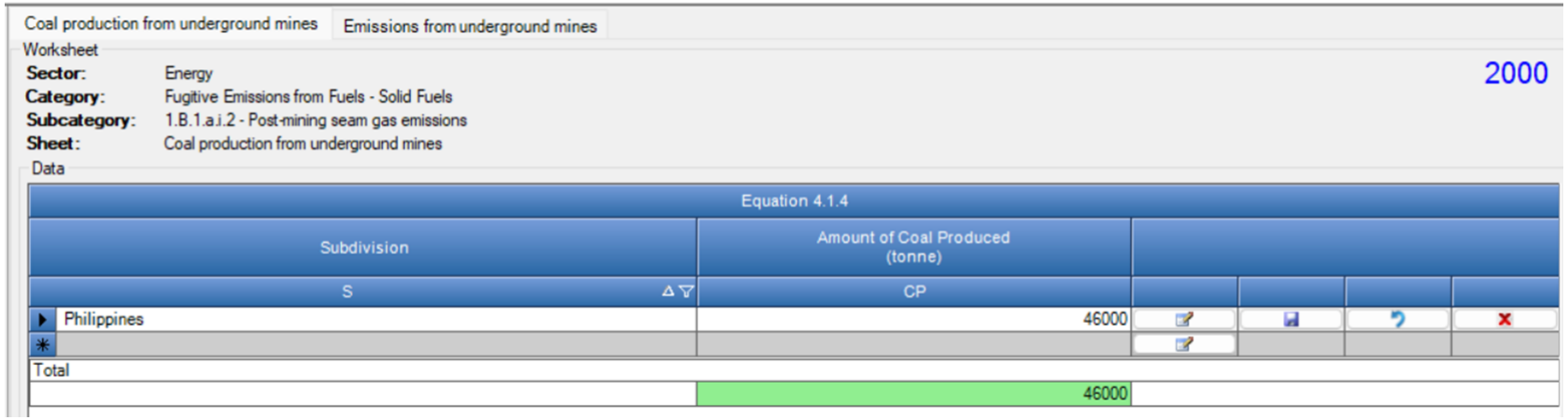
ESTIMATING POST MINING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software

step 02 : Select the “1.B.1.a.i.2 – Post Mining Seam Gas Emissions” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from underground Mines”.

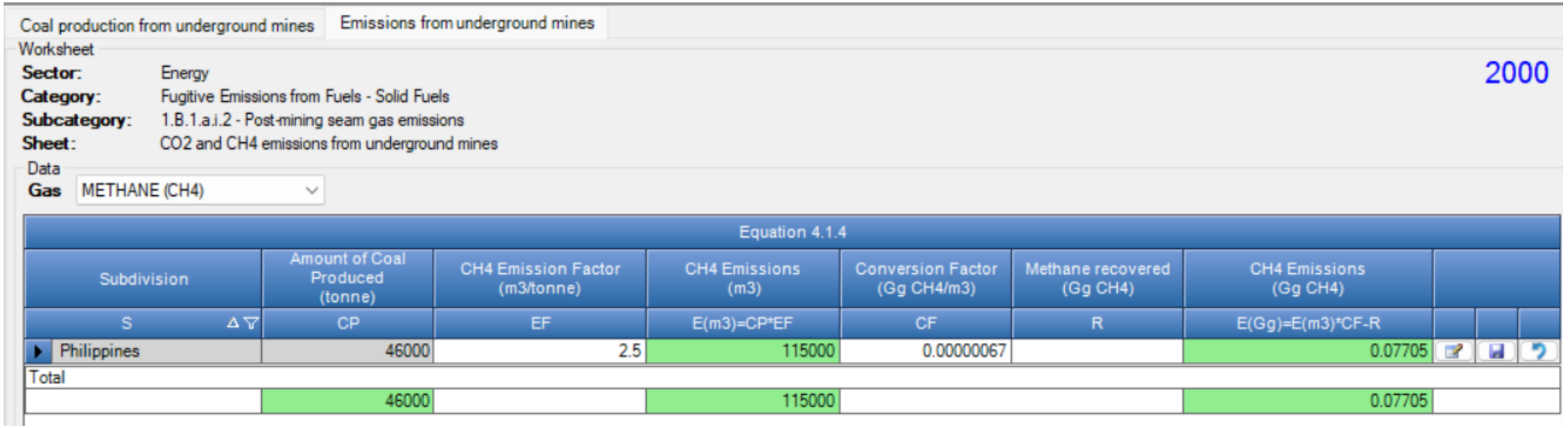
Step 04 : Save the changes using the save icon



ESTIMATING POST MINING EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT.

Step 04 : Enter the "CH_4 Emission Factor" in the sheet "Emissions from underground mines" and conversion factor will be automatically entered.

Step 05 : Enter "Methane recovered" if any.



Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.4

Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R
Philippines	46000	2.5	115000	0.00000067		0.07705
Total						
	46000		115000			0.07705

ESTIMATING TOTAL EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

GLOBAL AVERAGE METHOD – UNDERGROUND MINING

CH_4 emissions = CH_4 Emission from Underground mining+ Post-mining emission of CH_4

Methane emissions = Underground mining emissions of CH_4 + Post-mining emission of CH_4

= 0.55 Gg/year + 0.077Gg/year

= 0.627 Gg/year

NOTE : If there is any recovering of CH_4 or utilization for energy production or flaring, it should be subtracted from the final emission.
Example : If there is an assumed 0.1Gg/year recovering of CH_4 or utilization for energy production or flaring,
The adjusted CH_4 emission = 0.627 Gg/year - 0.1Gg/year
= 0.527 Gg/year

NOTE : According to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, a new section has been added to calculate the CO_2 emission from the underground mining along with emission factors.

$$CO_2 \text{ emissions} = CO_2 \text{ Emission Factor} \bullet \text{Underground Coal Production} \bullet \text{Conversion Factor}$$

Low CO_2 Emission Factor	$= 0.05\ m^3\ tonne^{-1}$
Average CO_2 Emission Factor	$= 5.9\ m^3\ tonne^{-1}$
High CO_2 Emission Factor	$= 12.3\ m^3\ tonne^{-1}$

Average CO_2 Emission Factor is recommended if there is no evidence to select high or low emission factor.

Conversion factor = $1.84 * 10^{-6}$ Gg m^{-3}

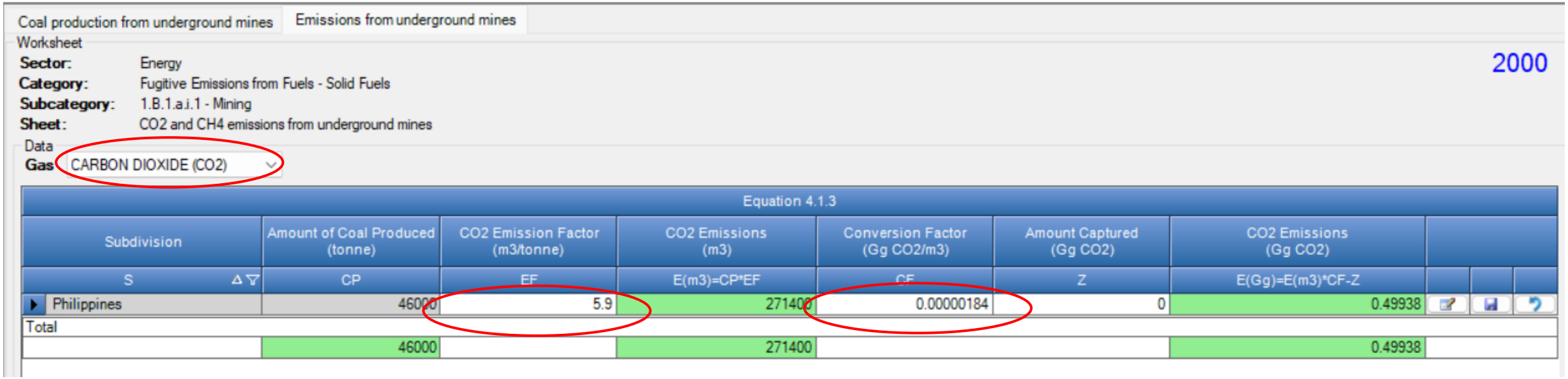
EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

CO_2 emissions = Raw underground coal production * Emission Factor * Units conversion factor

Parameter	Value	Source
Raw coal production	0.046 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	5.9 m^3 $tonne^{-1}$ (Average CO_2 Emission Factor)	2019 Refinement to the 2006 IPCC Guidelines
Units Conversion Factor	1.84 * 10^{-6} Gg m^{-3}	2019 Refinement to the 2006 IPCC Guidelines

CO_2 emissions = 0.046 million tonnes/year * 5.9 m^3 $tonne^{-1}$ * 1.84 * 10^{-6} Gg m^{-3}

= 0.4993 Gg/year



Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.1 - Mining

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas CARBON DIOXIDE (CO2)

Equation 4.1.3

Subdivision	Amount of Coal Produced (tonne)	CO2 Emission Factor (m3/tonne)	CO2 Emissions (m3)	Conversion Factor (Gg CO2/m3)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)
S	CP	EF	E(m3)=CP*EF	CF	Z	E(Gg)=E(m3)*CF-Z
Philippines	46000	5.9	271400	0.00000184	0	0.49938
Total						
	46000		271400			0.49938

EXAMPLE OF ESTIMATING POST CO_2 EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

CO_2 emissions = Raw underground coal production * Emission Factor * Units conversion factor

Parameter	Value	Source
Raw coal production	0.046 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	6 m^3 $tonne^{-1}$ (Average CO_2 Emission Factor)	Assumed value
Units Conversion Factor	1.84 * 10^{-6} Gg m^{-3}	2019 Refinement to the 2006 IPCC Guidelines

CO_2 emissions = 0.046 million tonnes/year * 6 m^3 $tonne^{-1}$ * 1.84 * 10^{-6} Gg m^{-3}

= 0.50784 Gg/year

Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas CARBON DIOXIDE (CO2)

Equation 4.1.4									
Subdivision	Amount of Coal Produced (tonne)	CO2 Emission Factor (m3/tonne)	CO2 Emissions (m3)	Conversion Factor (Gg CO2/m3)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)			
S	CP	EF	E(m3)=CP*EF	CF	Z	E(Gg)=E(m3)*CF-Z			
Philippines	46000	6	276000	0.00000184	0	0.50784			
Total									
	46000		276000			0.50784			

Let’s do an exercise!

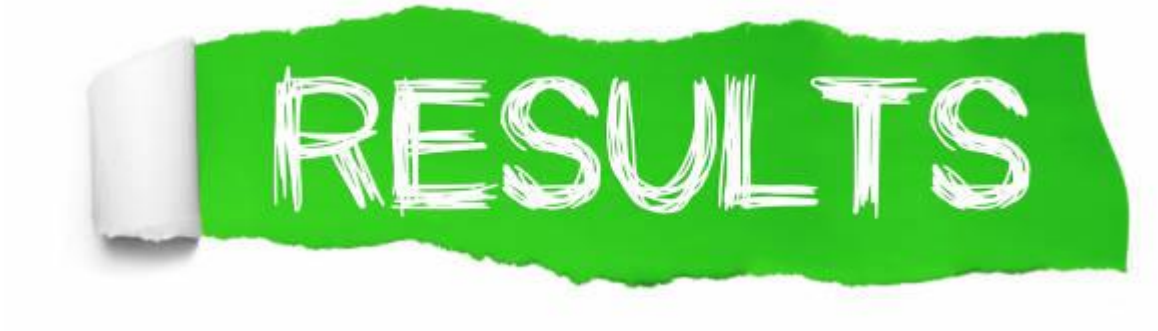
Step 01 : Open the software

step 02 : Select the “1.B.1.a.i.1 – Mining” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Underground Mines” and save. Use the data provided in the table below.

Step 04 : Enter the “Emission Factor in the sheet “Emissions from underground mines”.

Parameter	Value	Source
Raw coal production	100000 tonne/year	Assumed value
CH_4 Emission Factor	10 m^3 $tonne^{-1}$ (Low CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines



Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.1 - Mining

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.3									
Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)			
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R			
Philippines	100000	10	1000000	0.00000067		0.67			
Total									
	100000		1000000			0.67			

Step 01 : Open the software

step 02 : Select the “1.B.1.a.i.2 – Post Mining Seam Gas Emissions” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Underground Mines”. Use the data provided in the table below.

Step 04 : Enter the “CH_4 Emission Factor” in the sheet “Emissions from Underground mines”.

Parameter	Value	Source
Raw coal production	100000 tonne/year	Assumed Value
Emission Factor	0.9 m^3 $tonne^{-1}$ (Low CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

Coal production from underground mines | Emissions from underground mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.i.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from underground mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.4

Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R
Philippines	100000	0.9	90000	0.00000067		0.0603
Total						
	100000		90000			0.0603

ESTIMATING TOTAL EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

GLOBAL AVERAGE METHOD – UNDERGROUND MINING

CH_4 emissions = CH_4 Emission of Underground mining+ Post-mining emission of CH_4

Methane emissions = Underground mining emissions of CH_4 + Post-mining emission of CH_4

= 0.67 Gg/year + 0.0603 Gg/year

= 0.7303 Gg/year

ESTIMATING EMISSIONS FROM SURFACE COAL MINES

GENERAL EQUATION FOR ESTIMATING FUGITIVE EMISSIONS FROM SURFACE COAL MINING

CH_4 emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

ESTIMATING EMISSIONS FROM SURFACE COAL MINES

Step 02 : Estimating the Surface mining emissions of CH_4 using the equation below

TIER 1: GLOBAL AVERAGE METHOD – SURFACE MINES

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

Step 03 : Estimating the Post mining emissions of CH_4 using the equation below

TIER 1: GLOBAL AVERAGE METHOD – POST MINING EMISSIONS - SURFACE MINES

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

ESTIMATING EMISSIONS FROM SURFACE COAL MINES- TIER 01

A: Selection of Emission Factor for the Surface mining emissions of CH_4

Among these 3 types of emission factors, the appropriate emission factor can be selected according to the mining depth.

Mining Depth	Lower limit	Upper limit	Emission factor
Low	0.1	0.9	0.3 m^3/tonne
Average	0.4	3.6	1.2 m^3/tonne
High	0.6	6	2 m^3/tonne

NOTE : In the absence of data on mining depth, it is good practice to use the average emission factor, namely 1.2 m^3/tonne.

ESTIMATING EMISSIONS FROM SURFACE COAL MINES- TIER 01

B: Selection of CH_4 Emission Factor for the Post Mining Emissions -Surface mines

Among these 3 types of emission factors, the appropriate emission factor can be selected according to the mining depth.

Mining Depth	Lower limit	Upper limit	Emission factor
Low	0	0.03	0 m^3/tonne
Average	0.03	0.3	0.1 m^3/tonne
High	0.06	0.6	0.2 m^3/tonne

NOTE : In the absence of data on mining depth, it is good practice to use the average emission factor, namely 0.1 m^3/tonne.

ESTIMATING EMISSIONS FROM SURFACE COAL MINES- TIER 01

C: Getting the Activity Data (Surface Coal Production)

Same as with underground coal mines, the activity data required for Tiers 1 and 2 are raw coal production

D: Getting the Unit Conversion Factor

Same as with underground coal mines, the Units Conversion Factor should be the density of CH_4

EXAMPLE OF ESTIMATING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1

Parameter	Value	Source
Raw coal production	1.175 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (Page 34)
Emission Factor	1.2 m^3 $tonne^{-1}$ (Average CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

EXAMPLE OF ESTIMATING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1

TIER 1: GLOBAL AVERAGE METHOD – SURFACE MINES

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

Methane emissions = 1.175 million tonnes/year * 1.2 m^3 $tonne^{-1}$ * 0.67 * 10^{-6} Gg m^{-3}

= 0.9447 Gg/year

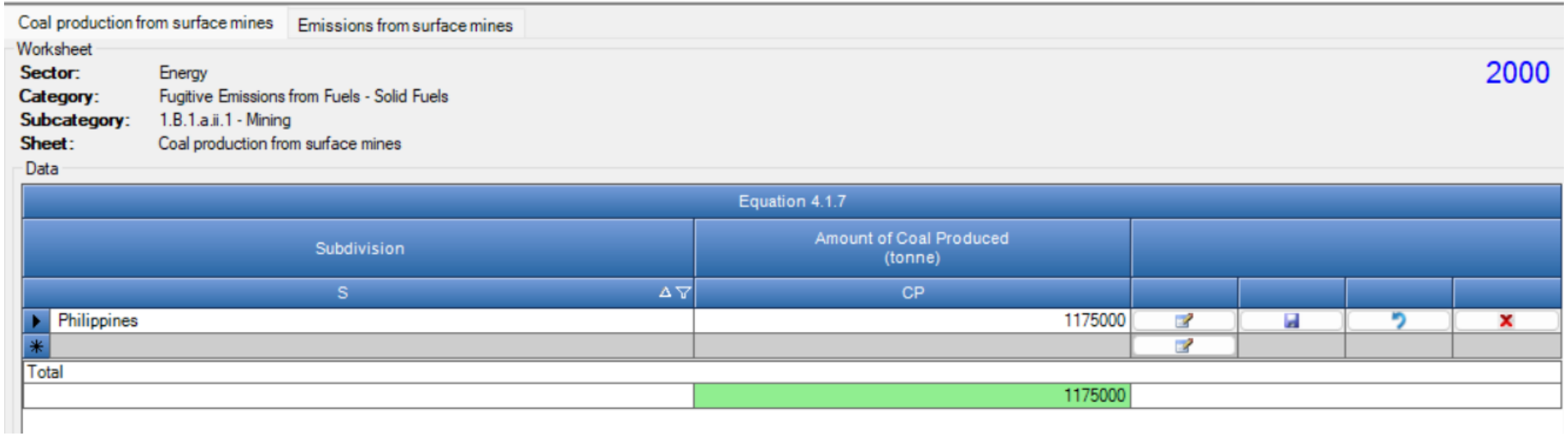
ESTIMATING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software

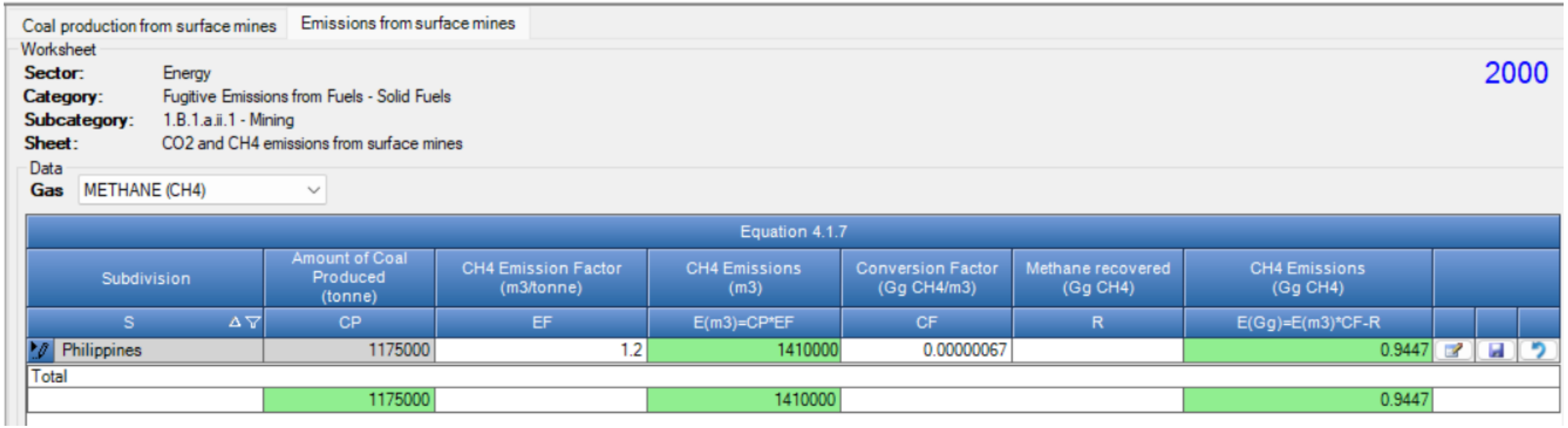
step 02 : Select the “1.B.1.a.ii.1 – Mining” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Surface Mines” and save using the save icon.

Step 04 : Enter the “CH_4 Emission Factor” in the sheet “Emissions from surface mines”.



ESTIMATING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT.



Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.1 - Mining

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.7

Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R
Philippines	1175000	1.2	1410000	0.00000067		0.9447
Total						
	1175000		1410000			0.9447

EXAMPLE OF ESTIMATING EMISSIONS FROM POST MINING OF SURFACE COAL MINES FOR TIER 1

Parameter	Value	Source
Raw coal production	1.175 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	0.1 m^3 $tonne^{-1}$ (Average CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

EXAMPLE OF ESTIMATING EMISSIONS FROM POST MINING OF SURFACE COAL MINES FOR TIER 1

TIER 1& Tier 2: GLOBAL AVERAGE METHOD – POST MINING EMISSIONS - SURFACE MINES

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

Methane emissions = CH_4 Emission Factor * Surface Coal Production * Conversion Factor

Methane emissions = 1.175 million tonnes/year * 0.1 m^3 $tonne^{-1}$ * 0.67 * 10^{-6} Gg m^{-3}

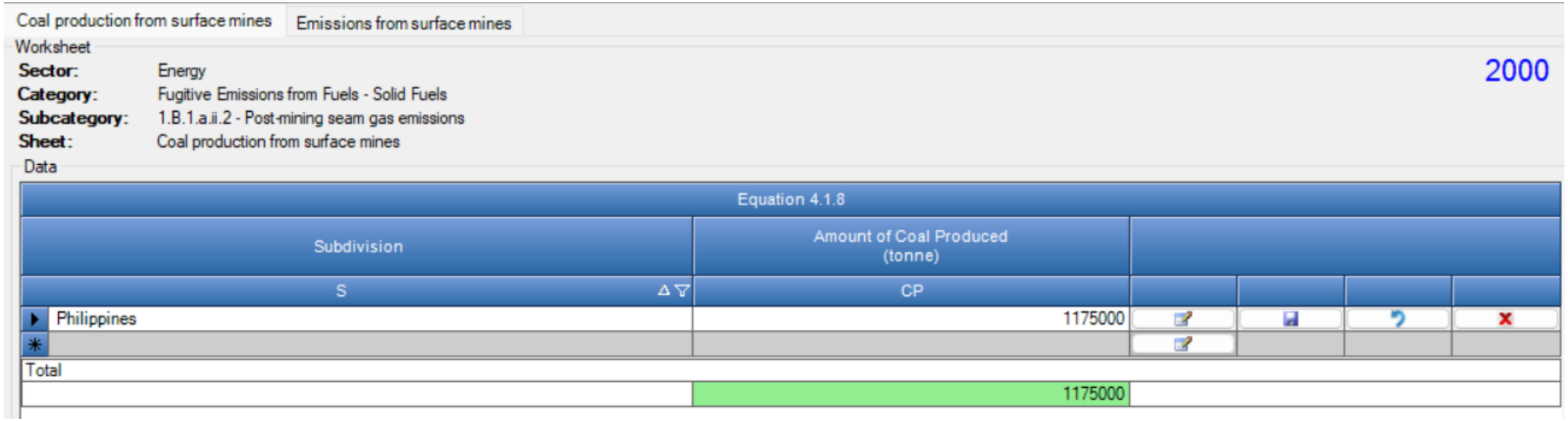
= 0.0787 Gg/year

ESTIMATING POST MINING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software

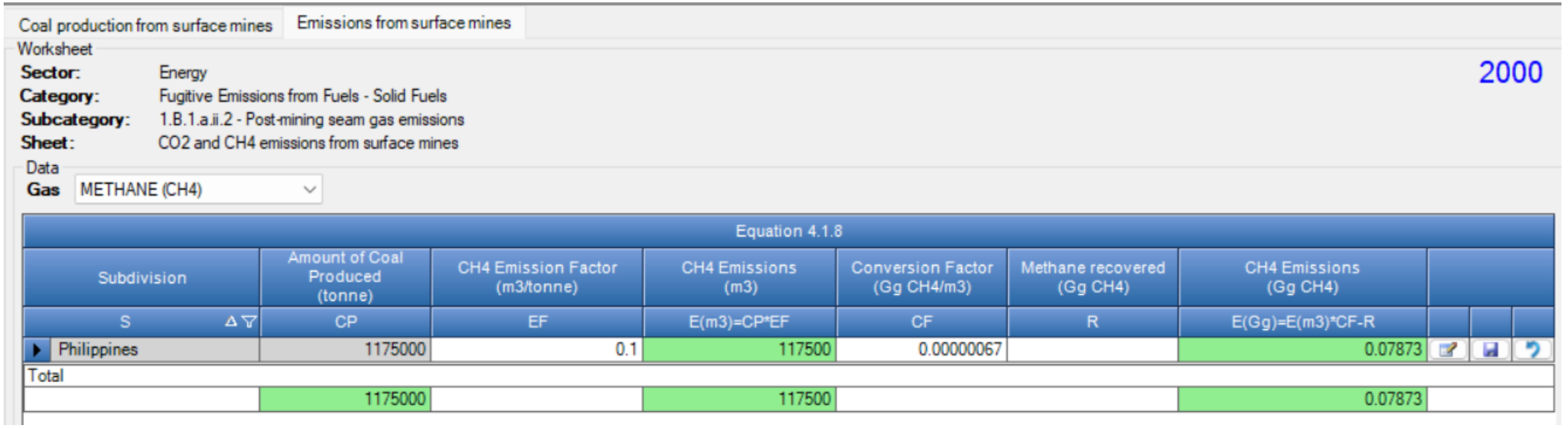
step 02 : Select the “1.B.1.a.ii.2 – Post Mining Seam Gas Emissions” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Surface Mines”.



ESTIMATING POST MINING EMISSIONS FROM SURFACE COAL MINES FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT.

Step 04 : Enter the "CH_4 Emission Factor" in the sheet "Emissions from surface mines".



Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.8									
Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)			
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R			
Philippines	1175000	0.1	117500	0.00000067		0.07873			
Total									
	1175000		117500			0.07873			

ESTIMATING TOTAL EMISSIONS FROM SURFACE COAL MINES FOR TIER 1

GENERAL EQUATION FOR ESTIMATING FUGITIVE EMISSIONS FROM SURFACE COAL MINING

CH_4 emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

Methane emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

= 0.9447 Gg/year + 0.0787 Gg/year

= 1.0234 Gg/year

NOTE : According to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, a new section has been added to calculate the CO_2 emission from the surface mining along with emission factors.

$$Carbon\ dioxide\ emissions = CO_2\ Emission\ Factor \bullet Surface\ Coal\ Production \bullet Conversion\ Factor$$

Low CO_2 Emission Factor	$= 0.01\ m^3\ tonne^{-1}$
Average CO_2 Emission Factor	$= 0.44\ m^3\ tonne^{-1}$
High CO_2 Emission Factor	$= 0.94\ m^3\ tonne^{-1}$

Average CO_2 Emission Factor is recommended if there is no evidence to select high or low emission factor.

Conversion factor = $1.84 * 10^{-6}$ Gg m^{-3}

EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

CO_2 emissions = Raw surface coal production * Emission Factor * Units conversion factor

Parameter	Value	Source
Raw coal production	1.175 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	0.44 m^3 $tonne^{-1}$ (Average CO_2 Emission Factor)	2019 Refinement to the 2006 IPCC Guidelines
Units Conversion Factor	1.84 * 10^{-6} Gg m^{-3}	2019 Refinement to the 2006 IPCC Guidelines

CO_2 emissions = 1.175 million tonnes/year * 0.44 m^3 $tonne^{-1}$ * 1.84 * 10^{-6} Gg m^{-3}

= 0.95128 Gg/year

Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.1 - Mining

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas CARBON DIOXIDE (CO2)

Equation 4.1.7

Subdivision	Amount of Coal Produced (tonne)	CO2 Emission Factor (m3/tonne)	CO2 Emissions (m3)	Conversion Factor (Gg CO2/m3)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)
S	CP	EF	E(m3)=CP*EF	CF	Z	E(Gg)=E(m3)*CF-Z
Philippines	1175000	0.44	517000	0.00000184	0	0.95128
Total						
	1175000		517000			0.95128

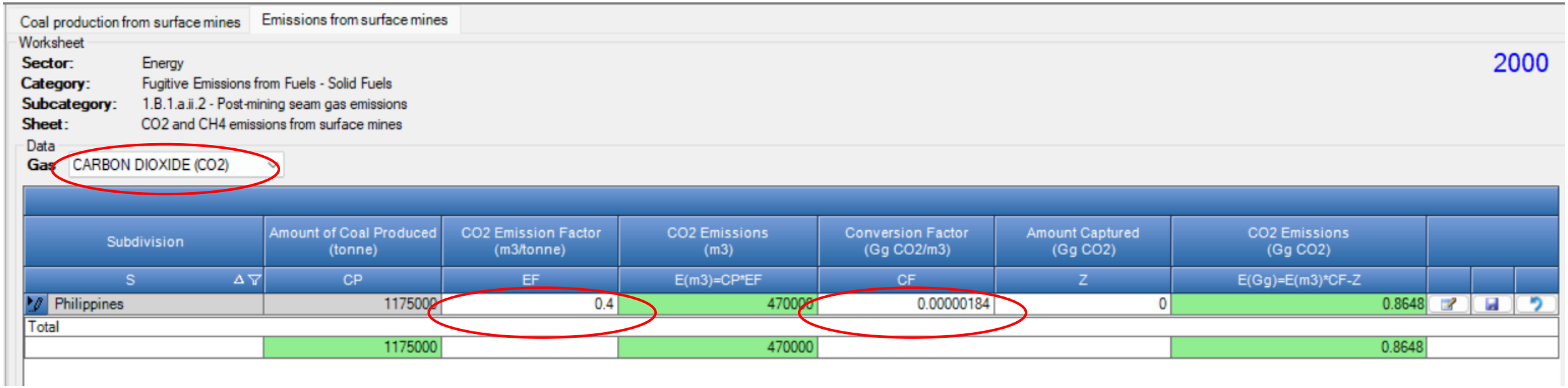
EXAMPLE OF ESTIMATING POST CO_2 EMISSIONS FROM UNDERGROUND COAL MINES FOR TIER 1

CO_2 emissions = Raw underground coal production * Emission Factor * Units conversion factor

Parameter	Value	Source
Raw coal production	1.175 million tonnes/year (In 2000)	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf (page 34)
Emission Factor	0.4 m^3 $tonne^{-1}$ (Average CO_2 Emission Factor)	Assumed value
Units Conversion Factor	1.84 * 10^{-6} Gg m^{-3}	2019 Refinement to the 2006 IPCC Guidelines

CO_2 emissions = 1.175 million tonnes/year * 0.4 m^3 $tonne^{-1}$ * 1.84 * 10^{-6} Gg m^{-3}

= 0.8648 Gg/year



Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas CARBON DIOXIDE (CO2)

Subdivision	Amount of Coal Produced (tonne)	CO2 Emission Factor (m3/tonne)	CO2 Emissions (m3)	Conversion Factor (Gg CO2/m3)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)
S	CP	EF	E(m3)=CP*EF	CF	Z	E(Gg)=E(m3)*CF-Z
Philippines	1175000	0.4	470000	0.00000184	0	0.8648
Total						
	1175000		470000			0.8648

Let’s do an exercise!

Step 01 : Open the software

step 02 : Select the “1.B.1.a.ii.1 – Mining” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Surface Mines”. Use the data provided in the table below.

Step 04 : Enter the “ CH4 Emission Factor” in the sheet “Emissions from surface mines”.

Parameter	Value	Source
Raw coal production	100000 tonne/year	-
Emission Factor	2 m^3 $tonne^{-1}$ (High CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.1 - Mining

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.7									
Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)			
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R			
Philippines	100000	2	200000	0.00000067		0.134			
Total									
	100000		200000			0.134			

Step 01 : Open the software

step 02 : Select the “1.B.1.a.ii.2 – Post Mining Seam Gas Emissions” under 1.B-Fugitive emissions from fuels.

Step 03 : Enter the “subdivision” and “Amount of Coal Produced” in the sheet “Coal Production from Surface Mines”. Use the data provided in the table below.

Step 04 : Enter the “CH_4 Emission Factor” in the sheet “Emissions from surface mines”.

Parameter	Value	Source
Raw coal production	100000 tonne/year	Assumed value
Emission Factor	0 m^3 $tonne^{-1}$ (Low CH_4 Emission Factor)	2006 IPCC Guidelines
Units Conversion Factor	0.67 * 10^{-6} Gg m^{-3}	2006 IPCC Guidelines

Coal production from surface mines | Emissions from surface mines

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Solid Fuels

Subcategory: 1.B.1.a.ii.2 - Post-mining seam gas emissions

Sheet: CO2 and CH4 emissions from surface mines

2000

Data

Gas METHANE (CH4)

Equation 4.1.8									
Subdivision	Amount of Coal Produced (tonne)	CH4 Emission Factor (m3/tonne)	CH4 Emissions (m3)	Conversion Factor (Gg CH4/m3)	Methane recovered (Gg CH4)	CH4 Emissions (Gg CH4)			
S	CP	EF	E(m3)=CP*EF	CF	R	E(Gg)=E(m3)*CF-R			
Philippines	100000	0	0	0.00000067		0			
Total									
	100000		0			0			

ESTIMATING TOTAL EMISSIONS FROM SURFACE COAL MINES FOR TIER 1

GENERAL EQUATION FOR ESTIMATING FUGITIVE EMISSIONS FROM SURFACE COAL MINING

CH_4 emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

Methane emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

= 0.134Gg/year + 0 Gg/year

= 0.134 Gg/year

ESTIMATING EMISSIONS FROM OIL PRODUCTION USING TIER 01

TIER 1: ESTIMATING FUGITIVE EMISSIONS FROM AN INDUSTRY SEGMENT

Annual Emissions (Gg)

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

Activity Value(Unit of activity)

Emission Factor(Gg/Unit of activity)

The list of industry segments to be considered are,

- Well drilling
- Well testing
- Well servicing
- Gas production
- Gas processing
- Gas transmission and storage
- Oil refining
- Gas distribution
- Liquefied Gases Transport
- oil production
- oil upgrading
- waste oil reclaiming
- Refined product distribution
- oil transport

1. Venting

ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION-VENTING-TIER 01

Step 02: selection of emission factors - There are two different default emission factors for CO_2 for developed countries and for developing countries. The correct one should be used.

Country/Territory	Value	Unit	Lower limit	Upper limit	Emission Source
Developed Countries	0.0053	Gg per 10^3 m3...	0.001325	0.009275	Venting
Developing/Transition Countries	0.0063	Gg per 10^3 m3...	0.002079	0.01575	Venting

Step 03: Gathering activity data – The annual amount of oil produced in the country should be known.

EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION – TIER 01

Parameter	Value	Source
Amount of oil produced	61578000 m^3	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf
Emission Factor	0.0063 Gg Per 10^3 m^3	Default value of IPCC Inventory software

EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION- TIER 01

TIER 1: ESTIMATING FUGITIVE EMISSIONS FROM AN INDUSTRY SEGMENT

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$= 61578000\ m^3 * 0.0063 * 10^{-3}\ Ggm^{-3}$$

$$= 387.941\ Gg$$

EXAMPLE OF ESTIMATING CH_4 EMISSIONS FROM OIL PRODUCTION – TIER 01

Parameter	Value	Source
Amount of oil produced	61578000 m^3	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf
Emission Factor	0.02 Gg Per 10^3 m^3	Default value of IPCC Inventory software

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$= 61578000\ m^3 * 0.02 * 10^{-3}\ Ggm^{-3}$$

$$= 1231.56\ Gg$$

EXAMPLE OF ESTIMATING N_2O EMISSIONS FROM OIL PRODUCTION – TIER 01

Parameter	Value	Source
Amount of oil produced	61578000 m^3	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf
Emission Factor	0.1 Gg Per 10^3 m^3	Assumed value

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$= 61578000\ m^3 * 0.1 * 10^{-3}\ Ggm^{-3}$$

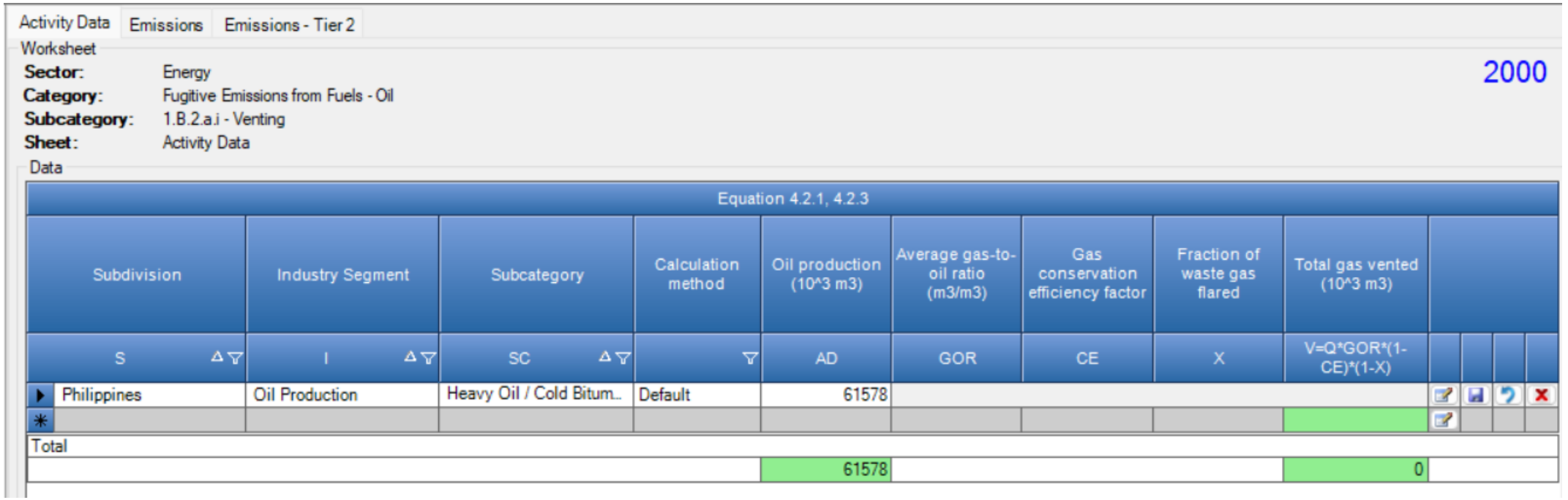
$$= 6157.8\ Gg$$

ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software

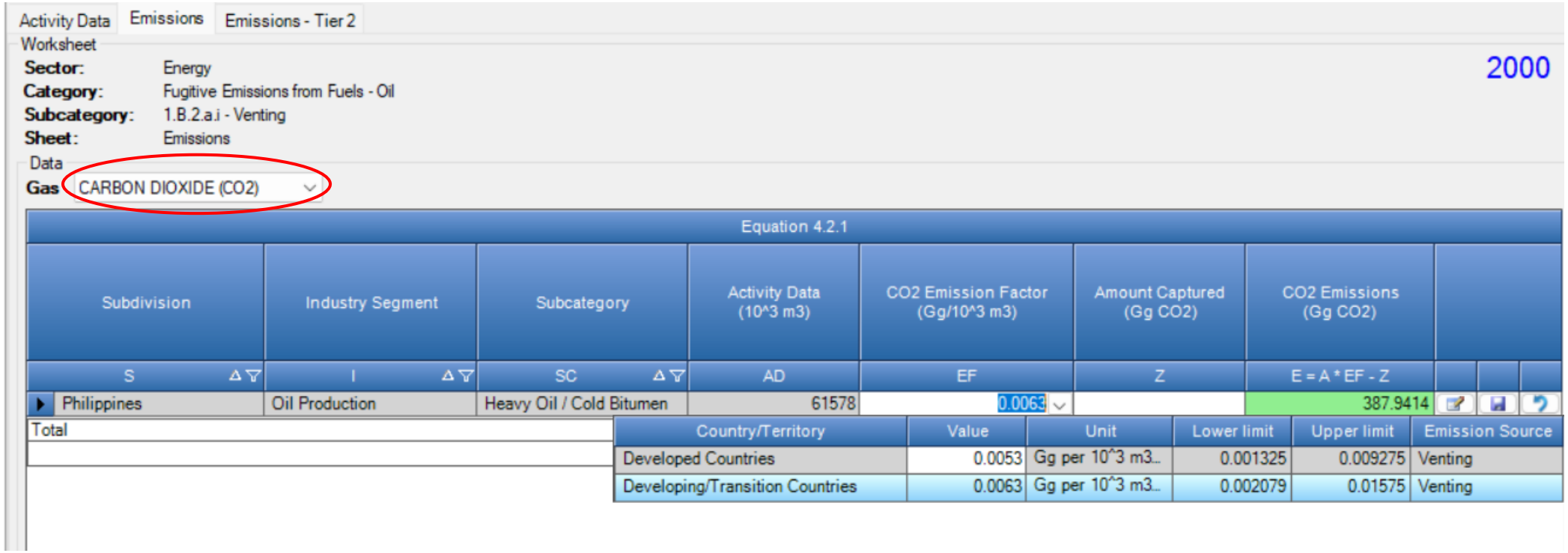
step 02 : Select the “1.B.2.a.i – Venting” under 1.B-Fugitive emissions from fuels.

Step 03 : Select the “subdivision”, “Industry Segment”, ”Subcategory”, “calculation method” and “oil production” in the sheet “Activity Data” and save.

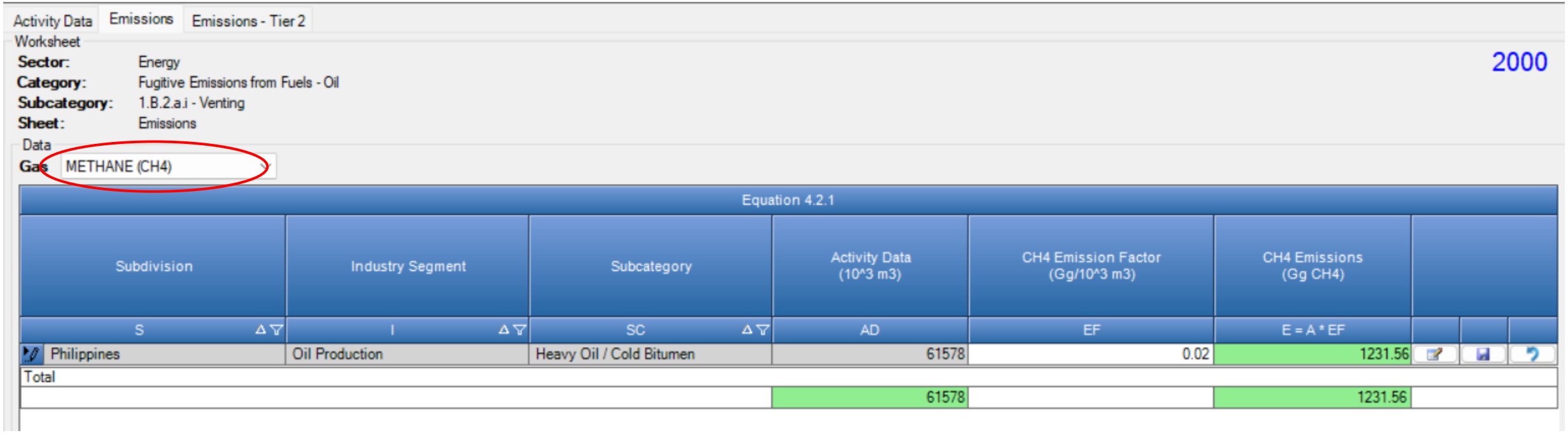


ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT..

Step 04 : Select the correct “Gas” and “Emission Factor” from the sheet “Emissions”.



ESTIMATING CH_4 EMISSIONS FROM OIL PRODUCTION FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT..



Activity Data | Emissions | Emissions - Tier 2

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil

Subcategory: 1.B.2.a.i - Venting

Sheet: Emissions

2000

Data

Gas: METHANE (CH4)

Equation 4.2.1

Subdivision	Industry Segment	Subcategory	Activity Data (10^3 m3)	CH4 Emission Factor (Gg/10^3 m3)	CH4 Emissions (Gg CH4)
S	I	SC	AD	EF	E = A * EF
Philippines	Oil Production	Heavy Oil / Cold Bitumen	61578	0.02	1231.56
Total					
			61578		1231.56

ESTIMATING N_2O EMISSIONS FROM OIL PRODUCTION FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT..

Activity Data | Emissions | Emissions - Tier 2

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil

Subcategory: 1.B.2.a.i - Venting

Sheet: Emissions

2000

Data

Gas NITROUS OXIDE (N2O)

Equation 4.2.1

Subdivision	Industry Segment	Subcategory	Activity Data (10^3 m3)	N2O Emission Factor (Gg/10^3 m3)	N2O Emissions (Gg N2O)
S	I	SC	AD	EF	E = A * EF
Philippines	Oil Production	Heavy Oil / Cold Bitumen	61578	0.1	6157.8
Total					
			61578		6157.8

Let’s do an exercise!

ESTIMATING EMISSIONS FROM OIL PRODUCTION – TIER 01

Parameter	Value	Source
Amount of oil produced	1000000 m^3	Assumed value
Emission Factor for CH_4	0.01 Gg Per 10^3 m^3	Assumed Value
Emission Factor for CO_2	0.005 Gg Per 10^3 m^3	Assumed Value
Emission Factor for N_2O	0.3 Gg Per 10^3 m^3	Assumed Value

Activity Data | Emissions | Emissions - Tier 2

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil

Subcategory: 1.B.2.a.i - Venting

Sheet: Emissions

2000

Data

Gas CARBON DIOXIDE (CO2)

Equation 4.2.1									
Subdivision	Industry Segment	Subcategory	Activity Data (10^3 m3)	CO2 Emission Factor (Gg/10^3 m3)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)			
S	I	SC	AD	EF	Z	E = A * EF - Z			
Philippines	Oil Production	Heavy Oil / Cold Bitumen	1000	0.005		5			
Total									
			1000			5			

Activity Data | Emissions | Emissions - Tier 2

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil

Subcategory: 1.B.2.a.i - Venting

Sheet: Emissions

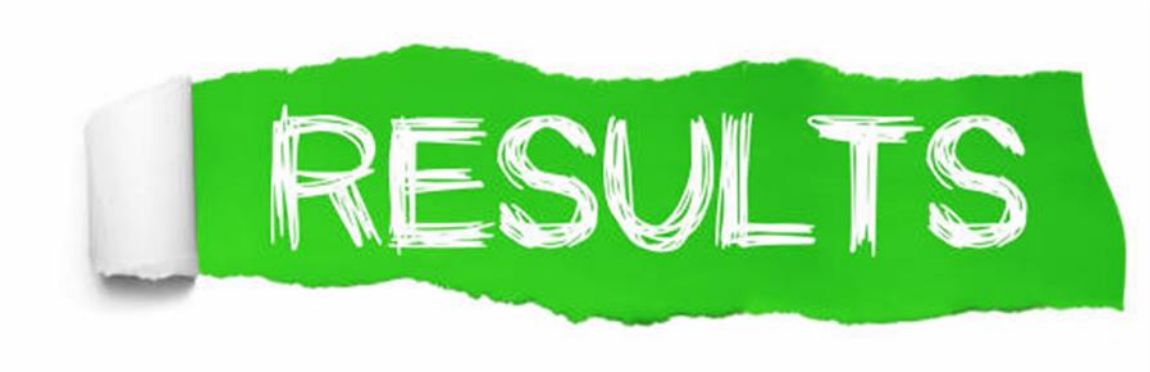
2000

Data

Gas METHANE (CH4)

Equation 4.2.1

Subdivision	Industry Segment	Subcategory	Activity Data (10^3 m3)	CH4 Emission Factor (Gg/10^3 m3)	CH4 Emissions (Gg CH4)
S	I	SC	AD	EF	E = A * EF
Philippines	Oil Production	Heavy Oil / Cold Bitumen	1000	0.01	10
Total			1000		10



Activity Data | Emissions | Emissions - Tier 2

Worksheet

Sector: Energy

Category: Fugitive Emissions from Fuels - Oil

Subcategory: 1.B.2.a.i - Venting

Sheet: Emissions

2000

Data

Gas NITROUS OXIDE (N2O)

Equation 4.2.1

Subdivision	Industry Segment	Subcategory	Activity Data (10^3 m3)	N2O Emission Factor (Gg/10^3 m3)	N2O Emissions (Gg N2O)
S	I	SC	AD	EF	E = A * EF
Philippines	Oil Production	Heavy Oil / Cold Bitumen	1000	0.3	300
Total					
			1000		300

2. Flaring

ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION-FLARING-TIER 01

Step 01: selection of emission factors - There are two different default emission factors for CO_2 for developed countries and for developing countries. The correct one should be used.

Country/Territory	Value	Unit	Lower limit	Upper limit	Emission Source
Developed Countries	0.022	Gg per 10^3 m3...	0.0055	0.0385	Flaring
Developing/Transition Countries	0.026	Gg per 10^3 m3...	0.00858	0.065	Flaring

Step 02: Gathering activity data – The annual amount of oil produced in the country should be known.

EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION – FLARING USING TIER 01

Parameter	Value	Source
Amount of oil produced	61578000 m^3	https://climate.emb.gov.ph/wp-content/uploads/2016/06/GHG-Manual.pdf
Emission Factor	0.026 Gg Per 10^3 m^3	2006 IPCC Guidelines

EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION- TIER 01

TIER 1: ESTIMATING FUGITIVE EMISSIONS FROM AN INDUSTRY SEGMENT

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} * EF_{\text{gas, industry segment}}$$

$$= 61578000\ m^3 * 0.026 * 10^{-3}\ Ggm^{-3}$$

$$= 1601.028\ Gg$$

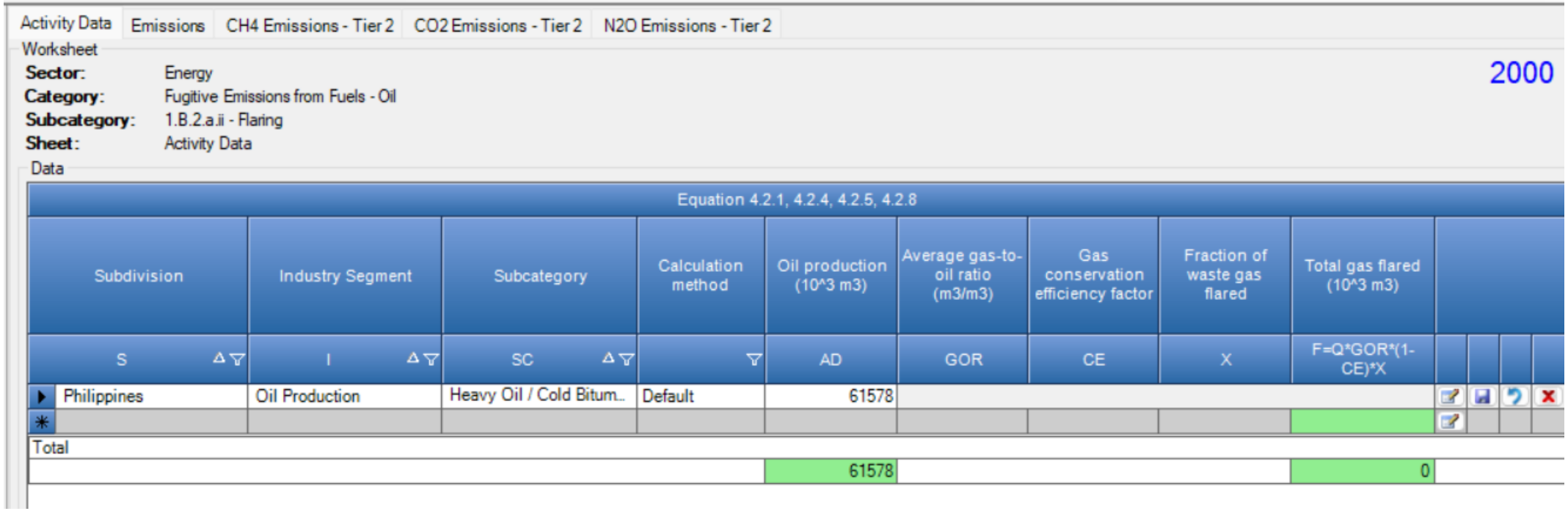
By using the Emission factors of CH_4 and N_2O, emissions of those gases can be calculated

ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION FOR TIER 1 FOR FLARING USING 2006 IPCC INVENTORY SOFTWARE

Step 01 : Open the software

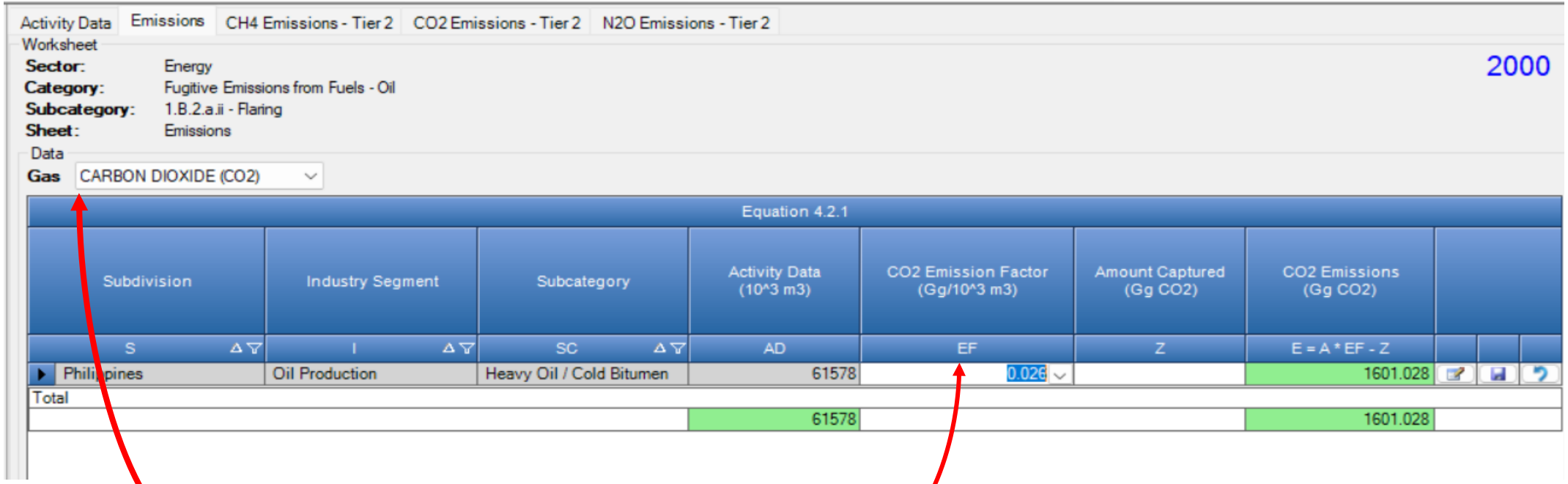
step 02 : Select the “1.B.2.a.ii – Flaring” under 1.B-Fugitive emissions from fuels.

Step 03 : Select the “subdivision”, “Industry Segment”, ”Subcategory”, “calculation method” and “oil production” in the sheet “Activity Data”.



EXAMPLE OF ESTIMATING CO_2 EMISSIONS FROM OIL PRODUCTION (FLARING) FOR TIER 1 USING 2006 IPCC INVENTORY SOFTWARE CONT..

Step 04 : Select the Emission Factor in the sheet “Emissions”.



By selecting CH_4 and N_2O with particular emission factor, emissions of those gases can be calculated

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