

Industrial Processes and Product Use (IPPU)

From the IPCC Guidelines to the IPCC Inventory Software

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Outline

- $\,\circ\,$ General and cross-cutting issues
 - 2019 Refinement Categories and Biogenic component in IPPU
 - Fuel Manager
 - F-gases Manager and F-blends Manager [will be presented separately]
- **o 2.A.1 Cement Production**
 - IPCC Guidelines Tier 1, 2 and 3 CO2
 - The worksheets in the IPCC Inventory Software
 - Dummy data exercise Tier 1, 2 and 3 and Capture CO2
- 2.C.1 Iron and Steel Production
 - IPCC Guidelines Iron and Steel Production Tier 1 and 2/3 for CO2
 - IPCC Guidelines Coke Production Tiers and Reporting
 - The worksheets in the IPCC Inventory Software
 - Dummy data exercise Iron and Steel Production Tier 1 and 2/3 for CO2
 - Dummy data exercise Coke Production Tier 1 for CO2 and CH4
- **o 2.B.8 Petrochemical and Carbon Black**
 - Demonstration of data input for 2.B.8.b Ethylene Production

Outline (Cont.)

○ 2.F.1 Refrigeration and Air Conditioning

- F-gases/ blends and the F-gases Manager
- Refrigeration and Air Conditioning Tier 1
- Refrigeration and Air Conditioning Tier 2



Introduction

○ The IPCC Inventory Software implements the 2006 IPCC Guidelines

There are elements of the <u>2019 Refinement</u> to meet the UNFCCC reporting requirements









2019 Refinement Categories Biogenic Component in IPPU

2019 Refinement categories

 To meet the UNFCCC reporting requirements, two new categories from the 2019 Refinement were introduced in the IPCC Inventory Software and they moved the numbering of categories in Chemical and Metal Industries (2.B and 2.C)

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2006 IPCC	2019 IPCC	UNFCCC
2.B.10 Other	2.B.10 Hydrogen Production	2.B.10.a. Hydrogen production
	2.B.11 Other	2.B.10.b. Other
2.C.7 Other	2.C.7 Rare Earths Production	2.C.7.a. Rare earths production
	2.C.8 Other	2.C.7.b. Other

Biogenic

 Biogenic component is not included in the national total. There are few instances in the IPPU sector, where the biogenic/biomass input can be used.

\odot The following categories contain Biogenic input:

- 2.B.1 Ammonia Production
- 2.B.5 Carbide Production
- 2.B.6 Titanium Dioxide Production
- 2.B.8 Petrochemical and Carbon Black Production
- 2.B.10 Hydrogen Production
- 2.C.1 Iron and Steel Production
- 2.C.2 Ferroalloys Production
- 2.C.5 Lead Production
- 2.C.6 Zinc Production
- 2.H.3 Other

Cross-cutting issues – IPPU/Energy

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Fuel Manager

Fuel Manager (1)

- Some IPPU worksheets (e.g., Iron and Steel Production) use data from the Fuel Manager, which contains default and country specific data on fuels – NCV and Carbon Content
- Energy experts are supposed to populate Fuel Manager, but IPPU experts may need to check and correct or input a specific fuel information

🏟 IPCC Inventory Software - TSU - [Workshe	ets]									—	D	\times
🖳 Application Database Inventory Y	/ear A	Administrate Worksheets	Tools E	Export/Import Repor	t Window Help							- 8 :
2006 IPCC Categories	CO2 Cem Work Sec Cate Sub She	Users Country/Territory CO2 Equivalents Energy IPPU AFOLU	} }	erials - Tier 3 (3/4) CC 2) Clinker production - Fuel Manager duction (1 of 2)	0. Emissions summary - Tier 3 (4/4 1 er 2 CO2 Emissions from carb	Capture and storage or other re conates - Tier 3 (1/4) CO2 Emiss	eduction ions from uncalcined CKD not recycled to th	e kiln - Tier 3 (2/4)			2	:015
- 2 - Industrial Processes and Product Us - 2.A - Mineral Industry - 2.A.1 - Cement production	Dat	Waste Delete Inventory	•			Equation 2.1						
		Subdivision		Individ at	Type of Cement Produced	Mass of Individual Type of Cement Produced (tonne)	Clinker Fraction in Cement (Fraction)	Mass of Clinker in the Individual Type of Cement Produced (tonne)				
			_	ΔV	<u>۵</u> 7	A	В	C=A*B				
- 2 A 4 c - Non Metallurgical M		Company A		Product Mix - 30/	70	2534000	0.817	2070278	2		っ	X
2.A.4.d - Other (please speci	0	Company B		Masonry		1204000	0.75	903000	2			
2.A.5 - Other (please specify)	*								2			
= 2.B - Chemical Industry	Total											
2.B.1 - Ammonia Production						3738000		2973278				
2.B.2 - Nitric Acid Production			Ad	Iministra	te 🔿							

Energy

Fuel Manager

Fuel Manager (2)

- The Fuel Manager contains data on carbon content and calorific value for each fuel.
- All IPCC default fuels are listed in. In addition, users can enter user-specific fuels together with relevant data required by the Fuel Manager (carbon content and calorific value).

Default IPCC fuels (embedded - in grey) and Country-specific fuels (manual input - in white)

Fuel Type	V	Fuel Name	Primary Fuel 🛛	Net Calorific Value (TJ / Gg)	Carbon content (NCV) (kg C / GJ)
		Gas Coke		28.2	29.2
		Gas Works Gas		38.7	12.1
		Lignite	Image: A state of the state	11.9	27.6
		Oil Shale / Tar Sands		8.9	29.1
		Other Bituminous Coal	Image: A start of the start	25.8	25.8
		Oxygen Steel Furnace Gas		7.06	49.6
		Patent Fuel		20.7	26.6
		Sub-Bituminous Coal		18.9	26.2
aseous Fuels		Natural Gas (Dry)		48	15.3
ther Fossil Fuels		Industrial Wastes		11	39
		Municipal Wastes (nonbiomass fraction)		10	25
ther Fossil Fuels		Natural Gas + Hydrogen (20%)		55	13
ther Fossil Fuels		Waste Oils		40.2	20
eat		Peat		9.76	28.9
iomass - solid		Charcoal		29.5	30.5
		Other Primary Solid Biomass		11.6	27.3
		Wood/Wood Waste		15.6	30.5
iomass - liquid		Biodiesels		27	19.3
		Biogasoline		27	19.3
		Other Liquid Biofuels		27.4	21.7
		Sulphite lyes (Black Liquor)		11.8	26
iomass - gas		Landfill Gas		50.4	14.9
		Other Biogas		50.4	14.9
		Sludge Gas	0	50.4	14.9
liomass - other		Municipal Wastes (biomass fraction)		11.6	27.3
iolid Fuels		Fuel Briquettes		20.9	26.5

Examples of Data Input

Cement Production (2.A.1)

○ Iron and Steel (2.C.1)

• Petrochemical (2.B.8)

• Refrigeration and Air Conditioning (2.F.1)

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Examples of Data Input

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Cement Production (2.A.1)

2.A.1: Cement Production





<u>Calcination:</u> CaCO₃ +(*Heat*) = CaO+CO₂ (IPPU) <u>Combustion:</u> Coal/Gas+O₂=CO₂ +(*Heat*) (Energy)

2.A.1 Cement Production - Tiers

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○ 2006 IPCC Guidelines provide three Tiers for Cement Production

• Tier 1 (based on <u>cement production</u> data)

• Tier 2 (based on <u>clinker production</u> data)

• Tier 3 (based on carbonates input data)

2.A.1 Cement Production

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Tier 1

TIER 1 METHOD: ESTIMATING CLINKER PRODUCTION THROUGH USE OF CEMENT PRODUCTION DATA

As noted above, calculating CO_2 emissions directly from cement production (i.e., using a fixed cement-based emission factor) is not consistent with *good practice*. Instead, in the absence of data on carbonate inputs or national clinker production data, cement production data may be used to estimate clinker production by taking into account the amounts and types of cement produced and their clinker contents and including a correction for clinker imports and exports. Accounting for imports and exports of clinker is an important factor in the estimation of emissions from this source. Emissions from the production of imported clinker should not be included in national emissions estimates as these emissions were produced and accounted for in another country. Similarly, emissions from clinker that is ultimately exported should be factored into national estimates of the country where the clinker is produced. An emission factor for clinker is then applied and the CO_2 emissions are calculated according to Equation 2.1.

EQUATION 2.1
TIER 1: EMISSIONS BASED ON CEMENT PRODUCTION

$$CO_2 \ Emissions = \left[\sum_i (M_{ci} \bullet C_{cli}) - Im + Ex\right] \bullet EF_{clc}$$

Where:

- CO_2 Emissions = emissions of CO_2 from cement production, tonnes
- M_{ci} = weight (mass) of cement produced³ of type *i*, tonnes
- C_{cli} = clinker fraction of cement of type *i*, fraction
- Im = imports for consumption of clinker, tonnes
- Ex = exports of clinker, tonnes
- EF_{clc} = emission factor for clinker in the particular cement, tonnes CO₂/tonne clinker The default clinker emission factor (EF_{clc}) is corrected for CKD.

tonnes CO₂/tonne clinker

(corrected for cement kiln dust (CKD))



- ✓ If cement production cannot be disaggregated by cement type, it is suspected that significant amounts of blended and/or masonry cements are being produced, and it is acceptable within good practice to assume an overall clinker fraction of 75%
- ✓ If cement production is known to be essentially all portland cement, then it is good practice to use a default value of 95% clinker

Tier 1 Emission Factor

\odot In Tier 1, it is good practice to assume the following:

- default CaO content for clinker is 65% (1 tonne of clinker contains 0.65 tonne CaO)
- CaCO₃ is 56.03 percent CaO and 43.97 percent CO₂ by weight (stoichiometry)
- 2% correction factor for cement kiln dust (CKD) not recycled into the kiln

• The amount of CaCO3 needed to yield 0.65 tonne CaO is: $CaCO_3 = 0.65 / 0.5603 = 1.1601$ tonne

 \odot The amount of CO₂ released by calcining this CaCO₃ is: CO₂ = 1.1601 x 0.4397 = 0.5101 tonne

Assuming a correction addition of 2 % CKD, the default EF is:
 EFcl = 0.5101 x 1.02 = 0.52 tonne CO₂ / tonne clinker

(with 0.5101 tonne of CO₂) CO₂ CaO **CO**₂ 43.97 56.03 Clinker **Calcium Carbonate** Ca CO₃ **CaO – 65%** $CaCO_3 = CaO \cdot CO_2$ Ca 40 + C 12 + O 16x3 = 100.08691.1601 tonne CaCO₃ = 1 tonne of Clinker (with 0.65 tonne CaO)

1.1601 tonne CaCO₃ = 1 tonne of Clinker



✓ Now let's see how it is realized in the Software

Cement Production – Tier 1



The Software breaks the Equation 2.1 into two worksheets:

- Cement Production (1/2) 1.
- ii. Cement Production (2/2)

$$CO_2 \text{ Emissions} = \left[\sum_{i} (M_{\text{cement},i} \times C_{\text{clinker fraction},i}) - \text{Im} + \text{Ex} \right] \times \text{EF}_{\text{Clinker}}$$
Cement Production (1/2) Cement Production (2/2)

🖳 Application Database Inventory Yea	ar Administrate Worksheets Tools Export/I	mport Reports Window Help			
2006 IPCC Categories - 7	Concert Designation (10)	- Tier 3 (3/4) CO2 Emissions summary - Tier 3 (4/	(4) Capture and storage or other	reduction	
- 2 - Industrial Processes and Product Use	Worksheet	Clinker production - Tier 2 CO2 Emissions from car	rbonates - Tier 3 (1/4) CO2 Emi	ssions from uncalcined CKD not recycled to	the kiln - Tier 3 (2/4)
2.A - Mineral Industry 2.A.1 - Cement production	Sector: Industrial Processes and Product Use Category: Mineral Industry	•			
- 2.A.2 - Lime production - 2.A.3 - Glass Production	Subcategory: 2.A.1 - Cement production Sheet CO2 Emissions from Cement production	on (1 of 2)			
	Data				
			Equation 2.1		
2.C - Metal Industry 2.D - Non-Energy Products from Fuels	Subdivision	Individual Type of Cement Produced	Mass of Individual Type of Cement Produced	Clinker Fraction in Cement	Mass of Clinker in the Individual Type of Cement Produced
			(tonne)	(Fraction)	(tonne)
⊕ 2.G - Other Product Manufacture and U	Δ γ	7 ۵7	A	В	C=A*B
⊞ 2.H - Other	Unspecified	type 1	56410	0.351	19799.91
H-3 - Agriculture Forestry and Other Land II		type 2	23541	0.655	15419.355

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Cement Production – Tier 1

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2006 IPCC Categories	CO2 Emissions from carbon-b Cement Production (1/2 Cer	earing non-fuel materia nent Production (2/2)	ls - Tier 3 (3/4) CC Clinker production -	02 Emissions summar Tier 2 CO2 Emissi	ry - Tier 3 (4/4) Cap ons from carbonates -	ture and storage or other reduction Tier 3 (1/4) CO2 Emissions from	n uncalcined CKD not recycled	to the kiln - Tier 3 (2/4)	
2.A.2 - Cline production 2.A.3 - Glass Production 2.A.4 - Other Process Uses of C -2.A.4.a - Ceramics -2.A.4.b - Other Uses of Sod -2.A.4.c - Non Metallurgical	Sector: Industrial Pr Category: Mineral Indu Subcategory: 2.A.1 - Cem Sheet: CO2 Emission Data	ocesses and Product U Istry ent production ns from Cement produc	se tion (2 of 2)						
2.A.4.d - Other (please specify)						Equation 2.1			
2.8.5 • Other (please specify) 2.8 • Chemical Industry 2.8.1 • Ammonia Production 2.8.2 • Nitric Acid Production 2.8.4 Addition	Subdivision	Mass of Clinker for Subdivision (tonne)	Imports for Consumption of Clinker (tonne)	Export of Clinker (tonne)	Emissio (tonne	n Factor for the Clinker es CO2/tonne Clinker)	CKD correction	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)
	ΔΥ	А		С		D	E	F = (A - B + C) * D * E	G = F / 1000
2.B.5 - Carbide Production	M Unspecified	81048.5	120	3540	Specified 🗸	0.51	1.02	43940.5137	43.94051
2.B.7 - Soda Ash Production 2.B.8 - Petrochemical and Carb		81048.5			Specified			43940.5137	43.94051
	Imp	ort and Ex (manua	al input)	inker	Emiss Tw Calculat (d	sion Factor – o Options: and or Specified rop-down)	vvner Defau (in d	I <u>Specified</u> – It Factor 0.51 drop-down)	





IPCC Inventory Software - pavel - [Worksheets]

(drop-down)



	Equation 2.4										
	Percentage CaO Content of Clinker (CaO) (%)	Percentage Non-carbonate sources of CaO (%)	Percentage CaO content of clinker from carbonate sources (%)	CaO percentage of CaCO3 (%)	Total CaCO3 needed for tonne CaO (tonne)	CO2 from calcining 1 tonne CaCO3 (tonne)	Emission Factor (uncorrected for Mg (tonnes CO2 / tonn Clinker)				
	A	В	C = A - B	D	E = C / D	F	G = E * F				
	► <u>65</u> ~	0	65	56.03	1.16009	0.44	0.510				
actor 65%	Cancel						Save				



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2006 IPCC Categories	CO2 Emissions from carbon-be Cement Production (1/2) Cer	earing non-fuel materia ment Production (2/2)	Ils - Tier 3 (3/4) CC Clinker production -)2 Emissions summa Tier 2 CO2 Emissi	ry - Tier 3 (4/4) Captu	re and storage or other reduct	tion from uncalcined CKD not recycled	to the kiln - Tier 3 (2/4)	
	Worksheet Sector: Industrial Pre-	ocesses and Product U	se						
2.A.4 - Other Process Uses of C 2.A.4.a - Ceramics	Category: Mineral Indu Subcategory: 2.A.1 - Cem	ustry ent production							
2.A.4.b - Other Uses of Sod 2.A.4.c - Non Metallurgical	Sheet : CO2 Emission	ons from Cement produc	tion (2 of 2)						
2.A.5 - Other (please specify)						Equation 2.1			
2.B - Chemical Industry 2.B.1 - Ammonia Production	Subdivision	Mass of Clinker for Subdivision	Imports for Consumption of	Export of Clinker	Emission	Factor for the Clinker	CKD correction	CO2 Emissions	CO2 Emissions
		(tonne)	(tonne)	(tonne)	(tonnes			(tonnes CO2)	(Gg CO2)
	Δγ	А		С			E	F = (A - B + C) * D * E	G = F / 1000
2.B.5 - Carbide Production	10 Unspecified	81048.5	120	3540	Calculated	0.51044	1.02	43978.49513	43.9785
- 2.B.6 - Titanium Dioxide Product	Total								
- 2.B.7 - Soda Ash Production		81048.5						43978.49513	43.9785
2.B.8 - Petrochemical and Carb									

		E	quation 2.4				
Percentage CaO Content of Clinker (CaO) (%)	Percentage Non-carbonate sources of CaO (%)	Percentage CaO content of clinker from carbonate sources (%)	CaO percentage of CaCO3 (%)	Total CaCO3 needed for tonne CaO (tonne)	CO2 from calcining 1 tonne CaCO3 (tonne)	Emission Factor (uncorrected for MgO) (tonnes CO2 / tonne Clinker)	Click Save (the calculate
A	В	C = A - B	D	E = C / D	F	G = E * F	
65	0	65	56.03	1.16009	0.44	0.51044	EF WIII
							automaticall
Cancel						Save	be transferre
						422	into the mai
							worksheet

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(in tonnes and Gg)

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2006 IPCC Categories • म 2.A.1 - Cement production • 2.A.2 - Lime production	CO2 Emissions from carbon-b Cement Production (1/2 Ce Worksheet	earing non-fuel materia ment Production (2/2)	als - Tier 3 (3/4) CO Clinker production -	D2 Emissions summa • Tier 2 CO2 Emissi	y - Tier 3 (4/4) Capture and s ons from carbonates - Tier 3 (1/4	torage or other reduction 4) CO2 Emissions from u	uncalcined CKD not recycled	to the kiln - Tier 3 (2/4)	
	Sector: Industrial Pr Category: Mineral Indu Subcategory: 2.A.1 - Cem Sheet: CO2 Emissi Data	rocesses and Product U ustry ent production ons from Cement produc	Jse ction (2 of 2)						
2 A 5 Other (please specify)					Equat	tion 2.1			
2.8.5 - Other (please specify) 2.8 - Chemical Industry 2.8.1 - Ammonia Production 2.8.2 - Nitric Acid Production 2.8.2 - Adiata Acid Production	Subdivision	Mass of Clinker for Subdivision (tonne)	Imports for Consumption of Clinker (tonne)	Export of Clinker (tonne)	Emission Factor ((tonnes CO2/to	for the Clinker Inne Clinker)	CKD correction	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)
2.B.3 - Adipic Acid Froduction	ΔΥ	A	В	С		D	E	F = (A - B + C) * D * E	G = F / 1000
	10 Unspecified	81048.5	120	3540	Calculated	0.51044 📝	1.02 🗸	43978.49513	43.9785
2.B.6 - Titanium Dioxide Product	Total						1.02		
2.B.7 - Soda Ash Production		81048.5						43978.49513	43.9785
Prochemical and Carb					Default Fac – 1.02 (in dro	ctor for CKD 2 or 2% p-down)	Ca	Iculated Amour	nt of

2.A.1 Cement Production

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Tier 2

Tier 2 – Clinker AD

TIER 2 METHOD: USE OF CLINKER PRODUCTION DATA

If detailed and complete data (including weights and composition) for carbonate(s) consumed in clinker production are not available (Tier 3), or if a rigorous Tier 3 approach is otherwise deemed impractical, it is *good practice* to use aggregated plant or national clinker production data and data on the CaO content in clinker, expressed as an emission factor in the following Equation 2.2:



Where:

2006 IPCC Guidelines for National Greenhouse Gas Inventories

2.9

Volume 3: Industrial Processes and Product Use

CO2 Emissions = emissions of CO2 from cement production, tonnes

Mcl=weight (mass) of clinker produced, tonnes

EF_{cl} = emission factor for clinker, tonnes CO₂/tonne clinker (See discussion under Section 2.2.1.2, Choice of Emission Factors, for Tiers 1 and 2 below.) This clinker emission factor (EF_{cl}) is not corrected for CKD.

 CF_{ckd} = emissions correction factor for CKD, dimensionless (see Equation 2.5)

Tier 2 – Specific EF for Clinker

TIER 2 METHOD

Emission factor for clinker (EF_{cl})

In the Tier 2 method, if sufficient country-specific data on CaO content of clinker and inputs of non-carbonate CaO sources are available, it is *good practice* to estimate a country-specific CO_2 emission factor for clinker. As noted above, the derivation of an emission factor for clinker requires that the CaO content of the clinker be known, as well as the fraction of CaO that was derived from a carbonate source (generally CaCO₃). The CaO content of clinker is generally within the range of 60 to 67 percent. At a given plant the CaO content will remain stable to within 1 to 2 percent. The basic default emission factor, as recommended under Tier 1, assumes that the clinker is 65 percent CaO and that this is 100 percent derived from CaCO₃ and that 100 percent calcination is achieved in the kiln.

The base (i.e., uncorrected for CKD) 0.51 emission factor in Equation 2.4 assumes a 65 percent CaO content in clinker. A similar calculation would yield emission factors for different CaO contents, if these contents are known. For example, for a clinker with 60 percent CaO all derived from $CaCO_3$ the EF_{cl} (not including a correction for CKD) is 0.47, and for 67 percent CaO the EF_{cl} is 0.53.

If it is known that a plant is deriving a significant fraction of CaO from a non-carbonate source (such as steel slag or fly ash), then this component of CaO should first be subtracted. For example, if 4 percent of the CaO in a 65 percent CaO clinker is from slag, then the CaO from carbonate is 61 percent and the calculation for this yields an EF_{cl} of 0.48.

The default emission factor does not include a correction for MgO. For every 1 percent of MgO derived from carbonate the emission factor is an additional 0.011 tonne CO_2 /tonne clinker (i.e., $EF_{cl} = 0.510 + 0.011 = 0.52$ tonne CO_2 /tonne clinker). Because MgO also may come from a non-carbonate source and because the MgO is deliberately kept low in portland cement, the true MgO from carbonate is likely to be very small. Given the fact that the assumption of a 100 percent carbonate source for the CaO already yields an overestimation of emissions (there is likely to be at least some contribution of CaO from non-carbonate sources) and the fact that some of the MgO is also likely to be from a non-carbonate source, a correction for MgO is not required for a Tier 2 calculation. For uncertainties associated with these assumptions please refer to Table 2.3.

Tier 2 – Specific Correction Factor for CKD

The CKD correction factor (CF_{ckd}) for use in Equation 2.2 can be derived as:

EQUATION 2.5 CORRECTION FACTOR FOR CKD NOT RECYCLED TO THE KILN $CF_{ckd} = 1 + (M_d / M_{cl}) \bullet C_d \bullet F_d \bullet (EF_c / EF_{cl})$

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Where:

 CF_{ckd} = emissions correction factor for CKD, dimensionless

 M_d = weight of CKD not recycled to the kiln, tonnes^a

 M_{cl} = weight of clinker produced, tonnes

 C_d = fraction of original carbonate in the CKD (i.e., before calcination), fraction^b

 F_d = fraction calcination of the original carbonate in the CKD, fraction^b

 EF_c = emission factor for the carbonate (Table 2.1), tonnes CO₂/tonne carbonate

EF_{cl} = emission factor for clinker uncorrected for CKD (i.e., 0.51 tonnes CO₂/tonne clinker), tonnes CO₂/tonne clinker







Cement Production – Tier 2





Tier 2 – Calculated EF for clinker





Tier 2 – Calculated Correction Factor for CKD

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2.A.1 Cement Production

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Tier 3
Tier 3 – Carbonates Input



Where:

CO2 Emissions = emissions of CO2 from cement production, tonnes

 EF_i = emission factor for the particular carbonate *i*, tonnes CO₂/tonne carbonate (see Table 2.1)

 M_i = weight or mass of carbonate *i* consumed in the kiln, tonnes

 F_i = fraction calcination achieved for carbonate *i*, fraction^a

M_d = weight or mass of CKD not recycled to the kiln (= 'lost' CKD), tonnes

C_d = weight fraction of original carbonate in the CKD not recycled to the kiln, fraction^b

 F_d = fraction calcination achieved for CKD not recycled to kiln, fraction^a

- EF_d = emission factor for the uncalcined carbonate in CKD not recycled to the kiln, tonnes CO₂/tonne carbonate^b
- M_k = weight or mass of organic or other carbon-bearing nonfuel raw material k, tonnes^c
- X_k = fraction of total organic or other carbon in specific nonfuel raw material k, fraction^c
- EF_k = emission factor for kerogen (or other carbon)-bearing nonfuel raw material k, tonnes CO₂/tonne carbonate^c

Cement Production – Tier 3

The Software breaks the Equation 2.3 into four worksheets:

- **Emissions from Carbonates**
- ii) Emissions from uncalcined CKD not recycled into the kiln
- iii) Emissions from carbon-bearing materials
- CO₂ Emissions Summary (Total) iv)



IPCC Inventory Software - pavel - [Worksheets]

🖳 Application Database Inventory Ye	ar Administrate	Worksheets Tools	Export/Import Reports	s Window Help					
2006 IPCC Categories 🗸 👎	CO2 Emissions f	rom carbon-bearing non-fuel	materials - Tier 3 (3/4)	02 Emissions summ	ary - Tier 3 (4/4) Capture a	nd storage or other reduction			
	Cement Productio	ment Production (1/2) Cement Production (2/2) Clinker production - Tier 2 CO2 Emissions from carbonates - Tier 3 (1/4) CO2 Emissions from uncalcined CKD not recycled to the kiln - Tier 3 (2/4)							
2.A.2 - Lime production	Worksheet	Ksneet							
2.A.3 - Glass Production 2.A.4 - Other Process Uses of C	Category:	atenony Mineral Industry							
-2.A.4.a - Ceramics	Subcategory:	category: 2 A 1 - Cement production							
2.A.4.b - Other Uses of Sod	Sheet:	et: CO2 Emissions from carbonates - Tier 3 (1/4)							
2.A.4.c - Non Metallurgical	Data	ıta							
2.A.4.d - Other (please speci		Equation 2.3 (1)							
2.A.5 - Other (please specify)						1410112.5(1)			
E-2.B - Chemical Industry					Mass of Carbonate	Emission Factor	Fraction calcination	CO2 Emissions from carbonates	
2.B.1 - Ammonia Production		Subdivision	Carbona	ate type	consumed (toppes)	(tonnes CO2/tonne	achieved for carbonate (Fraction)	(tonnes CO2)	
- 2 B 3 - Adinic Acid Production					(torines)	Carbonatej	(Tacuon)		
- 2.B.4 - Caprolactam, Glyoxal an		4	i 🗸	$\Delta \nabla$	Mi	EFi	Fi	Ei = EFi * Mi * Fi	
2.B.5 - Carbide Production	*								
- 2.B.6 - Titanium Dioxide Product	Total								
						0		(]
2.B.8 - Petrochemical and Carb									

Cement Production – Tier 3 (1/4)

INTERGOVERNMENTAL PAN<u>EL ON **CLIMATE CHANE**</u>



IPCC Inventory Software - TSU - [Worksheets]



Cement Production – Tier 3 (2/4)



IPCC Inventory Software - TSU - [Worksheets]

🛃 Application Database Inventory Y	'ear Administra	ate Worksheets Tools	Export/Import Reports	Window Help				
2006 IPCC Categories - 7	CO2 Emissions fr Cement Production	om carbon-bearing non-fuel mat n (1/2) Cement Production (2/	terials - Tier 3 (3/4) CO2 Emis /2) Clinker production - Tier 2	ssions summary - Tier 3 (4/4) CO2 Emissions from carbona	Capture and storage the ates - Tier 3 (1/4) CO2 Emis	sions from uncalcined CKD not	recycled to the kiln - Tier 3 (2/4)	
	Worksheet Sector: Category: Subcategory: Sheet: Data	Industrial Processes and Produc Mineral Industry 2.A.1 - Cement production CO2 Emissions from uncalcined	ct Use I CKD not recycled to the kiln - Tie	er 3 (2/4)				
2.A.3 - Glass Production 2.A.4 - Other Process Uses	Equation 2.3 (2)							
2.A.4.a - Ceramics 2.A.4.b - Other Uses of S 2.A.4.c - Non Metallurgic 2.A.4.d - Other (please s 2.A.5 - Other (please specify		Subdivision	Weight or mass of CKD not recycled to the kiln (tonnes)	Weight fraction of original carbonate in the CKD not recycled to the kiln (Fraction)	Fraction calcination achieved for CKD not recycled to kiln (Fraction)	Emission factor for the uncalcined carbonate in CKD not recycled to the kiln (tonnes CO2/tonne carbonate)	CO2 Emissions from uncalcined CKD not recycled to the kiln (tonnes CO2)	
= 2.B - Chemical Industry		Y	Md	Cd	Fd 🛆	EFd	Ed = Md*Cd*(1-Fd)*EFd	
2.B.1 - Ammonia Production	CementPro		570	1	0.97	0.43971	7.51904	
2.B.2 - Nitric Acid Production	*				· · · · · · · · · · · · · · · · · · ·			
- 2.B.4 - Caprolactam, Glyoxal	Total		E70			Λ	7.51004	
- 2.B.5 - Carbide Production			5/0				1,01004	
		Amount of C recycled f (manual input	CKD not to kiln ut of AD)	Default or Use arbonate Fract default – 1 or ma	r-defined ion in CKD anual input)	Calcination Fa (default – 1 manual inpu	or (default or (t) (t)	

Cement Production – Tier 3 (3/4)

IPCC Inventory Software - TSU - [Worksheets]



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Cement Production – Tier 3 (4/4)

IPCC Inventory Software - TSU - [Workshipsing]	neets]					– o ×
🖳 Application Database Inventory	Year Administrate Worksheets	Tools Export/Import Reports Wi	ndow Help			_ & ×
2006 IPCC Categories	Cement Production (1/2) Cement Produ CO2 Emissions from carbon-bearing non- Worksheet Sector: Industrial Processes an Category: Mineral Industry Subcategory: 2.A.1 - Cement product Sheet: CO2 Emissions summa	uction (2/2) Clinker production (2/2) Clinker production -fuel materials - Tier 3 (3/4) CO2 Emission nd Product Use tion ny - Tier 3 (4/4)	ns summary - Tier 3 (4/4)	(4) CO2 Emissions from uncalcined CKD n storage or other reduction	ot recycled to the kiln - Tier 3 (2/4)	2015
2.A.3 - Glass Production				uation 2.3		
-2.A.4.a - Ceramics -2.A.4.b - Other Uses of S -2.A.4.c - Non Metallurgic -2.A.4.d - Other (please s	Subdivision	CO2 Emissions from carbonates (tonnes CO2)	D2 Emissions from uncalcined CKD no recycled to the kiln (tonnes CO2)	CO2 Emissions from carbon-bearing nun- fuel materials (tonnes CO2)	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)
2.A.5 - Other (please specify	Δ 7	Ei	Ed	Ek	E = Ei - Ed + Ek	E/1000
2.B - Chemical Industry	CementPro	5474.389	1.51904	2967.195	8434.06546	8.43407
2.8.2 - Nitric Acid Production 2.8.3 - Adipic Acid Productio 2.8.4 - Canrolactam Glyoxal		5474.3895	7.51904	2967.195	8434.06546	8.43407
	TIER 3: EMI CO ₂ Emi	Equations Based on CARBO $ssions = \sum_{i} (EF_i \bullet M_i \bullet F_i) - i$ Emissions from carbonates	UATION 2.3 EVATE RAW MATERIAL $M_d \bullet C_d \bullet (1-F_d) \bullet EF_d + C_d \bullet$	Emissions from arbon-bearing non- tivel materials		

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2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE



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CO₂ Capture

2A1 Cement Production

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- Should CO₂ capture technology be installed and used at a plant, it is good practice to deduct the CO₂ captured in a higher tier emissions calculation.
- The default assumption is that there is no CO₂ capture and storage (CCS) taking place.
- O Any methodology taking into account CO₂ capture should consider that CO₂ emissions captured in the process may be both combustion and process-related. In cases where combustion and process emissions are to be reported separately, e.g. for cement production, inventory compilers should ensure that the same quantities of CO₂ are not double counted. In these cases, the total amount of CO₂ captured should preferably be reported in the corresponding energy combustion and IPPU source categories in proportion to the amounts of CO₂ generated in these source categories.

CO2 Emissions from carbon-bearing non-fuel materials - Tier 3 (3/4) CO2			CO2 Emissions summary	Tier 3 (4/4 Capture and store	age or other reduction	Cement Production (1/2)	Cement Production (2/2)	Clinker production	
Sector: Category Subcateg Sheet:	Industrial Processe Mineral Industry gory: 2.A.1 - Cement pro Capture and storag	es and Product duction ge or other redu	Use						
Gas	CARBON DIOXIDE (CO2)		~						
	Subdivision			Source	Amount CO2 captured and stored (tonne)	Other reduction (tonne)	Total redu (tonne	ction Total)	reduction (Gg)
	S	۵V		SRC 47	A	В	C = A +	B C	/ 1000
Unsp	pecified		Unspecified		200000		25000	225000	225



✓ Now let's do Exercises with Dummy data

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON **Climate change**



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Tier 1

Dummy Data – Tier 1

• There are two cement production companies in Country X (Company A and Company B).

- Company A produced 2,534 kt of cement in 2015 and 3,112 kt in 2022.
 - Cement is a product mix, so called '30/70' (30% portland cement and 70% blended cement) and 20% additives
- Company B produced 1,204kt of cement in 2015 and 4,205 kt in 2022.
 - ✓ Detailed information on cement type was not reported, but it is supposed that significant amounts of blended and/or masonry cements were produced in addition to portland cement (*i.e.* blended/masonry was much).
- Company B exported 45 kt of clinker in 2015 and 67 kt in 2022 (there is no import)

Dummy Data – Tier 1



• As regards clinker fraction to be used in the calculation, see Table 2.2 from the 2006 IPCC Guidelines

TABLE 2.2 CLINKER FRACTION OF BLENDED CEMENT 'RECIPES' AND OVERALL PRODUCT MIXES (BASED ON U.S. STANDARDS ASTM C-150 AND C-595; U.S. DATA MAY BE ILLUSTRATIVE FOR OTHER COUNTRIES)								
Cement Name	Symbol	Recipe	% Clinker	Notes				
Portland	'PC'	100% PC	95 - 97 90 - 92	Some U.S. states allow inclusion of 3% GGBFS. Latest standards allow inclusion of \leq 5% ground limestone.				
Masonry	'MC'	2/3 PC	64	varies considerably				
Slag-modified portland	I(SM)	slag < 25%	>70 - 93					
Portland BF Slag	IS	slag 25-70%	28 - 70					
Portland pozzolan	IP and P	pozz 15-40%	28 - 79/81	base is PC and/or IS				
Pozzolan-modified portland	I(PM)	pozz <15%	28 - 93/95	base is PC and/or IS				
Slag cement	S	slag 70+%	<28/29	can use CaO instead of clinker				
		PE	RCENT CLI	NKER IN THE PRODUCT MIX				

			-					_		-			
Dovoo	mt A	ddiff		(Dog	rolon	1.1	Clog	1	41.0	DL.	m.d.	Com	+

					67		
	Product Mix (PC/blend)**	0%	10%	20%	30%	40%	75%
-	100/0	<mark>95 - 97</mark>	0	0	0	0	0
	0/100	0	85.5	76	66.5	57	23.8
	15/85	14.2	86.9	78.9	70.8	62.7	26.4
	25/75	23.8	87.9	80.8	73.6	66.5	41.6
	30/70	28.5	88.35	81.7	75.1	68.4	45.2
	40/60	38	89.3	83.6	77.9	72.2	52.3
	50/50	47.5	90.3	85.5	80.8 ***	76	59.4
	60/40	57	91.2	87.4	83.6	79.8	66.5
	70/30	66.5	92.2	89.3	86.5	83.6	73.6
	75/25	71.1	92.6	90.1	87.8	85.4	77.1
	85/15	80.8	93.6	92.2	90.7	89.3	84.3

2.A.1 Cement Production

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Tier 2

2.A.1 Tier 2 – Clinker AD

 Company CementCarbo reports data based on clinker production. It produced 534 kt of clinker in 2015 and 612 kt in 2022.

- \odot For estimation of CO₂ EF from clinker, use the default CaO content in clinker 65%.
- For the data concerning the correction factor for cement kiln dust (CKD), see the table below (plant-specific data).

Parameter	2015	2022
Weight of CKD not recycled to the kiln (Md), tonne	65,230.0	74,940.0
Weight of clinker produced (McI), tonne	534,000.0	612000.0
Fraction of original carbonate in the CKD before calcination (Cd), fraction	1	1
Fraction calcination of the original carbonate in the CKD (Fd), fraction	1	1
Emission factor for the carbonate (EFc), tonne CO ₂ / tonne carbonate	0.43971	0.43971
Emission factor for clinker uncorrected for CKD (EFcI), tonne CO ₂ / tonne clinker	0.51044	0.51044

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON **Climate change**



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Tier 3

2.A.1 Tier 3 – Carbonates Input

 Company CementPro reports data based on the amount of carbonates consumed in cement production process:

- i. Carbonates used: amount of limestone (calcite CaCO3) used 12,45 kt in 2015 and 10.05 kt in 2022, calcination fraction achieved is assumed to be 100%
- ii. Correction for uncalcined CKD: the amount of CKD not recycled to the kiln 0.57 kt in 2015 and 0.51 kt in 2022, the weight fraction of original carbonate in the CKD not recycled to the kiln is assumed to be 100%, the calcination fraction is 0.99, the EF for Calcite is 0.43971 tonne CO₂/ tonne carbonate.
- iii. Additional carbon-bearing non-fuel materials Kerogen: the amount of kerogen used 1,05 kt in 2015 and 0.5 kt in 2022, carbon content 77%, the EF 3.67 tonne CO₂/ tonne of carbon.

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE



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CO₂ Capture

2A1 – CO₂ Capture

 Company X captured at the cement plant 200kt of CO₂ for the subsequent geological storage and 25kt of CO₂ for use (for re-conversion to carbonates, for production of methanol, etc.) in 2015. For 2022, the amounts are the same.

Examples of Data Input

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Iron and Steel (2.C.1)



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



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○ 2006 IPCC Guidelines provide three Tiers for CO₂

- Tier 1 (EF approach)
- Tier 2 (mass-balance approach using specific carbon content data)
- Tier 3 (mass-balance approach with plant-specific data)

○ 2006 IPCC Guidelines provide two Tiers for CH₄

- Tier 1 (default EFs)
- Tier 3 (plant-specific data)

1.A.1.c Coke Production - Tiers

- 2006 IPCC Guidelines: Tier 1 AD x EF
- \circ 2019 Refinement: Tier 1a AD x EF

Tier 1b – simplified carbon balance of carbon content of coking coal minus coke

INTERGOVERNMENTAL PANEL ON CLIMATE CHANS

- Tier 2 method for estimating CO₂ emissions is a mass-balance approach based on carbon content of all input and output materials. Tier 3 uses plant specific data.
- Tier 2 method is not applicable to estimating CH4 emissions (it is a mass-balance for all Carbon and subsequent CO₂)

N.B. Emissions from Coke Production should be reported in Energy Sector (in category 1.A.1.c Manufacture of Solid Fuels (not 2.C.1 !!!))

When preparing the JSON file for interoperability, these AD and emissions are automatically reported in Energy sector

Tier 1

EQUATION 4.4 CO₂ EMISSIONS FROM IRON AND STEEL PRODUCTION (TIER 1)

Iron & Steel: $E_{CO2, non-energy} = BOF \bullet EF_{BOF} + EAF \bullet EF_{EAF} + OHF \bullet EF_{OHF}$

 CO_2 Emissions = $\Sigma(AD_i \times EF_i)$

Equations 4.4-4.8

AD_{*i*} - quantity of material *i* produced, tonne

EF_i - emission factor for production of material *i*, tonne CO₂/tonne material *i* produced EQUATION 4.5 CO₂ EMISSIONS FROM PRODUCTION OF PIG IRON NOT PROCESSED INTO STEEL (TIER 1)

Pig Iron Production: $E_{CO2, non-energy} = IP \bullet EF_{IP}$

EQUATION 4.6 CO₂ EMISSIONS FROM PRODUCTION OF DIRECT REDUCED IRON (TIER 1)

Direct Reduced Iron: $E_{CO2, non-energy} = DRI \bullet EF_{DRI}$

EQUATION 4.7 CO₂ EMISSIONS FROM SINTER PRODUCTION (TIER 1) Sinter Production: $E_{CO2, non-energy} = SI \bullet EF_{SI}$

EQUATION 4.8 CO₂ EMISSIONS FROM PELLET PRODUCTION (TIER 1) Pellet Production: $E_{CO2, non-energy} = P \bullet EF_P$

Tier 1 – Default EFs

TABLE 4.1 TIER 1 DEFAULT CO ₂ EMISSION FACTORS FOR COKE PRODUCTION AND IRON & STEEL PRODUCTION						
Process	Emission Factor	Source				
Sinter Production (tonne CO ₂ per tonne sinter produced)	0.20	Sinter Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 4.1, Page 29. http://eippcb.jrc.es/pages/FActivities.htm				
Coke Oven (tonne CO ₂ per tonne coke produced)	0.56	Coke Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 6.2, Page 122. http://eippcb.jrc.es/pages/FActivities.htm				
Iron Production (tonne CO ₂ per tonne pig iron produced)	1.35	Iron Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Tables 7.2 and 7.3. http://eippcb.jrc.es/pages/FActivities.htm				
Direct Reduced Iron production (tonne CO ₂ per tonne DRI produced)	0.70	Direct Reduced Iron Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 10.1 Page 322 and Table 10.4 Page 331. http://eippcb.jrc.es/pages/FActivities.htm				
Pellet production (tonne CO ₂ per tonne pellet produced)	0.03	Pellet Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 5.1 Page 95. http://eippcb.jrc.es/pages/FActivities.htm				
Steelmaking Method						
Basic Oxygen Furnace (BOF) (tonne CO ₂ per tonne of steel produced)	1.46	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)				
Electric Arc Furnace (EAF) (tonne CO ₂ per tonne of steel produced) **	0.08	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)				
Open Hearth Furnace (OHF) (tonne CO ₂ per tonne of steel produced)	1.72	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)				
Global Average Factor (65% BOF, 30% EAF, 5% OHF)* (tonne CO ₂ per tonne of steel produced)	1.06	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)				







Iron and Steel – Tier 1

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IPCC Inventory Software - TSU - [Worksheets]

🖳 Application Database Inventory Year Administrate Work	sheets Tools Export/Import	Reports Window He	elp				
2006 IPCC Categories 🔹 🤻 CO2 Emissions from Sinter Pr	oduction - Tier 2/3 CO2 Emission	s from Direct Reduced Iron Pr	roduction - Tier 2/3	Colorisations from Dellat Desilections. The	2/2 Copture and storage or	other reduction	
CO2 and CH4 Emissions from 2.A.2 - Lime production 2.A.3 - Glass Production CO2 and CH4 Emissions from Worksheet Sector: Industrial P	Coke Production CO2 Emissions frocesses and Product Use	rom metallurgical coke produ	ction (mass balance))2 and CH4 Emissions from Iron and Ste	el Production CO2 Emission	s from Iron and Steel Production - T	
2.A.4 - Other Process Uses Category: Metal Indus 2.A.4 - Ceramics Subcategory: 2.C.1 km	stry and Steel Production				Default or Us	ser-defined	
-2.A.4.b - Other Uses of Sheet: CO2 and C	H4 Emissions from Iron and Steel Production	ction			Emission Fa	ctor (default	
)2) 🗸				from table or manual input)		
2.A.5 - Other (please specify	CARBON DIOXIDE (CO2)						
2.B - Chemical Industry METHANE (CH4)							
		aleration Mathead at	Amount of Steel or Iron	CO2 Emission Factor	C 02 Emissions	CO2 Emissions	
	n Type of Ste	eimaking method, etc	(tonne)	(tonnes CO2 / tonne produced)	(tonnes CO2)	(Gg CO2)	
	ΔΥ	ΔΥ	Р	EF	E = P * EF	E / 1000	
2.B.7 - Soda Ash Production National	Basic Oxygen Fu	rnace (BOF)	6120	00 1.4	6 89352	0 893.52	
2.B.8.a - Methanol	Open Hearth Furr	nace (OHF)	4250	00 1.7	2 73100	0 731	
2.B.8.b - Ethylene		Description	1820		CO2 Emission Eactor	JU 36.4	
-2.B.8.c - Ethylene Dichlo	Process	Direct Reduced Iron		Description (ton	nes CO2 / tonne produced)	Remark	
2.B.8.e - Acrylonitrile		production	12190	00 Sinter Production	0.2	Sinter Production: European IPPC E	
2 B & f - Carbon Black		Iron Production				Available Techniques Reference D	
		Pellet production				Production of Iron and Steel, Decen Page 29, http://einpob.irc.es/pages/	
		Sinter Production				age 23. http://eippeb.jrc.es/pages/	
Default or User-Defined	Steelmaking Method	Basic Oxygen Furnace (BOF)					
Type of Process		Electric Arc Furnace (E/	AF) Amou	nt of Material			
(drop-down and manual	(drop-down and manual			roduced			
input)		Open Hearth Furnace (OHF)	(manu	al input of AD)			

INTERGOVERNMENTAL PANEL ON Climate change



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Tier 2/3

<u>Tier 2</u> is a mass-balance approach. It is appropriate when the inventory compiler has access to <u>national data</u> on the use of process materials for iron and steel production, sinter production, pellet production, and direct reduced iron production.

<u>Tier 3 uses plant specific data.</u>



✓ Mass-balance of Input and Output materials multiplied by Carbon Content. The difference is CO₂ emissions.

Biogenic component

• Some input materials may be of a biogenic origin. Emissions from biogenic component is not included in the national total.

INTERGOVERNMENTAL PANEL ON CLIMATE CHAN

• In Iron and Steel Production *biochar/charcoal* can be used instead of *coal* or *coke*.

Iron and Steel – Tier 2/3 (#1)

INTERGOVERNMENTAL PANEL ON Climate change

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IPCC Inventory Software - TSU - [Worksheets]



By-product	Quantity of on-site coke oven by- product consumed in blast furnace (tonnes)	Carbon Content of by-product (tonnes C/tonne By-product)	Biogenic	Total Carbon in on-site by-products consume furnace (tonnes C)
	BP	СС		C = BP * CC
 Coke oven by-product BP1 	8200	0.1		
By-product gas G1	1000	0.6		
*				
Total				
	9200		Total carbon:	
			Biogenic carbon:	
			Biogenic fraction:	

Input Materials: Amount and Carbon Content (manual input and drop-down for defaults)

Coke, Coal, Limestone, Coke oven by-products

Iron and Steel – Tier 2/3 (#2)

INTERGOVERNMENTAL PANEL ON **Clima<u>te</u> change**



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IPCC Inventory Software - TSU - [Worksheets]



Iron and Steel – Tier 2 (#3)

INTERGOVERNMENTAL PANEL ON Climate change

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	UN (P) environment programme
	programme
WMO	programme

IPCC Inventory Software - TSU - [Worksheets] Application Database Inventory Year Administrate Worksheets Tools Export/Import Reports Window Help - 8 2006 IPCC Categories **-** CO2 Emissions from Pellet Production - Tier 2/3 Capt CO2 Emissions from Sinter Production - Tier 2/3 CO2 Emissions from Direct Reduced Iron Production - Tier 2/3 CO2 Emissions from Iron and Steel Production - Tier 2/3 = 2.C - Metal Industry CO2 and CH4 Emissions from Coke Production CO2 Emissions from metallurgical coke production (mass balance) CO2 and CH4 Emissions from Iron and Steel Production 2.C.1 - Iron and Steel Produ Worksheet 1990 2.C.2 - Ferroallovs Producti Industrial Processes and Product Use Sector: 2.C.3 - Aluminium productio Metal Industry Category: 2.C.4 - Magnesium producti 2.C.1 - Iron and Steel Production Subcategory: 2.C.5 - Lead Production Sheet: CO2 Emissions from Iron and Steel Production - Tier 2 / 3 2.C.6 - Zinc Production Data 2.C.7 - Rare Earths Producti 2.C.8 - Other (please specif Quantity of Blast furnace - 2.D - Non-Energy Products from Quantity of iron Quantity of steel blast furnace Annual non-Energy 2.D.1 - Lubricant Use Carbon Content of blast furnace gas Annual non-Energy CO2 emissions of steel produced production not produced converted to steel gas transferred (Mass. CO2 emissions (tonnes C / tonne converted to steel (tonnes C/GJ) (tonnes CO2) 2.D.2 - Paraffin Wax Use (Gg CO2) (tonnes) (tonnes C / tonne offsite Volume or factor Steel) (tonnes) 2.D.3 - Solvent Use Energy Unit) (GJ / Unit) Iron) 2.D.4 - Other (please specif E = [PC * Cpc + BPC + Cl * Cci + L * Cl + D * -2.E - Electronics Industry Cd + CE * Cce + PM + COG * CFcog * Ccog -E/1000 BG CFbg Cbg 2.E.1 - Integrated Circuit or S * Cs - IP * Cip - BG * CFbg * Cbg] * 44/12 2.E.2 - TFT Flat Panel Displ 0.003 500000 0.05 30000 GJ 0.0708 4074783,16667 4074.78317 1000000 1 Fuel Manager 2 E 3 - Photovoltaics Fuel Manager 0.0708 2.E.4 - Heat Transfer Fluid Specified 2.E.5 - Other (please specify 1000000 500000 30000 Including Biogenic CO2: 4074783.16667 4074,78317 - 2.F - Product Uses as Substitut 844.38259 Excluding Biogenic CO2: 844382.58747 - 2.F.1 - Refrigeration and Air **Drop-down menu Output Materials:** Results for Carbon Content Amount and Carbon Content Steel, Iron, BFG *(either from Fuel)* (manual input and drop-down Manager or Specified for defaults) – manual input)



Now let's do Exercises with Dummy data

INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE



Tier 1

Dummy Data – Tier 1

- There are two steel-making plants. They use two main steel-making processes:
- i) Basic oxygen furnace (BOF), where 612kt of steel was produced in 2015 and 720 kt in 2022
- ii) Open hearth furnace (OHF), where 425kt of steel was produced in 2015 and 312 kt in 2022.
 Also, 182kt of sinter was produced in 2015 and 199 kt in 2022.
- Estimate CO₂ emissions from Iron and Steel Production in 2015 and 2022 (as regards emission factors to be used in the calculation, see Table 4.1 of the 2006 IPCC Guidelines).

TABLE 4.1 TIER 1 DEFAULT CO ₂ EMISSION FACTORS FOR COKE PRODUCTION AND IRON & STEEL PRODUCTION		
Process	Emission Factor	Source
Sinter Production (tonne CO ₂ per tonne sinter produced)	0.20	Sinter Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 4.1, Page 29. http://eippcb.jrc.es/pages/FActivities.htm
Coke Oven (tonne CO ₂ per tonne coke produced)	0.56	Coke Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 6.2, Page 122. http://eippcb.jrc.es/pages/FActivities.htm
Iron Production (tonne CO ₂ per tonne pig iron produced)	1.35	Iron Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Tables 7.2 and 7.3. http://eippcb.jrc.es/pages/FActivities.htm
Direct Reduced Iron production (tonne CO ₂ per tonne DRI produced)	0.70	Direct Reduced Iron Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 10.1 Page 322 and Table 10.4 Page 331. http://eippcb.jrc.es/pages/FActivities.htm
Pellet production (tonne CO ₂ per tonne pellet produced)	0.03	Pellet Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 5.1 Page 95. http://eippcb.jrc.es/pages/FActivities.htm
Steelmaking Method		
Basic Oxygen Furnace (BOF) (tonne CO ₂ per tonne of steel produced)	1.46	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)
Electric Arc Furnace (EAF) (tonne CO ₂ per tonne of steel produced) **	0.08	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)
Open Hearth Furnace (OHF) (tonne CO ₂ per tonne of steel produced)	1.72	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)
Global Average Factor (65% BOF, 30% EAF, 5% OHF)* (tonne CO ₂ per tonne of steel produced)	1.06	Steel Production: Consensus of experts and IISI Environmental Performance Indicators 2003 STEEL (International Iron and Steel Institute, 2004)

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Tier 2/3
Dummy Data – Tier 2/3

• Company ZZZ reports the following input and output materials (in tonnes) in 2015 and 2022:

Input materials	2015	2022	Output Materials	2015	2022
Coke	360 000	450 000	Steel	1 020 000	1 275 000
Coal	160 000	200 000	Iron	980 000	1 225 000
Limestone	75 000	94 000	BFG	5 500 GJ	6 875 GJ
Dolomite	1 000	1 250	All value	es are in tonn	es, except
Natural Gas	2 200	2 750		BFG in GJ	
COG	11 000	13 750			

- Assume user applies all IPCC default carbon contents, see Table 4.3 of the 2006 IPCC Guidelines
- Estimate CO₂ emissions from Iron and Steel Production
- Also, let's tick the *biogenic* component and see the different results

T TIER 2 MATERIAL-SPECIFIC CARBON CONTENTS	able 4.3 For iron & steel and coke production (kg C/kg)
Process Materials	Carbon Content
Blast Furnace Gas	0.17
Charcoal*	0.91
Coal ¹	0.67
Coal Tar	0.62
Coke	0.83
Coke Oven Gas	0.47
Coking Coal	0.73
Direct Reduced Iron (DRI)	0.02
Dolomite	0.13
EAF Carbon Electrodes ²	0.82
EAF Charge Carbon ³	0.83
Fuel Oil ⁴	0.86
Gas Coke	0.83
Hot Briquetted Iron	0.02
Limestone	0.12
Natural Gas	0.73
Oxygen Steel Furnace Gas	0.35
Petroleum Coke	0.87
Purchased Pig Iron	0.04
Scrap Iron	0.04
Steel	0.01

Source: Default values are consistent with the those provided in Vol 2 and have been calculated with the assumptions below. Complete references for carbon content data are included in Table 1.2 and 1.3 in Volume 2, Chapter 1.

Notes:

Assumed other bituminous coal

Assumed 80 percent petroleum coke and 20 percent coal tar

Assumed coke oven coke

Assumed gas/diesel fuel

* The amount of CO₂ emissions from charcoal can be calculated by using this carbon content value, but it should be reported as zero in national greenhouse gas inventories. (See Section 1.2 of Volume 1.)

2.C.1 Iron and Steel Production

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Coke Production – Tier 1 (to be reported in Energy – 1.A.1.c)

Dummy Data – Tier 1

Tier 1 default CO₂ emission factor

 TABLE 4.1

 TIER 1 DEFAULT CO₂ EMISSION FACTORS FOR COKE PRODUCTION AND IRON & STEEL PRODUCTION

 Process
 Emission Factor
 Source

 Coke Oven (tonne CO₂ per tonne coke produced)
 0.56
 Coke Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 6.2, Page 122. http://eippcb.jrc.es/pages/FActivities.htm

Tier 1 default CH4 emission factor

TABLE 4.2 TIER 1 DEFAULT CH4 EMISSION FACTORS FOR COKE PRODUCTION AND IRON & STEEL PRODUCTION					
Process	Emission Factor	Source			
Coke Production	0.1 g per tonne of coke produced	Coke Production: European IPPC Bureau (2001), Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, Table 6.2-3, Page 122. http://eippcb.jrc.es/pages/FActivities.htm			

 Region North produced 45 kt of coke and Region South produced 1.2 kt of coke in 2015. In 2022 – 61 kt and 1.9 kt respectively.

 Estimate CO₂ and CH₄ emissions from Coke Production. As regards emission factors to be used in the calculation, see the Tables 4.1 and 4.2 from the 2006 IPCC Guidelines.

 Track CO2 and CH4 emissions from Coke Production in Reporting tables !



2.B.8 Petrochemical and Carbon Black Production (Example of Data Input for

2.B.8.b Ethylene)

2.B.8 Petrochemical Industry – Tier 1

Tier 1 product-based emission factor method

The Tier 1 emission factor methodology is applied to estimate CO_2 emissions from the petrochemical process in cases where neither plant specific data nor activity data for carbon flows are available for the petrochemical process. The Tier 1 emission factor method does not require activity data for the consumption of each carboncontaining feedstock to the petrochemical production process. It requires only activity data for the amount of product produced. The Tier 1 methodology does not consider the carbon content of emissions of carbon monoxide or NMVOC that may be generated by the petrochemical processes. The equations in this section for petrochemical production.

The Tier 1 method calculates emissions from petrochemical processes on the basis of activity data for production of each petrochemical and the process-specific emission factor for each petrochemical, as shown in the Equation 3.15 for production of each primary petrochemical product (e.g., methanol, ethylene, ethylene dichloride, ethylene oxide, acrylonitrile) and carbon black.

EQUATION 3.15 TIER 1 CO₂ EMISSION CALCULATION $ECO2_i = PP_i \bullet EF_i \bullet GAF / 100$

Where:

- $ECO2_i = CO_2$ emissions from production of petrochemical *i*, tonnes
- PP_i = annual production of petrochemical *i*, tonnes
- $EF_i = CO_2$ emission factor for petrochemical *i*, tonnes CO_2 /tonne product produced
- GAF = Geographic Adjustment Factor (for Tier 1 CO₂ emission factors for ethylene production, See Table 3.15), percent

Emission Factor Approach: AD x EF



Tier 1 default CO₂ EF for Ethylene

STEAM CRACKING ETHYLENE	TABLE 3.1 PRODUCTIO	14 N TIER 1 CO	O ₂ EMISSION	N FACTORS		
		tonnes	CO ₂ /tonne	ethylene p	roduced	
Feedstock	Naphtha	Gas Oil	Ethane	Propane	Butane	Other
Ethylene (Total Process and Energy Feedstock Use)	1.73	2.29	0.95	1.04	1.07	1.73
- Process Feedstock Use	1.73	2.17	0.76	1.04	1.07	1.73
- Supplemental Fuel (Energy Feedstock) Use	0	0.12	0.19	0	0	0

Tier 1 default Geographic Adjustment Factor for Ethylene

TABLE 3.15 DEFAULT GEOGRAPHIC ADJUSTMENT FACTORS FOR TIER 1 CO ₂ EMISSION FACTORS FOR STEAM CRACKING ETHYLI PRODUCTION						
Geographic Region	Adjustment Factor	Notes				
Western Europe	100%	Values in Table 3.14 are based on data from Western European steam crackers				
Eastern Europe	110%	Not including Russia				
Japan and Korea	90%					
Asia, Africa, Russia	130%	Including Asia other than Japan and Korea				
North America and South America and Australia	110%					

2.B.8 Petrochemical Industry – Tier 2

The overall mass balance equation for the Tier 2 methodology is Equation 3.17.

Mass-balance Approach based on carbon content of:

- Primary and Secondary Feedstock
- Primary and Secondary Products

○ The difference is CO₂ Emissions

EQUATION 3.17 OVERALL TIER 2 MASS BALANCE EQUATION	
$ECO2_{i} = \left\{ \sum_{k} \left(FA_{i,k} \bullet FC_{k} \right) - \left[PP_{i} \bullet PC_{i} + \sum_{j} \left(SP_{i,j} \bullet SC_{j} \right) \right] \right\} \bullet 44/12$	

Where:

- $ECO2_i = CO_2$ emissions from production of petrochemical *i*, tonnes
- $FA_{i,k}$ = annual consumption of feedstock k for production of petrochemical i, tonnes
- FC_k = carbon content of feedstock k, tonnes C/tonne feedstock
- PP_i = annual production of primary petrochemical product *i*, tonnes
- PC_i = carbon content of primary petrochemical product *i*, tonnes C/tonne product
- $SP_{i,j}$ = annual amount of secondary product *j* produced from production process for petrochemical *i*, tonnes

[The value of $SP_{i,j}$ is zero for the methanol, ethylene dichloride, ethylene oxide, and carbon black processes because there are no secondary products produced from these processes. For ethylene production and acrylonitrile production, see secondary product production Equations 3.18 and 3.19 below to calculate values for $SP_{i,j}$.]

 $SC_j = carbon content of secondary product j, tonnes C/tonne product$







2.B.8.b Ethylene Production – Data Input – Tier 1/2

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2006 IPCC Categories 🗾 👻 👎	CO2 and CH4 Emissions Summary - Tier 3 (3/3) A	tmospheric measurement data - CH4 emissions - Ti	er 3 Capture and storage or oth	ner reduction			
	Ethylene Production - Tier 1/2 CO2 Emissions - Tie	er 1 CH4 Emissions - Tier 1 CO2 Emissions - Ti	er 2 CO2 and CH4 Emissions fr	rom Combustion - Tier 3 (1/3) CO2 and CH4 Emis	sions from Flared Gas - Tier 3 (2	2/3)	
2.B.8.a - Methanol						1	2015
2.B.8.c - Ethylene Dichlori	Category: Chemical Industry - Petrochemical :	and Carbon Black Production					2015
	Subcategory: 2.B.8.b - Ethylene						
	Sheet: Ethylene production - Tier 1 / 2						
	Data						
			Activity Data				
2 B 9 a - By-product emis							
2.B.9.b - Fugitive Emissio	Subdivision	Type of Process	CO2 Calculation method	Amount of Ethylene Produced	Feedstock		
- 2.B.10 - Hydrogen Production	Cabarrison	Type of Freedows	COL Ouronation include	(tonne)	r coustoon		
- 2.B.11 - Other (Please specif				7			
E 2.C - Metal Industry	National	Sterm erzeking #1	Tier 1	Specified	100000		
2.C.1 - Iron and Steel Product	Nauonai	Steam cracking #1	Tier 1	From feedstock	108000		¥
2.C.2 - Ferroalloys Production	Plant #1	Steam cracking #2	Tier 2	Specified	55500	2 4 /	-
2.C.4 - Magnesium production	Plant #2	Steam cracking #4	Tier 2	From feedstock	288000	3	
- 2.C.5 - Lead Production	*					3	
- 2.C.6 - Zinc Production	Total						
2.C.7 - Rare Earths Productio					551500		
2.C.8 - Other (please specify)							
			Let's Conside	er 4 cases:	Data Inp	ut in the	
			T' 4 0			T 1 1	
		I)	ecified	Pop-Ur	p lable	
		:	i) Tior 1 Ero	m Eagdatack	/Γvoont	Tior 1	
		I I	i) ilei i – Fro		(⊏xcept		
			ii) Tior 2 _ Sna	acified	Spor	vified)	
		I '	10^{11} 10^{12} $- 0^{10}$	CUIICU	oper		
		l i	v) Tier 2 – Fro	om Feedstock 丿			
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Case #1: Tier 1 – Specified (input)

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2006 IPCC Categories	CO2 and CH4 En Ethylene Product	ion - Tier 1/2 CO2 Emissions - Tier	mospheric measurement data - CH4 emissions - Tie 1 CH4 Emissions - Tier 1 CO2 Emissions - Tie	r 3 Capture and storage or oth r 2 CO2 and CH4 Emissions fr	rem reduction rom Combustion - Tier 3 (1/3)	CO2 and CH4 Emissions from Flare	d Gas - Tier 3 (2/	3)			
2.8.8.5 - Ethylene 2.8.8.c - Ethylene Dichlori 2.8.8.d - Ethylene Oxide 2.8.8.e - Acrylonitrile 2.8.8.f - Carbon Black	Sector: Category: Subcategory: Sheet: Data	Industrial Processes and Product Us Chemical Industry - Petrochemical ar 2.B.8.b - Ethylene Ethylene production - Tier 1 / 2	e Id Carbon Black Production							2	.015
- 2.B.9 - Fluorochemical Produ			1	Activity Data							
2.B.9.a - By-product emis 2.B.9.b - Fugitive Emissio 2.B.10 - Hydrogen Production		Subdivision	Type of Process	CO2 Calculation method	Amount of E (thylene Produced tonne)	Feedstock				
= 2.C - Metal Industry		ΔΥ	Δ 🖓	T	7	PP					
- 2.C.1 - Iron and Steel Product	National		Steam cracking #1	Tier 1	Specified	100000		2			
2.C.2 - Ferroalloys Production			Steam cracking #2	Tier 1	From feedstock	108000	3	3		ッ	×
- 2.C.3 - Aluminium production	Plant #1		Steam cracking #3	Tier 2	Specified	55500	2	2			
2.C.4 - Magnesium productio	Plant #2		Steam cracking #4	Tier 2	From feedstock	288000		3			
- 2.C.5 - Lead Production	*							3			
	Total					551500					
D 2D No Form Budiet (mase specify)						Amo Ethylene (manua	unt of Produc al input)	ed:			

Case #2: Tier 1 – From feedstock

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gories $- \Psi$ (3 - Petrochemical and Ca A	CO2 and CH4 Emissions Summary - Ethylene Production - Tier 1/2 CO	Tier 3 (3/3) Atm 2 Emissions - Tier 1	ospheric measurement data - CH4 en CH4 Emissions - Tier 1 CO2 En	nissions - Tie nissions - Tie	r 3 Capture and r 2 CO2 and Cl	d storage or othe 14 Emissions fro	er reduction om Combustion - Tier 3 (1/3)	CO2 and CH4 Emissions from Flare	d Gas - Tier 3 (2/3)	
18.8.a - Methanol 18.8.b - Ethylene 18.8.c - Ethylene Dichlori 18.8.d - Ethylene Oxide 18.8.e - Acrylonitrile 18.8.f - Carbon Black	Sector: Industrial Process Category: Chemical Industry Subcategory: 2.8.8.b - Ethylene Sheet: Ethylene producti Data	es and Product Use - Petrochemical and on - Tier 1 / 2	Carbon Black Production							20
2.8.8.x - Other petrochem						Activity Data				
.B.9.a - By-product emis .B.9.b - Fugitive Emissio 0 - Hydrogen Production	Subdivision		Type of Process		CO2 Calculat	ion m e thod	Amount of E	Ethylene Produced (tonne)	Feedstock	
1 - Other (Please specif				ΔV		7		PP		
- Iron and Steel Product	National		Steam cracking #1		Tier 1		Specified	100000		
2 - Ferroallovs Production	•		Steam cracking #2		Tier 1		From feedstock	108000	3 3	a 🤊
3 - Aluminium production	Plant #1		Steam cracking #3		Tier 2		Specified	55500	3 3	
4 - Magnesium productio	Plant #2		Steam cracking #4		Tier 2		From feedstock	288000	3 3	
5 - Lead Production	*									
7 - Rare Earths Productio 3 - Other (please specify)	Feedstock Consumption		Equation 3.1 Annual consumption of feedstock consumed for	16 Specific pr productio	imary product on factor for	Amount of p	X	551500 D	ata Input in t Pop-Up Table	he e
	Type of Feedstock	Biogenic	production of petrochemical (tonnes)	(tonne product/tor	ine feedstock)	(ton		<u> </u>		
	Nachtha		FA 120000		5PP	PP = F	A * SPP 100000			
	Naphtha		120000		0.9					
	* Total						^			
	Total	Total consum	ntion: 120000				PPt = 108000			
		Biogenic consump	otion: 0							

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Case #3: Tier 2 – Specified (#1)

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IPCC Inventory Software - TSU - [Worksheets] Application Database Inventory Year Administrate Worksheets Tools Export/Import Reports Window Help - 8 : 2006 IPCC Categories **•** CO2 and CH4 Emissions - Tier 3 (3/3) Atmospheric measurement data - CH4 emissions - Tier 3 Capture and storage or other reduction 2.8.8 - Petrochemical and Ca Ethylene Production - Tier 1/2 CO2 Emissions - Tier 1 CH4 Emissions - Tier 1 CO2 Emissions - Tier 2 CO2 and CH4 Emissions from Combustion - Tier 3 (1/3) CO2 and CH4 Emissions from Flared Gas - Tier 3 (2/3) 2.B.8.a - Methanol worksneet 2015 2.B.8.b - Ethylene Industrial Processes and Product Use Sector: 2.B.8.c - Ethylene Dichlori Chemical Industry - Petrochemical and Carbon Black Production Category: 2.B.8.d - Ethylene Oxide 2.B.8.b - Ethylene Subcategory: 2.B.8.e - Acrylonitrile Sheet: Ethylene production - Tier 1 / 2 2.B.8.f - Carbon Black Data 2.B.8.x - Other petrochem Activity Data - 2.B.9 - Fluorochemical Produ 2.B.9.a - By-product emis Amount of Ethylene Produced -2.B.9.b - Fugitive Emissio Subdivision Type of Process CO2 Calculation method Feedstock 2.B.10 - Hydrogen Production -2.B.11 - Other (Please specif AV AV ∇ PP - 2.C - Metal Industry 100000 Steam cracking #1 Specified 12 2.C.1 - Iron and Steel Product National Tier 1 Steam cracking #2 Tier 1 From feedstock 108000 12 X ゥ 2.C.2 - Ferroalloys Production Plant #1 Steam cracking #3 Tier 2 Specified 55500 2 2.C.3 - Aluminium production 2.C.4 - Magnesium productio Plant #2 Steam cracking #4 Tier 2 From feedstock 288000 2.C.5 - Lead Production 2.C.6 - Zinc Production Total 2.C.7 - Rare Earths Productio 551500 2.C.8 - Other (please specify) Amount of Amount of **Ethylene Produced** Feedstock and (manual input) **Secondary Products** (in the pop-up table)

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Case #3: Tier 2 – Specified (#2)



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Case #4: Tier 2 – From feedstock (#1)



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2006 IPCC Categories 🗸 🗸	CO2 and CH4 En	nissions Summary - Tier 3 (3/3) A	tmospheric meas	surement data - CH4 emissio	ons - Tier	r 3 Capture and storage or ot	her reduction					
2.B.8 - Petrochemical and Ca	Ethylene Product	ion - Her 1/2 CO2 Emissions - Tie	er 1 CH4 Emiss	ions - Tier 1 CO2 Emissio	ons - Tier	r 2 CO2 and CH4 Emissions	from Combustion - Tier	3 (1/3) CO2 and CH4 Emissions from	n Flared Gas - Tier 3 (2/3)			
2.B.8.b - Ethylene	Sector:	Industrial Processes and Product U	se und Cathon Plack	Production							20	015
2.B.8.d - Ethylene Oxide	Subcategory:	2.B.8.b - Ethylene	Ind Calport black	rioduction								
2.B.8.e - Acrylonitrile 2.B.8.f - Carbon Black	Sheet: Data	Ethylene production - Tier 1 / 2										
						Activity Data						
2.B.9.a - By-product emis								neurof of Dividing a Deciding of				
2.B.9.b - Fugitive Emissio		Subdivision		Type of Process		CO2 Calculation method	-	(tonne)	Feedstock			
2.B.11 - Other (Please specif		Δ	7				7	PP				
- 2.C Metal Industry - 2.C.1 - Iron and Steel Product	National		Steam crackin	ng #1		Tier 1	Specified	1	00000			
- 2.C.2 - Ferroalloys Production			Steam crackin	ng #2		Tier 1	From feedstock	1	08000		う	×
- 2.C.3 - Aluminium production	Plant #1		Steam crackin	ng #3		Tier 2	Specified		55500			_
- 2.C.4 - Magnesium production	Plant #2		Steam crackin	ng #4		Tier 2	From teedstock	2	88000			_
- 2.C.6 - Zinc Production	Total											_
- 2.C.7 - Rare Earths Productio		E THE REAL PROPERTY OF						5	51500			
2.C.8 - Other (please specify)		Feedstock Consumption						X				
Fan Casandama				E	Equation	3.16, 3.18				\mathbf{N}		
For Secondary				Annual consumption of	Carbon	content Total carbon	Specific primary	Amount of				
Products		Type of Feedstock	Biogenic	feedstock consumed for production of	of feed	dstock content of f	actor for feedstock	petrochemical	Data Innut i	n the		
iioddolo				petrochemical (toppos)	(tonnes) feeds	stock) (tonnes C)	(tonnes primary product/tonne	(tonnes)				
(the expandable				(tonnes)	-		feedstock)		Рор-Ор Та	ble	J	
table)		Ethane		320000		0.856 273920	0.9	288000 ×				
								×				
		Total				070000						
		Diana	otal consumption	320000		2/3920		PPt = 288000				
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Case #4: Tier 2 – From feedstock (#2)



2.B.8.b: Tier 1 – EFs and Results

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Type of Feedstock	Amount of petrochemical produced (tonnes)	CO2 Emission Factor (tonnes CO2/tonne petrochemical produced)
	PPk	EFk (CO2)
Naphtha	108000	1.7
otal		
	108000	$EF = \Sigma(PPk^*EFk)/PPt = 1.7$

Geographic region	Geographic Adjustment Factor (%)	Remark
Western Europe	100	Values in Table 3.14 are based on data from Western European steam crackers
Eastern Europe	110	Not including Russia
Japan and Korea	90	
Asia, Africa, Russia	130	Including Asia other than Japan and Korea
North America and South America and Australia	110	

Default EF (and manual input)

2B8b: Tier 2 – EFs and Results

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2006 IPCC Categories 🗸 👎	CO2 and CH4 Emissions Summa	ary - Tier 3 (3/3) Atmospheric measurem	ent data CH4 emissions	Ties 2 Capture and s	storage or other reduction						
 2.B.8 - Petrochemical and Ca 2.B.8.a - Methanol 2.B.8.b - Ethylene 2.B.8.c - Ethylene Dichlori 2.B.8.d - Ethylene Oxide 2.B.8.e - Acrylonitrile 2.B.8.f - Carbon Black 	Ethylene Production - Tier 1/2 Worksheet Sector: Industrial Proc Category: Chemical Indu Subcategory: 2.B.8.b - Ethy Sheet: CO2 Emission Data	CO2 Emissions - Tier 1 CH4 Emissions - cesses and Product Use ustry - Petrochemical and Carbon Black Produ lene is from Ethylene Production - Tier 2 (Mass Bal	CO2 Emissions	CO2 and CH4	Emissions from Combustio	on - Tier 3 (1/3) CO2 and	ICH4 Emiss	sions from Flared Gas - 1	Tier 3 (2/3)	2	015
				Equ	uation 3.17						
2.B.9.a - By-product emis 2.B.9.b - Fugitive Emissio 2.B.10 - Hydrogen Production 2.B.11 - Other (Please specif	Subdivision	Type of Process	Total carbon content of feedstock (tonnes C)	Amount of Ethylene Produced (tonne)	Carbon content of Ethylene produced (tonnes C / tonne Ethylene)	Total carbon content of secondary product (tonnes C)	C (02 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)		
- 2.C.1 - Iron and Steel Product	Δ _V	Δγ	CC = FA * FC	PP	PC	SPC	E = (CC	- (PP * PC + SPC)) * 44/12	E / 1000		
- 2.C.3 - Aluminium production	Plant #1	Steam cracking #3	78300	55500	(0.9 6696		7939	3 79.398	2	
- 2.C.4 - Magnesium productio	Plant #2	Steam cracking #4	273920	288000	0.856	✓ 4384.256		84361.72	8 84.36173	2	2
2.C.5 - Lead Production 2.C.6 - Zinc Production	Total			343500	Petrochemical Cart (ton	bon content of petrochemic nes C / tonne petrochemic	cal :al)	163759.72	163.75973		
2.C.7 - Rare Earths Productio					Ethylene	0.	856	163759.72	163.75973		
 I am 2118 - Other (plasse specify) 											

Carbon Content for Ethylene

(drop-down for defaults and manual input)

Results – CO2 Emissions from Ethylene Production (mass-balance approach based on carbon content)



(2.F.1)

Refrigeration and Air Conditioning

Outline

Theory and exercises for:

- 1. F-gases/ blends and the F-gases Manager
- 2. Refrigeration and Air Conditioning Tier 1
- 3. Refrigeration and Air Conditioning Tier 2



1. F-gases/ blends and the Fgases Manager



F-gases and Blends

Most common highlighted in 2006 IPCC Guidelines

1	MAIN APPLICAT	T. TION AREAS FOR H	ABLE 7.1 IFCs and PI	FCs as ODS	SUBSTITUTE	s ¹	
Chemical	Refrigeration	Fire Suppression	Aer	osols	Solvent	Foam	Other
	and Air Conditioning	and Explosion Protection	Propellants	Solvents	Cleaning	Blowing	Applications
HFC-23	x	х					
HFC-32	x						
HFC-125	X	Х					
HFC-134a	x	х	x			x	x
HFC-143a	x						
HFC-152a	x		x			x	
HFC-227ea	x	х	x			x	x
HFC-236fa	x	Х					
HFC-245fa				x		x	
HFC-365mfc				x	x	x	
HFC-43-10mee				x	x		
PFC-14 ³ (CF ₄)		х					
PFC-116 (C ₂ F ₆)							x
PFC-218 (C ₃ F ₈)							
PFC-31-10 (C ₄ F ₁₀)		х					
PFC-51-14 ⁴ (C ₆ F ₁₄)					x		

Blend	Constituents	Composition (%)
R-400	CFC-12/CFC-114	Should be specified ¹
R-401A	HCFC-22/HFC-152a/HCFC-124	(53.0/13.0/34.0)
R-401B	HCFC-22/HFC-152a/HCFC-124	(61.0/11.0/28.0)
R-401C	HCFC-22/HFC-152a/HCFC-124	(33.0/15.0/52.0)
R-402A	HFC-125/HC-290/HCFC-22	(60.0/2.0/38.0)
R-402B	HFC-125/HC-290/HCFC-22	(38.0/2.0/60.0)
R-403A	HC-290/HCFC-22/PFC-218	(5.0/75.0/20.0)
R-403B	HC-290/HCFC-22/PFC-218	(5.0/56.0/39.0)
R-404A	HFC-125/HFC-143a/HFC-134a	(44.0/52.0/4.0)
R-405A	HCFC-22/HFC-152a/HCFC-142b/PFC-318	(45.0/7.0/5.5/42.5)
R-406A	HCFC-22/HC-600a/HCFC-142b	(55.0/14.0/41.0)
R-407A	HFC-32/HFC-125/HFC-134a	(20.0/40.0/40.0)
R-407B	HFC-32/HFC-125/HFC-134a	(10.0/70.0/20.0)
R-407C	HFC-32/HFC-125/HFC-134a	(23.0/25.0/52.0)
R-407D	HFC-32/HFC-125/HFC-134a	(15.0/15.0/70.0)
R-407E	HFC-32/HFC-125/HFC-134a	(25.0/15.0/60.0)
R-408A	HFC-125/HFC-143a/HCFC-22	(7.0/46.0/47.0)
R-409A	HCFC-22/HCFC-124/HCFC-142b	(60.0/25.0/15.0)
R-409B	HCFC-22/HCFC-124/HCFC-142b	(65.0/25.0/10.0)
R-410A	HFC-32/HFC-125	(50.0/50.0)
R-410B	HFC-32/HFC-125	(45.0/55.0)
R-411A	HC-1270/HCFC-22/HFC-152a	(1.5/87.5/11.0)
R-411B	HC-1270/HCFC-22/HFC-152a	(3.0/94.0/3.0)
R-411C	HC-1270/HCFC-22/HFC-152a	(3.0/95.5/1.5)
R-412A	HCFC-22/PFC-218/HCFC-142b	(70.0/5.0/25.0)
R-413A	PFC-218/HFC-134a/HC-600a	(9.0/88.0/3.0)
R-414A	HCFC-22/HCFC-124/HC-600a/HCFC-142b	(51.0/28.5/4.0/16.5)
R-414B	HCFC-22/HCFC-124/HC-600a/HCFC-142b	(50.0/39.0/1.5/9.5)
R-415A	HCFC-22/HFC-152a	(\$2.0/18.0)
R-415B	HCFC-22/HFC-152a	(25.0/75.0)
R-416A	HFC-134a/HCFC-124/HC-600	(59.0/39.5/1.5)
R-417A	HFC-125/HFC-134a/HC-600	(46.6/50.0/3.4)
R-418A	HC-290/HCFC-22/HFC-152a	(1.5/96.0/2.5)
R-419A	HFC-125/HFC-134a/HE-E170	(77.0/19.0/4.0)
R-420A	HFC-134a/HCFC-142b	(88.0/12.0)
R-421A	HFC-125/HFC-134a	(58.0/42.0)
R-421B	HFC-125/HFC-134a	(85.0/15.0)
K-422A	HFC-125/HFC-134a/HC-600a	(85.1/11.5/3.4)
R-422B	HFC-125/HFC-134a/HC-600a	(55.0/42.0/3.0)
R-422C	HFC-125/HFC-134a/HC-600a	(82.0/15.0/3.0)
R-500	CFC-12/HFC-152a	(73.8/26.2)
R-501	HCFC-22/CFC-12	(75.0/25.0)
R-502	HCFC-22/CFC-115	(48.8/51.2)
R-503	HFC-23/CFC-13	(40.1/59.9)
K-504	HFC-32/CFC-115	(48.2/51.8)
R-505	CFC-12/HCFC-31	(78.0/22.0)
R-506	CFC-31/CFC-114	(55.1/44.9)
R-507A	HFC-125/HFC-143a	(50.0/50.0)
R-508A	HFC-23/PFC-116	(39.0/61.0)
R-508B	HFC-23/PFC-116	(46.0/54.0)

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F-gases and Blends

Complete list in AR5

- Software calculates emissions from all Fgases in the AR5.
- For interoperability:
 - If the F-gas appears in CRT 2(II): the corresponding gas maps to that gas in background and sectoral tables.
 - If the F-gas does not appear in CRT 2(II): the corresponding gas maps to the "Unspecified mix", as shown in the table.

HFCs	
HFC-23 (CHF ₃)	HFC-23
HFC-32 (CH ₂ F ₂)	HFC-32
HFC-41 (CH ₃ F)	HFC-41
HFC-43-10mee (CF ₃ CHFCHFCF ₂ CF ₃)	HFC-43-10mee
HFC-125 (CHF ₂ CF ₃)	HFC-125
HFC-134 (CHF ₂ CHF ₂)	HFC-134
HFC-134a (CH ₂ FCF ₃)	HFC-134a
HFC-143 (CH ₂ FCHF ₂)	HFC-143
HFC-143a (CH ₃ CF ₃)	HFC-143a
HFC-152 (CH ₂ FCH ₂ F)	HFC-152
HFC-152a (CH ₃ CHF ₂)	HFC-152a
HFC-161 (CH ₃ CH ₂ F)	HFC-161
HFC-227ca (CF ₃ CF ₂ CHF ₂)	Unspecified mix of HFCs
HFC-227ea (CF ₃ CHFCF ₃)	HFC-227ea
HFC-236cb (CH ₂ FCF ₂ CF ₃)	HFC-236cb
HFC-236ea (CHF ₂ CHFCF ₃)	HFC-236ea
HFC-236fa (CF ₃ CH ₂ CF ₃)	HFC-236fa
HFC-245ca (CH ₂ FCF ₂ CHF ₂)	HFC-245ca
HFC-245cb (CF ₃ CF ₂ CH ₃)	Unspecified mix of HFCs
HFC-245ea (CHF ₂ CHFCHF ₂)	Unspecified mix of HFCs
HFC-245eb (CH ₂ FCHFCF ₃)	Unspecified mix of HFCs
HFC-245fa (CHF ₂ CH ₂ CF ₃)	HFC-245fa
HFC-263fb (CH ₃ CH ₂ CF ₃)	Unspecified mix of HFCs
HFC-272ca (CH ₃ CF ₂ CH ₃)	Unspecified mix of HFCs
HFC-329p (CHF ₂ CF ₂ CF ₂ CF ₃)	Unspecified mix of HFCs
HFC-365mfc (CH ₃ CF ₂ CH ₂ CF ₃)	HFC-36mfc
HFC-1132a (CH ₂ =CF ₂)	Unspecified mix of HFCs
HFC-1141 (CH ₂ =CHF)	Unspecified mix of HFCs
(Z)-HFC-1225ye (CF ₃ CF=CHF(Z))	Unspecified mix of HFCs
(E)-HFC-1225ye ($CF_3CF=CHF(E)$)	Unspecified mix of HFCs
(Z)-HFC-1234ze (CF ₃ CH=CHF(Z)	Unspecified mix of HFCs
HFC-1234yf ((CF ₃ CF=CH ₂))	Unspecified mix of HFCs
(E)-HFC-1234ze (trans-CF ₃ CH=CHF)	Unspecified mix of HFCs
(Z)-HFC-1336 (CF ₃ CH=CHCF ₃ (Z))	Unspecified mix of HFCs
HFC-1243zf (CF ₃ CH=CH ₂)	Unspecified mix of HFCs
HFC-1345zfc ($C_2F_5CH=CH_2$)	Unspecified mix of HFCs
3,3,4,4,5,5,6,6,6- Nonafluorohex -1-ene (C ₄ F ₀ CH=CH ₂)	Unspecified mix of HFCs
3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooct-1-ene (C ₆ F ₁₃ CH=CH ₂)	Unspecified mix of HFCs
3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Hep-tadecafluorodec- 1-ene (C ₈ F ₁₇ CH=CH ₂)	Unspecified mix of HFCs

PFCs	
FC-14 (CF ₄)	CF4
FC-116 (C ₂ F ₆)	C2F6
FC-218 (C ₃ F ₈)	C3F8
FC-31-10 (C ₄ F ₁₀)	C4F10
FC-318 (c-C ₄ F ₈)	c-C4F8
FC-4-1-12 (n-C ₅ F ₁₂)	C5F12
FC-5-1-14 (n- C_6F_{14})	C6F14
ulphuryl fluoride (SO ₂ F ₂)	Unspecified mix of PFCs
FC-c216 (c- C_3F_6)	c-C3F6
FC-61-16 (n-C ₇ F ₁₆)	Unspecified mix of PFCs
FC-71-18 (C ₈ F ₁₈)	Unspecified mix of PFCs
FC-91-18 (C ₁₀ F ₁₈)	C10F18
erfluorobuta-1,3-diene (C_4F_6)	Unspecified mix of PFCs
erfluorocyclopentene (c-C ₅ F ₈)	Unspecified mix of PFCs
erfluorodecalin (cis) (Z-C ₁₀ F ₁₈)	Unspecified mix of PFCs
erfluorodecalin (trans) (E-C ₁₀ F ₁₈)	Unspecified mix of PFCs
FC-1114 (CF ₂ =CF ₂)	Unspecified mix of PFCs
FC-1216 (CF ₃ CF=CF ₂)	Unspecified mix of PFCs
erfluorobut-1-ene	United with a f DEC.
$CF_3CF_2CF=CF_2$	Unspecified mix of PFCs
erfluorobut-2-ene $(CF_3CF=CFCF_3)$	Unspecified mix of PFCs
SF ₆	

NF₂

F-gases for UNFCCC Reporting

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TABLE 2(II) SECTORAL REPOR	RT FO	DR II	NDUS	TRI	AL P	ROC	ESSE	S AN	D PR	ODU	JCT U	USE -	EMI	SSIC	ONS C	OF H	FCs, I	PFCs	s, SF ₆	AND NF ₃															Year
(Sheet 1 of 1)																																		Subm	ission
																																		Co	Juntry
Back to Index																																			
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134	HFC-134a	HFC-143	HFC-143a	HFC-152	HFC-152a	HFC-161	HFC-227ea	HFC-236cb	HFC-236ea	HFC-236fa	HFC-245ca	HFC-245fa	HFC-365mfc	Unspecified mix of HFCs ⁽¹⁾	Total HFCs	CF4	$\mathbf{C}_{2}\mathbf{F}_{6}$	C_3F_8	C_4F_{10}	c-C4F8	C5F12	C6F14	$C_{10}F_{18}$	c-C3F6	Unspecified mix of PFCs ⁽¹⁾	Total PFCs	Unspecified mix of HFCs and PFCs ⁽¹⁾	SF_6	NF ₃
										(t)										CO ₂ quivale	ents (kt) ⁽²⁾					(t)					CO2 6	quivalent	(kt) ⁽²⁾	(t)
2. Total actual emissions of halocarbons (by chemical), SF_6 and NF_3	L								1																										
2.B. Chemical industry																			1 I	Jnspe	ecifie	d												£:00	
2.B.9. Fluorochemical production								Spe	eci	fic										N/ix	v of											U	spec	mec	2
2.B.9.a. By-product emissions								ц		<u> </u>									1														Mix c	of	
2.B.9.b. Fugitive emissions										5										HF	Cs													and a	
2.B.10. Other																																			
2.C. Metal industry																																	PFC	S	
2.C.3. Aluminium production																																			
2.C.4. Magnesium production																																			
2.C.7. Other																																			
2.E. Electronics industry																																			
2.E.1. Integrated circuit or semiconducto	r																																		

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Confirm CO₂ Equivalents Used

- User may view list of F-gases and CO₂ equivalents used in the Software.
- F-gases and blends may be added, if needed, through the F-gases Manager.
- For interoperability: confirm Software shows Type = AR5 GWPs in the Administrate tab (is set by default in latest versions of Software, unless changed by user).



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INTERGOVERNMENTAL PANEL ON Climate change

		ents		
уре	AR5 GWPs (100 year time horizon)	~	Set as default	Add type Delete type
	Gas Group			
⊕) (:02, CH4 & N2O			
÷ F	IFCs			
Ģ. F	FCs			
	Gas	CO2 Equiv	alent	Remark
	PFC-14 (CF4)		6630	
	PFC-116 (C2F6)		11100	
	PFC-C216 (c-C3F6)		9200	
	PFC-218 (C3F8)		8900	
	PFC-31-10 (C4F10)		9200	
	Perfluorocyclopentane (c-C5F8)		2	
	PFC-318 (c-C4F8)		9540	
	PFC-4-1-12 (n-C5F12)		8550	
	PFC-5-1-14 (n-C6F14)		7910	
	PFC-61-16 (n-C7F16)		7820	
	PFC-71-18 (C8F18)		7620	
	PFC-91-18 (C10F18)		7190	
	Perfluorodecalin (cis) (Z-C10F18)		7240	
	Perfluorodecalin (trans) (E-C10F18)		6290	
	PFC-1114 (CF2=CF2)		1	<1
	PFC-1216 (CF3CF=CF2)		1	<1
	Perfluorobuta-1,3-diene (CF2=CFCF=CF2)		1	<1
	Perfluorobut-1-ene (CF3CF2CF=CF2)		1	<1
	Perfluorobut-2-ene (CF3CF=CFCF3)		2	
	Gas Group			
÷ S	F6			

F-gases Manager

- Purpose of F-gases Manager:
 - Identify all F-gases consumed (including imported) and/or produced/emitted in the country.
 - Customize *Software* so limited to F-gases relevant for the user.
 - Designate specific gas/category confidential, if applicable, for UNFCCC reporting.
 - Ultimately to minimize double counting.
- F-gases Manager to be set up for individual F-gas species and blends



- 2-step process
 - List F-gases /blends relevant at country level- done through main Administrate tab, then
 - Identify those relevant for individual IPCC category done at **worksheet** level.

F-gases Manager – Country level

- 1. Check /uncheck boxes for F- gases:
- Produced \checkmark
- Imported \checkmark
- Exported \checkmark
- **Emitted as Fugitive** \checkmark

lanager - Chemicals				- C
	Chemicals - definition	and applicability at country level		
		hamical group		
IFCs				
				Consumed
	∆⊽ Chemical			and/or Exported at country level
HFCs listed in Table 7.1	HFC-23	CHF3	12400	
	HFC-32	CH2F2	677	Sector 1
	HFC-43-10mee	CF3CHFCHFCF2CF3	1650	Sec.
	HFC-125	CHF2CF3	3170	
	HFC-134a	CH2FCF3	1300	
	HFC-152a	CH3CHF2	138	
	HFC-143a	CH3CF3	4800	Sector 1
	HFC-227ea	CF3CHFCF3	3350	
	HFC-236fa	CF3CH2CF3	8060	
	HFC-245fa	CHF2CH2CF3	858	
	HFC-365mfc	CH3CF2CH2CF3	804	
Other HFCs with AR5 GWP	HFC-41	CH3F	116	
	HFC-134	CHF2CHF2	1120	
	HFC-143	CH2FCHF2	328	
	HFC-227ca	CF3CF2CHF2	2640	
	HFC-245ca	CH2FCF2CHF2	716	
	HFC-245cb	CF3CF2CH3	4620	
	HFC-245ea	CHF2CHFCHF2	235	
	HFC-245eb	CH2FCHFCF3	290	
	HFC-152	CH2FCH2F	16	
	HFC-161	CH3CH2F	4	
	HFC-236cb	CH2FCF2CF3	1210	
	HFC-236ea	CHF2CHFCF3	1330	
	HFC-263fb	CH3CH2CF3	76	
	HFC-272ca	CH3CF2CH3	144	

2. Check /uncheck boxes for blends:

Preferable to do inventory calculations based on individual F-gas species and not blends. The Software can accommodate blends, but user should ensure there is no double counting with F-gas species.

INTERGOVERNMENTAL PANEL ON Climate chane

-Gas	ies Manager - Blends				- 0	
		Blends - definition an	d applicability at country level			
	Δγ	, Blend name	Composition		Consumed and/or Exported at country T level	7
.	Blends referenced in section 7.5.1 of the 2006 GL	R-410A	HFC-32/HFC-125 (50.0/50.0)			
		R-404A	HFC-125/HFC-143a/HFC-134a (44.0/52.0/4.0)			
÷.		R-407C	HFC-32/HFC-125/HFC-134a (23.0/25.0/52.0)			
		R-507A	HFC-125/HFC-143a (50.0/50.0)			
.	Other blends	R-401A	HCFC-22/HFC-152a/HCFC-124 (53.0/13.0/34.0)			
		R-401B	HCFC-22/HFC-152a/HCFC-124 (61.0/11.0/28.0)			
<u>ا</u>		R-401C	HCFC-22/HFC-152a/HCFC-124 (33.0/15.0/52.0)			
÷.		R-402A	HFC-125/HC-290/HCFC-22 (60.0/2.0/38.0)			
¢٠.		R-402B	HFC-125/HC-290/HCFC-22 (38.0/2.0/60.0)			
÷.		R-403A	HC-290/HCFC-22/PFC-218 (5.0/75.0/20.0)			
.		R-403B	HC-290/HCFC-22/PFC-218 (5.0/56.0/39.0)			
÷.		R-405A	HCFC-22/ HFC-152a/ HCFC-142b/PFC-318 (45.0/7.0/5.5/42.	5)		
¢٠.		R-407A	HFC-32/HFC-125/HFC-134a (20.0/40.0/40.0)			
•		R-407B	HFC-32/HFC-125/HFC-134a (10.0/70.0/20.0)			
¢٠.		R-407D	HFC-32/HFC-125/HFC-134a (15.0/15.0/70.0)			
.		R-407E	HFC-32/HFC-125/HFC-134a (25.0/15.0/60.0)			
÷.		R-408A	HFC-125/HFC-143a/HCFC-22 (7.0/46.0/47.0)			
÷.		R-410B	HFC-32/HFC-125 (45.0/55.0)			
				Save	Undo	Close

Blends

F-gases Manager – Country level

- 1. User may add country-specific F-gases / Blends using row with [*].
- 2. For blends, information on the composition must also be added.

Chemicals

	Chemicals - definition a	and applicability at country level			DI	ienus	
	Ch	nemical group					
HFCs				F-Gases Manager - Blends			- 0
PFCs						I INTERNATION IN THE I	
			Consumed and/or		Blends - definition a	and applicability at country level	
	A Y Chemical		Country level				Consumed and/or
PFCs listed in Table 7.1	PFC-14	CF4	6630 🗹		A∀ Blend name		Exported at country ⊽
	PFC-116	C2F6	11100 🕑		R-4120	HCEC-22/PEC-218/HCEC-1425 (70.0/5.0/25.0)	
-	PFC-218	C3F8	8900		P 412A	PEC 219/HEC 1245/HC 2005 (9.0/09.0/20.0)	
-	PFC-31-10	C4F10	9200 🕑		D 515A	HCEC 22/UEC 152- (92.0/19.0)	
-	PFC-5-1-14	n-C6F14	7910 🥑		R-515A	HCFC-22/HFC-1528 (62.0/16.0)	
Other PFCs with AR5 GWP	PFC-C216	c-C3F6	9200		R-515B		
-	Perfluorocyclopentane	c-C5F8	2		R-416A	HFC-134a/HCFC-124/HC-600 (59.0/39.5/1.5)	
	PFC-318	c-C4F8	9540		R-41/A	HEC-125/HEC-134a/HC-600 (46.6/50.0/3.4)	
	PFC-4-1-12	n-C5F12	8550		R-418A	HC-290/HCFC-22/HFC-152a (1.5/96.0/2.5)	
	PFC-61-16	n-C7F16	7820		R-419A	HFC-125/HFC-134a/HE-E170 (77.0/19.0/4.0)	
-	PFC-71-18	C8F18	7620		R-420A	HFC-134a/HCFC-142b (88.0/12.0)	
-	PFC-91-18	C10F18	7190		R-421A	HFC-125/HFC-134a (58.0/42.0)	
-	Perfluorodecalin (cis)	Z-C10F18	7240		R-421B	HFC-125/HFC-134a (85.0/15.0)	
	Perfluorodecalin (trans)	E-C10F18	6290		R-422A	HFC-125/HFC-134a/HC-600a (85.1/11.5/3.4)	
	PFC-1114	CF2=CF2	1 0		R-422B	HFC-125/HFC-134a/HC-600a (55.0/42.0/3.0)	
-	PFC-1216	CF3CF=CF2	1 0		R-422C	HFC-125/HFC-134a/HC-600a (82.0/15.0/3.0)	
	Perfluorobuta-1.3-diene	CF2=CFCF=CF2	1 0		R-500	CFC-12/HFC-152a (73.8/26.2)	
-	Perfluorobut-1-ene	CF3CF2CF=CF2	1 0		R-503	HFC-23/CFC-13 (40.1/59.9)	
	Perfluorobut-2-ene	CF3CF=CFCF3	2		R-504	HFC-32/CFC-115 (48.2/51.8)	
User-defined PECs	INSERT country specific name	INSERT country specific formula	200		R-508A	HFC-23/PFC-116 (39.0/61.0)	
*		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			R-508B	HFC-23/PFC-116 (46.0/54.0)	
					R-509A	HCFC-22/PFC-218 (44.0/56.0)	
SEC	Ch	nemical group		User-defined blends	XYZ	INSERT composition	
NE3							Composition
NF3				Constituent			(%)
			Save Undo Ck	HFC-23		12400	25
				HFC-125		3170	25
				Ŧ			

Blends

INTERGOVERNMENTAL PANEL ON CLIMATE CHANES



✓ Now let's do exercise with dummy data

Exercise: Customize F-gases Manager

- Country imports F-gases, and the blend R410A.
- No production/export of F-gases.
- List includes all F-gases/blends emitted in any year of time series.
- The following information is known about the use of the different gases/blends in different applications.
- Exercise: Please set up the F-gases Manager at the national level for this scenario.

		Refrigeration			
F-gases		and Air	Fire		Soundproof
Consumed	Electronics	Conditioning	protection	Aerosols	windows
		HFCs			
HFC-23	Х	X			
HFC-32		X			
HFC-125		X			
HFC-134a		Х		Х	
HFC-143a		X			
HFC-152a		X			
HFC-227ea			Х	Х	
		PFCs			
CF4	X				
C2F6	Х				
c-C4F8	Х				
SF6	X				X
NF3	X				
		Blends			
R410A		X			





The user has customized the Software for all F-gases /blends relevant in the country.

The user must then identify the gases relevant for Refrigeration and Air Conditioning, but first, let's learn more about the category:

2.F.1 Refrigeration and Air Conditioning (RAC)



2.F.1: Tiers

- For Refrigeration and Air Conditioning (2.F.1) the 2006 IPCC Guidelines provide the following Tiers:
 - **Tier 1** (default hybrid approach based on a historic development of the bank)
 - Estimates emissions at the <u>application level (i.e.</u> emissions calculated for all RAC, except mobile air conditioning combined (category 2.F.1.a)), and mobile air conditioning (category 2.F.1.b).
 - Tier 2 requires separate data for <u>6 RAC sub-applications</u> (commercial, domestic, industrial, transport, stationary air conditioning and mobile air conditioning)
 - Tier 2a (EF approach).
 - Tier 2b (mass-balance approach).

2.F.1: Deciding Among Tiers



1000

	Tier 1	Tier 2a	Tier 2b
Consumption by sub-application (e.g. domestic refrigeration versus commercial refrigeration)		Х	Х
Year of introduction of chemical	Х	Х	Х
Domestic production of chemical in current year	Х	Х	Х
Imports of chemical in current year (bulk and in equipment)	X (total)	Х	Х
Exports of chemical in current year (bulk and in new equipment)	X (total)	Х	Х
Growth rate in new equipment sales	Х		
Destroyed in current year	Х	Х	Х
Exported in used equipment for subsequent year		Х	Х
Amount added to /withdrawn from stockpile (if any)			Х
Amount used to fill new equipment factory charged/not factory charged			Х

Notes:

- Additional parameters required, but there are defaults. Generally, if destruction is not known, assume 0

- Table 7.9 of Vol. 3 Chpt 7, contains defaults for charge/ equipment

F-gases Consumption Quality Check



- Important not to double count consumption.
- A QC check to ensure consistency of F-gases available versus consumption to mitigate double counting.
- Function to be incorporated into Software in future.

Step 1: Estimate national consumption per gas/per year Step 2: Allocate to end use applications Step 3: Compare top-down estimates of consumption per gas/category/year with bottomup consumption estimates input into *Software*

F-gases Consumption Quality Check



Step 1: Estimate national consumption per gas/per year

A	D	C	D	E	Г	G	П	I		
		·								
		т	otal national co	Chemical in country	Chemical/blend					
	Production	Impo	orts	Exports Rec			used to produce blends	available for		
					In		(if known) and if blends	consumption in year		
(tonnes)		in Bulk	In equipment	in Bulk	equipment		accounted separately)	(B+C+D-E-F+G-H)		
Chemical #1										
Chemical #2										
Chemical #N										
Blend # 1										
Blend # N										

Step 2: Allocate to end use applications

	2.C.4 2.C.8 Oth	2.C.8 Other	2.E Electronics Industry			2.F.1.a 2	2.F.1.b Mobile	2.F.3 Fire	2.5.4	2.F.6 Other	2.G.1	2.G.2 SE6 and PECs	2.G.4 Other	2.H.3 Other	
Magensium Production	(Metal industry)	2.E.1 Integrated Circuit or	2.E.2 TFT Flat Panel	2.E.4 Heat Transfer	2.E.5 Other	Refrigeration and AC	Air Conditioning	Extinguisher s	Aerosols	Application s	Electrical Equipment	from Other Products	from other product use)	(IPPU)	
F-gases Consumed			Semiconductor	Display	Fluid	(Electronics)									
Chemical #1															
Chemical #2															
Chemical #N															
Blend # 1															
Blend # N															

Step 3: Compare topdown (Step 2) with bottom-up (worksheets)

Α	В	С	D					
Check for refrigeration and air conditioning								
	Top down	Bottom up	Comparisor					
Chemical #1	ESTIMATED ALLOCATION - Step 2	Total of each F-gas Consumed in Tier 1 and Tier 2 worksheets (e.g. IPCC 2.F.1.a <f-gas emissions=""> <gas =<br="">BH2> <year= current="" inventory="" year=""> <value in<br="">column D> PLUS IPCC 2.F.1.a <f-gas -<br="" emissions="">Tier 2a> <subapplication =="" all=""> <gas =="" bh2=""> <year= current inventory year> Value in column H/1,000 PLUS IPCC 2.F.1.a <f-gas -tier="" 2b="" emissions=""> <subapplication =="" all=""> <gas =="" bh2=""> <year= current<br="">inventory year>Value in column G/1,000)</year=></gas></subapplication></f-gas></year= </gas></subapplication></f-gas></value></year=></gas></f-gas>	Column C-B					

- ✓ Category by category comparison
- Can the user explain differences between total national consumption and the sum of data entered in worksheets?





2.F.1 Refrigeration and Air Conditioning
• The Tier 1 method back-calculates the development of a bank of a refrigerant from the current reporting year to the year of its introduction.

 $_{\odot}$ Enables estimation of actual emissions, even if there are no historic data available.

\odot Minimum data requirements /assumptions needed:

- Year of introduction of chemical
- Domestic production of chemical in current year
- Imports of chemical in current year
- Exports of chemical in current year
- Growth rate of sales of equipment that uses the chemical

 $\,\circ\,$ Defaults available for other parameters.

EQUATION 7.2B CALCULATION OF EMISSIONS OF A CHEMICAL FROM AN APPLICATION WITH BANKS Annual Emissions = Net Consumption \bullet Composite EF_{FY} + Total Banked Chemical \bullet Composite EF_B



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Application Database Inventory Year Administrate Worksheets Tools Export/Import Reports Window Help _ 8 × 2006 IPCC Categories F-Gas Emissions F-Gas Parameters - Tier 2 F-Gas Emissions - Tier 2a F-Gas Emissions - Tier 2b 2.F.1.a - Refrigeration and Station Worksheet 2015 Industrial Processes and Product Use Sector: 2.F.1.b - Mobile Air Conditioning Product Uses as Substitutes for Ozone Depleting Substances 2.F.2 - Foam Blowing Agents Category: 2.F.1.a - Refrigeration and Stationary Air Conditioning Subcategory: 2.F.3 - Fire Protection Sheet: Emissions 2.F.4 - Aerosols Data 2.F.5 - Solvents Subdivision Unspecified Gas Chemical's Data 2.F.6 - Other Applications (please spe \sim Other Product Manufacture and Use Intro Year NA Growth Rate (%) NA EF (%) NA Destroyed (%) NA Lifetime (d) (years) NA 2.G.1 - Electrical Equipment 2.G.1.a - Manufacture of Electrical 2.G.1.b - Use of Electrical Equipm 2.G.1.c - Disposal of Electrical Eq 2.G.2 - SF6 and PFCs from Other Pro When the user first accesses the category, there are 2.G.2.a - Military Applications 2.G.2.b - Accelerators no subdivisions, no gases, and no default parameters 2.G.2.c - Other (please specify) 2.G.3 - N2O from Product Uses present. The user must <u>customize</u> the Software using 2.G.3.a - Medical Applications 2.G.3.b - Propellant for pressure a the category level F-gases Manager 2.G.3.c - Other (Please specify) 2.G.4 - Other (Please specify) Other Uncertainties 2.H.1 - Pulp and Paper Industry

through Chemicals' Data tab

Chemicals' Data tab:

✓ Add relevant F-gases for IPCC category

✓ Add subdivisions, if applicable

✓ Add parameters



IN @



Then, for each combination of subdivision and gas/blend, enter parameters:

N	
×	
Chemical`s Data	
Country/Territory World	
Category 2.F.1.a - Refrigeration and Stationary Air Conditioning	
Subdivision Unspecified V +	
Gas HFC-23 (CHF3) ~ +	
Data	
Year of Introduction 1990 🗢	
Growth Rate in New Equipment Sales3.00% 🖨	Default is 15 years
Assumed Equipment Lifetime (years)	
Emission Factor from installed base 15.00% 🚖	Default is 15%
% of Gas Destroyed at End of Life 0.00% 🖨	
	Generally, where information is not
	available for a GHG Inventory,
	destruction is assumed to be 0
Save	
Jave Close	Source: Figure 7.7 of volume 3, chpt 7 of the 2006
	IPCC Guidelines

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Then, the user enters consumption data for each gas/blend



Consumption data entered for each gas, must know at least current year (but should add all known years). Consumption for unknown years extrapolated back based on equipment growth rate.

Green cells automatically calculated based on parameters entered.

Column E = Total Emissions Columns K, L, M calculated AD for interoperability.



✓ Now let's do exercise with dummy data



Exercise #1a: Set up the <u>IPCC category level</u> F-gases Manager

Recall earlier dataset and the F-gases consumed for RAC. The user should populate the IPCC category level F-gases Manager for 2.F.1.a.

• <u>Note that this is a category level Manager, so gases</u> entered will be available for all subdivisions and Tier 2 calculations also.

Indicate that HFC-152a is confidential.

In Exercise #1b the users will input all data for each gas/subdivision to estimate emissions.

		Refrigeration			
F-gases		and Air	Fire		Soundproof
Consumed	Electronics	Conditioning	protection	Aerosols	windows
		HFCs			
HFC-23	Х	Х			
HFC-32		Х			
HFC-125		Х			
HFC-134a		Х		Х	
HFC-143a		Х			
HFC-152a		Х			
HFC-227ea			Х	Х	
		PFCs			
CF4	X				
C2F6	Х				
c-C4F8	X				
SF6	X				Х
NF3	Х				
		Blends			
R410A		Х			

Exercise: Estimate 2.F.1.using Tier 1 Method



Exercise 1b: Estimate emissions, in tonnes, for 2015 and 2022 for category 2.F.1.a, using the following data/assumptions:

- The country does not have any subdivisions.
- All gases/blends, except HFC-125, were introduced in 2000, HFC-125 introduced in 1995.
- Imported quantities for 2015 and 2022 are as shown.
- Equipment growth rate is 3.0%.
- No information is available on F-gas destruction at the end of life.
- IPCC defaults used for lifetime and EF from installed base.

	Refrigeration	Import	s (t)							
F-gases	and Air									
Consumed	Conditioning	2015	2022							
	HFCs									
HFC-23	Х	10	5							
HFC-32	Х	15	10							
HFC-125	Х	20	10							
HFC-134a	Х	5	20							
HFC-143a	Х	5	5							
HFC-152a	Х	5	5							
	Blends									
R410A	Х	10	20							



2.F.1: **Preview** Interoperability with UNFCCC ETF Reporting Tool for Tier 1



TABLE 2(II).B-H SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES AND PRODUCT USE Sources of fluorinated substances (Sheet 2 of 2)

Table2(II).B-Hs2

Refresh values

IPPU

Year 2015

Table2(I) Table2(I),A-H Table2(II) Table2(II),B-Hs1

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	/		1	MPLIED EMISSIO FACTORS (1)	N			EMISSIONS (2)		RECOVERY (3,4)	
	Filled into new manufactured products	in operating systems (average annual stocks)	Remaining in products at decommissioning	Product manufacturing factor	Product life factor	Disposal loss factor		anufacturing	From stocks	From disposal	
	(t)								(t)		(t)
2.F. Product uses as substitutes for ODS	_										
2.F.1. Refrigeration and air-conditioning											
2.F.1.a. Commercial refrigeration											
HFC-23	2.13391124	50.2982376	5.45582655					IE	7.22338252	5.45582655	NE
HPC-32	4.26782249	100.59647519	10.91165311					IE	14.44676504	10.91165311	NE
HFC-41	NE	NE	NE					NE	NE	NE	NE
HFC-125	9.47127303	103.53881757	8.02683117					IE	15.5329183	8.02683117	NE
HFC-134	NE	NE	NE					NE	NE	NE	NE
HFC-134a	1.06695562	25.1491188	2.72791328					IE	3.61169126	2.72791328	NE
HFC-143	NE	NE	NE					NE	NE		115
HFC-143a	95562	25.1491188	2.72791328					IE	3.61169126	2.7.7913	Column
▶ HFC-152a	umn 🕒	<u>C</u>	<u>C</u>					IE	IE		
HFC-227ea	NE	NE	NE					NE	NE	N	
HFC-236fa	NE	NE						NE	NE	N	
HFC-245fa	NE	١E	Colum				61 E	-,, NE	NE	1	
HFC-365mfc	NE	IE						NE	NE		
CF4	NE	IE						NE	NE	Colum	NE NE
C2F6	NE	IE	I K				tion	· 1 🖳	NE	Colum	NE
C3F8	NE	IE					UEI	NE	NE	\sim	NE
C6F14	NE	NE I	NE					NE	NE	G	NE
Unspecified mix of HFCs and PFCs	NE	RE.	ME					NE	NE		NE
2.F.1.b. Domestic refrigeration	"Δι	iorano ai	nnual" ie								
HFC-23		i ci aye ai	inual is					IE	IE	IE	NE
	ave	rade of c	olumn M								
		ruge er e		•							
	11-								Column		
	this year and last									•	
Voor											
		yea									

Current year (2015)

mode

Note for interoperability: For Tier 1, all maps to commercial refrigeration (see "IE" for domestic refrigeration)

Note inclusion of all gases added in *Software.*

See "C" for AD of HFC-152a and "IE" for emissions?

2.F.1 Refrigeration and Air Conditioning

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iocc

Tier 2

WMO UN G environment programme

2.F.1: Steps to estimating emissions following Tier 2 method



2.F.1: F-Gas Parameters – Tier 2

F-Gas Emissions

Subcategory:

F-Gases Manager

HFCs

PFCs

SF6

NF3

Blends

±.

+

÷.

+

÷.

User no

Worksheet

Sector:

Sheet:

Data

+

Category:



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2.F.1: Steps to estimating emissions following Tier 2 method



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2.F.1: Steps to estimating emissions following Tier 2 method



8. For interoperability: user may indicate if the gas in this category is confidential- all confidential emissions will be reported, in tCO_2 eq in 2.H.3 as unspecified mix of HFCs and PFCs.

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2.F.1 Refrigeration and Air Conditioning

INTERGOVERNMENTAL PANEL ON CLIMATE CHANCE



IOCC

Tier 2a

2.F.1: Tier 2a

• **<u>Tier 2a</u>** (*Emission Factor Approach*):





2.F.1: Tier 2a

The Tier 2a worksheet will be blank until all EFs and Parameters are added in worksheet F-gas Parameters – Tier 2

F-Gas Emissic Worksheet Sector: Category: Subcategory Sheet:	Industrial Pr Product Use r: 2.F.1.a - Re F-Gas Emiss	ameters - Tier 2 ocesses and Pro es as Substitutes frigeration and St sions - Emission F	F-Gas Emissio duct Use for Ozone Depleti ationary Air Condi actor Approach -	nns - Tier 2a F Ing Substances tioning Tier 2a	-Gas Emissions	- Tier 2b							201	5
Subdivision	E	Fc [%]	Sub-appl	ication	EFx [%]	Lifetim	∨ Ga e(d)[уг]	s p [½]	n(r	✓ ec,d) [½]		gustion 7.10 7.1	4	
Year	Amount in the bank on January 1st of year t (kg)	Domestically Manufactured HFC in year t (kg)	Imported in bulk in year t (kg)	Exported in bulk in year t (kg)	Contained in factory- charged Imported equipment in year t	Contained in factory- charged Exported new -equipment in year t	Domestic Sales of chemical (in bulk) in year t (kg)	Emitted by containers management (during transfer from bulk to small,	Used to fill domestically manufactured new equipment in year t	Emitted during filling of new equipment in year t (kg)	Contained in new equipment filled in country in year t	Contained in equipment going to the bank in year t (kg)	equipment in use in year t, including servicing (kg)	
t ∆	B = U(t-1)	с	D	E	F	G	H = C + D - E + Q(t-1)	I = H * (EFc / 100)	J=H-I-0	K = J * (EFk / 100)	L = J - K	M=L+F-G	N = ∑(M(t- d+1,t)) * (EFx / 100)	

-Gas Emission	s F-Gas Parameters	- Tier 2 F-Gas Emission	ns-Tier2a F-Gas	Emissions - Tier 2b									
forksheet ector: ategory: ubcategory: heet:	csneet Industrial Processes and Product Use egory: Product Uses as Substitutes for Ozone Depleting Substances scategory: 2.F.1.a - Refrigeration and Stationary Air Conditioning ett: F-Gas Parameters - Tier 2												
F-Gases Manager													
					Subd	livision							
Capital city													
Resto	Rest of country												
Sub-application													
Do	mestic Refrigeration												
	Chemical	Tier	Year of Introduction	Emission factor for containers management (%/yr)	Emission factor for filling (production/manufacturing) of new equipment (% initial charge/yr)	Emission factor for equipment operation (leakage/servicing) (% initial charge/yr)	Lifetime of equipment (years)	Share of initial charge remaining at the end of life (%)	Recovery efficiency of charge (to be reclaimed/recycled) remaining at end of life in retired equipment (%)	UNFCCC CRT Confidenti ality			
			t(start)	EFc	EFk	EFx	d	p	η(rec,d)				
	HFC-23 (CHF3)	Tier 2a	2000	2	1	0.5	12	80	35				
*	_				Suba	application							
*					500-8	pheadon							
					Subd	livision							
*											~ 2 7		

2.F.1: Tier 2a – EF



Default parameters and EFs can be found in:

- Worksheet: F-Gas Parameters- Tier 2
- o Table 7.9 of the 2006 IPCC Guidelines

• EF for container management between 2-10% (see equation 7.11)

Gas Emiss lorksheet ector: ategory: ubcatego heet: Data	ions F-Gas Parameters - Tier 2 F-G Industrial Processes and Product U Product Uses as Substitutes for Oz ry: 2.F.1.a - Refrigeration and Stationa F-Gas Parameters - Tier 2	ias Emissions - Tier 2a I Ise one Depleting Substances ny Air Conditioning	F-Gas Emissions - Tier 2b				1990
F-Gases	Manager						
			Subdivis	sion			
E Uns	specified						
			Sub-app	lication			
.	Stand-alone Commercial Applications						
Đ.	Domestic Refrigeration						
	Medium & Large Commercial Refrigerat	ion					
	Transport Refrigeration						
.	Industrial Refrigeration including Food	Processing and Cold Store	age				
	Chillers						
	Residential and Commercial A/C, include	ding Heat Pumps					
						✓	3 2
	Sub-application	Lifetime of equipment (years)	Emission factor for filling (production/manufacturing) of new equipment (% initial charge/yr)	Emission factor for equipment operation (leakage/servicing) (% initial charge/yr)	Recovery efficiency of charge (to be reclaimed/recycled) remaining at end of life in retired equipment (%)	Share of initial charge remain the end of life (%)	ning at
*	Domestic Refrigeration	12 ≤ d ≤ 20	0.2 ≤ k ≤ 1	0.1 ≤ x ≤ 0.5	0 < ηrec,d < 70	0 < p < 80	
	Stand-alone Commercial Applications	10 ≤ d ≤ 15	0.5 ≤ k ≤ 3	1 ≤ x ≤ 15	0 < ηrec.d < 70	0 < p < 80	
	Medium & Large Commercial Refrigeration	7 ≤ d ≤ 15	0.5 ≤ k ≤ 3	10 ≤ x ≤ 35	0 < ηrec,d < 70	50 < p < 100	
	Transport Refrigeration	6≤d≤9	0.2≤k≤1	15 ≤ x ≤ 50	0 < ηrec,d < 70	0 < p < 50	
	Industrial Refrigeration including Food Processing and Cold Storage	15 ≤ d ≤ 30	0.5 ≤ k ≤ 3	7 ≤ x ≤ 25	0 < ŋrec,d < 90	50 < p < 100	
	Chillers	15 ≤ d ≤ 30	0.2 ≤ k ≤ 1	2≤x≤15	0 < ηrec,d < 95	80 < p < 100	
	Residential and Commercial A/C, including Heat Pumps	10 ≤ d ≤ 20	0.2 ≤ k ≤ 1	1 ≤ x ≤ 10	0 < ηrec,d < 80	0 < p < 80	
er notes			- 1	2.5.1.a Time Series			

ESTIMATES ¹ FOR CE	I ABLE 7.9 ESTIMATES ¹ FOR CHARGE, LIFETIME AND EMISSION FACTORS FOR REFRIGERATION AND AIR-CONDITIONING SYSTEMS												
Sub-application	Charge (kg)	Lifetimes (years) ²	Emission F initial ch	Factors (% of arge/year) ³	End-of Emissio	f-Life on (%)							
Factor in Equation	(M)	(d)	(k)	(x)	$(\eta_{rec,d})$	(p)							
			Initial Emission	Operation Emission	Recovery Efficiency⁴	Initial Charge Remaining							
Domestic Refrigeration	$\begin{array}{c} 0.05 \leq M \leq \\ 0.5 \end{array}$	$12 \leq d \leq 20$	$0.2 \leq k \leq 1$	$0.1 \le x \le 0.5$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 70 \end{array}$	0							
Stand-alone Commercial Applications	$0.2 \leq M \! \leq 6$	$10 \leq d \leq 15$	$0.5 \leq k \leq 3$	$1 \leq x \leq 15$	$0 < \! \eta_{rec,d} < \! 70$	0							
Medium & Large Commercial Refrigeration	$\begin{array}{c} 50 \leq M \leq \\ 2000 \end{array}$	$7 \leq d \leq 15$	$0.5 \leq k \leq 3$	$10 \leq x \leq 35$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 70 \end{array}$	50 100							
Transport Refrigeration	$3 \le M \le 8$	$6 \leq d \leq 9$	$0.2 \leq k \leq 1$	$15 \leq x \leq 50$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 70 \end{array}$	0							
Industrial Refrigeration including Food Processing and Cold Storage	10 ≤ M ≤ 10,000	$15 \leq d \leq 30$	$0.5 \leq k \leq 3$	$7 \leq x \leq 25$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 90 \end{array}$	50 100							
Chillers	10 ≤ M≤ 2000	$15 \leq d \leq 30$	$0.2 \leq k \leq 1$	$2 \leq x \leq 15$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 95 \end{array}$	80							
Residential and Commercial A/C, including Heat Pumps	$\begin{array}{c} 0.5 \leq M \leq \\ 100 \end{array}$	$10 \leq d \leq 20$	$0.2 \leq k \leq 1$	$1 \leq x \leq 10$	$0 < \frac{\eta_{rec,d}}{80} <$	0 < p < 80							
Mobile A/C	$\begin{array}{c} 0.5 \leq M \leq \\ 1.5 \end{array}$	$9 \leq d \leq 16$	$0.2 \le k \le 0.5$	$10 \le x \le 20^5$	$\begin{array}{c} 0 < \eta_{rec,d} < \\ 50 \end{array}$	$0 \le p \le 50$							

¹ Based on information contained in UNEP RTOC Reports (UNEP-RTOC, 1999; UNEP-RTOC, 2003)

2.3 Lower value for developed countries and higher value for developing countries

⁴ The lower threshold (0%) highlights that there is no recovery in some countries.

⁵ Schwarz and Harnisch (2003) estimates leakage rates of 5.3% to 10.6%; these rates apply only to second generation mobile air conditioners installed in European models in 1996 and beyond.

Source: 2006 IPCC Guidelines

2.F.1: Tier 2a - AD

Once all parameters are entered in <u>F-gas Parameters-Tier 2</u>, the times series data entry grid appears in worksheet <u>F-Gas Emissions-Tier 2a</u>, ready for AD entry.

Application Database Inventory Year Administrate Workcheets Tools Export/Import Reports Window Help P-Gas Emissions Fire22 P-Gas Emissions Tier22 P-Gas Emissions Tier23 P-Gas Emission 2 P-Gas Emis	2015
P-Gas Emissions F-Gas Parameters - Tier 2 F-Gas Emissions - Fier 2a P-Gas Emissions - Tier 2a Worksheet Sector: Industrial Processes and Product Use F-Gas Emissions - Tier 2a F-Gas Emissions - Tier 2a Subcategory: Product Uses as Subtattees for Ozone Depieting Subtances Subcategory: F-Gas Emissions - Tier 2a Subcategory: Product Use Sub-application Domestic Refrigeration Sub-application Subcategory: Product Use Sub-application Domestic Refrigeration Sub-application Subcategory: Product Use Sub-application Domestic Refrigeration Sub-application Subcategory: Product Use Sub-application Domestic Refrigeration Subcategory: Vear Amount Im Domestically Imported Exported Emitted by Used to fill Emitted during Contained in Equipment in requipment in factory- Emitted during in requipment in requipment in requipment in receiver	2015
Subdivision Subdivision <th>Exported in used bank on t equipment December 31st of in year t vear t</th>	Exported in used bank on t equipment December 31st of in year t vear t
Intro Year2000EFe [7]2EHk [7]1EFk [7]0.5Lifetime (d) [yr]12p [7]80n(rec.d) [7]35Equation 7.10 - 7.14 $Vear$ Amount in black in contained in to graph of the contained in the contained i	Exported Amount in the in used bank on Total emissions in vear t or total emissions in vear t total emissions in total emission
Amount in the bank on January t (kg)Domestically manufactured t (kg)Imported in bulk in yeart 	Exported in used bank on t equipment (for December 31st of in year t
t A B = U(1-1) C D E F G H = C + D. E + C (1-1) I = H * (EFc / 100) J = H - I - O K = J * (EFk / 100) L = J - K M = L + F - G N = ∑(M(t) (EFx / 100) O = H ² (2/3) or specified P = A(t.d)* Q = P * (n (rec, d)/100) R = P - Q S 2001 0	subsequen yeart (Kg) (Gg) t use) in ye (kg)
2000 0	T U = B + M + O - V = I + K + N + W = V / N - P - T R - S - T 1000000
2001 0	0 0 2 2
2004 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
2005 0 0 0 0 0 0 0 0 0 0 0 Calculated 0 0 0 0 0 0	0 0 0 2
	0 0 0
	0 0 0
2010 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0
2011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
2014 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0
2015 0 0 0 0 0 0 0 0 0 0 0 Calculated 0 0 0 0 0 0	0 0 0 2
2016 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2

2.F.1 Refrigeration and Air Conditioning

INTERGOVERNMENTAL PANEL ON CLIMATE CHANES



IOCC

Tier 2b

EQUATION 7.9

DETERMINATION OF REFRIGERANT EMISSIONS BY MASS BALANCE

Emissions = Annual Sales of New Refrigerant – Total Charge of New Equipment

+ Original Total Charge of Retiring Equipment – Amount of Intentional Destruction

- Annual Sales of New Refrigerant: the amount of a chemical introduced in a given year. It includes all chemical used to fill or refill equipment, whether the chemical is charged into equipment at the factory, charged into equipment after installation, or used to recharge equipment at servicing. It does not include recycled or reclaimed chemical.
- **Total Charge of New Equipment:** the sum of the full charges of all the new equipment that is sold in a given year. It includes both the chemical required to fill equipment in the factory and the chemical required to fill the equipment after installation. It does not include charging emissions or chemical used to recharge equipment at servicing.
- Original Total Charge of Retiring Equipment: the sum of the full charges of all the retiring equipment decommissioned in a given year. It assumes that the equipment will have been serviced right up to its decommissioning and will therefore contain its original charge.
- Amount of Intentional Destruction: quantity of the chemical duly destroyed by a recognised destruction technology.

2.F.1: Tier 2b

The Tier 2b worksheet will be blank until all EFs and Parameters are added in worksheet F-gas Parameters – Tier 2



2.F.1: Tier 2b – parameters

Default parameters for lifetime and recovery efficiency:

- Worksheet: F-Gas Parameters- Tier 2
- o Table 7.9 of the 2006 IPCC Guidelines

y: Product Uses as Substitutes for Oz agory: 2.F.1.a - Refrigeration and Stationa F-Gas Parameters - Tier 2	lse one Depleting Substances ry Air Conditioning					1	99
ases Manager							
		Subdivis	sion				
Unspecified							
		Sub-app	lication				
Stand-alone Commercial Applications		444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 444 - 44					
Domestic Refrigeration							
Medium & Large Commercial Refrigerat	ion						
Transport Refrigeration						++	
Industrial Refrigeration including Food	Processing and Cold Store	age				++	
Chillers							
Residential and Commercial A/C, include	ding Heat Pumps						
*						- 🖬	っ
N: Sub-application	Lifetime of equipment (years)	Emission factor for filling (production/manufacturing) of new equipment (% initial charge/yr)	Emission factor for equipment operation (leakage/servicing) (% initial charge/yr)	Recovery efficiency of charge (to be reclaimed/recycled) remaining at end of life in retired equipment (%)	Share of initial charge rem the end of life (%)	naining	g at
Domestic Refrigeration	12 ≤ d ≤ 20	0.2 ≤ k ≤ 1	0.1 ≤ x ≤ 0.5	0 < ηrec,d < 70	0 < p < 80		
Stand-alone Commercial Applications	10 ≤ d ≤ 15	0.5 ≤ k ≤ 3	1 ≤ x ≤ 15	0 < ηrec,d < 70	0 < p < 80		
Medium & Large Commercial Refrigeration	7≤d≤15	0.5 ≤ k ≤ 3	10 ≤ x ≤ 35	0 < ηrec,d < 70	50 < p < 100		
Transport Refrigeration	6≤d≤9	0.2 ≤ k ≤ 1	15 ≤ x ≤ 50	0 < ηrec,d < 70	0 < p < 50		
Industrial Refrigeration including Food Processing and Cold Storage	15≤d≤30	0.5≤k≤3	7 ≤ x ≤ 25	0 < ŋrec,d < 90	50 < p < 100		
Chillers	15 ≤ d ≤ 30	0.2 ≤ k ≤ 1	2≤x≤15	0 < ηrec,d < 95	80 < p < 100		
Residential and Commercial A/C,	10 ≤ d ≤ 20	0.2 ≤ k ≤ 1	1 ≤ x ≤ 10	0 < ηrec,d < 80	0 < p < 80		

TABLE 7.9 ESTIMATES¹ FOR CHARGE, LIFETIME AND EMISSION FACTORS FOR REFRIGERATION AND AIR-CONDITIONING SYSTEMS End-of-Life Lifetimes Emission Factors (% of Sub-application Charge (kg) (years)² initial charge/year)³ Emission (%) Factor in Equation (M) (d) (k) **(x)** (nrec.d) (p) Initial Initial Operation Recovery Charge Emission Efficiency Emission Remainin Domestic $0.05 \le M \le$ $0 < \eta_{rec,d} < 70$ $12 \leq d \leq 20$ $0.2 \le k \le 1$ $0.1 \leq x \leq 0.5$ 0Refrigeration 0.5 Stand-alone $0 \leq \eta_{rec,d} \leq 70$ Commercial $0.2 \le M \le 6$ $10 \le d \le 15$ $0.5 \leq k \leq 3$ $1 \le x \le 15$ 0Applications Medium & Large $0 \le \eta_{rec,d} \le 70$ $50 \leq M \leq$ 50 < p < $0.5 \leq k \leq 3$ $10 \le x \le 35$ Commercial $7 \leq d \leq 15$ 2000 100 Refrigeration Transport $0 \leq \eta_{rec,d} \leq 70$ $3 \le M \le 8$ $6 \le d \le 9$ $0.2 \le k \le 1$ $15 \leq x \leq 50$ 0Refrigeration Industrial Refrigeration $0 < \eta_{rec,d} < 0$ $10 \leq M \leq$ 50 < p < including Food $15 \leq d \leq 30$ $0.5 \leq k \leq 3$ $7 \le x \le 25$ 10,000 100 Processing and Cold Storage 80 < p < $10 \le M \le$ $0 \le \eta_{rec,d} \le 95$ Chillers $15 \leq d \leq 30$ $0.2 \le k \le 1$ $2 \le x \le 15$ 2000 100 Residential and Commercial A/C $0.5 \leq M \leq$ $0 \leq \eta_{rec,d} \leq 80$ $10 \leq d \leq 20$ $0.2 \le k \le 1$ $1 \leq x \leq 10$ 0including Heat 100 Pumps $0 < \eta_{rec,d} <$ $0.5 \le M \le$ $0.2 \leq k \leq$ 0Mobile A/C $9 \le d \le 16$ $10 \le x \le 20^5$ 1.5 0.5

¹ Based on information contained in UNEP RTOC Reports (UNEP-RTOC, 1999; UNEP-RTOC, 2003)

2.3 Lower value for developed countries and higher value for developing countries

⁴ The lower threshold (0%) highlights that there is no recovery in some countries.

⁵ Schwarz and Harnisch (2003) estimates leakage rates of 5.3% to 10.6%; these rates apply only to second generation mobile air conditioners installed in European models in 1996 and beyond.

Source: 2006 IPCC Guidelines

INTERGOVERNMENTAL PANEL ON Climate change

2.F.1: Tier 2b - AD

Once all parameters are entered in <u>F-gas Parameters-Tier 2</u>, the times series data entry grid appears in worksheet <u>F-Gas Emissions-Tier 2b</u>, ready for AD entry.

F. W S C S S	Gas Emissic Jorksheet Sector: Category: Subcategory Sheet: Data	F-Gas Pa Industrial F Product U r: 2.F.1.a - R F-Gas Emi	Processes and ses as Substit Refrigeration a ssions - Mass	ier 2 F-Gi d Product U tutes for Ozo nd Stationar Balance Ap	as Emissions - 1 se one Depleting Su ny Air Conditionin oproach - Tier 2b	Tier 2a F-Gas	Emissions - Ti	er 2b							1							2015
Subdivision Rest of country V Sub-application Domestic Refrigeration V Gas HFC-32 (CH2F2) V																						
	Equation 7.9										Informati on for UNFCCC CRT											
	Year	Domestically Manufacture d HFC in year t (kg)	Imported in bulk in year t (kg)	Exported in bulk in year t (kg)	Contained in factory- charged Imported equipment in year t (kg)	Contained in factory- charged Exported new -equipment in year t (kg)	Domestic Sales of new chemical in year t (kg)	To / from stockpile (kg)	Used in year t to fill new equipment not factory- charged (kg)	Used in year t to fill new equipment factory- charged (kg)	Total Charge in new- equipment in year t (kg)	Used in year t-d to fill new equipment not factory- charged (kg)	Used in year t-d to fill new equipment factory- charged (kg)	Original Total Charge in year t-d of Equipment Retiring in year t (kg)	Reco recycle from retire	vered and ed/reclaimed equipment ed in year t (kg)	Destroyed in year t (kg)	Exported in used equipment in year t (kg)	Total emissions in year t (kg)	Total emissions in year t (Gg)	Bank (kg)	
	t ∆	в	с	D	E	F	G = B + C - D + E - F	s	н	1	J = H + I	K = H(t-d)	L = I(t-d)	M = K + L		N = M * (η (rec,d)/100) or specified	o	Р	Q = (G - S) - J + M - N - O - P	R = Q / 1000000	$\begin{array}{l} X = \sum (J(t) \\ d+1, t)) - \\ Mt \end{array}$	
	2000	1000			100		1100	25	1000		1000	0	0	0	Calcul	0		25	50	0.00005	1000	
	2001	1100			100		1200	22	1000		1000	0	0	0	Calcul	0		25	153	0.00015	2000) 🛃
	2002	1211			100		1311	0	1000		1000	0	0	0	Calcul	0		30	281	0.00028	3000	
	2003	2000			100		2100	0	1000		1000	0	0	0	Calcul	0		30	1070	0.00107	4000	
	2004	3000			100		3100	0	1000		1000	0	0	0	Calcul	0		40	2060	0.00206	5000	
	2005	1000			100		1100	0	1000		1000	0	0	0	Calcul	0		-	100	0.0001	6000	
	2006	2000			100		2100	0	1000		1000	0	0	0	Calcul.	0		24	1076	0.00108	7000	
	2007	1600			100		1700	0	1000		1000	0	0	0	Calcul.	0		56	644	0.00064	8000	
	2008	2000			100		2100	0	1000		1000	0	0	0	Calcul.	0		35	1065	0.00107	9000	
	2009	4000			100		4100	0	1000		1000	0	0	0	Calcul.	0		30	3070	0.00307	11000	
	2010	1500			100		1600	100	1000		1000	0	0	0	Calcul	0			500	0.0001	1200	
	2012	2000			100		2100	10	1000		1000	0	0	0	Calcul	0		100	990	0.0000	1200	
	2013	1000			100		1100	0	1000		1000	0	0	0	Calcul	0		100	100	0.0001	1400	
	2014	900	90		100		1090	0	1000		1000	0	0	0	Calcul.	0			90	0.00009	1500	
	2015	1000	100		100		1200	0	1200		1200	1000	0	1000	Calcul.	800	100		100	0.0001	1420	
	2016	1000	100		1000		2100	0	1200		1200	1000	0	1000	Calcul	800	25	5	1075	0.00108	1440	0 3
	2017	1590	25		900		2515	0	1200		1200	1000	0	1000	Calcul	800	100		1415	0.00142	1460	03
	2018	2000	1000		800		3800	0	1200		1200	1000	0	1000	Calcul	800	200		2600	0.0026	1480	0 2
	2019	233	25		900		1158	0	1200		1200	1000	0	1000	Calcul	800			158	0.00016	1500	
	2020	1000	25		1000		2025	0	1200		1200	1000	0	1000	Calcul	800			1025	0.00103	1520) 🕜 📩
	2021						0				0	1000	0	1000	Calcul	800			200	0.0002	1420) 🛃
	2022	I			I.		0				0	1000	01	1000	Calcul	800			200	0.0002	1320) = 2



✓ Now let's do exercise with dummy data

Exercise: Add gases for Tier 2 method



Scenario: The user has already populated the IPCC <u>category level</u> F-gases Manager for the Tier 1 exercise. As the Manager is for <u>category level</u>, these F-gases/blends also appear for Tier 2.

However, assume that the user realizes that for the part of the country applying the Tier 2 method, C_2F_6 is also imported for industrial refrigeration.

Exercise #2a: Modify the IPCC <u>category level</u> F-gases Manager to include C_2F_6 emissions for category 2.F.1.

		Refrigeration			Soundpr
F-gases		and Air			oof
Consumed	Electronics	Conditioning	Fire protection	Aerosols	windows
		HFCs			
HFC-23	Х	Х			
HFC-32		Х			
HFC-125		Х			
HFC-134a		Х		Х	
HFC-143a		Х			
HFC-152a		Х			
HFC-227ea			Х	Х	
		PFCs			
CF4	Х				
C2F6	Х	X (added)			
c-C4F8	Х				
SF6	Х				Х
NF3	Х				
		Blends			
R410A		Х			

Exercise: Set Subdivision and subapplications for Tier 2

The user has added all possible F-gases for Tier 2. Now it is time to create subdivisions in the country and identify the applications for calculating emissions

Exercise 2b:

Add two subdivisions for the country:

✓ "Capital city" and "Rest of country"

✓ For "Capital City" set the *Software* so that the following sub-applications exist:

- ✓ Domestic Refrigeration
- ✓ Medium & Large Commercial Refrigeration
- ✓ Transport Refrigeration
- ✓ Industrial Refrigeration including Food Processing and Cold Storage
- ✓ Residential and Commercial A/C, including Heat Pumps
- ✓ No further modification for subdivision "Rest of country" needed for this exercise.

Note for Interoperability

	Sub-application per IPCC	Mapping to CRT				
	Domestic Refrigeration	Maps to domestic refrigeration in CRT				
:	Medium & Large Commercial Refrigeration	Maps to commercial refrigeration				
	applications Chillers					
	Industrial Refrigeration, incl. food processing and cold storage	Maps to industrial refrigeration in CRT				
	Transport Refrigeration	Maps to transport refrigeration in CRT				
	Residential and commercial A/C, incl heat pumps User defined sub- applications	Maps to stationary air conditioning in CRT				

Exercise: Set EFs and parameters

This exercise will focus on adding EFs and parameters for one gas, in one sub-application, in one subdivision.

Exercise 2c:

- In subdivision= Capital City
- In sub-application= Domestic Refrigeration
- Enter relevant information for gas = HFC-134a (not confidential)
- Indicate use of the Tier 2a method

HINTs:

- ✓ Information added in worksheet **F-gas Parameters Tier 2**
- ✓ <u>Default data</u> See how data fall in ranges of <u>Table 7.9</u> of the 2006 IPCC Guidelines and the EF for container management from equation 7.11.

Table 1

Sub-division:	Capital City				
Sub-application =	Domestic Refrigeration				
Gas=	HFC-134a				
	Parameter				
Tier 2a parameters	name	Data			
Year of introduction	t(stsart)	2000			
EF for containers	EFc	2			
EF for filling	EFk	0.5			
EF for equipment	EEv	0.25			
operation	EFX	0.25			
Lifetime	d	12			
Share of initial					
charge remaining at	ρ	80			
end of life					
Recovery efficiency	η (rec,d)	35			

2.F.1: Enter AD and Estimate Emissions

Exercise 2d:

- Estimate emissions of HFC-134a, following Tier 2a method, for subdivision = capital city, sub-application = Domestic Refrigeration
- All consumption from imports (bulk and in equipment); no production or export.
- Assume input data were known for 2015 and 2022 (see table).
 - <u>Note:</u> The user did not want to use Tier 1 and decided to extrapolate existing AD to full time series, noting that there was a 2% change in AD between 2015 and 2022, the user extrapolated back the 2% to the year of introduction of the gas.
- No country-specific information on the amount of gas used to refill equipment versus for new equipment, so calculate with default.
- No data on destruction for each year.
- No export of gas in used equipment.

		Contained in factory-
	Imports in bulk	charged imported
	(kg)	equipment (kg)
2000	3.7	0.7
2001	3.8	0.8
2002	3.9	0.8
2003	3.9	0.8
2004	4.0	0.8
2005	4.1	0.8
2006	4.2	0.8
2007	4.3	0.9
2008	4.4	0.9
2009	4.4	0.9
2010	4.5	0.9
2011	4.6	0.9
2012	4.7	0.9
2013	4.8	1.0
2014	4.9	1.0
2015	5.0	1.0
2016	5.1	1.0
2017	5.2	1.0
2018	5.3	1.1
2019	5.4	1.1
2020	5.5	1.1
2021	5.6	1.1
2022	5.7	1.1

INTERGOVERNMENTAL PANEL ON Climate change

2.F.1: **Preview** Interoperability with UNFCCC ETF Reporting Tool for Tier 2a



🍪 IPCC Inventory Software - Ihanle2 - [CRT Tables - Baku Tier 2]

Reports Window Were Administrate Worksheets Tools Export/Import Reports Window

Sector IPPU V Year 2015 V

Table2(I) Table2(I).A-H Table2(II) Table2(II).B-Hs1 Table2(II).B-Hs2

TABLE 2(II).B-H SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES AND PRODUCT USE Sources of fluorinated substances (Sheet 2 of 2)

Refresh values

_											
	GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA Amount			IMPLIED EMISSION FACTORS (1)			EMISSIONS (2)		RECOVERY (3,4)
		Filled into new manufactured products	In operating systems (average annual stocks)	Flemaining in products at decommissioning	Product manufacturing factor	Product life factor	Disposal loss factor	From manufacturing	From stocks	From disposal	
		(t)	(t)	(t)	%	%	%	(t)	(t)	(t)	(t)
►	2.F. Product uses as substitutes for ODS										
	2.F.1. Refrigeration and air-conditioning										
	2.F.1.a. Commercial refrigeration	"Avorage	onnual" i	o ovorogo	of						
	HFC-23	Average		S average				NE	NE	NE	N
	HFC-32							NE	NE	NE	N
	HFC-41	hank in	haainnina	(Column F	2)			NE	NE	NE	N
	HFC-125		Deginning					NE	NE	NE	N
	HFC-134				\			NE	NE	NE	N
	HFC-134a	and en	d ot vear ((Column LI						NE	NI
	HFC-143		a or your (/				lumn i		Jump
	HFC-1438	NE	NE	NE							Jumns
			INE NE						NI		
	HEC-22/68		NE						IN		$\cap_{\perp} c$
2	HEC-245fa	NE NE	NE					NIE I	NE.		WTO
۲	HEC-365mfc	NE	NE					NE	NE	NE	N
	CF4	U NE	NE					NE	NE	NE	N
	C2F6	NE	NE					NE	_		N
	C3F8	NE	NE	NE				NE			NE
	C6F14	NE	NE	NE				NE		JOIUMINS	N
	Unspecified mix of HFCs and PFCs	NE	NE	NE				NE			NE
	2.F.1.b. Domestic refrigeration					_				DCT	
	HFC-23	NE	NE	NE				NE		1-0-1	N
	HFC-32	NE	NE	NE			imns	NE			N
	HFC-41	NE	NE	NE				NE	NE	NE	N
	HFC-125	NE	NE	NE			17	NE	NE	NE	N
	HFC-134	NE	NE	NE		-	+K	NE	NE	NE	N
	HFC-134a	0.00174353	0.07386399	0.00161271				0.00012001	0.00007029	0.00104826	-0.0005644
	HFC-143a	NE	NE	NE				NE	NE	NE	NE

Help

Note for interoperability: Tier 2 maps to relevant gas and subapplication.

2015

Software values divided by 1,000 to convert to tonnes.

IEFs will calculate in UNFCCC tool.

Emissions are "net" of recovery/ destruction/oxidation/etc.



THANK YOU FOR YOUR ATTENTION

STAY IN TOUCH

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Results of Exercises

Results of Data Input

INCC INTERGOVERNMENTAL PANEL ON CLIMATE CHANE



Cement Production (2.A.1)

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON **Climate change**



iocc

Tier 1

Results (1/2) and (2/2) - 2015

INTERGOVERNMENTAL PANEL ON Climate change

ipcc



IPCC Inventory Software - TSU -	Worksheets]								_	o ×
Application Database In	entory Year Administrate Wo	rksheets Tools Exp	ort/Import Repo	rts Window Help						_ 8 ×
06 IPCC Categories	Cement Production (1/2)	bearing non-fuel materials ement Production (2/2)	s - Tier 3 (3/4) CO Clinker production -	2 Emissions summary - Tier Tier 2 CO2 Emissions from	3 (4/4) Capture and n carbonates - Tier 3 (1	storage or other reduct (4) CO2 Emissions	tion from uncalcined CKD not recycled to t	he kiln - Tier 3 (2/4)		
2.A.2 - Lime production 2.A.3 - Glass Production 2.A.4 - Other Process Usr 2.A.4.a - Ceramics 2.A.4.b - Other Uses o 2.A.4.c - Non Metallur 2.A.4.d - Other (pleas	Sector: Industrial Category: Mineral In Subcategory: 2.A.1 - Ce Sheet: CO2 Emis Data	Processes and Product Use dustry ment production sions from Cement producti	e on (1 of 2)		Ec	uation 2.1				2015
2.A.5 - Other (please sper	fv III									
2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Produc	Subdi	vision	Individual	Type of Cement Produced	Mass of Indi Cement (to	ridual Type of Produced nne)	Clinker Fraction in Cement (Fraction)	Mass of Clinker in the Individu Type of Cement Produced (tonne)	Jal	
2.B.3 - Adipic Acid Produc	•	Δ`	7			A	В	C=A*B		
2.B.4 - Caprolactam, Glyc	a Company A		Product Mix - 30/	70		2534000	- 0.81	7 20702	78 2	
- 2.B.5 - Carbide Production	Company B		Masonry			1204000	0.7	5 9030	00 🕜 🛃	2 X
2.B.7 - Soda Ash Product	Soda Ash Production									
2.B.8 - Petrochemical and	Total				I					
···· 2.B.8.a - Methanol						3738000		29732	78	
IPCC Inventory Software - TSU	Workshoots]								_	
Application Database Ir	ventory Year Administrate Wo	rksheets Tools Exp	ort/Import Repo	rts Window Help						_ = ×
06 IPCC Categories			Ti 2/2/4) CO	2 Entiretana automatica Tira	2/4/4) Contract and		tion.			
2 A 1 Competereduction	CO2 Emissions from care	ement Production (2/2)	Clickeenergeduction	Z Emissions summary - Her	S(4/4) Capture and	storage of other reduct	uon	La Lila - Tias 2 (2/4)		
	Worksheet	ement Production (2/2)	-linker production -	Tier 2 CO2 Emissions from	n carbonates - 11er 3 (1	4) CO2 Emissions	from uncalcined CKD not recycled to t	ne kiin - Tier 3 (2/4)		
- 2.A.3 - Glass Production	Sector: Industrial	Processes and Product Us	a							2015
- 2.A.4 - Other Process Us	Category: Mineral In	dustry	-							2010
2.A.4.a - Ceramics	Subcategory: 2.A.1 - Ce	ment production								
2.A.4.b - Other Uses (Sheet: CO2 Emis	sions from Cement producti	on (2 of 2)							
2.A.4.c - Non Metallur	Data									
2.A.4.d - Other (pleas	S				Eq	uation 2.1				
10 E ()11	A.5 - Other (please specify									
2.A.5 - Other (please spe			Imports for							
2.A.5 - Other (please spe 2.B - Chemical Industry		Mass of Clinker for	Imports for Consumption of	Export of Clinker	Emission Fac	or for the Clinker		CO2 Emissions	CO2 Emissions	
2.A.5 - Other (please spe 2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Product	Subdivision	Mass of Clinker for Subdivision (tonne)	Imports for Consumption of Clinker	Export of Clinker (tonne)	Emission Fac (tonnes CO2	or for the Clinker /tonne Clinker)	CKD correction	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)	
2.A.5 - Other (please spe 2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Produc 2.B.3 - Adipic Acid Produc	Subdivision	Mass of Clinker for Subdivision (tonne)	Imports for Consumption of Clinker (tonne)	Export of Clinker (tonne)	Emission Fac (tonnes CO)	or for the Clinker /tonne Clinker)	CKD correction	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)	
2.A.5 - Other (please spe 2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Produc 2.B.3 - Adipic Acid Produc 2.B.4 - Caprolactam, Glyce	Subdivision	Mass of Clinker for Subdivision (tonne) 文 A	Imports for Consumption of Clinker (tonne) B	Export of Clinker (tonne) C	Emission Fac (tonnes CO)	or for the Clinker /tonne Clinker) D	CKD correction E	CO2 Emissions (tonnes CO2) F = (A - B + C) * D * E	CO2 Emissions (Gg CO2) G = F / 1000	
2.8.5 - Other (please spe 2.8 - Chemical Industry 2.8.1 - Ammonia Producti 2.8.2 - Nitric Acid Produc 2.8.3 - Adipic Acid Produc 2.8.4 - Caprolactam, Glyc 2.8.5 - Carbide Production	Subdivision	Mass of Clinker for Subdivision (tonne) ▼ A 2070278	Imports for Consumption of Clinker (tonne) B	Export of Clinker (tonne) C 0 Spec	Emission Fac (tonnes CO)	or for the Clinker /tonne Clinker) D 0.51	CKD correction E 1.02	CO2 Emissions (tonnes CO2) F = (A - B + C) * D * E 1076958.6156	CO2 Emissions (Gg CO2) G = F / 1000 1076.95862	
 2.A.5 - Other (please spe 2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Produc 2.B.3 - Adipic Acid Produc 2.B.4 - Caprolactam, Glyc 2.B.5 - Carbide Production 2.B.6 - Titanium Dioxide F 	Subdivision	Mass of Clinker for Subdivision (tonne) A A 2070278 903000	Imports for Consumption of Clinker (tonne) B 0 0	Export of Clinker (tonne) C 0 Spec 45000 Spec	Emission Fac (tonnes CO) ified	or for the Clinker /tonne Clinker) D 0.51 0.51	CKD correction E 1.02 1.02	CO2 Emissions (tonnes CO2) F = (A - B + C) * D * E 1076958.6156 493149.6	CO2 Emissions (Gg CO2) G = F / 1000 1076.95862 493.1496	3
 2.A.5 - Other (please spe 2.B - Chemical Industry 2.B.1 - Ammonia Producti 2.B.2 - Nitric Acid Produc 2.B.3 - Adipic Acid Produc 2.B.4 - Caprolactam, Glyc 2.B.5 - Carbide Production 2.B.6 - Titanium Dioxide F 2.B.7 - Soda Ash Producti 	Subdivision Company A Company B Total	Mass of Clinker for Subdivision (tonne) A 2070278 903000	Imports for Consumption of Clinker (tonne) B 0 0	Export of Clinker (tonne) C 0 Spec 45000 Spec	Emission Fac (tonnes CO) ified ified	or for the Clinker /tonne Clinker) D 0.51 0.51	CKD correction E 1.02 1.02	CO2 Emissions (tonnes CO2) F = (A - B + C) * D * E 1076958.6156 493149.6	CO2 Emissions (Gg CO2) G = F / 1000 1076.95862 493.1496	
Results (1/2) and (2/2) - 2022

INTERGOVERNMENTAL PANEL ON Climate change

ipcc



(ii) IPCC Inventory Software - IPCC - [Worksheets]

🍪 IPCC Inventory Software - IPCC - [Worksheet	ts]								—	o ×
🖳 Application Database Inventory Yea	ar Administrate Workshe	eets Tools Expor	t/Import Reports	Window Help						_ @ >
2006 IPCC Categories 🚽 🕂	CO2 Emissions from carbon-bea	aring non-fuel materials	- Tier 3 (3/4) CO2	Emissions summary -	Tier 3 (4/4) Cap	oture and storage or other redu	uction			
1.C.2 - Injection and Storage 1.C.2.a - Injection 1.C.2.b - Storage 1.C.3 - Other	Cement Production (1/2) Cementaria Sector: Industrial Pro Category: Mineral Indus	ent Production (2/2) (cesses and Product Use try	Clinker production - T	ier 2 CO2 Emission	s from carbonates	- Tier 3 (1/4) CO2 Emission	ns from uncalcined CKD not recycled to t	he kiln - Tier 3 (2/4)		2022
	Subcategory: 2.A.1 - Cemer Sheet: CO2 Emission	nt production ns from Cement production	on (1 of 2)							
- 2.A.1 - Cement production - 2.A.2 - Lime production	Data					Equation 2.1				
	Subdivisi	on	Individual Ty	ype of Cement Produ	Ced	s of Individual Type of Cement Produced (tonne)	Clinker Fraction in Cement (Fraction)	Mass of Clinker in the Individua Type of Cement Produced (tonne)		
2.A.4.c - Non Metallurgica		Δ 7	7		ΔV	A	В	C=A*B		
2.A.5 - Other (please specify)	Company A		Product Mix - 30/70	D		3112000	0.817	2542504) X
2.B - Chemical Industry	Company B		Masonry			4205000	0.75	3153750		_
2.B.1 - Ammonia Production	Total									
- 2.B.3 - Adipic Acid Production						7317000		5696254	4	
- 2.B.4 - Caprolactam, Glyoxal									-	
🏟 IPCC Inventory Software - IPCC - [Workshee	ets]								_	o ×
🖳 Application Database Inventory Ye	ear Administrate Worksh	eets Tools Expo	rt/Import Report	s Window Help	þ					- 8
2006 IPCC Categories 🗸 🕂	CO2 Emissions from carbon b	المتعادية أساك معمومته	- Tier 3 (3/4) CO	2 Emissions summary	- Tier 3 (4/4) Ca	apture and storage or other red	duction			
- 1.C.2 - Injection and Storage	Cement Production (1/2) Cen	nent Production (2/2)	Clinker production - 1	Tier 2 CO2 Emissio	ns from carbonates	-Tier 3 (1/4) CO2 Emissio	ons from uncalcined CKD not recycled to	the kiln - Tier 3 (2/4)		
	Worksheet									2022
1.C.2.D - Storage	Sector: Industrial Pro	cesses and Product Us	e							2022
2 - Industrial Processes and Product	Subcategory: 2.A.1 - Cem	ent production								
⊡-2.A - Mineral Industry	Sheet: CO2 Emissio	ns from Cement product	ion (2 of 2)							
2.A.1 - Cement production	Data									
2.A.2 - Lime production						Equation 2.1				
□ 2.A.4 - Other Process Uses of		Mass of Clinker for	Imports for							
2.A.4.a - Ceramics 2.A.4.b - Other Uses of S	Subdivision	Subdivision (tonne)	Consumption of Clinker (tonne)	Export of Clinker (tonne)	Emis (to	sion Factor for the Clinker nnes CO2/tonne Clinker)	CKD correction	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)	
- 2.A.4.c - Non Metallurgica										
2444 01 44		A	В	С		D	E	F = (A - B + C) * D * E	G = F / 1000	
2.A.4.d - Other (please sp 2.A.5. Other (please specific)	△ ▽ Company A	A 2542504	в 0	C 0	Specified	D 0.51	E 1.02	F = (A - B + C) * D * E 1322610.5808	G = F / 1000 1322.61058	2 2 2
2.A.4.d - Other (please sp 2.A.5 - Other (please specify) ⊡-2.B - Chemical Industry		A 2542504 3153750	B 0 0	C 0 67000	Specified Specified	D 0.51 0.51	E 1.02 1.02	F = (A - B + C) * D * E 1322610.5808 1675434.15	G = F / 1000 1322.61058 1675.43415	3 3 7
		A 2542504 3153750	B 0 0	C 0 67000	Specified Specified	D 0.51 0.51	E 1.02 1.02	F = (A - B + C) * D * E 1322610.5808 1675434.15	G = F / 1000 1322.61058 1675.43415	3 3 7

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON **Climate change**



iocc

Tier 2

2.A.1 Tier 2 – Results – 2015

INTERGOVERNMENTAL PANEL ON Climate change



ipcc

IPCC Inventory Software - TSU - [Work	(sheets]								– 0 ×
🖳 Application Database Invento	ry Year Administrate Worksheets To	ools Export/Import Repor	ts Window Help						_ & ×
2006 IPCC Categories - 7 2.A.1 - Cement production A 2.A.2 - Lime production	CO2 Emissions from carbon-bearing non-fu Cement Production (1/2) Cement Production	uel materials - Tier 3 (3/4) CO2 tion (2/2) Clinker production - T	2 Emissions summary - Tie Tier 2 CO2 Emissions fro	r 3 (4/4) Capture and st om carbonates - Tier 3 (1/4)	orage or other reduction) CO2 Emissions from u	ncalcined (CKD not recycled to the kiln - Tier 3 (;	2/4)	
	Sector: Industrial Processes and Category: Mineral Industry Subcategory: 2.A.1 - Cement production Sheet: CO2 Emissions from Clink	Product Use on ker Production - Tier 2							2015
2.A.5 - Other (please specify				Equa	ation 2.2				
2.B - Chemical Industry 2.B.1 - Ammonia Production 2.B.2 - Nitric Acid Productio 2.B.3 - Adinic Acid Productio	Subdivision	Name of plant or type of clinker	Clinker production (tonnes)	E (tonnes	mission Factor s CO2/tonne Clinker)		Correction Factor for Cement Kiln Dust (CF ckd) (dimensionless)	CO2 Emissions (Gg CO2)	
- 2.B.4 - Caprolactam, Glyoxa	ΔΥ	ΔΥ	А		В		С	D = A*B*C/10^3	
2.8.5 - Carbide Production	National	CementCarbo	534000	Calculated	0.51044	2	1.10523 📝	301.2576	9 📝 🛃 🄊 🗙
- 2.B.7 - Soda Ash Production	Total						2		
2.B.8 - Petrochemical and C			534000					301.2576	9
Emission Factor				×	IPCC Inventory Softwa	re Col	rrection Factor for Cemer	nt Kiln Dust, CF ckd	×
Percentage Percentage CaO Content Non-	Equation Percentage CaO CaO Tot content of clinker CaO CaC	on 2.4 al CO2 from Emissio O3 calcining 1 (uncorri	on Factor Percent Mg ected for derived fro	O Emission m Factor			Weight of CKD not recycl	led to the kiln (tonnes), Md	65,230.00000
of Clinker carbonate (CaO) sources of (%) CaO	from carbonate sources (%) (%) (%) (tonne	d for tonne Mo CaO CaCO3 (tonne ne) (tonne) tonne	gO) carbonate es CO2 / (optional) Clinker) (%)	(tonnes CO2 / tonne Clinker)	Fra	action of orig	ginal carbonate in the CKD (i.e., befor	e calcination) (fraction), Cd	1.00000 💎
A B	C = A - B D E = C	/D F G=	E*F H	I = G + (H * 0.011)		Fract	ion calcination of the original carbona	te in the CKD (fraction), Fd	1.00000 🕐
► 65 0	65 56.03 1.1	6009 0.44	0.51044	0 0.51044		Emissi	on factor for the carbonate (tonnes CC	J2/ tonne carbonate), EFc	0.43971
Cancel				Save	Emis	sion factor f	or clinker uncorrected for CKD (tonne	s CO2/tonne clinker), EFcl	0.51044
				.a				CF ckd	1.10523
					Copy last			Apply to works	heet cell Cancel

2.A.1 Tier 2 – Results – 2022

INTERGOVERNMENTAL PANEL ON Climate change

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IPCC Inventory Software - IPCC - [Worksheets]

Application Database Inventory	Year Administrate Work	sheets Tools	Export/Imp	ort Reports	Window Help								- 8
2006 IPCC Categories 🚽 👎	CO2 Emissions from carbon-	bearing non-fuel	materials - Tier	3 (3/4) CO2 Er	missions summary - Tie	r 3 (4/4) Capture a	nd storage or oth	er reduction					
- 1.C.2 - Injection and Storage - 1.C.2.a - Injection - 1.C.2.b - Storage - 1.C.3 - Other - 2.4 - Industrial Processes and Product - 2.A - Mineral Industry - 2.A - Cement production - 2.A - Linea stochastion	Cement Production (1/2) Ca Worksheet Sector: Industrial R Category: Mineral Ind Subcategory: 2.A.1 - Cer Sheet: CO2 Emiss	ement Productio Processes and Pr dustry ment production sions from Clinker	n (2/2) Clinker roduct Use r Production - Tier	r production - Tier	CO2 Emissions fro	m carbonates - Tier 3	(1/4) CO2E	missions from (uncalcined	CKD not recycled to the kiln - Tier 3	(2/4)		2022
- 2.A.3 - Glass Production							Equation 2.2						
- 2.A.4 - Other Process Uses of - 2.A.4.a - Ceramics - 2.A.4.b - Other Uses of S - 2.A.4.b - Ner Uses of S	Subdivision		Name of plant clinke	t or type of er	Clinker production (tonnes)	(to	Emission Fa	tor Clinker)		Correction Factor for Cement Kiln Dust (CF ckd) (dimensionless)	CO2 Emissions (Gg CO2)		
		ΔV		ΔV	A			В		С	D = A*B*C/10^3		
2.A.5 - Other (please specify)	National	C	CementCarbo		612000	Calculated		0.51044	2	1.10548 📝	345.341	66 📝 🛛	a 🤊 🗙
- 2.B - Chemical Industry	* Total												
2.B.2 - Nitric Acid Production					612000						345.341	66	
Emission Factor						×	IPCC Invento	ry Software	Correc	tion Factor for Cement K	üln Dust, CF ckd		×
		Equation 2.4								Weight of CKD not recycled to	the kiln (tonnes), Md	74,940	.00000
Percentage Percentage Pe CaO Content Non- cor	ercentage CaO CaO ntent of clinker	Total CaCO3	CO2 from calcining 1	Emission Fact (uncorrected f	tor Percent MgO or derived from	Emission Factor				Weight of clinker pr	roduced (tonnes), Mcl	612,000	.00000
(CaO) sources of	sources (%)	tonne CaO	tonne CaCO3	MgO) (tonnes CO2	(optional)	(tonnes CO2 / tonne		Fraction	n of original	carbonate in the CKD (i.e., before cal	cination) (fraction), Cd	1	.00000 🕐
(%) CaO	(%) (%)	(tonne)	(tonne) F	G = E * E	r) (%) н	Clinker) I = G + (H *			Fraction c	alcination of the original carbonate in t	the CKD (fraction), Fd	1	.00000 💎
65 0	65 56.03	1 16009	0.44	0.510	44 0	0.011)			Emission fa	ctor for the carbonate (tonnes CO2/ to	onne carbonate), EFc	0.439	971 🗸
	00 00.00	1.10003	0.44	0.010		0.01044		Emission f	factor for clir	nker uncorrected for CKD (tonnes CO)	2/tonne clinker), EFcl	0	.51044 🕐
Cancel						Save					CF ckd	μ	.10548
							Copy last				Apply to workshee	t cell	Cancel

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON **Climate change**



iocc

Tier 3

2.A.1 Tier 3 – Results

INTERGOVERNMENTAL PANEL ON Climate change

IOCC



IPCC Inventory Software - TSU - [Worksheets]

П \times 🖳 Application Database Inventory Year Administrate Worksheets Tools Export/Import Reports Window - 8 Help 2006 IPCC Categories Cement Production (1/2) Cement Production (2/2) Clinker production - Tier 2 CO2 Emissions from carbonates - Tier 3 (1/4) CO2 Emissions from uncalcined CKD not recycled to the kiln - Tier 3 (2/4) CO2 Emissions from carbon-bearing non-fuel materials - Tier 3 (3/4) CO2 Emissions summary - Tier 3 (4/4) Capture and storage or other reduction 2.A.1 - Cement production 2.A.2 - Lime production Worksheet 2015 2.A.3 - Glass Production Sector: Industrial Processes and Product Use - 2.A.4 - Other Process Uses Category: Mineral Industry 2.A.4.a - Ceramics Subcategory: 2.A.1 - Cement production -2.A.4.b - Other Uses of CO2 Emissions summary - Tier 3 (4/4) Sheet: -2.A.4.c - Non Metallurgic Data 2.A.4.d - Other (please s Equation 2.3 2.A.5 - Other (please specify = 2.B - Chemical Industry CO2 Emissions from uncalcined CO2 Emissions from carbon-CO2 Emissions from carbonates CO2 Emissions CO2 Emissions 2.B.1 - Ammonia Production Subdivision CKD not recycled to the kiln bearing non-fuel materials (tonnes CO2) (tonnes CO2) (Gg CO2) 2.B.2 - Nitric Acid Productio (tonnes CO2) (tonnes CO2) 2.B.3 - Adipic Acid Productio $\Delta \nabla$ Ei Ed Ek E = Ei - Ed + Ek E/1000 2.B.4 - Caprolactam, Glyoxa CementPro 5474.3895 2.50635 2967.195 8439.07815 8.43908 2.B.5 - Carbide Production 2.B.6 - Titanium Dioxide Pro Total 2.B.7 - Soda Ash Production 5474.3895 2.50635 2967.195 8439.07815 8.43908 2.B.8 - Petrochemical and C IPCC Inventory Software - IPCC - [Worksheets] _ Π \times 🖳 Application Database Inventory Year Administrate Worksheets Tools Export/Import Reports Window Help _ 8 × 2006 IPCC Categories Cement Production (1/2) Cement Production (2/2) Clinker production - Tier 2 CO2 Emissions from carbonates - Tier 3 (1/4) CO2 Emissions from uncalcined CKD not recycled to the kiln - Tier 3 (2/4) CO2 Emissions from carbon-bearing non-fuel materials - Tier 3 (3/4) CO2 Emissions summary - Tier 3 (4/4) Capture and storage or other reduction I.C.2 - Injection and Storage -1.C.2.a - Injection Worksheet 2022 1.C.2.b - Storage Industrial Processes and Product Use Sector: 1.C.3 - Other Mineral Industry Category: 2 - Industrial Processes and Product 2.A.1 - Cement production Subcategory: = 2.A - Mineral Industry CO2 Emissions summary - Tier 3 (4/4) Sheet: 2.A.1 - Cement production Data 2.A.2 - Lime production

- 2.A.3 - Glass Production			Equation 2.3												
- 2.A.4 - Other Process Uses of - 2.A.4.a - Ceramics - 2.A.4.b - Other Uses of S		Subdivision	CO2 Emissions from carbonates (tonnes CO2)	CO2 Emissions from uncalcined CKD not recycled to the kiln (tonnes CO2)	CO2 Emissions from carbon- bearing non-fuel materials (tonnes CO2)	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)								
2.A.4.c - Non Metallurgica															
2.A.4.d - Other (please sp		ΔV	Ei	Ed	Ek	E = Ei - Ed + Ek	E/1000								
2.A.5 - Other (please specify)	CementPro		4419.0855	2.24252	1412.95	5829.79298	5.82979								
- 2.B - Chemical Industry	Total														
- 2.B.1 - Ammonia Production			4419.0855	2.24252	1412.95	5829.79298	5.82979								
2.B.2 - Nitric Acid Production															

2.A.1 Cement Production

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE



iOCC

CO₂ Capture

2.A.1 Cement Production

IPCC Inventory Software - TSU - [Worksheets]

🖳 Application Database Inventory	Year Administrate Worksheets Tools Ex	port/Import Reports Window Help				
2006 IPCC Categories 🗸 🗸	CO2 Emissions from carbonates - Tier 3 (1/4) CO	D2 Emissions from uncalcined CKD not recycled	to the kiln - Tier 3 (2/4)			
-2 - Industrial Processes and Product Us	CO2 Emissions from carbon-bearing non-fuel mater Worksheet	rials - Tier 3 (3/4) CO2 Emissions summary -	Tier 3 (4/4) Capture and store	age or other reduction Ceme	ent Production (1/2) Cement Pro	duction (2/2) Clinker production
2.A - Mineral Industry 2.A.1 - Cement production	Sector: Industrial Processes and Product Category: Mineral Industry	Use				
	Subcategory: 2.A.1 - Cement production Sheet: Capture and storage or other redu	uction				
- 2.A.4.a - Ceramics - 2.A.4.b - Other Uses of Soda	Gas CARBON DIOXIDE (CO2)	~				
2.A.4.c - Non Metallurgical M 2.A.4.d - Other (please speci			Amount CO2 cantured and			
2.A.5 - Other (please specify) 2.B - Chemical Industry	Subdivision	Source	stored (tonne)	Other reduction (tonne)	Total reduction (tonne)	Total reduction (Gg)
	S AV	SRC 47	A	В	C = A + B	C / 1000
2.B.3 - Adipic Acid Production	Unspecified	Unspecified	200000	2500	0 225000	225
2.B.5 - Carbide Production	Total					
2.B.6 - Titanium Dioxide Product					225000	225

Results of Data Input

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Iron and Steel (2.C.1)

2.C.1 Iron and Steel Production

INTERGOVERNMENTAL PANEL ON CLIMATE CHARGE



Tier 1

Results – 2015 and 2022



2.C - Metal Industry 2.C.1 - Iron and Steel Produ 2.C.2 - Ferroalloys Producti 2.C.3 - Aluminium productio 2.C.4 - Magnesium producti 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Producti	 CO2 and CH4 Emissions from Coke Production CO2 Emissions from metallurgical coke production (mass balance) CO2 and CH4 Emissions from Iron and Steel Production CO2 Emissions from Iron and Steel Production CO2 Emissions from Iron and Steel Production Co2 and CH4 Emissions from Iron and Steel Production Subcategory: CO2 and CH4 Emissions from Iron and Steel Production Subcategory: CO2 and CH4 Emissions from Iron and Steel Production Subcategory: CO2 and CH4 Emissions from Iron and Steel Production Subcategory: CO2 and CH4 Emissions from Iron and Steel Production 											
2.C.8 - Other (please specif				Equation	on 44-48							
2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use		Subdivision	Type of Steelmaking Method, etc	Amount of Steel or Iron Production (tonne)	CO2 Emission Factor (tonnes CO2 / tonne produced)	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)					
2.D.4 - Other (please specif		ΔΥ	۵7	Р	EF	E = P * EF	E / 1000					
2.E - Electronics Industry	National		Basic Oxygen Furnace (BOF)	612000	1.46	893520	893.52	2 2 1	🤊 🗙			
2.E.I - Integrated Circuit or			Open Hearth Furnace (OHF)	425000	1.72	731000	731	2				
2.E.2 - TFT Flat Panel Dispi			Sinter Production	182000	0.2	36400	36.4	2				
2.E.3 - Photovoltaics	*							2				
2 E 5 - Other (please specify	Total											
= 2 E - Product Uses as Substitut				1219000		1660920	1660.92					
- 2.C.1 - Iron and Steel Product		nissions from Coke Production	CO2 Emissions from metallurgical coke prod	uction (mass balance) CO2	and CH4 Emissions from Iron and Steel	Production CO2 Emissions	from Iron and Steel Production	1 - Tier 2/3				
	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Productio CO2 and CH4 Emissions from In	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production	uction (mass balance) CO2	and CH4 Emissions from Iron and Steel	Production CO2 Emissions	from Iron and Steel Production	n - Tier 2/3	2022			
	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Productio CO2 and CH4 Emissions from Ir	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production	uction (mass balance) CO2	and CH4 Emissions from Iron and Steel	Production CO2 Emissions	from Iron and Steel Production	n - Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E - Electronics Industry 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc	Equat Amount of Steel or Iron Production (tonne)	ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced)	CO2 Emissions CO2 Emissions (tonnes CO2)	from Iron and Steel Production CO2 Emissions (Gg CO2)	1 - Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E - Electronics Industry 2.E.1 - Integrated Circuit or S 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc	Equat Amount of Steel or Iron Production (tonne)	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF	Production CO2 Emissions CO2 Emissions (tonnes CO2) E = P * EF	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000	1 - Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E - Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc a var Basic Oxygen Furnace (BOF)	Equat Amount of Steel or Iron Production (tonne) P 720000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46	Production CO2 Emissions CO2 Emissions (tonnes CO2) E = P * EF 1051200	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2	- Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 2.E.3 - Photovoltaics 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc Basic Oxygen Furnace (BOF) Open Hearth Furnace (OHF)	Equat Amount of Steel or Iron Production (tonne) P 720000 312000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46 1.72	Production CO2 Emissions CO2 Emissions (tonnes CO2) E = P * EF 1051200 536640	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2 536.64	- Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc Basic Oxygen Furnace (BOF) Open Hearth Furnace (OHF) Sinter Production	Equat Amount of Steel or Iron Production (tonne) P 720000 312000 199000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46 1.72 0.2	Production CO2 Emissions CO2 Emissions (tonnes CO2) 1051200 E = P * EF 1051200 536640 39800	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2 536.64 _39.8	- Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 2.E.5 - Other (please specify) 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc Basic Oxygen Furnace (BOF) Open Hearth Furnace (OHF) Sinter Production	Equat Amount of Steel or Iron Production (tonne) P 720000 312000 199000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46 1.72 0.2	Production CO2 Emissions CO2 Emissions (tonnes CO2) E = P * EF 1051200 536640 39800	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2 536.64 39.8	- Tier 2/3	2022			
	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc Pasic Oxygen Furnace (BOF) Open Hearth Furnace (OHF) Sinter Production	Equat Amount of Steel or Iron Production (tonne) P 720000 312000 199000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46 1.72 0.2	Production CO2 Emissions CO2 Emissions (tonnes CO2) E = P * EF 1051200 536640 39800 Output 000000000000000000000000000000000000	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2 536.64 39.8	- Tier 2/3	2022			
 2.C.2 - Ferroalloys Production 2.C.3 - Aluminium production 2.C.4 - Magnesium productio 2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify) 2.D - Non-Energy Products from 2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E - Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 2.E.5 - Other (please specify) 2.F - Product Uses as Substitutes 2.F.1 - Refrigeration and Air 	Worksheet Sector: Category: Subcategory: Sheet: Data Gas CARBON	Industrial Processes and Production Industrial Processes and Production Metal Industry 2.C.1 - Iron and Steel Production CO2 and CH4 Emissions from In N DIOXIDE (CO2)	CO2 Emissions from metallurgical coke prod ct Use on ron and Steel Production Type of Steelmaking Method, etc 2 Basic Oxygen Furnace (BOF) Open Hearth Furnace (OHF) Sinter Production	Equat Amount of Steel or Iron Production (tonne) P 720000 312000 199000	and CH4 Emissions from Iron and Steel ion 4.4 - 4.8 CO2 Emission Factor (tonnes CO2 / tonne produced) EF 1.46 1.72 0.2	Production CO2 Emissions CO2 Emissions (tonnes CO2) 1051200 E = P * EF 1051200 536640 39800 1627640 1627640	from Iron and Steel Production CO2 Emissions (Gg CO2) E / 1000 1051.2 536.64 39.8	- Tier 2/3	2022			

2.C.1 Iron and Steel Production

INTERGOVERNMENTAL PANEL ON Climate change



iocc

Tier 2/3

Results – 2015

Sector: Category: Subcategory: Sheet: Data	Industria Metal In 2.C.1 - Ir CO2 Em	al Processes and Prod ndustry Iron and Steel Product nissions from Iron and	duct Use tion Steel Production - Ti	er 2 / 3									
Subdivision	C bio F	Quantity of coke / ichar consumed in iron and steel production (not including sinter production)	Carbon Content of coke / biochar (tonnes C / tonne PC)	Biochar instead of coke	Total Carbon in o site coke oven b products consume blast furnace (tonnes C)	n- y- d in injected into blast furnace (tonnes)	Carbon Content of coal / biochar directly injected int blast furnace (tonnes C / tonne Coal)	f Biochar instead of coal	Quantity of limestone consumed in iron and steel production (tonnes)	Carbon Content of limestone (tonnes C / tonne Limestone)	Quantity of dolomite consumed in iron and steel production (tonnes)	Carbon Content of dolomite (tonnes C / tonne Dolomite)	
4	۵V	PC	Срс		BPC	СІ	Cci	V	L	СІ	D	Cd	
Company ZZ	ZZ	360000	0.82344			160000	0.6	7	75000	0.12	1000	0.13	
Cate Subo Shee Data	egory: category et: a	Metal Industry 2.C.1 - Iron and CO2 Emissions f	Steel Production from Iron and Steel P	roduction	- Tier 2 / 3								2
						Equation 4.9	, 4.11						
	Quantity o electrode: onsumed EAFs (tonnes)	of is in (tonnes C / tor Electrode)	ent carbonaceous materials con (tonnes	in other process isumed C)	Quantity of coke oven gas consume in blast furnace in iron and steel production (Unit)	d Consumption Unit (Mass, Volume or Energy Unit)	Coke oven gas conversion factor (GJ / Unit)	Carbon Co (tor	ontent of coke oven gas nnes C / GJ)	Quantity of steel produced (tonnes)	Carbon Content of steel produced (tonnes C / tonne Steel)	Quantity of iron production not converted to steel (tonnes)	Carbon Content of iron production not converted to steel (tonnes C / tonne Iron)
	CE	Cce	РМ		COG	U	CFcog		Ccog	s	Cs	IP	Cip
		0	0 1606	2	1100	0 tonne	38.7	Fuel Manag	ger 0.0121	1 1020000	0.0	1 980000	0.04
									0.012	1			



Quantity of blast furnace gas transferred offsite (Unit)	Consumption Unit (Mass, Volume or Energy Unit)	Blast furnace gas conversion factor (GJ / Unit)	Carbon Cor (t	itent of blast furnace gas onnes C / GJ)	Annual non-Energy CO2 emissions (tonnes CO2)	Annual non- Energy CO2 emissions (Gg CO2)			
BG	U	CFbg		Cbg	E = [PC * Cpc + BPC + Cl * Cci + L * Cl + D * Cd + CE * Cce + PM + COG * CFcog * Ccog - S * Cs - IP * Cip - BG * CFbg * Cbg] * 44/12	E / 1000			
5500	GJ	1	Fuel Manager	0.0708	1355698.55667	1355.69856	36	1 7	X
				0.0708			3		

2

2015

Results – 2022



Results – Biogenic – 2022

With Biogenic

UN 💮

environment programme

Annual non-

Energy CO2

(Gg CO2)

E/1000

1694.7332

1694.7332

1694.7332

Biogenic CO₂ = 1694.73-64.27 = 1 630.46

Annual non-Energy CO2 emissions

(tonnes CO2)

E = [PC * Cpc + BPC + CI * Cci + L * CI + D * Cd + CE * Cce + PM + COG * CFcog * Ccog -

S * Cs - IP * Cip - BG * CFbg * Cbg] * 44/12

1694733.19583

1694733.19583

1694733.19583

	Subdivision	Quantity of coke / biochar consumed in iron and steel production (not including sinter production)	Carbon Content of coke / biochar (tonnes C / tonne PC)	Biochar instead of coke	Total Carbon site coke ove products consi blast furna (tonnes (in on- en by- umed in uce C)	Quantity of coal / biochar directly injected into blast furnace (tonnes)	Carbon Content of coal / biochar directly injected into blast furnace (tonnes C / tonne Coal)	Biochar instead of coal	ntent of blast furnace gas onnes C / GJ)	Annual non-Energy CO2 emissions (tonnes CO2)	Annual non- Energy CO2 emissions (Gg CO2)	
	۵V	PC	Срс	_	BPC		CI	Cci	V	Cbg	E = [PC * Cpc + BPC + Cl * Cci + L * Cl + D * Cd + CE * Cce + PM + COG * CFcog * Ccog - S * Cs - IP * Cip - BG * CFbg * Cbg] * 44/12	E / 1000	
0	Company ZZZ	450000	0.82344	\triangleleft		2	200000	0.67	\checkmark	0.0708	1694733.19583	1694.7332	E
*						3				0.0708			C
										Including Biogenic CO2:	1694733.19583	1694.7332	
	Witho	ut Bioaenic								Excluding Biogenic CO2:	64270.97969	64.27098	
													2
		Quantity of coke /	Carbon	-	Total Carbon	in an	Quantity of	Carbon Content					T

intent of blast furnace gas

Cbg

Including Biogenic CO2:

Excluding Biogenic CO2:

0.0708

0.0708

(tonnes C/GJ)

	Subdivision	biochar consumed in iron and steel production (not including sinter production) (tonnes)	Carbon Content of coke / biochar (tonnes C / tonne PC)	Biochar instead of coke	Total Carbor site coke ov products cons blast furn (tonnes	n in on- ven by- sumed in lace C)	Quantity of coal / biochar directly injected into blast furnace (tonnes)	Carbon Content of coal / biochar directly injected into blast furnace (tonnes C / tonne Coal)	Biochar instead of coal
	ΔΥ	PC	Срс	_ 7	BPC		CI	Cci	V
	Company ZZZ	450000	0.82344			2	200000	0.6	
*						3			

<u>Assuming</u> biochar has the same carbon content as coal or coke, <u>which is not !!</u>

Biogenic CO₂ = 1694.73-64.27 = 1 630.46

IPCC Inventory Software - TSU - [IPPU Backgound Tables]

🖶 Application Database Inventory Year Adminis	strate Works	heets To	ols Export/In	nport Rep	orts Window	Help
Table 2.3 IPPU Background Table: 2.C Metal Industry CO2, 0	CH4 and N2O	Table 2.4	IPPU Backgroun	d Table: 2.C N	Metal Industry HF	Cs, PFCs, SF6 and ot
		Activ	vity Data			
Categories	Pro	duction/Cor	nsumption Quan			
	Descript	ion (1)	Quantity	Unit (2)	Emissions (3)	Information Item Biogenic CO2
2.C - Metal Industry					8347.914	4013 144
2.C.1 - Iron and Steel Production	Basic Oxyge	n Furnace	1231000.000	t	2452.794	1630.462
2.C.2 - Ferroalloys Production	Ferrochromiu	ım; Ferro	983500.000	t	4983.311	1838.333
2.C.3 - Aluminium production	Prebake; So	derberg;	209500.000	t	136.555	
2.C.4 - Magnesium production	Dolomite; Ma	gnesite;	68250.000	t	122.320	
2.C.5 - Lead Production	From Direct	Smelting (120500.000	t	57.405	329.908
2.C.6 - Zinc Production	Default Facto	r; Electro	234500.000	t	380.810	214.440
2.C.7 - Rare Earths Production	Rare Earth M	letal prod	101567.000	t	162.239	
2.C.8 - Other (please specify)					52.480	

2C1 Iron and Steel Production

INTERGOVERNMENTAL PANEL ON CLIMATE CHANES



Coke Production – Tier 1 (to be reported in Energy – 1A1c)

Results – CO₂ and CH₄ – 2015

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

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2006 IPCC Categories 🚽 📮	CO2 Emissions from Sinter Broduction Tier 2/2	CO2 Emissions from Direct Reduced Iron P	roduction - Tier 2/3 CO2 En	nissions from Pellet Production - Tier 2/3	Capture and storage or other	reduction	
2.C.1 - Iron and Steel Production	CO2 and CH4 Emissions from Coke Production	CO2 Emissions from metallurgical coke produ	ction (mass balance) CO2 a	nd CH4 Emissions from Iron and Steel Pr	oduction CO2 Emissions from	n Iron and Steel Production - Tie	er 2/3
-2.C.2 - Ferroalloys Production	Castan Industrial Descences and Desdu						2015
- 2.C.3 - Authinium production	Category: Metal Industry	a Use					2015
2.C.5 - Lead Production	Subcategory: 2.C.1 - Iron and Steel Production	n					
- 2.C.6 - Zinc Production	Sheet: CO2 and CH4 Emissions from Co	oke Production					
- 2.C.7 - Rare Earths Production	Data						
2,C.8 - Other (please specify)	Gas CARBON DIOXIDE (CO2) V						
2.D - Non-Energy Products from Fue			Fou	ation 4.1			
2.D.1 - Lubricant Use			-40				
- 2 D 3 - Solvent Use	Subdivision	Calla production property	Amount of coke production	CO2 Emission Factor	CO2 Emissions	CO2 Emissions	
2.D.4 - Other (please specify)	Subdivision	Coke production process	(tonne)	(tonnes CO2 / tonne produced)	(tonnes CO2)	(Gg CO2)	
= 2.E - Electronics Industry					E - 0 + 55	E / 1000	
- 2.E.1 - Integrated Circuit or Semi	A V	Color Occar	P 45000	LF 0.50	E = P · EP	E71000	
- 2.E.2 - TFT Flat Panel Display	Pagion North	Coke Oven	40000	0.56	20200 670	25.2	
2.E.3 - Photovoltaics	Region South	Coke Oven	1200	0.0	0/2	0.072	2
2.E.4 - Heat Transfer Fluid	Total						1
= 2 F - Product Uses as Substitutes fo	100		46200		25872	25.872	
- 2 F 1 - Refrigeration and Air Con							
2006 IPCC Categories 🗸 🗸	CO2 Emissions from Sinter Production - Tier 2/3	3 CO2 Emissions from Direct Reduced Iron	Production - Tier 2/3 CO2 E	missions from Pellet Production - Tier 2/	3 Capture and storage or oth	er reduction	
2.C.1 - Iron and Steel Production	CO2 and CH4 Emissions from Coke Production	CO2 Emissions from metallurgical coke proc	luction (mass balance) CO2	and CH4 Emissions from Iron and Steel F	Production CO2 Emissions fro	m Iron and Steel Production - T	ier 2/3
- 2.C.2 - Ferroalloys Production	Worksheet						
- 2.C.3 - Aluminium production	Sector: Industrial Processes and Produ	uct Use					2015
- 2.C.4 - Magnesium production	Category: Metal Industry						
-2.C.5 - Lead Production	Subcategory: 2.C.1 - Iron and Steel Producti	on					
2.C.6 - Zinc Production	Sheet: CO2 and CH4 Emissions from (Coke Production					
2.C.7 - Nare Earths Production							
□ 2.D - Non-Energy Products from Fue	Gas METHANE (CH4)						
- 2.D.1 - Lubricant Use			Eq	uation 4.1			
- 2.D.2 - Paraffin Wax Use			1		ALL - 1	0005	
2.D.3 - Solvent Use	Subdivision	Coke production process	Amount of coke production (tonne)	(kg CH4 / tonne produced)	CH4 Emissions (kg CH4)	(Ga CH4)	
2.D.4 - Other (please specify)				(ing children in proceed)	(as only	(090.00)	an an an
2.E - Electronics Industry	47	۵ <u>۲</u>	7 P	EF	E = P * EF	E / 1000000	
-2 E 2 - TET Elat Panel Display	Region North	Coke Oven	45000	0.1	4500	0.0045	3 🔒 🤉 🗙
2.E.3 - Photovoltaics	Region South	Coke Oven	1200	0.1	120	0.00012	3
2.E.4 - Heat Transfer Fluid	*						2
2.E.5 - Other (please specify)	Total				(ees)		
□ 2.F - Product Uses as Substitutes fo			46200		4620	0.00462	
P 2 F 1 - Refrineration and Air Con							

Results – CO₂ and CH₄ – 2022

INTERGOVERNMENTAL PANEL ON Climate change

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2006 IPCC Categories	CO2 Emissions from Sinter Production - Tier 2/3 CO2 and CH4 Emissions from Coke Production	3 CO2 Emissions from Direct Reduced Iron P	Production - Tier 2/3 CO2 En	nissions from Pellet Production - Tier 2/ nd CH4 Emissions from Iron and Steel F	3 Capture and storage or ot Production CO2 Emissions fr	her reduction rom Iron and Steel Production -	Tier 2/3								
	orksheet ector: Industrial Processes and Product Use 202 tategory: Metal Industry 202 subcategory: 2.C.1 - Iron and Steel Production 202 Sheet: CO2 and CH4 Emissions from Coke Production 202														
- 2.C.7 - Rare Earths Productio 2.C.8 - Other (please specify)	Gas CARBON DIOXIDE (CO2) V														
- 2.D - Non-Energy Products from			Equa	ition 4.1											
2.D.1 - Lubricant Use 2.D.2 - Paraffin Wax Use 2.D.3 - Solvent Use 2.D.4 - Other (please specify)	Subdivision	Coke production process	Amount of coke production (tonne)	CO2 Emission Factor (tonnes CO2 / tonne produced)	CO2 Emissions (tonnes CO2)	CO2 Emissions (Gg CO2)									
= 2.E - Electronics Industry	Δ7	7 47	P	EF	E = P * EF	E / 1000									
- 2.E.1 - Integrated Circuit or S	Region North	Coke Oven	61000	0.56	34160	34.16	🕜 🛃 🂙 🗙								
- 2.E.2 - TFT Flat Panel Displa	Region South	Coke Oven	1900	0.56	1064	1.064	2								
2.E.3 - Photovoltaics	*														
2.E.4 - Heat Hansler Fluid	Total														
□ 2.F - Product Uses as Substitutes			62900		35224	35.224									
2006 IPCC Categories 🗸 🗸	CO2 Emissions from Sinter Production - Tier 2	/ 3 CO2 Emissions from Direct Reduced Iron	Production - Tier 2/3 CO2	Emissions from Pellet Production - Tier	2/3 Capture and storage or	other reduction									
2.C - Metal Industry	CO2 and CH4 Emissions from Coke Production	CO2 Emissions from metallurgical coke proc	duction (mass balance) CO2	and CH4 Emissions from Iron and Stee	Production CO2 Emissions	from Iron and Steel Production	- Tier 2/3								
	Worksheet						0000								
2.C.2 - Ferroalloys Production	Sector: Industrial Processes and Pro	duct Use					2022								
2.C.3 - Aluminium production	Category: Metal Industry	-													
- 2 C 5 - Lead Production	Sheet: CO2 and CH4 Emissions from	alon Coke Production													
- 2.C.6 - Zinc Production		Coke Houdcion													
2.C.7 - Rare Earths Productio	Gas METHANE (CH4)														
2.C.8 - Other (please specify)															
2.D - Non-Energy Products from			Eq	uation 4.1											
2.D.1 - Lubricant Use			Amount of coke production	CH4 Emission Factor	CH4 Emissions	CH4 Emissions									
Z.D.Z - Paramin Wax Use															
2 D 3 - Solvent Lise	Subdivision	Coke production process	(tonne)	(kg CH4 / tonne produced)	(kg CH4)	(Gg CH4)									
2.D.3 - Solvent Use	Subdivision	Coke production process	(tonne)	(kg CH4 / tonne produced)	(kg CH4)	(Gg CH4)									
	Subdivision	Coke production process	(tonne) 7 P	(kg CH4 / tonne produced) EF	(kg CH4) E = P * EF	(Gg CH4) E / 1000000									
	Subdivision	Coke production process	(tonne) 7 P 61000	(kg CH4 / tonne produced) EF 0.1	(kg CH4) E = P * EF 6100	(Gg CH4) E / 1000000 0.0061	3 a 7 x								
	Subdivision	Coke production process	(tonne) 7 P 61000 1900	(kg CH4 / tonne produced) EF 0.1 0.1	(kg CH4) E = P * EF 6100 190	(Gg CH4) E / 1000000 0.0061 0.00019	3 a 3 X								
	Subdivision	Coke production process	(tonne) 7 P 61000 1900	(kg CH4 / tonne produced) EF 0.1 0.1	(kg CH4) E = P * EF 6100 190	(Gg CH4) E / 1000000 0.0061 0.00019									
 2.D.3 - Solvent Use 2.D.4 - Other (please specify) 2.E - Electronics Industry 2.E.1 - Integrated Circuit or S 2.E.2 - TFT Flat Panel Displa 2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 	Subdivision	Coke production process	(tonne) 7 P 61000 1900	(kg CH4 / tonne produced) EF 0.1	(kg CH4) E = P * EF 6100 190	(Gg CH4) E / 1000000 0.00019 0.00019									

Reports: Energy/Background - 2022

INTERGOVERNMENTAL PANEL ON Climate change



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(i) IPCC Inventory Software - TSU - [Energy Background Tables]

•	Application Database Inventory Year Administrate W	/orksheets	Tools Exp	ort/Import Re	eports Window	Help														
Ta	Table 1.1 Energy Background Table: 1.A.1 - 1.A.2 Table 1.2 Energy B	ackground Ta	able: 1.A.3 - 1.A	.5 Table 1.3 E	nergy Background T	able: 1.B Tab	le 1.4b En	ergy Backgr	ound Table: 1	1.C - Ov	erview	Table	1.5 Energy	Backgr	ound T	able: F	Refere	nce Approa	:h	
	2006 IPCC Categories			Emi Solid f	ssions ⁻ uels (Gg)	Emissions Liquid Fuels +¤ (Gg)		Emissions Gaseous +⊐ Fuels (Gg)		Emissions Other Fossil += Fuels (Gg)		Emissions Peat (Gg) (1)		Emissio ns Biomas s (Gg)	Emi Tot	ssions + al (Gg)				
		Solid Fuel	s Liquid Fuels	Gaseous Fuels	Other Fossil Fuels	Peat Biomass	CO2	CH4 N2C	0 СО2 СН4	4 N2O	CO2 CI	H4 N2O	CO2 CH	14 N2O	CO2	CH4	N2O	CH4 N2O	CO2	CH4 N2O
	1.A - Fuel Combustion Activities						35.224	0.006											35.224	0.006
	1.A.1 - Energy Industries						35.224	0.006											35.224	0.006
	1.A.1.a - Main Activity Electricity and Heat Production																			
	1.A.1.a.i - Electricity Generation																			
	1.A.1.a.ii - Combined Heat and Power Generation (CHP)																			
	1.A.1.a.iii - Heat Plants																			
	1 A 1 b - Petroleum Refining																			
	1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries						35.224	0.006											35.224	0.006
	1.A.1.c.i - Manufacture of Solid Fuels						35.224	0.006											35.224	0.006
	1.A.1.c.ii - Other Energy Industries																			
	1.A.2 - Manufacturing Industries and Construction																			
	1.A.2.a - Iron and Steel																			
	1.A.2.b - Non-Ferrous Metals																			
	1.A.2.c - Chemicals																			
	1.A.2.d - Pulp, Paper and Print																			
	1.A.2.e - Food Processing, Beverages and Tobacco																			
	1.A.2.f - Non-Metallic Minerals																			

2.F.1 Refrigeration and Air Conditioning



F-gases Manager

Answers: Customize F-gases Manager

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE



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2.F.1:Answers: Set up the IPCC category level F-gases Manager

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2.F.1 Refrigeration and Air Conditioning

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Tier 1

2.F.1:Answers: Enter EFs / Parameters

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2.F.1:Answers: Enter AD and Estimate Emissions

F-Gas Emissie Worksheet Sector: Category: Subcategory Sheet: Data	Das Emissions F-Gas Parameters - Tier 2 F-Gas Emissions - Tier 2a F-Gas Emissions - Tier 2b irksheet rksheet 2015 stegory: Product Uses as Substitutes for Ozone Depleting Substances 2015 ibcategory: 2.F.1.a - Refrigeration and Stationary Air Conditioning Image: HFC-23 (CHF3) Emissions ata ata																
Subdivision	Unspecified	~	Gas HFC-2	3 (CHF3)	 	Chemical's Data											
Intro Year	r 2000	Growth Rate	(%) 3	Lifetime (d) (years) 15	EF (%) 15	Destr	oyed (%) 0									
					Inform	ation for UNFC	CC CRT										
Year	Agent production (tonnes)	Agent export (tonnes)	Agent import (tonnes)	Total new agent to domestic market (tonnes)	Retired in equipment at end-of-life (tonnes)	Destruction of agent in retired equipment (tonnes)	Release of agent from retired equipment (tonnes)	Bank (tonnes)	Emissions from installed equipment (tonnes)	Total Emissions (tonnes)	Agent for servicing (tonnes)	Agent in new equipment installed in year t (tonnes)	Agent in all equipment installed (tonnes)				
t ∆⊽		Ex	Im	D = P - Ex + Im	R = [L(t-(d-1)) - (L(t-(d-1)) * EF/100)] - [S_needed(t-d)) - S_done(t-d)]	F = R * (destroyed/10 0)	G = R - F	H = H(t-1) + D - R - I	I = M * EF/100	E = G + I	K = IF(D>I(t- 1), I(t-1), D)	L = D - K	M = ∑(L(t, t-(d- 1))				
2000	0	0	6.41862	6.41862	0	0	0	5.45583	0.96279	0.96279	0	6.41862	6.41862	-	\Box		
2001	0	0	6.61118	6.61118	0	0	0	10.25695	1.81005	1.81005	0.96279	5.64839	12.067	2			
2002	0	0	6.80951	6.80951	0	0	0	14.5065	2.55997	2.55997	1.81005	4 99946	17.06647		\square		
2003	0	0	7.0138	7.0138	0	0	0	18.29225	3.22804	3.22804	2.55997	4.45383	21.5203				
2004	0	0	7.22421	7.22421	0	0	0	21.68899	3.82/4/	3.82/4/	3.22804	3.99617	25.51646	2	+		
2005	0	0	7.44094	7.44094	0	0	0	24.76044	4.36949	4.36945	3.82/4/	3.61347	29.12993		+		
2006	0	0	7.00417	7.00417	0	0	0	27.00032	4.00305	4.00303	4.30345	3.23466	32.42401		+1		
2007	0	0	8 13092	8 13092	0	0	0	32,53752	5.31625	5.31025	5 31825	2 81266	38 26768		+		
2000	0	0	8 37484	8 37484	0	0	0	34 76701	6 13535	6 13535	5 74015	2.63469	40 90237	-	<u>+-</u> '		
2010	0	0	8 62609	8 62609	0	0	0	36,88413	6.50896	6.50896	6,13535	2 49073	43 3931	2	-		
2011	0	0	8.88487	8.88487	0	0	0	38,90365	6.86535	6.86535	6.50896	2.37591	45.769	2	+		
2012	0	0	9.15142	9.15142	0	0	0	40.84681	7.20826	7,20826	6.86535	2.28607	48.05507	2	<u> </u>		
2013	0	0	9.42596	9.42596	0	0	0	42.73185	7.54092	7.54092	7.20826	2 2177	50.27277	1			
2014	0	0	9.70874	5.70874	0	0	0	44.5745	7.86609	7.86609	7.54092	2.16782	52.44059	2			
> 2015	0	0	10	10	5.45583	0	5.45583	41.89529	7.22338	12.67921	7.86609	2.13391	48.15588	2	2		
2016	0	0	9.28571	9.28571	4.80113	0	4.80113	39.69441	6.68547	11.4866	7.22338	2.06233	44.56983	2			
2017	0	0	8.57143	8.57143	4.24954	0	4.24954	37.79784	6.21845	10.46799	6.68547	1.88595	41.45632	2			
2018	0	0	7.85714	7.85714	3.78575	0	3.78575	36.07305	5.79618	9.58193	6.21845	1.63869	38.64119	2			
2019	0	0	7.14286	7.14286	3.39674	0	3.39674	34.42041	5.39875	8.7955	5.79618	1.34668	35.9917	2			
2020	0	0	6.42857	6.42857	3.07145	0	3.07145	32.76633	5.01121	8.08266	5.39875	1.02982	33.40805	3			
2021	0	0	5.71429	5.71429	2.80048	0	2.80048	31.05767	4.62247	7.42294	5.01121	0.70308	30.81645	2	-		
2022	0	0	5	5	2.57584	0	2.57584	29.25729	4.22454	6.80038	4.62247	0.37753	28.16358				

INTERGOVERNMENTAL PANEL ON Climate change

WMO UN O environment programme

1. Note that after the EFs/ parameters for a gas are entered in "Chemical's Data" the parameters appear here, and a worksheet for data entry appears. Note IPCC defaults for lifetime and EF.

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2. AD are entered in orange cells. Where country-specific data are entered (2015, 2022), cells become white. Remaining orange cells are calculated/ interpolated based on the growth rate. <u>Note: Do NOT add zeros</u> for years data are not known, the system will interpolate from a "0"

3. Green cells are calculated.

4. Note that although the user is in the 2015 inventory year, Fgases are calculated for entire time series.

2.F.1 Refrigeration and Air Conditioning

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE



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Tier 2

2.F.1:Answers: Add gas for Tier 2



IUUU



2.F.1:Answers: Add subdivisions and sub-applications



1. Add names of subdivisions.

INTERGOVERNMENTAL PANEL ON Climate change

IOCC

UN 💮

2. In "Capital city" subdivision, select the relevant dropdowns for sub-applications. Select "Save" after entering each one.

Remember, for interoperability, user should only modify subapplications names if necessary. Any modified names will map to stationary air conditioning in CRT.

Although the user is in 2015, the information will be applied to the entire time series.

2.F.1:Answers: Enter EFs and Parameters

Application	Database Inventory Yea	r Administrate Workshee	ts Tools Export/Imp	port Reports Window Help								_ 8 ×			
F-Gas Emis Worksheet Sector: Category: Subcatego Sheet: Data F-Gase	sions F-Gas Parameters - Tier Industrial Processes and I Product Uses as Substitut yry: 2.F.1.a - Refrigeration and F-Gas Parameters - Tier 2 s Manager	F-Gas Emissions - Tier 2a Product Use les for Ozone Depleting Substance I Stationary Air Conditioning	F-Gas Emissions - Tier 2	b								2015			
					Si	bdivision									
Ca	pital city														
	Sub-application														
þ.	Domestic Refrigeration														
	Chemical	Tier	Year of Introduction	Emission factor for containers management (%/yr)	Emission factor for filling (production/manufacturing) of new equipment (% initial charge/yr)	Emission factor for equipment operation (leakag <i>e/</i> servicing) (% initial charge/yr)	Lifetime of equipment (years)	Share of initial charge remaining at the end of life (%)	Recovery efficiency of charge (to be reclaimed/recycled) remaining at end of life in retired equipment (%)	UNFCCC CRT Confidentialit y					
			t(start)	EFc	EFk	EFx	d	р	η(rec,d)						
	😽 HFC-134a (CH2FCF3)	Tier 2a	2000	2	0.5	0.25	12	80	35			X			
					Su	b-application									
.	Medium & Large Commercial F	Refrigeration													
ŧ٠	Transport Refrigeration														
.	Industrial Refrigeration includir	ng Food Processing and Cold Sto	orage												
. ⊕	Residential and Commercial A	/C, including Heat Pumps													
*		N									×	/			
		- AF	2		Su	bdivision									
🖶 Re	est of country														
*															

INTERGOVERNMENTAL PANEL ON CLIMATE CHANES



iocc

2. F	.1:	Ans	SW	er	S:	En	ite	r A	Da	and	Es	tim	ate)		IN	TERGOVER	NMENTAL	PANEL	on clim a	İPCC ate change	WMC	environmen programme
Emissions – Tier 2a 1. Note data added in "Parameters".									3. Note that these activities were norther known to occur. In IPCC software, be left blank. The Software is an extra tool, not a reporting tool, so notation such as "NO" not accepted.								not e, this c estima tion key	an tion 's					
F-Gas Emissions F-Gas Paraneters - Tier F-Gas Emissions - Tier 2 Worksheet Sector: Industrial Processes and Product Use Category: Product Uses as Substitutes for Ozone Depleting Substances Subcategory: 2. F.1.a - Refrigeration and Stationary Air Conditioning Sheet: F-Gas Emissions - Emission Factor Approach - Tier 2a Data Subdivision Capital city Sub-application Domestic Refrigeration Gas HFC-134a (CH2FCF3)													System ca	lculate	2015 S								
Intro Year Year	Amount in the bank on January 1st of year t (kg)	EFc [%] 2 Domestically Manufactured HFC in year t (kg)	Imported in bulk in year t (kg)	Exported in bulk in year t (kg)	Contained in factory- charged Imported equipment	Contained in factory- charged Exported new-	Lifetim Domestic Sales of chemical (in bulk) in year t	e (d) [yr] 12 Emitted by containers management (during transfer from	p [%] Used to fill domestically manufactured new equipment in	Emitted during filling of new equipment in year t (kg)	n(rec.d) [%] Contained in new equipment filled in country in	35 Contained in equipment going to the bank in year t (kg)	Emitted from equipment in use in year t, including servicing	Used to m	efill in year t <g)< th=""><th>In equipment retired in year t (kg)</th><th>Recovered and recycled/reclai med from equipment</th><th>Emitted at end of life in year t (kg)</th><th>Destroyed in year t (kg)</th><th>Exported in used equipment (for subsequent</th><th>Amount in the bank on December 31st of year t (kg)</th><th>kg and Ital emissions in year t (kg)</th><th>Total emissions in year t (Gg)</th></g)<>	In equipment retired in year t (kg)	Recovered and recycled/reclai med from equipment	Emitted at end of life in year t (kg)	Destroyed in year t (kg)	Exported in used equipment (for subsequent	Amount in the bank on December 31st of year t (kg)	kg and Ital emissions in year t (kg)	Total emissions in year t (Gg)
t Δ	B = U(t-1)	С	D 3.7	E	F 0.7	G	H = C + D - E + Q(t-1)	I = H * (EFc / 100) 0.074	J = H - I - O 1.15933	K = J * (EFk / 100) 0.0058	L = J - K 1.15354	M = L + F - G 1.85354	(Kg) N = ∑(M(t- d+1,t)) * (EFx / 100) 0.00463	Calculated	O = H*(2/3) or specified 2.46667	P = M(t-d) * (p/100)	Q = P * (η (rec,d)/100)	R = P - Q	S	T	U = B + M + O - N - P - T 4.31557	V = I + K + N + - S - T 0.08443	W = V / 1000000 0
2001 2002 2003 2004 2005	4.31557 8.82402 13.42528 18.02149 22.71043		3.8 3.9 3.9 4 4.1		0.8 0.8 0.8 0.8 0.8		3.8 3.9 3.9 4 4.1	0.078 0.078 0.08 0.08	1.19067 1.222 1.223 1.25333 1.28467	0.00595 0.00611 0.00611 0.00627 0.00642	1.18471 1.21589 1.21589 1.24707 1.27824	2.01589 2.01589 2.04707 2.07824	0.0196 0.01968 0.02479 0.02999	Calculated Calculated Calculated Calculated Calculated	2.53333 2.6 2.6 2.66667 2.73333	0 0 0 0	0 0 0 0	0 0 0 0			8.02402 13.42528 18.02149 22.71043 27.49202	0.09155 0.09875 0.10379 0.11106 0.11841	0 0 0 0
2006 2007 2008 2009 2010	27.49202 32.36618 37.43258 42.59114 47.74403		4.2 4.3 4.4 4.4 4.5		0.8 0.9 0.9 0.9 0.9		4.2 4.3 4.4 4.4 4.5	0.084 0.086 0.088 0.088 0.09	1.316 1.34733 1.37867 1.37867 1.41	0.00658 0.00674 0.00689 0.00689 0.00705	1.30942 1.3406 1.37177 1.37177 1.40295	2.10942 2.2406 2.27177 2.27177 2.30295	0.03526 0.04086 0.04654 0.05222 0.05798	Calculated Calculated Calculated Calculated Calculated	2.8 2.86667 2.93333 2.93333 3	0 0 0 0	0 0 0 0	0 0 0 0			32.36618 37.43258 42.59114 47.74403 52.989	0.12584 0.1336 0.14144 0.14712 0.15503	0 0 0 0
2011 2012 2013 2014 2015	52.989 58.32597 62.27669 66.82642 71.48327) 7)) 2 7	4.6 4.7 4.8 4.9 5		0.9 0.9 1 1		4.6 4.7 5.31899 5.45572 5.56445	0.092 0.094 0.10638 0.10911 0.11129	1.44133 1.47267 1.66662 1.70946 1.74353	0.00721 0.00736 0.00833 0.00855 0.00872	1.43413 1.4653 1.65828 1.70091 1.73481	2.33413 2.3653 2.65828 2.70091 2.73481	0.06381 0.06509 0.06678 0.06849 0.07029	Calculated Calculated Calculated Calculated Calculated	3.06667 3.13333 3.54599 3.63715 3.70963	0 1.48283 1.58777 1.61271 1.61271	0 0.51899 0.55572 0.56445 0.56445	0 0.96384 1.03205 1.04826 1.04826	2 2 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		58.32597 62.27669 66.82642 71.48327 76.24471	0.16302 1.1303 1.21354 1.23442 1.23856	0 0 0 0
2016 2017 2018 2019 2020	76.24471 81.07726 85.98945 91.08101 96.17221	j j	5.1 5.2 5.3 5.4 5.5		1 1 1.1 1.1 1.1		5.66445 5.77318 5.88191 5.99064 6.12737	0.11329 0.11546 0.11764 0.11981 0.12255	1.77486 1.80893 1.843 1.87707 1.91991	0.00887 0.00904 0.00921 0.00939 0.0096	1.76599 1.79988 1.83378 1.86768 1.91031	2.76599 2.79988 2.93378 2.96768 3.01031	0.07209 0.07389 0.07595 0.07777 0.07961	Calculated Calculated Calculated Calculated Calculated	3.7763 3.84879 3.92127 3.99376 4.08491	1.63765 1.66259 1.68754 1.79248 1.81742	0.57318 0.58191 0.59064 0.62737 0.6361	1.06447 1.08069 1.0969 1.16511 1.18132	2 2 2		81.07726 85.98945 91.08101 96.17221 101.3704	1.25872 1.27908 1.2997 1.37208 1.39308	0 0 0 0 0 0 0 0
2021 2022	101.3704 106.67304	4	5.6 5.7		1.1 1.1		6.2361 6.3361	0.12472 0.12672	1.95398 1.98531	0.00977 0.00993	1.94421 1.97538	3.04421 3.07538	0.08155 0.08348	Calculated Calculated	4.1574 4.22406	1.81742 1.84236	0.6361 0.64483	1.18132 1.19753			106.67304 112.04665	1.39736 1.41766	0



Preview....IPPU and Interoperability





Software:

- Is a valuable tool to aid in emissions calculations for this sector, which has a variety of industries following a variety of methods.
- Accommodates these multiple tiers relying on different types of AD (e.g. production versus consumption).
- Visualizes the CRT, allowing users to see how data will appear in the CRT.
- Allows for addition of notation keys, including explanations, and method/EF used.
- Tracks emissions from biogenic feedstocks/ these are not reported to UNFCCC.
- Allows users to designate information, particularly AD, as confidential. User responsibility to understand how confidentiality works.

FOR YOUR ATTENTION

STAY IN TOUCH

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STAY CONNECTED

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- O @ipcc
- **f** ipcc