

ANNEX 1

WORKSHEETS

[In Annex 1 of Volume 3 of the *2019 Refinement* only new and updated worksheets are provided, see below.
The other worksheets of Annex 1 of Volume 3 of the *2006 IPCC Guidelines* are not refined]

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2B10 HYDROGEN PRODUCTION (NEW)

Sector	Industrial Processes and Product Use			
Category	Chemical Industry - Hydrogen Production			
Category Code	2B10			
Sheet	1 of 3 CO₂ Emissions from Hydrogen Production (calculation based on feedstock used)			
	A	B	C	D
Type of Feedstock	Feedstock Consumption	Carbon Content Factor	CO ₂ recovered	CO ₂ Emissions
	(GJ)	(tonne C / GJ feedstock)	(tonne CO ₂)	(Gg)
				$D = A * B * (44/12) - C$
Total				
Note: Inventory compilers should use either this sheet (1 of 3), the second sheet (2 of 3) or the third sheet (3 of 3), not all of them. This sheet is for the Tier 1a method.				

Sector	Industrial Processes and Product Use				
Category	Chemical Industry - Hydrogen Production				
Category Code	2B10				
Sheet	2 of 3 CO₂ Emissions from Hydrogen Production (calculation based on hydrogen produced)				
	A	B	C	D	E
Type of Feedstock	Hydrogen Produced	Feedstock Requirement Factor	Carbon Content Factor	CO ₂ recovered	CO ₂ Emissions
	(tonne)	(GJ feedstock / tonne hydrogen produced)	(tonne C / GJ feedstock)	(tonne CO ₂)	(Gg)
					$E = A * B * C * (44/12) - D$
Total					
Note: Inventory compilers should use either this sheet (2 of 3), the first sheet (1 of 3) or the third sheet (3 of 3), not all of them. This sheet is for the Tier 1b method.					

Sector	Industrial Processes and Product Use		
Category	Chemical Industry - Hydrogen Production		
Category Code	2B10		
Sheet	3 of 3 CO₂ Emissions from Hydrogen Production (calculation based on hydrogen produced)		
	A	B	D
Hydrogen Produced	Feedstock Requirement Factor	Carbon Content Factor	CO ₂ Emissions
(tonne)	(GJ feedstock / tonne hydrogen produced)	(tonne C / GJ feedstock)	(Gg)
			$D = A * B * C * (44/12)$
Note: Inventory compilers should use either this sheet (3 of 3), the first sheet (1 of 3) or the second sheet (2 of 3), not all of them. This sheet is for the Tier 1c method.			

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2C3 ALUMINIUM PRODUCTION (UPDATED)

Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	1 of 8: CO ₂ Emissions From Anode or Paste Consumption			
Type of Technology	A	B	C	D
	Amount of Aluminium Production	Emission Factor	CO ₂ Emissions	CO ₂ Emissions
	(tonne aluminium produced)	(tonne CO ₂ /tonne aluminium produced)	(tonne)	(Gg)
			$C = A * B$	$D = C/10^3$
Prebake				
Soderberg				
Total				

Sector	Industrial Processes and Product Use				
Category	Metal Industry - Aluminium Production				
Category Code	2C3				
Sheet	2 of 8: CO ₂ Emissions From Sintering				
Type of Technology	A	B	C	D	E
	Mass of Alumina Produced	Mass Fraction of Alumina Produced by Sintering Process	Emission Factor for sintering	CO ₂ Emissions	CO ₂ Emissions
	(tonne)	(fraction)	(tonne CO ₂ /tonne alumina)	(tonne CO ₂)	(Gg CO ₂)
				$D = A * B * C$	$E = D/10^3$
Bayer-sintering					
Nepheline-sintering process					
Total					

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	3 of 8: CO₂ Emissions From Lime Production¹⁾			
Type of Lime Produced ^{2), 3)}	A	B	C	D
	Mass of Lime Produced	Emission Factor for Lime Production	CO ₂ Emissions	CO ₂ Emissions
	(tonne)	(tonne CO ₂ / tonne lime)	(tonne CO ₂)	(Gg CO ₂)
			$C = A * B$	$D = C/10^3$
Total				
1) CO ₂ Emissions from Lime Production are estimated here, if Lime Production is a part of Alumina Production Process and is not considered as Emissions of Mineral Industry, Lime Production category. 2) Insert additional rows if more than two types of lime are produced. 3) When country-specific information on lime production by type is not available, apply the default emission factor to national level lime production data. (See Equation 2.8 in Chapter 2 of this volume.)				

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	4 of 8: CO₂ Emissions (Total)			
	A	B	C	D
	Emissions From Anode or Paste Consumption	Emissions From Sintering	Emissions From Lime Production ¹⁾	Total CO ₂ Emissions
	(Gg)	(Gg)	(Gg)	(Gg)
	From D in Sheet 1 of 8	From E in Sheet 2 of 8	From D in Sheet 3 of 8	$D = A + B + C$
Total				
1) CO ₂ Emissions from Lime Production are estimated here, if Lime Production is a part of Alumina Production Process and is not considered as Emissions of Mineral Industry, Lime Production category.				

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	5 of 8: CF ₄ Emissions (High Voltage Anode Effect)			
Type of Technology ^{1), 2)} (please specify)	A	B	C	D
	Amount of Aluminium Production	Emission Factor	HVAE-CF ₄ Emissions	HVAE-CF ₄ Emissions
	(tonne aluminium produced)	(kg CF ₄ /tonne aluminium produced)	(kg)	(Gg)
			C = A * B	D = C/10 ⁶
Total				
1) Insert relevant type of technology, e.g.: PFPB _L , PFPB _M , PFPB _{MW} , SWPB, VSS, HSS. For more details, refer to Section 4.4.1 in Volume 3, Chapter 4.				
2) Insert additional rows if necessary.				

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	6 of 8: CF ₄ Emissions (Low Voltage Anode Effect)			
Type of Technology ^{1), 2)} (please specify)	A	B	C	D
	Amount of Aluminium Production	Emission Factor	LVAE-CF ₄ Emissions	LVAE-CF ₄ Emissions
	(tonne aluminium produced)	(kg CF ₄ /tonne aluminium produced)	(kg)	(Gg)
			C = A * B	D = C/10 ⁶
Total				
1) Insert relevant type of technology, e.g.: PFPB _L , PFPB _M , PFPB _{MW} , SWPB, VSS, HSS. For more details, refer to Section 4.4.1 in Volume 3, Chapter 4.				
2) Insert additional rows if necessary.				

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Sector	Industrial Processes and Product Use		
Category	Metal Industry - Aluminium Production		
Category Code	2C3		
Sheet	7 of 8: CF₄ Emissions (Total)		
	A	B	C
	HVAE-CF ₄ Emissions	LVAE-CF ₄ Emissions	Total CF ₄ Emissions
	(Gg)	(Gg)	(Gg)
	From D in Sheet 4 of 7	From D in Sheet 5 of 7	C = A + B
Total			

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Aluminium Production			
Category Code	2C3			
Sheet	8 of 8: C₂F₆ Emissions (High Voltage Anode Effect)			
Type of Technology ^{1), 2)} (please specify)	A	B	C	D
	Amount of Aluminium Production	Emission Factor	HVAE-C ₂ F ₆ Emissions	HVAE-C ₂ F ₆ Emissions
	(tonne aluminium produced)	(kg C ₂ F ₆ /tonne aluminium produced)	(kg)	(Gg)
			C = A * B	D = C/10 ⁶
Total				
1) Insert relevant type of technology, e.g.: PFPB _L , PFPB _M , PFPB _{MW} , SWPB, VSS, HSS. For more details, refer to Section 4.4.1 in Volume 3, Chapter 4. 2) Insert additional rows if necessary.				

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2C7 RARE EARTH PRODUCTION (NEW)

Sector	Industrial Processes and Product Use			
Category	Metal Industry – Rare Earths Production			
Category Code	2C7			
Sheet	1 of 4: CO ₂ Emissions			
Type of Rare Earth Metal / Alloy ^{1), 2)} (please specify)	A	B	C	D
	Amount of Rare Earth Production	Emission Factor	CO ₂ Emissions	CO ₂ Emissions
	(tonne rare earth metal produced)	(tonne CO ₂ /tonne metal produced)	(tonne)	(Gg)
			$C = A * B$	$D = C/10^3$
Total				
1) Insert relevant rare earth metal or alloy, e.g.: Nd metal, Pr metal, Dy-Fe alloy, etc. For more details, refer to Section 4.8.1 in Volume 3, Chapter 4.				
2) Insert additional rows if necessary.				

Sector	Industrial Processes and Product Use			
Category	Metal Industry - Rare Earths Production			
Category Code	2C7			
Sheet	2 of 4: CF ₄ Emissions			
Type of Rare Earth Metal / Alloy ^{1), 2)} (please specify)	A	B	C	D
	Amount of Rare Earth Production	Emission Factor	CF ₄ Emissions	CF ₄ Emissions
	(tonne rare earth metal produced)	(g CF ₄ /tonne metal produced)	(kg)	(Gg)
			$C = A * B / 10^3$	$D = C/10^6$
Total				
1) Insert relevant rare earth metal or alloy, e.g.: Nd metal, Pr metal, Dy-Fe alloy, etc. For more details, refer to Section 4.8.1 in Volume 3, Chapter 4.				
2) Insert additional rows if necessary.				

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Rare Earths Production			
Category Code	2C7			
Sheet	3 of 4: C₂F₆ Emissions			
Type of Rare Earth Metal / Alloy ^{1), 2)} (please specify)	A	B	C	D
	Amount of Rare Earth Production	Emission Factor	C ₂ F ₆ Emissions	C ₂ F ₆ Emissions
	(tonne rare earth metal produced)	(g C ₂ F ₆ /tonne metal produced)	(kg)	(Gg)
			$C = A * B / 10^3$	$D = C / 10^6$
Total				
1) Insert relevant rare earth metal or alloy, e.g.: Nd metal, Pr metal, Dy-Fe alloy, etc. For more details, refer to Section 4.8.1 in Volume 3, Chapter 4. 2) Insert additional rows if necessary.				

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Sector	Industrial Processes and Product Use			
Category	Metal Industry - Rare Earths Production			
Category Code	2C7			
Sheet	4 of 4: C₃F₈ Emissions			
Type of Rare Earth Metal / Alloy ^{1), 2)} (please specify)	A	B	C	D
	Amount of Rare Earth Production	Emission Factor	C ₃ F ₈ Emissions	C ₃ F ₈ Emissions
	(tonne rare earth metal produced)	(g C ₃ F ₈ /tonne metal produced)	(kg)	(Gg)
			$C = A * B / 10^3$	$D = C / 10^6$
Total				
1) Insert relevant rare earth metal or alloy, e.g.: Nd metal, Pr metal, Dy-Fe alloy, etc. For more details, refer to Section 4.8.1 in Volume 3, Chapter 4. 2) Insert additional rows if necessary.				

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