

## II

(Non-legislative acts)

## DECISIONS

## COMMISSION DECISION

of 18 August 2011

**on amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting guidelines for greenhouse gas emissions from new activities and gases**

(notified under document C(2011) 5861)

(Text with EEA relevance)

(2011/540/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC <sup>(1)</sup> as amended by Directive 2004/101/EC <sup>(2)</sup>, Directive 2008/101/EC <sup>(3)</sup> and Regulation (EC) No 219/2009 <sup>(4)</sup>, and in particular Articles 14(1) and 24(3) thereof,

Whereas:

- (1) Directive 2003/87/EC establishes a scheme for greenhouse gas emission allowance trading within the Union (hereinafter 'the ETS').
- (2) Pursuant to Article 14(1) of Directive 2003/87/EC as amended by Directive 2004/101/EC, Directive 2008/101/EC and Regulation (EC) No 219/2009, the Commission adopted Decision 2007/589/EC <sup>(5)</sup> establishing guidelines for the monitoring and reporting of greenhouse gas emissions.
- (3) Pursuant to Article 24(3) of Directive 2003/87/EC as amended by Directive 2004/101/EC, Directive 2008/101/EC and Regulation (EC) No 219/2009, the Commission may, on its own initiative, adopt monitoring and reporting guidelines for emissions from

activities, installations and greenhouse gases which are not listed in Annex I if the monitoring and reporting of those emissions can be carried out with sufficient accuracy.

- (4) Pursuant to Article 3 of Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community <sup>(6)</sup>, Articles 14 and 24 of Directive 2003/87/EC as amended by Directive 2004/101/EC, Directive 2008/101/EC and Regulation (EC) No 219/2009, continue to apply until 31 December 2012.
- (5) Directive 2009/29/EC includes new gases and activities in the ETS as of 2013. The Commission should adopt guidelines for the monitoring and reporting of greenhouse gas emissions resulting from new activities and new gases with a view to the inclusion of such activities in the ETS from 2013 and their possible unilateral inclusion in the ETS before 2013.
- (6) Decision 2007/589/EC should therefore be amended accordingly.
- (7) The measures provided for in this Decision are in accordance with the opinion of the Committee referred to in Article 23 of Directive 2003/87/EC,

HAS ADOPTED THIS DECISION:

*Article 1*

Decision 2007/589/EC is amended as follows:

<sup>(1)</sup> OJ L 275, 25.10.2003, p. 32.

<sup>(2)</sup> OJ L 338, 13.11.2004, p. 18.

<sup>(3)</sup> OJ L 8, 13.1.2009, p. 3.

<sup>(4)</sup> OJ L 87, 31.3.2009, p. 109.

<sup>(5)</sup> OJ L 229, 31.8.2007, p. 1.

<sup>(6)</sup> OJ L 140, 5.6.2009, p. 63.

(1) Article 1 is replaced by the following:

*Article 1*

The guidelines for the monitoring and reporting of greenhouse gas emissions from the activities listed in Annex I to Directive 2003/87/EC, and of activities included pursuant to Article 24(1) of that Directive, are set out in Annexes I to XIV and XVI to XXIV to this Decision.

The guidelines for the monitoring and reporting of tonne-kilometre data from aviation activities for the purpose of an application pursuant to Article 3e or 3f of Directive 2003/87/EC are set out in Annex XV. Those guidelines are based on the principles set out in Annex IV to that Directive.;

(2) the Table of Annexes and the following Annexes are amended as follows:

- (a) The Table of Annexes is amended according to Annex I to this Decision;
- (b) Annex I is amended according to Annex II to this Decision;
- (c) Annex II is amended according to Annex III to this Decision;
- (d) Annex IV is amended according to Annex IV to this Decision;
- (e) Annex V is amended according to Annex V to this Decision;
- (f) Annex VI is amended according to Annex VI to this Decision;
- (g) Annex VII is amended according to Annex VII to this Decision;
- (h) Annex VIII is amended according to Annex VIII to this Decision;
- (i) Annex IX is amended according to Annex IX to this Decision;

(j) Annex X is amended according to Annex X to this Decision;

(k) Annex XI is amended according to Annex XI to this Decision;

(l) Annex XII is amended according to Annex XII to this Decision;

(m) Annex XVI is amended according to Annex XIII to this Decision;

(3) the following Annexes are added:

(a) Annex XIX is added according to Annex XIV to this Decision;

(b) Annex XX is added according to Annex XV to this Decision;

(c) Annex XXI is added according to Annex XVI to this Decision;

(d) Annex XXII is added according to Annex XVII to this Decision;

(e) Annex XXIII is added according to Annex XVIII to this Decision;

(f) Annex XXIV is added according to Annex XIX to this Decision.

*Article 2*

This Decision is addressed to the Member States.

Done at Brussels, 18 August 2011.

*For the Commission*  
Connie HEDEGAARD  
*Member of the Commission*

## ANNEX I

The Table of Annexes is amended as follows:

(1) the entries for Annex II and Annexes IV to XII are replaced by the following:

- 'Annex II: Guidelines for combustion emissions from activities as listed in Annex I to Directive 2003/87/EC carried out in installations
- Annex IV: Activity-specific guidelines for the production of coke as listed in Annex I to Directive 2003/87/EC
- Annex V: Activity-specific guidelines for metal ore roasting and sintering as listed in Annex I to Directive 2003/87/EC
- Annex VI: Activity-specific guidelines for the production of pig iron and steel including continuous casting as listed in Annex I to Directive 2003/87/EC
- Annex VII: Activity-specific guidelines for the production of cement clinker as listed in Annex I to Directive 2003/87/EC
- Annex VIII: Activity-specific guidelines for the production of lime or calcination of dolomite or magnesite as listed in Annex I to Directive 2003/87/EC
- Annex IX: Activity-specific guidelines for the manufacture of glass or mineral wool insulation material as listed in Annex I to Directive 2003/87/EC
- Annex X: Activity-specific guidelines for the manufacture of ceramic products as listed in Annex I to Directive 2003/87/EC
- Annex XI: Activity-specific guidelines for pulp and paper production as listed in Annex I to Directive 2003/87/EC
- Annex XII: Guidelines for determination of emissions or amount of transfer of greenhouse gases by continuous measurement systems';

(2) the following titles of new Annexes XIX, XX, XXI, XXII, XXIII and XXIV are added:

- 'Annex XIX: Activity-specific guidelines for the production of soda ash and sodium bicarbonate as listed in Annex I to Directive 2003/87/EC
  - Annex XX: Activity-specific guidelines for the production of ammonia as listed in Annex I to Directive 2003/87/EC
  - Annex XXI: Activity-specific guidelines for the production of hydrogen and synthesis gas as listed in Annex I to Directive 2003/87/EC
  - Annex XXII: Activity-specific guidelines for the production of bulk organic chemicals as listed in Annex I to Directive 2003/87/EC
  - Annex XXIII: Activity-specific guidelines for the production or processing of ferrous and non-ferrous metals as listed in Annex I to Directive 2003/87/EC
  - Annex XXIV: Activity-specific guidelines for the production or processing of primary aluminium as listed in Annex I to Directive 2003/87/EC'.
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## ANNEX II

Annex I is amended as follows:

- (1) in Section 1 entitled 'Introduction', the words 'Annexes II to XI and Annexes XIII to XVIII' are replaced by the words 'Annexes II to XI and Annexes XIII to XXIV';
- (2) in the introductory part of Section 2 entitled 'Definitions' the words 'Annexes II to XVIII' are replaced by the words 'Annexes II to XXIV';
- (3) Section 4.3 entitled 'The Monitoring Plan' is amended as follows:
  - (a) in the fourth paragraph, point (e) is replaced as follows:
    - (e) a list and description of the tiers for activity data, carbon content (where mass balance or other approaches directly requiring the carbon content for emission calculation are applied), emission factors, oxidation and conversion factors for each of the source streams to be monitored;
  - (b) the following subparagraphs are added after subparagraph (t):
    - (u) where applicable, the dates when measurements for the determination of the installation specific emission factors for  $\text{CF}_4$  and  $\text{C}_2\text{F}_6$  have been carried out, and a schedule for future repetitions of this determination;
    - (v) where applicable, the protocol describing the procedure used to determine the installation specific emission factors for  $\text{CF}_4$  and  $\text{C}_2\text{F}_6$ , showing also that the measurements have been and will be carried out for a sufficiently long time for measured values to converge, but at least for 72 hours;
    - (w) where applicable, the methodology for determining the collection efficiency for fugitive emissions at installations for primary aluminium production;
- (4) Section 5 is amended as follows:
  - (a) in Section 5.1, under the heading 'process emissions', the second paragraph is replaced by the following:

'The calculation of process emissions is further specified in the activity-specific guidelines in the Annexes II to XI and XVI to XXIV. Not all calculation methods in Annexes II to XI and XVI to XXIV use a conversion factor.';
  - (b) in Section 5.2 entitled 'Tiers of Approaches', the words 'Annexes II to XI and Annexes XIV to XVIII' are replaced by the words 'Annexes II to XI and XIV to XXIV';
  - (c) in Section 5.2, the following ninth paragraph is added:

'For commercial standard fuels minimum tier approaches as stated in Table 1 for Annex II on combustion activities can be applied also for other activities.';
  - (d) 'Table 1: Minimum Requirements' is replaced by the following table:



	Activity Data						Emission Factor			Composition Data			Conversion Factor		
	Material Flow			Net Calorific Value											
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<b>III: Refineries</b>															
Catalytic Cracker Regeneration	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hydrogen Production	1	2	2	n.a.	n.a.	n.a.	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>IV: Coke Ovens</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
Fuel as process input	1	2	3	2	2	3	2	3	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>V: Metal Ore Roasting &amp; Sintering</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
Carbonate Input	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	1
<b>VI: Iron &amp; Steel</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
Fuel as process input	1	2	3	2	2	3	2	3	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>VII: Cement</b>															
Kiln Input Based	1	2	3	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	2
Clinker Output	1	1	2	n.a.	n.a.	n.a.	1	2	3	n.a.	n.a.	n.a.	1	1	2
CKD	1	1	2	n.a.	n.a.	n.a.	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Non-Carbonate Carbon	1	1	2	n.a.	n.a.	n.a.	1	1	2	n.a.	n.a.	n.a.	1	1	2
<b>VIII: Lime, Dolomite and Magnesite</b>															
Carbonates	1	2	3	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	2
Alkali Earth Oxide	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	2

	Activity Data						Emission Factor			Composition Data			Conversion Factor		
	Material Flow			Net Calorific Value											
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<b>IX: Glass, Mineral Wool</b>															
Carbonates	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>X: Ceramic</b>															
Carbon Inputs	1	1	2	n.a.	n.a.	n.a.	1	2	3	n.a.	n.a.	n.a.	1.	1	2
Alkali Oxide	1	1	2	n.a.	n.a.	n.a.	1	2	3	n.a.	n.a.	n.a.	1	1	2
Scrubbing	1	1	1	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>XI: Pulp &amp; Paper</b>															
Standard Method	1	1	1	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>XIX: Soda ash and sodium bicarbonate</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
<b>XX: Ammonia</b>															
Fuel as process input	2	3	4	2a/2b	2a/2b	3	2a/2b	2a/2b	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>XXI: Hydrogen and synthesis gas</b>															
Fuel as process input	2	3	4	2a/2b	2a/2b	3	2a/2b	2a/2b	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
<b>XXII: Bulk organic chemicals</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
<b>XXIII: Metals production or processing</b>															
Mass balance	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
Process emissions	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	2

	Activity Data						Emission Factor			Composition Data			Conversion Factor		
	Material Flow			Net Calorific Value											
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<b>XXIV: Aluminium production</b>															
Mass balance for CO <sub>2</sub> emissions	1	2	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	3	3	n.a.	n.a.	n.a.
PFC emissions (slope method)	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PFC emissions (overvoltage method)	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.



- (e) in Section 5.4 entitled 'Activity Data of Stationary Installations', in the second subparagraph, the words 'Annexes II to XI' are replaced by the words 'Annexes II to XXIV';
- (f) in Section 5.5, entitled 'Emissions Factors', the first paragraph is replaced by the following:
- 'Emission factors for CO<sub>2</sub> emissions are based on the carbon content of fuels or input materials and expressed as tCO<sub>2</sub>/TJ (combustion emissions), or tCO<sub>2</sub>/t or tCO<sub>2</sub>/Nm<sup>3</sup> (process emissions). For non-CO<sub>2</sub> greenhouse gases, appropriate emission factors are defined in the relevant activity-specific Annexes to these Guidelines.;
- (g) Section 5.7 is amended as follows:
- the first indent of the first paragraph is replaced by the following:
 

'as pure substance, or directly used and bound in products or as feedstock, unless other requirements as set out in Annexes XIX to XXII apply, or',
  - in the second paragraph, the words 'or XVIII' are replaced by 'to XXII';
- (5) in Section 6.3(c), third paragraph, the words ', XVII and XVIII' are replaced by 'to XXIV';
- (6) in Section 7.1, fifth paragraph, the word 'XVIII' is replaced by XXIV';
- (7) Section 8 is amended as follows:
- (a) in subparagraph (6) of the fifth paragraph, the words ', XVII and XVIII' are replaced by 'to XXIV';
- (b) the following subparagraph (11) is added to the fifth paragraph:
- '(11) where applicable, the production level of primary aluminium, the frequency and average duration of anode effects during the reporting period, or the anode effect overvoltage data during the reporting period, as well as the results of the most recent determination of the installation specific emission factors for CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> as outlined in Annex XXIV, and of the most recent determination of the collection efficiency of the ducts.;
- (c) In Section 8, seventh paragraph, the words 'under (2)' are replaced by 'under (2) and (11)';
- (8) in Section 9, the following ninth paragraph is added:
- 'The following additional information shall be retained for primary aluminium production:
- documentation of results from measurement campaigns for the determination of the installation specific emission factors for CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub>,
  - documentation of results of the determination of the collection efficiency for fugitive emissions,
  - all relevant data on primary aluminium production, anode effect frequency and duration or overvoltage data.;
- (9) Section 14.1 is amended as follows:
- In footnote 2 the text is replaced by the following: 'Only to be filled in if installation is required to report under EPRTR.;
- (10) a new Section 14.8 is added:

'14.8. PFC EMISSIONS REPORTING FOR PRODUCTION OF PRIMARY ALUMINIUM

	Activity			
	Cell type			
	Slope method (A) or overvoltage method (B)?			
	Parameter	Unit	Value	Tier applied
	Primary aluminium production	t		
Method A	Number of anode effects			
	Average duration of anode effects	min		
	Anode effect minutes/cell-day	min/cell-day		
	SEF <sub>CF<sub>4</sub> ...</sub> Slope emission factor	(kg CF <sub>4</sub> /t Al)/(min/cell-day)		

Method B	AEO ... Anode effect overvoltage per cell	mV		
	CE ... average current efficiency	%		
	AEO/CE	mV		
	OVC ... Overvoltage coefficient	kg CF <sub>4</sub> / (t Al mV)		
	F <sub>C<sub>2</sub>F<sub>6</sub></sub> ... Weight fraction of C <sub>2</sub> F <sub>6</sub>	t C <sub>2</sub> F <sub>6</sub> /t CF <sub>4</sub>		
	CF <sub>4</sub> emissions	t		
	C <sub>2</sub> F <sub>6</sub> emissions	t		
	GWP <sub>CF<sub>4</sub></sub> applied	t CO <sub>2(e)</sub> /t		
	GWP <sub>C<sub>2</sub>F<sub>6</sub></sub> applied	t CO <sub>2(e)</sub> /t		
	<b>Total emissions</b>	<b>t CO<sub>2(e)</sub>'</b>		

## ANNEX III

Annex II is amended as follows:

- (1) the title of Annex II is replaced by the following:

**'Guidelines for combustion emissions from activities as listed in Annex I to Directive 2003/87/EC carried out in installations';**

- (2) in Section 1, the first paragraph is replaced by the following:

'The activity-specific guidelines contained in this Annex shall be used to monitor emissions from combustion activities as listed in Annex I to Directive 2003/87/EC carried out in installations and defined pursuant to Article 3(t) and to monitor combustion emissions from other activities as listed in that Annex I to Directive 2003/87/EC where referred to in Annexes III to XI and XVI to XXIV to these Guidelines. Furthermore this Annex shall be used to monitor emissions from combustion processes being part of any activity listed in Annex I to Directive 2003/87/EC for which no other activity-specific Annex to these Guidelines applies.';

- (3) Section 2 is amended as follows:

- (a) in the introductory phrase, the wording 'installations and processes' is replaced by 'activities';
- (b) in the first paragraph of Section 2.1.1.1, the word 'installations' is replaced by 'activities';
- (c) in Section 2.1.1.2(b), Carbon Content, Tier 1, the wording 'the Annexes IV-VI' is replaced by 'other activity-specific Annexes'.

## ANNEX IV

Annex IV is amended as follows:

- (1) The title of Annex IV is replaced by the following:

**'Activity-specific guidelines for the production of coke as listed in Annex I to Directive 2003/87/EC';**

- (2) The first paragraph of Section 1 is replaced by the following:

'Coke ovens can be part of steel works with a direct technical connection to sintering activities and activities for the production of pig iron and steel including continuous casting, causing an intensive energy and material exchange (for example, blast furnace gas, coke oven gas or coke) to take place in regular operation. If an installation's permit according to Articles 4, 5 and 6 of Directive 2003/87/EC encompasses the entire steel works and not solely the coke oven, the CO<sub>2</sub>-emissions may also be monitored for the integrated steel works as a whole, using the mass balance approach specified in Section 2.1.1 of this Annex.';

- (3) In Section 2.1.1(b) Carbon Content, Tier 1, the introductory phrase is replaced by the following:

'The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or the Annexes IV-X. The carbon content is derived as follows:'.

## ANNEX V

Annex V is amended as follows:

- (1) the title of Annex V is replaced by the following:

**'Activity-Specific Guidelines for metal ore roasting and sintering as listed in Annex I to Directive 2003/87/EC';**

- (2) the first paragraph of Section 1 is replaced by the following:

'Metal ore roasting, sintering or pelletisation activities can form an integral part of steel works with a direct technical connection to coke ovens and activities for the production of pig iron and steel including continuous casting. Thus an intensive energy and material exchange (e.g. blast furnace gas, coke oven gas, coke or limestone) takes place in regular operation. If an installation's permit according to Articles 4, 5 and 6 of Directive 2003/87/EC encompasses the entire steel works and not solely the roasting or sintering activity, the CO<sub>2</sub>-emissions may also be monitored for the integrated steel works as a whole. In such cases the mass balance approach (Section 2.1.1 of this Annex) may be used.';

- (3) in Section 2.1.1(b) Carbon Content, Tier 1, the introductory phrase is replaced by the following:

'The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or the Annexes IV-X. The carbon content is derived as follows:'.

## ANNEX VI

Annex VI is amended as follows:

- (1) the title of Annex VI is replaced by the following:

**'Activity-specific guidelines for the production of pig iron and steel including continuous casting as listed in Annex I to Directive 2003/87/EC';**

- (2) Section 1 is modified as follows:

(a) the first paragraph is replaced by the following wording: 'The guidelines in this Annex can be applied for emissions from production of pig iron and steel activities, including continuous casting activities. They refer in particular to primary (blast furnace (BF) and basic oxygen furnace (BOF)) and secondary (electric arc furnace (EAF)) steel production.';

(b) the second paragraph is replaced by the following wording: 'Activities for the production of pig iron and steel including continuous casting are generally integral parts of steel works with a technical connection to coke oven and sinter activities. Thus an intensive energy and material exchange (e.g. blast furnace gas, coke oven gas, coke or limestone) takes place in regular operation. If an installation's permit according to Articles 4, 5 and 6 of Directive 2003/87/EC encompasses the entire steel works and not solely the blast furnace, the CO<sub>2</sub>-emissions may also be monitored for the integrated steel works as a whole. In such cases the mass balance approach as presented in Section 2.1.1 of this Annex may be used.';

- (3) in Section 2.1.1(b) Carbon Content, Tier 1, the introductory phrase is replaced by the following:

'The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or the Annexes IV-X. The carbon content is derived as follows:'.

## ANNEX VII

Annex VII is amended as follows:

(1) the title of Annex VII is replaced by the following:

**'Activity-specific guidelines for the production of cement clinker as listed in Annex I to Directive 2003/87/EC';**

(2) the first sentence of Section 2 is replaced by the following:

'In cement producing activities, CO<sub>2</sub> emissions result from the following emission sources and source streams:'.

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## ANNEX VIII

Annex VIII is amended as follows:

- (1) The title of Annex VIII is replaced by the following:

**'Activity-specific guidelines for the production of lime or calcination of dolomite or magnesite as listed in Annex I to Directive 2003/87/EC';**

- (2) Section 2 is amended as follows:

- (a) in the first paragraph, the introductory phrase is replaced as follows: 'In the production of lime or calcination of dolomite or magnesite, CO<sub>2</sub> emissions result from the following emission sources and source streams';
- (b) in the first paragraph, first indent, the wording is replaced as follows: 'calcination of limestone, dolomite or magnesite in the raw materials';
- (c) under subsection 2.1.1, Combustion Emissions, the wording is replaced as follows: 'Combustion processes involving different types of fuels (e.g. coal, petcoke, fuel oil, natural gas and the broad range of waste fuels) that take place at installations for the production of lime or calcination of dolomite or magnesite shall be monitored and reported in accordance with Annex II.';
- (d) under subsection 2.1.2, Process Emissions, first paragraph, the wording is replaced as follows: 'Relevant emissions occur during calcination and from the oxidation of organic carbon in the raw materials. During calcination in the kiln, CO<sub>2</sub> from carbonates is released from the raw materials. Calcination CO<sub>2</sub> is directly linked with the lime, dolime or magnesia production. On an installation level, calcination CO<sub>2</sub> can be calculated in two ways: based on the amount of calcium and magnesium carbonate from the raw material (mainly limestone, dolomite and magnesite) converted in the process (calculation method A), or based on the amount of calcium and magnesium oxides in the products (calculation method B). The two approaches are considered to be equivalent and can be mutually used by the operator to validate the results of the respective other method';
- (e) under subsection 2.1.2, 'Calculation Method A: Carbonates', the introductory phrase is replaced as follows: 'Calculation shall be based on the amount of calcium carbonate and magnesium carbonate – and where relevant, of other carbonates – in the raw materials consumed. The following formula shall be used:';
- (f) under subsection 2.1.2(b), the following sentence is inserted at the end of the first paragraph: 'Where relevant, carbonate content values shall be adjusted for the respective moisture and gangue content of the applied carbonate material, and take into account other magnesium bearing minerals than carbonates.';
- (g) 'Table 1: Stoichiometric ratios' is replaced by the following:

'Carbonate	Ratio[t CO <sub>2</sub> /t Ca-, Mg- or other Carbonate]	Remarks
CaCO <sub>3</sub>	0,440	
MgCO <sub>3</sub>	0,522	
general: X <sub>Y</sub> (CO <sub>3</sub> ) <sub>Z</sub>	Emission factor = $[M_{CO_2}]/\{Y * [M_x] + Z * [M_{CO_3^{2-}}]\}$	X = alkali earth or alkali metal M <sub>x</sub> = molecular weight of X in [g/mol] M <sub>CO<sub>2</sub></sub> = molecular weight of CO <sub>2</sub> = 44 [g/mol] M <sub>CO<sub>3</sub></sub> = molecular weight of CO <sub>3</sub> <sup>2-</sup> = 60 [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of CO <sub>3</sub> <sup>2-</sup> = 1'

- (h) under subsection 2.1.2, Calculation method B: Alkali Earth Oxides is replaced by the following: 'CO<sub>2</sub> emissions arise from the calcination of carbonates and shall be calculated based on the amounts of CaO and MgO contents in the lime, dolime or magnesia produced. Already calcined Ca and Mg entering the kiln, for instance through fly ash or fuels and raw materials with a relevant CaO or MgO content, as well as other magnesium bearing minerals than carbonates shall be considered appropriately by means of the conversion factor. Kiln dust leaving the kiln system shall be considered appropriately.';

(i) 'Table 2: Stoichiometric ratios' is replaced by the following:

'Oxide	Stoichiometric ratios	Remarks
CaO	0,785 [tonne CO <sub>2</sub> per tonne of oxide]	
MgO	1,092 [tonne CO <sub>2</sub> per tonne of oxide]	
general: X <sub>Y</sub> (O) <sub>Z</sub>	Emission factor = $[M_{CO_2}]/\{Y * [M_X] + Z * [M_O]\}$	X = alkali earth or alkali metal M <sub>X</sub> = molecular weight of X in [g/mol] M <sub>CO<sub>2</sub></sub> = molecular weight of CO <sub>2</sub> = 44 [g/mol] M <sub>O</sub> = molecular weight of O = 16 [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of O = 1'

#### ANNEX IX

Annex IX is amended as follows:

(1) the title of Annex IX is replaced by the following:

**'Activity-specific guidelines for the manufacture of glass or mineral wool insulation material as listed in Annex I to Directive 2003/87/EC';**

(2) Section 2 is amended as following:

(a) the introductory phrase is replaced by the following:

'In the production of glass or mineral wool, CO<sub>2</sub> emissions result from the following emission sources and source streams:';

(b) subsection 2.1.1, is replaced by the following:

##### 2.1.1. COMBUSTION EMISSIONS

Combustion processes that take place in installations for the manufacture of glass or mineral wool shall be monitored and reported in accordance with Annex II. This includes emissions from carbon containing additives (coke and coal dust, organic coatings of glass fibres and mineral wool) and flue gas cleaning (post-combustion).';

(c) the second paragraph of subsection 2.1.2, is replaced by the following:

'CO<sub>2</sub> from carbonates in the raw materials released during melting in the furnace is directly linked with the glass or mineral wool production and shall be calculated based on the converted quantity of carbonates from raw material – mainly soda, lime/limestone, dolomite and other alkali and alkali earth carbonates supplemented by carbonate free recycled glass (cullet).';

## ANNEX X

Annex X is amended as follows:

(1) the title of Annex X is replaced by the following:

**'Activity-specific guidelines for the manufacture of ceramic products as listed in Annex I to Directive 2003/87/EC';**

(2) in the first line of Section 2 the wording 'installations for' is deleted.

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## ANNEX XI

The title of Annex XI is replaced by the following:

**'Activity-specific guidelines for pulp and paper production as listed in Annex I to Directive 2003/87/EC'**

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## ANNEX XII

The title of Annex XII is replaced by the following:

**'Guidelines for determination of emissions or amount of transfer of greenhouse gases by continuous measurement systems'**

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## ANNEX XIII

In Annex XVI, Section 3, subsection 3.1, reference to  $T_{input}$ , after the wording 'Annexes I to XII' the following wording is added: 'and XIX to XXIV.'

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## ANNEX XIV

The following Annex XIX is added:

## 'ANNEX XIX

**Activity-specific guidelines for the production of soda ash and sodium bicarbonate as listed in Annex I to Directive 2003/87/EC**

**1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines in this Annex shall be applied for emissions from installations for the production of soda ash and sodium bicarbonate as listed in Annex I to Directive 2003/87/EC.

**2. DETERMINATION OF CO<sub>2</sub> EMISSIONS**

In installations for the production of soda ash and sodium bicarbonate emission sources and source streams for CO<sub>2</sub> emissions include:

- fuels used for combustion processes, e.g. with the purpose of producing hot water or steam,
- raw materials (e.g. vent gas from calcination of limestone, to the extent it is not used for carbonation),
- waste gases from washing or filtration steps after carbonation, to the extent they are not used for carbonation.

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS**

As soda ash and sodium bicarbonate contain carbon stemming from the process inputs, the calculation of process emissions shall be based on a mass balance approach pursuant to Section 2.1.1. Emissions from the combustion of fuels can either be monitored separately pursuant to Section 2.1.2 or be taken into account in the mass balance approach.

**2.1.1. MASS-BALANCE APPROACH**

The mass-balance approach shall consider all carbon in inputs, stocks, products and other exports from the installation to determine the level of emissions of greenhouse gases over the reporting period, except for emission sources monitored in accordance with Section 2.1.2 of this Annex. The amount of CO<sub>2</sub> used for producing sodium bicarbonate from soda ash shall be considered as emitted. The following equation shall be used:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With:

- *input* [t C]: all carbon entering the boundaries of the installation,
- *products* [t C]: all carbon in products (!) and materials, including by-products, leaving the boundaries of the installation,
- *export* [t C]: carbon exported from the boundaries of the installation in liquid and/or solid phases, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases or carbon monoxide into the atmosphere,
- *stock changes* [t C]: stock increases of carbon within the boundaries of the mass balance.

The calculation shall then be as follows:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\sum (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \sum (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \sum (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \sum (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3,664$$

With:

(a) **activity data**

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the energy content [t C/TJ] of the respective mass flow for the calculation of the mass balance.

*Tier 1*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 7,5\%$ .

*Tier 2*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 5\%$ .

*Tier 3*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

*Tier 4*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

**(b) carbon content***Tier 1*

The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or in other activity-specific Annexes to these Guidelines. The carbon content is derived as follows:

$$\text{C content [t/t or T]} = \text{Emission factor [t CO}_2\text{/t or T]}/3,664 \text{ [t CO}_2\text{/t C]}$$

*Tier 2*

The operator applies country-specific carbon content for the respective fuel or material as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 3*

The carbon content of input or output stream shall be derived following the provisions of Section 13 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

**2.1.2. COMBUSTION EMISSIONS**

Emissions from combustion of fuels shall be monitored and reported in accordance with Annex II, unless they are taken into account in the mass balance under Section 2.1.1.

**2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS**

The measurement guidelines contained in Annexes I and XII shall be applied.

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(<sup>1</sup>) For the purpose of this mass balance all sodium bicarbonate produced from soda ash shall be treated as soda ash.

## ANNEX XV

The following Annex XX is added:

'ANNEX XX

**Activity-specific guidelines for the production of ammonia as listed in Annex I to Directive 2003/87/EC**

**1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines contained in this Annex shall be used to monitor emissions from installations producing ammonia as listed in Annex I to Directive 2003/87/EC.

Ammonia production installations can be part of integrated installations in the chemical or refinery industry causing an intensive energy and material exchange. CO<sub>2</sub> emissions may occur from combustion of fuels as well as from fuels used as process input for the production of ammonia. In a number of ammonia producing installations CO<sub>2</sub> resulting from the production process is captured and used for other production processes, e.g. for the production of urea. Such captured CO<sub>2</sub> shall be accounted for as emitted.

**2. DETERMINATION OF CO<sub>2</sub> EMISSIONS**

In installations for the production of ammonia, CO<sub>2</sub> emissions result from the following emission sources and source streams:

- combustion of fuels supplying the heat for reforming or partial oxidation,
- fuels used as process input in the ammonia production process (reforming or partial oxidation),
- fuels used for other combustion processes, e.g. with the purpose of producing hot water or steam.

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS**

**2.1.1. COMBUSTION EMISSIONS**

Emissions from combustion of fuels not used as process input shall be monitored and reported in accordance with Annex II.

**2.1.2. EMISSIONS FROM FUEL USED AS PROCESS INPUT FOR AMMONIA PRODUCTION**

Emissions from fuel used as process input shall be monitored and reported in accordance with Annex II.

**2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS**

The measurement guidelines contained in Annexes I and XII shall be applied.'

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## ANNEX XVI

The following Annex XXI is added:

## 'ANNEX XXI

**Activity-specific guidelines for the production of hydrogen and synthesis gas as listed in Annex I to Directive 2003/87/EC**

**1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines contained in this Annex shall be used to monitor emissions from installations producing hydrogen or synthesis gas as listed in Annex I to Directive 2003/87/EC. Where hydrogen production is technically integrated in a mineral oil refinery, the operator of such installation shall use the relevant provisions of Annex III instead.

Installations for the production of hydrogen or synthesis gas can be part of integrated installations in the chemical or refinery industry causing an intensive energy and material exchange. CO<sub>2</sub> emissions may occur from combustion of fuels as well as from fuels used as process input.

**2. DETERMINATION OF CO<sub>2</sub> EMISSIONS**

In installations for the production of hydrogen or synthesis gas, CO<sub>2</sub> emissions result from the following emission sources and source streams:

- fuels used in the hydrogen or synthesis gas production process (reforming or partial oxidation),
- fuels used for other combustion processes, e.g. with the purpose of producing hot water or steam.

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS**

**2.1.1. COMBUSTION EMISSIONS**

Emissions from combustion of fuels not used as process input for the production of hydrogen or synthesis gas production, but for other combustion processes shall be monitored and reported in accordance with Annex II.

**2.1.2. EMISSIONS FROM FUEL USED AS PROCESS INPUT**

Emissions from fuels used as process input in hydrogen production shall be calculated using the input-related methodology laid down under Section 2.1.2.1. For synthesis gas production a mass balance as under Section 2.1.2.2 shall be used. Where hydrogen and synthesis gas are produced at the same installation, the operator may choose to calculate the respective emissions from both production processes using one mass balance according to Section 2.1.2.2.

**2.1.2.1. HYDROGEN PRODUCTION**

Emissions from fuel used as process input shall be calculated using the formula

$$\text{CO}_2 \text{ emissions} = \text{activity data} * \text{emission factor}$$

where

- activity data is expressed as the net energy content of the fuel used as process input [TJ] or, when a mass or volume related emission factor is used, as the amount of fuel used as process input [t or Nm<sup>3</sup>],
- emission factor is expressed as tonnes CO<sub>2</sub>/TJ or as tonnes CO<sub>2</sub>/t or as tonnes CO<sub>2</sub>/Nm<sup>3</sup> of fuel used as process input.

The following tier requirements shall be applied:

**(a) Activity data**

Activity data are generally expressed as the net energy content of the fuel used [TJ] during the reporting period. The energy content of the fuel used shall be calculated by means of the following formula:

$$\text{Energy content of fuel used [TJ]} = \text{fuel used [t or Nm}^3\text{]} * \text{net calorific value of fuel [TJ/t or TJ/Nm}^3\text{]}$$

In case a mass or volume related emission factor [ $\text{t CO}_2/\text{t}$  or  $\text{t CO}_2/\text{Nm}^3$ ] is used, activity data are expressed as the amount of fuel used [ $\text{t}$  or  $\text{Nm}^3$ ].

With:

(a1) **Fuel used**

*Tier 1*

Amount of fuel used as process input [ $\text{t}$  or  $\text{Nm}^3$ ] processed during the reporting period, derived with a maximum uncertainty of  $\pm 7,5\%$ .

*Tier 2*

Amount of fuel used as process input [ $\text{t}$  or  $\text{Nm}^3$ ] processed during the reporting period, derived with a maximum uncertainty of  $\pm 5,0\%$ .

*Tier 3*

Amount of fuel used as process input [ $\text{t}$  or  $\text{Nm}^3$ ] processed during the reporting period, derived with a maximum uncertainty of  $\pm 2,5\%$ .

*Tier 4*

Amount of fuel used as process input [ $\text{t}$  or  $\text{Nm}^3$ ] processed during the reporting period, derived with a maximum uncertainty of  $\pm 1,5\%$ .

(a2) **Net calorific value**

*Tier 1*

Reference values for each fuel are used as specified in Section 11 of Annex I.

*Tier 2a*

The operator applies country-specific net calorific values for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 2b*

For commercially traded fuels the net calorific value as derived from the purchasing records for the respective fuel provided by the fuel supplier is used, provided it has been derived based on accepted national or international standards.

*Tier 3*

The net calorific value representative for the fuel in an installation is measured by the operator, a contracted laboratory or the fuel supplier in accordance with the provisions of Section 13 of Annex I.

(b) **Emission factor**

*Tier 1*

The reference values listed in Section 11 of Annex I to these guidelines are used.

*Tier 2a*

The operator applies country specific emission factors for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 2b*

The operator derives emission factors for the fuel based on one of the following established proxies:

- density measurement of specific oils or gases common e.g. to the refinery or steel industry, and
- net calorific value for specific coal types,

in combination with an empirical correlation as determined at least once per year according to the provisions of Section 13 of Annex I. The operator shall ensure that the correlation satisfies the requirements of good engineering practice and that it is applied only to values of the proxy which fall into the range for which it was established.

*Tier 3*

Use of an activity-specific emission factor [ $\text{CO}_2/\text{T}$ ] or  $\text{CO}_2/\text{t}$  or  $\text{CO}_2/\text{Nm}^3$  feed] calculated from the carbon content of the fuel used, determined according to Section 13 of Annex I.

## 2.1.2.2. PRODUCTION OF SYNTHESIS GAS

As part of the carbon in the fuels used as process input is contained in the produced synthesis gas, a mass balance approach is to be used for the calculation of greenhouse gas emissions.

The mass-balance approach shall consider all carbon in inputs, stocks, products and other exports from the installation to determine the level of emissions of greenhouse gases over the reporting period, except for emission sources monitored in accordance with Section 2.1.1 and 2.1.2.1 of this Annex. The following equation shall be used:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2/\text{C}$$

With:

- *input* [t C]: all carbon entering the boundaries of the installation,
- *products* [t C]: all carbon in products and materials, including by-products, leaving the boundaries of the installation,
- *export* [t C]: carbon exported from the boundaries of the installation, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases or carbon monoxide into the atmosphere,
- *stock changes* [t C]: stock increases of carbon within the boundaries of the mass balance.

The calculation shall then be as follows:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\sum (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \sum (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \sum (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \sum (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3,664$$

With:

(a) **activity data**

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the energy content [t C/T] of the respective mass flow for the calculation of the mass balance.

*Tier 1*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 7,5\%$ .

*Tier 2*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 5\%$ .

*Tier 3*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

*Tier 4*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

(b) **carbon content**

*Tier 1*

The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or in other activity-specific Annexes to these Guidelines. The carbon content is derived as follows:

$$\text{C content [t/t or T]} = \text{Emission factor [t CO}_2\text{/t or T]} / 3,664 \text{ [t CO}_2\text{/t C]}$$

*Tier 2*

The operator applies country-specific carbon contents for the respective fuel or material as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 3*

The carbon content of input or output stream shall be derived following the provisions of Section 13 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS

The measurement guidelines contained in Annexes I and XII shall be applied.'

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## ANNEX XVII

The following Annex XXII is added:

## 'ANNEX XXII

**Activity-specific guidelines for the production of bulk organic chemicals as listed in Annex I to Directive 2003/87/EC****1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines contained in this Annex shall be used to monitor emissions from the production of bulk organic chemicals as listed in Annex I to Directive 2003/87/EC. Where such production is technically integrated in a mineral oil refinery, the operator of such installation shall use the relevant provisions of Annex III instead, especially for emissions from catalytic crackers.

Installations for the production of bulk organic chemicals can be part of integrated installations in the chemical or refinery industry causing an intensive energy and material exchange. CO<sub>2</sub> emissions may occur from combustion of fuels as well as from fuels or materials used as process input.

**2. DETERMINATION OF CO<sub>2</sub> EMISSIONS**

Potential emission sources for CO<sub>2</sub> include fuels and input materials of the following processes:

- cracking (catalytic and non-catalytic),
- reforming,
- partial or full oxidation,
- similar processes which lead to CO<sub>2</sub> emissions from carbon contained in hydrocarbon-based feedstock,
- combustion of waste gases and flaring,
- other combustion of fuel for supply of heat to the abovementioned processes.

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS**

In case of combustion processes where the fuels used do not take part in or stem from chemical reactions for the production of bulk organic chemicals, e.g. for generating process heat or electricity, the emissions shall be monitored and reported pursuant to Section 2.1.1. In all other cases the emissions from bulk organic chemicals production shall be calculated using a mass-balance approach laid down in Section 2.1.2. All CO in the flue gas shall be accounted for as CO<sub>2</sub>. Based on the approval of the competent authority, an input-based approach such as presented in Annex II, taking into account industry best practice can be used instead of a mass-balance approach if the operator can show that this is more cost-efficient and leads to a comparable accuracy level.

**2.1.1. COMBUSTION EMISSIONS**

Emissions from combustion processes shall be monitored and reported in accordance with Annex II. If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated using the mass balance pursuant to Section 2.1.2, they shall be calculated in accordance with Annex II.

**2.1.2. MASS-BALANCE APPROACH**

The mass-balance approach shall consider all carbon in inputs, stocks, products and other exports from the installation to account for the emissions of greenhouse gases, except for emission sources monitored in accordance with Section 2.1.1 of this Annex. The following equation shall be used:

$$\text{Emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With:

- *input [t C]*: all carbon entering the boundaries of the installation,
- *products [t C]*: all carbon in products and materials, including by-products, leaving the boundaries of the installation,



- *export [t C]*: carbon exported from the boundaries of the installation, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases or carbon monoxide into the atmosphere,
- *stock changes [t C]*: stock increases of carbon within the boundaries of the installation.

The calculation shall then be as follows:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\Sigma (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \Sigma (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \Sigma (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \Sigma (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3,664$$

With:

(a) **Activity data**

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the energy content [t C/TJ] of the respective mass flow for the calculation of the mass balance.

*Tier 1*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 7,5\%$ .

*Tier 2*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 5,0\%$ .

*Tier 3*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

*Tier 4*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

(b) **carbon content**

*Tier 1*

The carbon content of input or output streams shall be derived from reference emission factors for fuels or materials listed in Section 11 of Annex I, in the Table below or in other activity-specific Annexes to these Guidelines. The carbon content is derived as follows:

$$\text{C content [t/t or T]} = \text{Emission factor [t CO}_2\text{/t or T]}/3,664 \text{ [t CO}_2\text{/t C]}$$

For substances not listed in Section 11 of Annex I or in other activity-specific Annexes to these Guidelines, operators may calculate the carbon content from the stoichiometric carbon content in the pure substance and the concentration of the substance in the input or output stream.

Table

**Reference Emission Factors <sup>(1)</sup>**

Substance	Carbon content (t C/t feedstock or t C/t product)
Acetonitril	0,5852 t C/t
Acrylonitrile	0,6664 t C/t
Butadiene	0,888 t C/t
Carbon Black	0,97 t C/t
Ethylene	0,856 t C/t

Substance	Carbon content (t C/t feedstock or t C/t product)
Ethylene dichloride	0,245 t C/t
Ethylene glycol	0,387 t C/t
Ethylene oxide	0,545 t C/t
Hydrogen cyanide	0,4444 t C/t
Methanol	0,375 t C/t
Methane	0,749 t C/t
Propane	0,817 t C/t
Propylene	0,8563 t C/t
Vinyl chloride monomer	0,384 t C/t

(<sup>1</sup>) See IPCC 2006 Guidelines for National Greenhouse Gas Inventories.

#### *Tier 2*

The operator applies country-specific carbon content for the respective fuel or material as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

#### *Tier 3*

The carbon content of input or output stream shall be derived following the provisions of Section 13 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

## 2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS

The measurement guidelines contained in Annexes I and XII shall be applied.'

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## ANNEX XVIII

The following Annex XXIII is added:

## 'ANNEX XXIII

**Activity-specific guidelines for the production or processing of ferrous and non-ferrous metals as listed in Annex I to Directive 2003/87/EC**

**1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines in this Annex shall be applied for emissions from the production or processing of ferrous and non-ferrous metals as listed in Annex I to Directive 2003/87/EC except for production of pig iron and steel and primary aluminium.

**2. DETERMINATION OF CO<sub>2</sub> EMISSIONS**

In installations for the production or processing of ferrous and non-ferrous metals emission sources and source streams for CO<sub>2</sub> emissions include:

- conventional fuels (e.g. natural gas, coal and coke, or fuel oil),
- other fuels (plastics, e.g. from recycling of batteries, or granulated (organic) material from post shredder plants),
- reducing agents (e.g. coke or graphite electrodes),
- raw materials (e.g. calcination of limestone, dolomite, and carbon containing metal ores and concentrates),
- secondary feed materials (e.g. organic materials contained in scrap).

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS**

In installations where carbon stemming from fuels or input materials used at this installation remains in the products or other outputs of the production, e.g. for the reduction of metal ores, a mass balance approach shall be applied (see Section 2.1.1). In installations where this is not the case combustion emissions and process emissions shall be calculated separately (see Sections 2.1.2 and 2.1.3).

**2.1.1. MASS-BALANCE APPROACH**

The mass-balance approach shall consider all carbon in inputs, stocks, products and other exports from the installation to determine the level of emissions of greenhouse gases over the reporting period, using the following equation:

$$\text{Emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With:

- *input* [t C]: all carbon entering the boundaries of the installation,
- *products* [t C]: all carbon in products and materials, including by-products, leaving the boundaries of the installation,
- *export* [t C]: carbon exported from the boundaries of the installation, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases or carbon monoxide into the atmosphere,
- *stock changes* [t C]: stock increases of carbon within the boundaries of the mass balance.

The calculation shall then be as follows:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\sum (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \sum (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \sum (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \sum (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3,664$$

With:

(a) **activity data**

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the energy content [t C/T] of the respective mass flow for the calculation of the mass balance.

*Tier 1*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 7,5\%$ .

*Tier 2*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 5\%$ .

*Tier 3*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

*Tier 4*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

(b) **carbon content**

*Tier 1*

The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or in other activity-specific Annexes to these Guidelines. The carbon content is derived as follows:

$$\text{C content [t/t or T]} = \text{Emission factor [t CO}_2\text{/t or T]} / 3,664 \text{ [t CO}_2\text{/t C]}$$

*Tier 2*

The operator applies country-specific carbon content for the respective fuel or material as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 3*

The carbon content of input or output stream shall be derived following the provisions of Section 13 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

### 2.1.2. COMBUSTION EMISSIONS

Emissions from combustion processes taking place at installations for the production or processing of ferrous and non-ferrous metals that are not monitored using a mass balance approach, shall be monitored and reported in accordance with Annex II.

### 2.1.3. PROCESS EMISSIONS

For each type of input material used the amount of CO<sub>2</sub> shall be calculated as follows:

$$\text{CO}_2 \text{ emissions} = \sum \text{activity data}_{\text{process input}} * \text{emission factor} * \text{conversion factor}$$

With:

(a) **activity data**

*Tier 1*

Amounts [t] of input material and process residues used as input material in the process not reported under Section 2.1.2 of this Annex over the reporting period are determined with a maximum uncertainty of less than  $\pm 5,0\%$ .

*Tier 2*

Amounts [t] of input material and process residues used as input material in the process not reported under Section 2.1.2 of this Annex over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

(b) **emission factor**

Tier 1

For carbonates, use of stoichiometric ratios given in the following Table:

Table

**Stoichiometric emission factors**

Carbonate	Ratio [t CO <sub>2</sub> /t Ca-, Mg- or other Carbonate]	Remarks
CaCO <sub>3</sub>	0,440	
MgCO <sub>3</sub>	0,522	
general: X <sub>Y</sub> (CO <sub>3</sub> ) <sub>Z</sub>	Emission factor = $\frac{[M_{CO_2}]}{\{Y * [M_x] + Z * [M_{CO_3^{2-}}]\}}$	X = metal M <sub>x</sub> = molecular weight of X in [g/mol] M <sub>CO<sub>2</sub></sub> = molecular weight of CO <sub>2</sub> in [g/mol] M <sub>CO<sub>3</sub></sub> = molecular weight of CO <sub>3</sub> <sup>2-</sup> in [g/mol] Y = stoichiometric number of X Z = stoichiometric number of CO <sub>3</sub> <sup>2-</sup>

These values shall be adjusted for the respective moisture and gangue content of the applied carbonate material.

For process residues and other input materials than carbonates not reported under Section 2.1.2 of this Annex, activity-specific factors shall be determined according to the provisions of Section 13 of Annex I.

(c) **conversion factor**

Tier 1

Conversion factor: 1,0.

Tier 2

Activity-specific factors determined according to the provisions of Section 13 of Annex I, determining the amount of carbon in the sinter, slag or other relevant output as well as in filtered dust. In case filtered dust is re-employed in the process, the amount of carbon [t] contained shall not be accounted for in order to avoid double counting.

2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS

The measurement guidelines contained in Annexes I and XII shall be applied.'

## ANNEX XIX

The following Annex XXIV is added:

## 'ANNEX XXIV

**Activity-specific guidelines for the production or processing of primary aluminium as listed in Annex I to Directive 2003/87/EC****1. BOUNDARIES AND COMPLETENESS**

The activity-specific guidelines in this Annex shall be applied for emissions from installations for the production or processing of primary aluminium as listed in Annex I to Directive 2003/87/EC.

This Annex includes guidelines for monitoring emissions from the production of electrodes for primary aluminium smelting, which is also applicable for stand-alone plants for the production of such electrodes.

**2. DETERMINATION OF GREENHOUSE GAS EMISSIONS**

In installations for the production or processing of primary aluminium emission sources and source streams for greenhouse gas emissions include:

- fuels for the production of heat or steam,
- anode production (CO<sub>2</sub>),
- reduction of Al<sub>2</sub>O<sub>3</sub> during electrolysis (CO<sub>2</sub>) which is related to electrode consumption,
- use of soda ash or other carbonates for waste gas scrubbing (CO<sub>2</sub>),
- anode effects (PFCs) including fugitive emissions of PFCs.

**2.1. CALCULATION OF CO<sub>2</sub> EMISSIONS****2.1.1. COMBUSTION EMISSIONS**

Emissions from combustion of fuels, including flue gas scrubbing, shall be monitored and reported in accordance with Annex II, unless they are included in a mass balance pursuant to Section 2.1.2.

**2.1.2. MASS BALANCE**

Process emissions from anode production and consumption shall be calculated by using a mass-balance approach. The mass-balance approach shall consider all carbon in inputs, stocks, products and other exports from the mixing, forming, baking and recycling of anodes as well as from the electrode consumption in electrolysis. Where pre-baked anodes are used, either separate mass balances for production and consumption may be applied, or one common mass balance taking into account both production and consumption of electrodes. In the case of Søderberg cells, the operator shall use one common mass balance. The mass balance shall determine the level of emissions of greenhouse gases over the reporting period, using the following equation independently of whether a common mass balance or separate mass balances are used:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With:

- input [t C]: all carbon entering the boundaries of the mass balance, e.g. pitch, coke, packing coke or purchased anodes,
- products [t C]: all carbon in products and materials, including by-products and waste, leaving the boundaries of the mass balance, e.g. sold anodes,
- export [t C]: carbon exported from the boundaries of the mass balance, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases into the atmosphere,
- stock changes [t C]: stock increases of carbon within the boundaries of the mass balance.

The calculation shall then be as follows:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = (\sum (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \sum (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \sum (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \sum (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3,664$$

With:

(a) **activity data**

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials (e.g. pitch, coke or packing coke) separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the energy content [t C/TJ] of the respective mass flow for the calculation of the mass balance.

*Tier 1*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 7,5 \%$ .

*Tier 2*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 5 \%$ .

*Tier 3*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 2,5 \%$ .

*Tier 4*

Activity data over the reporting period are determined with a maximum uncertainty of less than  $\pm 1,5 \%$ .

(b) **carbon content**

*Tier 1*

The carbon content of input or output streams is derived from reference emission factors for fuels or materials named in Section 11 of Annex I or in other activity-specific Annexes to these Guidelines. The carbon content is derived as follows:

$$\text{C content [t/t or TJ]} = \text{Emission factor [t CO}_2\text{/t or TJ]} / 3,664 \text{ [t CO}_2\text{/t C]}$$

*Tier 2*

The operator applies country-specific carbon content for the respective fuel or material as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

*Tier 3*

The carbon content of input or output stream shall be derived following the provisions of Section 13 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

The carbon content can be derived from direct analysis as well as from indirect analysis, i.e. by subtracting the measured content of known constituents (such as sulphur, hydrogen and ash) from the total amount, as appropriate and subject to the approval of the competent authority.

## 2.2. MEASUREMENT OF CO<sub>2</sub> EMISSIONS

The measurement guidelines contained in Annexes I and XII shall be applied.

## 3. DETERMINATION OF PFC EMISSIONS

PFC-Emissions from primary aluminium production shall include CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> emissions expressed as CO<sub>2</sub>-equivalents:

$$\text{PFC emissions [t CO}_2\text{(e)]} = \text{CF}_4\text{-emissions [t CO}_2\text{(e)]} + \text{C}_2\text{F}_6\text{-emissions [t CO}_2\text{(e)]}$$

Carbon dioxide equivalents (t CO<sub>2(e)</sub>) shall be calculated using Global Warming Potential values provided in the Intergovernmental Panel on Climate Change's Second Assessment Report (1995 IPCC GWP value). These are:

$$\text{GWP}_{\text{CF}_4} = 6\,500 \text{ t CO}_{2(e)}/\text{t CF}_4$$

$$\text{GWP}_{\text{C}_2\text{F}_6} = 9\,200 \text{ t CO}_{2(e)}/\text{t C}_2\text{F}_6$$

Total PFC emissions are calculated from the emissions which are measurable in a duct or stack (point source emissions) plus the fugitive emissions using the collection efficiency of the duct:

$$\text{PFC emissions (total)} = \text{PFC emissions (duct)}/\text{collection efficiency}$$

The collection efficiency is measured when the installation specific emission factors are determined. For its determination the most recent version of the guidance mentioned under Tier 3 of Section 4.4.2.4 of the 2006 IPCC Guidelines shall be used.

Emissions of CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> emitted through a duct or stack shall be calculated by one of the following two approaches, depending on the control technologies used. Calculation method A is used where the anode effect minutes per cell-day are recorded, calculation method B shall be used where the anode effect overvoltage is recorded.

#### Calculation Method A – Slope Method

Where the anode effect minutes per cell-day are measured, the following equations shall be used for determining PFC emissions:

$$\text{CF}_4 \text{ emissions [t CO}_{2(e)}] = \text{AEM} \times (\text{SEF}_{\text{CF}_4}/1\,000) \times \text{Pr}_{\text{Al}} \times \text{GWP}_{\text{CF}_4}$$

$$\text{C}_2\text{F}_6\text{-emissions [t CO}_{2(e)}] = \text{CF}_4 \text{ emissions} \times \text{F}_{\text{C}_2\text{F}_6} \times \text{GWP}_{\text{C}_2\text{F}_6}$$

With:

AEM ... Anode effect minutes/cell-day

SEF<sub>CF<sub>4</sub></sub> ... (l) Slope emission factor [(kg CF<sub>4</sub>/t Al produced)/(anode effect minutes/cell-day)]

Pr<sub>Al</sub> ... Annual production of primary Aluminium [t]

F<sub>C<sub>2</sub>F<sub>6</sub></sub> ... Weight fraction of C<sub>2</sub>F<sub>6</sub> (t C<sub>2</sub>F<sub>6</sub>/t CF<sub>4</sub>)

With

#### Activity data

##### (a) Primary Aluminium production

###### Tier 1

The primary aluminium production over the reporting period is determined with a maximum uncertainty of less than ± 2,5 %.

###### Tier 2

The primary aluminium production over the reporting period is determined with a maximum uncertainty of less than ± 1,5 %.

##### (b) Anode effect minutes (AEM)

The Anode effect minutes per cell-day expresses the frequency of anode effects [number of anode effects/cell-day] multiplied by the average duration of anode effects [anode effect minutes/occurrence]:

$$\text{AEM} = \text{frequency} \times \text{average duration}$$

###### Tier 1

Frequency and average duration of anode effects over the reporting period are determined with a maximum uncertainty of less than ± 2,5 %.

###### Tier 2

Frequency and average duration of anode effects over the reporting period are determined with a maximum uncertainty of less than ± 1,5 %.



**Emission factor**

The emission factor for CF<sub>4</sub> (slope emission factor SEF<sub>CF<sub>4</sub></sub>) expresses the amount [kg] of CF<sub>4</sub> emitted per ton of aluminium produced per anode effect minute/cell-day. The emission factor (weight fraction F<sub>C<sub>2</sub>F<sub>6</sub></sub>) of C<sub>2</sub>F<sub>6</sub> expresses the amount [t] of C<sub>2</sub>F<sub>6</sub> emitted as proportionate to the amount [t] of CF<sub>4</sub> emitted.

*Tier 1*

Technology specific emission factors from Table 1 are used.

Table 1

**Technology specific emission factors related to the slope method**

Technology	Emission Factor for CF <sub>4</sub> (SEF <sub>CF<sub>4</sub></sub> ) [(kg CF <sub>4</sub> /t Al)/(AE-Minutes/cell-day)]	Emission Factor for C <sub>2</sub> F <sub>6</sub> (F <sub>C<sub>2</sub>F<sub>6</sub></sub> ) [t C <sub>2</sub> F <sub>6</sub> /t CF <sub>4</sub> ]
Centre Worked Prebake (CWPB)	0,143	0,121
Vertical Stud Søderberg (VSS)	0,092	0,053

*Tier 2*

Installation-specific emission factors for CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> established through continuous or intermittent field measurements are used. For the determination of these emission factors the most recent version of the guidance mentioned under Tier 3 of Section 4.4.2.4 of the 2006 IPCC Guidelines<sup>(2)</sup> shall be used. The emission factors are to be determined with a maximum uncertainty of ± 15 % each.

The emission factors shall be established at least every 3 years or earlier if necessary due to relevant changes at the installation. Relevant changes include a change in the distribution of anode effect duration, or a change in the control algorithm affecting the mix of types of anode effects or the nature of the anode effect termination routine.

**Calculation Method B – Overvoltage Method**

Where the anode effect overvoltage is measured, the following equations shall be used for determining PFC emissions:

$$\text{CF}_4 \text{ emissions [t CO}_2\text{(e)]} = \text{OVC} \times (\text{AEO/CE}) \times \text{Pr}_{\text{Al}} \times \text{GWP}_{\text{CF}_4} \times 0,001$$

$$\text{C}_2\text{F}_6 \text{ emissions [t CO}_2\text{-eq]} = \text{CF}_4 \text{ emissions} \times \text{F}_{\text{C}_2\text{F}_6} \times \text{GWP}_{\text{C}_2\text{F}_6}$$

with

OVC ... Overvoltage coefficient ('emission factor') expressed as kg CF<sub>4</sub> per tonne aluminium produced per mV overvoltage

AEO ... Anode effect overvoltage per cell [mV] determined as the integral of (time × voltage above the target voltage) divided by the time (duration) of data collection

CE ... average current efficiency of aluminium production [%]

Pr<sub>Al</sub> ... Annual production of primary Aluminium [t]

F<sub>C<sub>2</sub>F<sub>6</sub></sub> ... Weight fraction of C<sub>2</sub>F<sub>6</sub> (t C<sub>2</sub>F<sub>6</sub>/t CF<sub>4</sub>)

**Activity data****(a) Primary Aluminium Production***Tier 1*

The primary aluminium production over the reporting period is determined with a maximum uncertainty of less than ± 2,5 %.

*Tier 2*

The primary aluminium production over the reporting period is determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

**(b) Anode effect overvoltage**

The term AEO/CE (Anode effect overvoltage/current efficiency) expresses the time-integrated average anode effect overvoltage [mV overvoltage] per average current efficiency [%].

*Tier 1*

Anode effect overvoltage as well as current efficiency over the reporting period are each determined with a maximum uncertainty of less than  $\pm 2,5\%$ .

*Tier 2*

Anode effect overvoltage as well as current efficiency over the reporting period are each determined with a maximum uncertainty of less than  $\pm 1,5\%$ .

**Emission factor**

The emission factor for  $\text{CF}_4$  ('overvoltage coefficient' OVC) expresses the amount [kg] of  $\text{CF}_4$  emitted per t aluminium produced per millivolt overvoltage [mV]. The emission factor of  $\text{C}_2\text{F}_6$  (weight fraction  $F_{\text{C}_2\text{F}_6}$ ) expresses the amount [t] of  $\text{C}_2\text{F}_6$  emitted as proportionate to the amount [t] of  $\text{CF}_4$  emitted.

*Tier 1*

Technology specific emission factors as laid down under Table 2 are used:

Table 2

**Technology specific emission factors related to overvoltage activity data**

Technology	Emission Factor for $\text{CF}_4$ [(kg $\text{CF}_4$ /t Al)/mV]	Emission Factor for $\text{C}_2\text{F}_6$ [t $\text{C}_2\text{F}_6$ /t $\text{CF}_4$ ]
Centre Worked Prebake (CWPB)	1,16	0,121
Vertical Stud Søderberg (VSS)	N.A.	0,053

*Tier 2*

Installation-specific emission factors for  $\text{CF}_4$  [(kg  $\text{CF}_4$ /t Al)/mV] and  $\text{C}_2\text{F}_6$  [t  $\text{C}_2\text{F}_6$ /t  $\text{CF}_4$ ] established through continuous or intermittent field measurements are used. For the determination of these emission factors the most recent version of the guidance mentioned under Tier 3 of Section 4.4.2.4 of the 2006 IPCC Guidelines<sup>(2)</sup> shall be used. The emission factors are to be determined with a maximum uncertainty of  $\pm 15\%$  each.

The emission factors shall be established at least every 3 years or earlier if necessary due to relevant changes at the installation. Relevant changes include a change in the distribution of anode effect duration or a change in the control algorithm affecting the mix of types of anode effects or the nature of the anode effect termination routine.

<sup>(1)</sup> Where different cell-types are used, different SEFs can be applied.

<sup>(2)</sup> International Aluminium Institute; The Aluminium Sector Greenhouse Gas Protocol; October 2006; US Environmental Protection Agency and International Aluminium Institute; Protocol for Measurement of Tetrafluoromethane ( $\text{CF}_4$ ) and Hexafluoroethane ( $\text{C}_2\text{F}_6$ ) Emissions from Primary Aluminium Production; April 2008.'