EUROPEAN COMMISSION
DIRECTORATE-GENERAL
CLIMATE ACTION
Directorate C – Climate Strategy, Governance and Emissions from non-trading sectors
Unit C.2 – Governance and Effort Sharing

User Manual

The Monitoring and Reporting Regulation – Annual Emissions Report Template

24 April 2017

This document is part of the suite of guidance documents provided by the Commission services for supporting the implementation of Commission Regulation (EU) No. 601/2012 on the monitoring and reporting of greenhouse gas emissions and Commission Regulation (EU) 600/2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council[1] of 21 June 2012.

The guidance represents the views of the Commission services at the time of publication. It is not legally binding.

All guidance documents and templates can be downloaded from the Commission's website at the following address: **http://ec.europa.eu/clima/policies/ets/monitoring/documentation_en.htm**.

[1] **http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012R0601-20140730&qid=1480592359932&from=DE**

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1 INTRODUCTION

This document provides further guidance for the completion of the Commission's annual emission report (AER) template for stationary installations published on DG CLIMA's website[2]:

http://ec.europa.eu/clima/policies/ets/monitoring/documentation_en.htm

The AER template itself already contains extensive guidance for the operator. The term guidance here is to be understood not only as guidance text but also as guidance tools such as conditional formatting and automatic display of the relevant sections depending on entries made in previous sections.

The aim of this document is therefore not to duplicate the guidance provided in the AER template. Instead, it should support the guidance with specific examples and screenshots related to how the sections in the template should be completed for different types of installations, monitoring methodologies, source streams, etc.

Please note that Member States may have published Member State-specific versions of the AER template for operators to use. Besides translation of the guidance text these templates may also deviate in other sections from the Commission's template. However, in most cases the differences should not be significant. Therefore, most of the guidance provided in this document should also be applicable for the AER template in Member States that are using a template based on the Commission's. It should be noted though, that the AER template may be of a completely different design in Member States that are using their own dedicated IT system for EU ETS reporting purposes. In those cases this document may still prove useful. Nevertheless please use any guidance provided by the Member State as the starting point for completing the AER.

[2] http://ec.europa.eu/clima/policies/ets/monitoring/documentation_en.htm

2 INTRODUCTION TO THE EXAMPLES

Throughout this document, guidance on how to appropriately complete sections of the AER template is supported by screenshots showing entries for the following specific examples:

Example A - Liquid fuel

This installation is combusting heavy fuel oil for the production of electricity and district heating. The annual consumption of heavy fuel oil during the example reporting year amounted to 252,000 t determined by aggregation of metering of quantities and taking into account stock changes. The EF and NCV are determined in accordance with tier 3 by sampling and analysis.

Example B – Process emissions in the ceramic sector

The example source stream is clay from which process emissions arise during the process. The source stream is part of an installation with low emissions (Article 47 MRR) producing bricks. The installation uses 121,000 t of clay during the example reporting year, determined by aggregation of metering of quantities and taking into account stock changes. For the EF the tier 1 default value is used in accordance with method A in Annex IV MRR.

Example C – Mass balance in the chemical industry

The example source stream is formaldehyde, the installation's main product. The installation itself is a category B installation covered by the Annex I activity bulk organic chemicals producing formaldehyde from methanol by a partial oxidation reaction. In accordance with Annex IV MRR, the installation applies a mass balance for the emissions arising from the chemical reaction. The installation produced 71,000 t of formaldehyde from which only 68,000 t were sold on the market. The EF and NCV are determined in accordance with tier 3 by sampling and analysis.

Example D – Nitric acid production

The example installation is producing nitric acid. The N_2O emissions arising from the chemical reaction are monitored by a measurement-based methodology, i.e. continuous emissions measurement system (CEMS). The flue-gas flow is 265,000 Nm³/h and the measurement by this CEMS only occurred for 4 hours during the year.

Example E – Transferred CO_2 (CCS)

The example installation is a coal-fired power plant which is capturing part of the CO_2 stemming from the combustion. The captured CO_2 is transferred in accordance with Article 49 MRR to another EU ETS installation carrying out the Annex I activity transport of greenhouse gases by pipelines for geological storage. Based on a measurement-based monitoring (CEMS) of the transfer the annual emissions are determined to amount to 455,000 t of CO_2.

Example F – PFC emissions from primary aluminium production

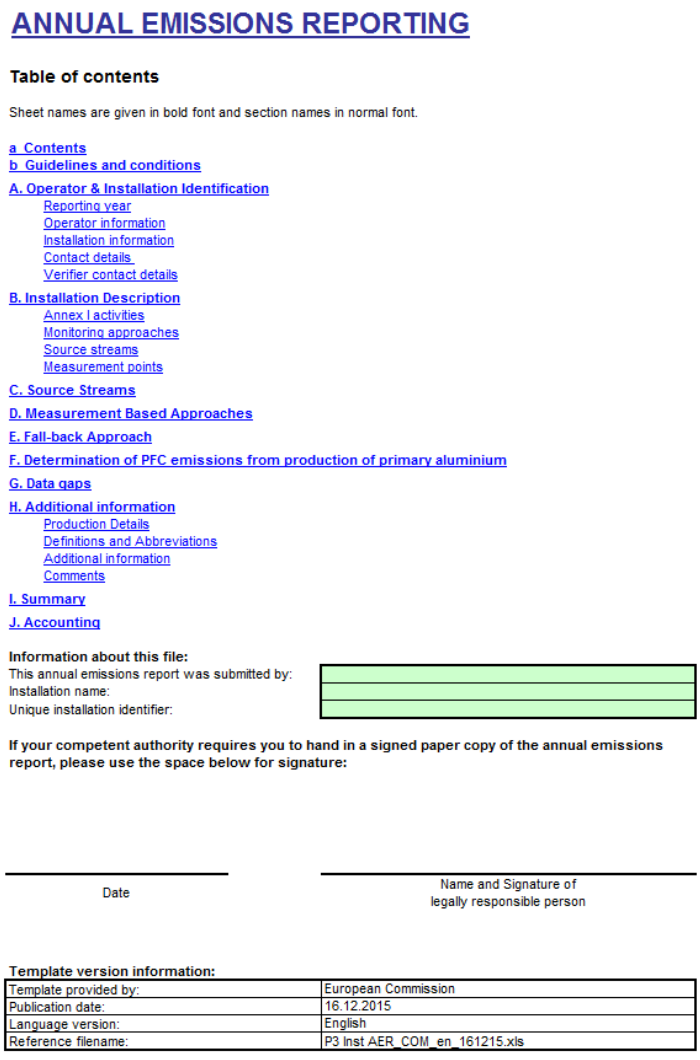
The example source stream is related to the PFC emissions stemming from the use of anodes during the primary aluminium production. The operator uses centre worked pre-bake (CWPB) anodes and applies the slope method in accordance with Annex IV MRR. During the example reporting year the installation consumed 5,000 t of CWPB anodes and determined installation-specific emission factors.

3 GUIDANCE FOR THE AER TEMPLATE

3.1 Sheet a: Contents

This sheet contains a table of contents with hyperlinks to the sheets and sections of the AER template. In addition, it displays the name of the operator and the installation as well as the unique ID. Furthermore, the version number of the template is displayed, including the following information:

- Template provided by: This is either the European Commission or the name of the Member State in case a Member State-specific version has been published
- Publication date: This is usually a reference date of e.g. endorsement, publication, etc. This allows checking whether the latest version is being used.
- Language version: This indicates the language used in the template
- Reference filename: This is a generic filename consisting of the following parts 1) “P3 Inst AER_” 2) who the template is provided by (see above, e.g. “COM” for Commission), 3) the language (e.g. “en” for English) and 4) the publication date above.



ANNUAL EMISSIONS REPORTING

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Information about this file:
This annual emissions report was submitted by:
Installation name:
Unique installation identifier:

If your competent authority requires you to hand in a signed paper copy of the annual emissions report, please use the space below for signature:

Date

Name and Signature of legally responsible person

Template version information:

Template provided by:	European Commission
Publication date:	16.12.2015
Language version:	English
Reference filename:	P3 Inst AER_COM_en_161215.xls

3.2 Sheet b: General guidelines and conditions

Please carefully read the guidance provided on this page of the AER template before you proceed. It contains all the relevant background information on the template including guidance on how the template functions (e.g. colour coding and which Excel functions to be used).

Colour codes and fonts:

Black bold text:	This is text provided by the Commission template. It should be kept as it is.
Smaller italic text:	This text gives further explanations. Member States may add further explanations in MS specific versions of the template.
	Light yellow fields indicate input fields.
	Green fields show automatically calculated results. Red text indicates error messages (missing data etc.).
	Shaded fields indicate that an input in another field makes the input here irrelevant.
	Grey shaded areas should be filled by Member States before publishing customized version of the template.

3.3 Sheet A: Operator & installation identification

This sheet requires entry of general information related to the report, the operator and installation. This is the sheet where Member States usually make the biggest changes compared to the AER template provided by the Commission to accommodate further reporting requirements related to administrative information (e.g. further IDs, information on legal entity etc.). This sheet comprises the following sections:

- Reporting Year: This is the year to which the report relates and corresponding emissions occurred. For instance, when reporting in March 2017 for the emissions in 2016, the year “2016” needs to be entered here.
- About the operator
- About your installation and the monitoring plan
- Contact details
- Verifier details

3.4 Sheet B: Installation description

3.4.1 Section 6: Activities pursuant to Annex I of the EU ETS Directive

In this section the operator has to provide the following information:

- Each activity listed in Annex I of the EU ETS that is carried out in the installation. Please make sure that the installation boundaries are correct. For further information please consult the relevant sections of the Commission's Guidance on Interpretation of Annex I which can be downloaded under the following link: **https://ec.europa.eu/clima/sites/clima/files/ets/docs/guidance_interpretation_en.pdf**
- The production capacity and corresponding units for each activity. Capacity in this context means:
  - Rated thermal input (for activities whose inclusion in the EU ETS depends on the 20MW threshold), which is the rate at which fuel can be burned at the maximum continuous rating of the installation multiplied by the calorific value of the fuel and expressed as megawatts thermal.
  - Production capacity for those specified Annex I activities for which production capacity determines the inclusion in the EU ETS.

- CRF categories of the activities carried out in the installation. Further guidance on how to complete these columns can be found in the chapter on frequently asked questions (see sections 4.1 and 4.2).

Ref.	Annex I Activity	CRF Category 1 (Energy)	CRF Category 2 (Process emission)	Total Activity Capacity	Capacity units	GHG emitted
A01	*Production of cement clinker*	*1A2f - Energy - Other industries*	*2A1 - Process - Cement Production*	*1500*	*tonnes per day*	*CO2*
A02	*Combustion of fuels*	*1A1a - Energy - Public Electricity and*		*120*	*MW(th)*	*CO2*
A1	Manufacture of ceramics	1A2f - Energy - Non-Metallic Minerals	2A4 - Process - Other Process Uses	500	tonnes per day	CO2
A2	Production of bulk chemicals	1A2c - Energy - Chemicals	2B2 - Process - Nitric Acid Production	1200	tonnes per day	CO2
A3	Combustion of fuels	1A1a - Energy - Public Electricity and		150	MW(th)	CO2
A4	Production of primary aluminium	1A2b - Energy - Non-Ferrous Metals	2C3 - Process - Aluminium Production	1200	tonnes per day	CO2 & PFCs
A5						

3.4.2 Section 7: About your emissions

(a) Monitoring approaches

In this section the operator has to select all the monitoring approaches applied by choosing “TRUE” or “FALSE” from the drop-down list. Based on entries here, all relevant sections of the template are displayed and those sections are indicated as “relevant” or “not relevant” throughout the template. Sections that are "not relevant" are greyed out.

Calculation approach for CO_2:	TRUE	Relevant sections: 7(b), 8	Examples A, B, C, F
Measurement approach for CO_2:	TRUE	Relevant sections: 7(c), 9	Examples D, E
Fall-back approach (Article 22):	TRUE	Relevant sections: 10	-
Monitoring of N_2O emissions:	TRUE	Relevant sections: 7(c), 9	Example D
Monitoring of PFC emissions:	TRUE	Relevant sections: 7(b), 11, 12	Example F
Monitoring of transferred/inherent CO_2 and CCS:	TRUE	Relevant sections: 7(c), 9	Example E

(b) Relevant source streams

Based on entries above for the Annex I activities carried out (see section 3.4.1) different source stream types are available from the drop-down list. In turn, based on the source stream types selected appropriate source stream categories are available for selection.

ID	Source stream type	Source stream category	Source stream Name	error
F01	*Cement clinker: Kiln input based (Method A)*	*Raw meal*		
F02	*Combustion: Other gaseous & liquid fuels*	*Heavy fuel oil*		
F03	*Combustion: Other gaseous & liquid fuels*	*Other gases*	*Process waste gas*	
F04	*Iron & steel: Mass balance*	*Scrap Iron*		
F1	Combustion: Commercial standard fuels	Gaseous - Propane		
F2	Bulk organic chemicals: Mass balance methodology	Material - Methanol		
F3	Bulk organic chemicals: Mass balance methodology	Material - Formaldehyde		incomplete!
F4				
F5				
F6				
F7				
F8				
F9				
F10				

Material - Formic acid
Material - Acetic acid
Material - Formaldehyde
Material - Acetic anhydride
Material - Phthalic acid
Material - Acrylic acid
Material - Other Inputs
Material - Other Outputs

(c) Measurement points

Here all measurement points have to be listed where a CEMS is installed for measuring GHG emissions. In the last column, the type of GHG measured has to be selected from the drop-down list.

measurement point ref. M1, M2,...	Description	GHG measured
Example M01	*Stack of coal fired boiler, measurement platform A*	*CO2*
M1	Nitric acid line 1, measurement platform A	N2O
M2	Transfer to EU ETS installation X, pipeline Y	CO2 transfer
M3		
M4		
M5		
M6		
M7		
M8		
M9		
M10		

CO2
N2O
CO2 transfer

3.5 Sheet C: Source streams

Before completing this section in the template, please carefully read the guidance at the top of the sheet in the template. For the examples below, further guidance is provided on some specific points.

Example A - Liquid fuel

3	F3. Liquid - Heavy fuel oil; Northeast type				Combustion		CO2 fossil:	827.820,0	t CO2e
	Combustion: Other gaseous & liquid fuels						*CO2 bio:*	*0,0*	*t CO2e*
	Detailed instructions for data entries in this tool can be found at the top of this sheet.								
i. AD:	Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?						TRUE (1)		
ii. AD: (2)	Open:	25.000,00	Close:	23.000,00	Import:	250.000,00	Export:	0,00	
	Tier	**tier description**		**Unit**		**Value**		**error**	
iii. AD:	4	± 1,5%		t	(3)	252.000,00			
iv. (prelim) EF:	3	Lab. analyses		tCO2/TJ			73,00		
v. NCV:	3	Lab. analyses		GJ/t			45,00		
vi. OxF:	1	OxF=1		-		100,00%			
vii. ConvF:									
viii. CarbC:									
ix. BioC: (4)	n.a								
x. non-sust. BioC:	n.a								
Tiers valid from: (5)			until:			Waste catalogue number (if relevant): (6)			
						ID that has been used in the monitoring plan for this source stream:		3	
Comments:									

Guidance is provided below on some specific points:

1) Here you can enter whether the activity data of the source stream is based on aggregation of metering of data (Article 27(1), point b). In some Member States this field might be optional which would be indicated by a light yellow cell colour. If you have selected “TRUE”, appropriate values have to be provided in row ii.

2) When entries are made in row ii, the activity data value is calculated automatically in row iii. If in row i “FALSE” is selected (i.e. activity data is either based on continual metering (Article 27(1), point a) or entries in row i are not mandatory), the activity data value has to be entered manually in row iii.

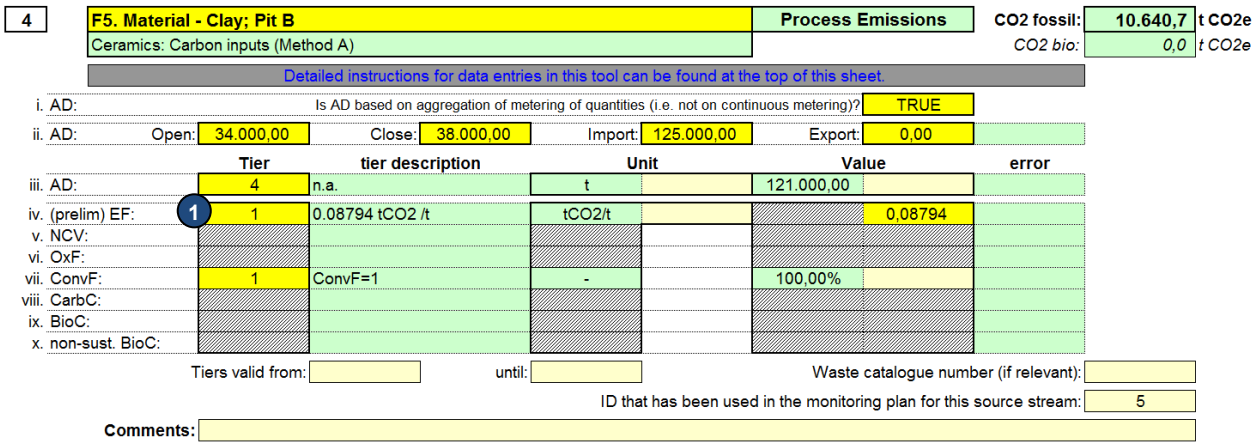
3) The units used for activity data and the EF can be changed by making appropriate selections from the drop-down lists in column J, respectively. Note that units still have to be consistent. Otherwise the message “inconsisent!” will be displayed in the error column.

4) An example of how to enter information in rows ix and x for biomass containing source streams is provided in section ‘Sheet G: Data gaps’.

5) Here you have to enter dates for the validity of tiers in case they do not apply for the whole year. An example of this could be if data gaps occurred (see section ‘Sheet G: Data gaps’)

6) Here the waste catalogue number has to be entered, if applicable. This cell corresponds to the requirements under Annex X, 1(14).

Example B – Process emissions in the ceramic sector

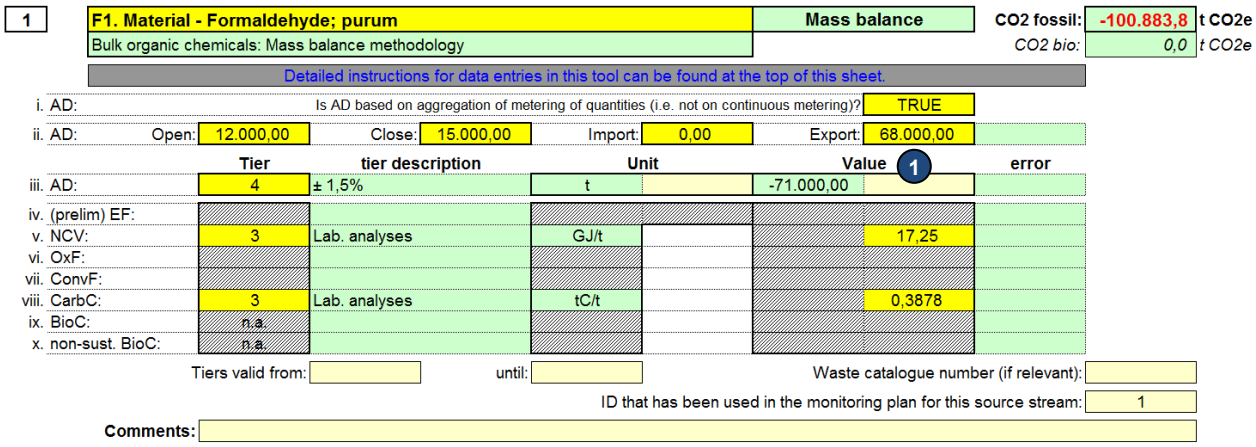


4	F5. Material - Clay; Pit B				Process Emissions		CO2 fossil:	10.640,7	t CO2e
	Ceramics: Carbon inputs (Method A)						*CO2 bio:*	*0,0*	*t CO2e*
	Detailed instructions for data entries in this tool can be found at the top of this sheet.								
i. AD:	Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?					TRUE			
ii. AD:	Open:	34.000,00	Close:	38.000,00	Import:	125.000,00	Export:	0,00	
	Tier	**tier description**		**Unit**		**Value**		**error**	
iii. AD:	4	n.a.		t		121.000,00			
iv. (prelim) EF: (1)	1	0.08794 tCO2 /t		tCO2/t			0,08794		
v. NCV:									
vi. OxF:									
vii. ConvF:	1	ConvF=1		-		100,00%			
viii. CarbC:									
ix. BioC:									
x. non-sust. BioC:									
Tiers valid from:		until:				Waste catalogue number (if relevant):			
						ID that has been used in the monitoring plan for this source stream:		5	
Comments:									

Guidance is provided above under ‘example A’ and below on some further specific points displayed in the screenshot above:

1) In the example shown above, the operator reports the EF at tier 1, i.e. the default value set out in Annex IV, section 12(B), method A. Please note that in this case the template does not automatically use this value, instead it has to be entered manually. Where higher tiers are applied for the EF and values are determined by sampling and analysis, the EF entered here has to be determined in accordance with Annex II, section 4 of the MRR. This means that the EF is determined as the sum of the product of the analytic result for each carbonate contained in the material multiplied by the corresponding stoichiometric factor.

Example C – mass balance in the chemical industry



1	F1. Material - Formaldehyde; purum				Mass balance		CO2 fossil:	-100.883,8	t CO2e
	Bulk organic chemicals: Mass balance methodology						*CO2 bio:*	*0,0*	*t CO2e*
	Detailed instructions for data entries in this tool can be found at the top of this sheet.								
i. AD:	Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?					TRUE			
ii. AD:	Open:	12.000,00	Close:	15.000,00	Import:	0,00	Export:	68.000,00	
	Tier	**tier description**			**Unit**		**Value** (1)		**error**
iii. AD:	4	± 1,5%			t		-71.000,00		
iv. (prelim) EF:									
v. NCV:	3	Lab. analyses			GJ/t			17,25	
vi. OxF:									
vii. ConvF:									
viii. CarbC:	3	Lab. analyses			tC/t			0,3878	
ix. BioC:	n.a.								
x. non-sust. BioC:	n.a.								
	Tiers valid from:		until:				Waste catalogue number (if relevant):		
							ID that has been used in the monitoring plan for this source stream:	1	
	Comments:								

Guidance is provided above under ‘example A’ and below on some further specific points displayed in the screenshot above:

1) Note that when a mass balance is applied, activity of outgoing source streams have to be entered as negative values. However, in this example this is being done automatically if “TRUE” is entered in row i and appropriate values are entered in row ii. Outgoing source streams in this case are to be entered under ‘export’.

Further specific examples

Further guidance and examples can be found in the chapter on frequently asked questions (see chapter 4)

3.6 Sheet D: Measurement-based approaches

Before completing this section in the template, please carefully read the guidance at the top of the sheet in the template.

Example D – Nitric acid production

The screenshot below shows an example of how this section should be completed in the template for an N_2O measurement of a nitric acid producing installation. Guidance on some specific points is provided below.

1	N2O	M1. Nitric acid line 1, measurement platform A		Total fossil emissions:	20.308,7 t CO2e
				Total biomass emissions:	*0,0 t CO2e*
				Total fossil energy content:	TJ
				Total energy content from biomass:	TJ

(a) Calculations

Reference to the relevant source streams, if applicable: (1)

Result of corroborating calculation (fossil):
Result of corroborating calculation (biomass):

			Unit	
Tier used:	4	i. GHG concentration (annual hourly average):	g/Nm3	64,2925
	n.a.	ii. Biomass fraction:	-	0,00%
		iii. non-sust. biomass fraction:	-	0,00% (2)
GWP:	298	iv. Hours of operation:	h/year	4
(t CO2e/t GHG)		v. Flue gas flow (annual hourly average):	1000Nm3/h	265,00
		vi. Flue gas flow (annual total):	1000Nm3/year	1.060
		vii. Annual fossil amount of GHG	t	68

(b) Transferred/Inherent CO2

i. **Installation Name**	
ii. **Operator Name**	
iii. **Unique ID of Installation**	
iv. **Type of transfer**	

Comments (e.g. description of corroborating calculations or if a significant amount of data is missing):

1) Note that Article 46 usually requires corroborating calculations where measurement-based approaches are applied. Further details on how this can be done are provided in the chapter on frequently asked questions (see section 4.11). However, N_2O from nitric acid production is exempted from this requirement; therefore entries are not mandatory here.

2) A more detailed description for how to enter data in rows i to v is shown in the chapter on frequently asked questions (see sections 4.9 and 4.11)

Example E – Transferred CO_2 (CCS)

The screenshot below shows an example of how this section should be completed in the template for a transfer of CO_2 from a capturing EU ETS installation.[3] Guidance is provided above under 'example D'.

3	CO2 transfer	M2. Transfer to EU ETS installation X, pipeline Y	Total fossil emissions:	-455.000,0	t CO2e
			Total biomass emissions:	*0,0*	*t CO2e*
			Total fossil energy content:	0,00	TJ
			Total energy content from biomass:	*0,00*	TJ

(a) Calculations

Reference to the relevant source streams, if applicable: F3. Liquid - Light fuel oil

Result of corroborating calculation (fossil): -457.350
Result of corroborating calculation (biomass): 0

Tier used: 4 (± 2,5%)

GWP: 1 (t CO2e/t GHG)

		Unit	
i.	GHG concentration (annual hourly average):	g/Nm3	1.820,0000
ii.	Biomass fraction:	-	0,00%
iii.	non-sust. biomass fraction:	-	0,00%
iv.	Hours of operation:	h/year	5.000
v.	Flue gas flow (annual hourly average):	1000Nm3/h	50,00
vi.	Flue gas flow (annual total):	1000Nm3/yea	250.000
vii.	Annual fossil amount of GHG	t	455.000

(b) Transferred/Inherent CO2

i.	**Installation Name**	EU ETS installation X
ii.	**Operator Name**	Operator X
iii.	**Unique ID of Installation**	123456
iv.	**Type of transfer**	Exporting transferred CO2

Comments (e.g. description of corroborating calculations or if a significant amount of data is missing):
calculation-based approach according to the methodology in sheet C

Further specific examples

Further guidance and examples can be found in the chapter on frequently asked questions (see chapter 4)

3.7 Sheet E: Fall-back approaches

Before completing this section in the template, please carefully read the guidance at the top of the sheet in the template. For the examples below, further guidance is provided on some specific points.

The screenshot below shows an example of how this section should be completed for fall-back approaches.

[3] Note that the negative emissions are only related to the transferred amount of CO_2 which is deducted from the installation's total emissions. However, the total emissions of the whole installation must not be negative.

Reference to the relevant source streams, if applicable:

Total fossil emissions:	**2.850,0**	**t CO2e**
Total biomass emissions:	*340,0*	*t CO2e*
Total fossil energy content:	**45,00**	**TJ**
Total energy content from biomass:	*5,00*	TJ
Total non-sustainable biomass emissions:	*0*	*t CO2e*

Description of the fall-back approach applied:

A description of the fall-back approach should be provided here. This description should be consistent with the methodology described in the latest approved monitoring plan. It should however go into more detail, in particular with regard to the data and information sources used as well as the figures and steps used for the calculation of the annual emissions.

Annual uncertainty assessment:

Article 22(b) of the MRR requires to assess and quantify each year the uncertainty of all parameters relevant for the determination of the annual emissions applying a fall-back approach. The results of this assessment have to be included in the annual emissions report.

Please attach this uncertainty assessment highlighting why at least for one source stream / emission source not reaching at least tier 1 is possible.

Reference to the file containing the uncertainty assessment: Fall-back uncertainty assessment Year 2016.pdf

3.1 Sheet F: PFC emissions

Before completing this section in the template, please carefully read the guidance at the top of the sheet in the template.

Example E – PFC emissions from primary aluminium production

The screenshot below shows an example of how this section in the template should be completed for the PFC emissions of a primary aluminium installation. Further relevant guidance is provided in section 'Sheet C: Source streams'.

1 **F2. Material - Centre Worked Pre-Bake (CWPB); Anode type A** — **Emissions:** **39.681,0** **t CO2e**

Primary aluminium: PFC emissions (slope method)

Detailed instructions for data entries in this tool can be found at the top of this sheet.

		Tier	tier description	Unit	Value	error
i.	AD:	2	± 1,5%	t	5.000,00	
ii.	A: Frequency	2	± 1,5%	1/(cell-day)	3,00	
iii.	A: Duration	2	± 1,5%	min	2,00	
iv.	A: SEF(CF4)	2	Specific EF	(kgCF4/tAl)/(min/cell-day)	0,146	
v.	B: AEO					
vi.	B: CE					
vii.	B: OVC					
viii.	F(C2F6)	2	Specific EF	tC2F6 / tCF4	0,122	
ix.	CF4 Emissions			t	4,38	
x.	C2F6 Emissions			t	0,53	
xi.	GWP (CF4)			t CO2e / t CF4	7390	
xii.	GWP (C2F6)			t CO2e / t C2F6	12200	
xiii.	CF4 Emissions			t CO2e	32.368	
xiv.	C2F6 Emissions			t CO2e	6.519	
xv.	Collection efficiency			-	98,00%	

Tiers valid from: until:

Comments:

3.2 Sheet G: Data gaps

Before completing this section in the template, please carefully read the guidance at the top of the sheet in the template.

The screenshot below shows an example of how this section in the template should be completed for a data gap related to a source stream.

	Source stream name or other ID	from	until	Description, reasons and methods	Estimated emissions (t CO2e)
1	F3. Liquid - Light fuel oil	25.06.16	28.06.16	main meter electronic malfunctioning, data used from back-up meter	242
2					
3					

3.3 Sheet H: Additional information

In sub-section 14 the operator has to enter data for the product produced in the installation. An example of how this section should be completed is shown in the screenshot below. Please note that some Member States may have chosen to render this section optional, which would be indicated by pale yellow colour coding.

Product identifier (name)	PRODCOM Code	Unit	Activity level
Fine paper grade A	12.34.56.78	t	150.000,00
Electricity	98.76.54.32	GWh	200,00
District heating	00.00.00.00	TJ	100,00

3.4 Sheet I: Summary

This sheet provides an overview of the most important information and emissions and energy figures of the installation in any given reporting year.

Summary of Annual Report on Greenhouse Gas Emissions Pursuant to Directive 2003/87/EC

Reporting Year:	**2016**
Operator Name:	Example operator
Installation name:	Example installation
Unique ID of the installation:	XYZ123

	Annex I Activity	Total Activity Capacity	Capacity units	GHG emitted
A1	Manufacture of ceramics	500	tonnes per day	CO2
A2	Production of bulk chemicals	1200	tonnes per day	CO2
A3	Combustion of fuels	150	MW(th)	CO2
A4	Production of primary aluminium	1500	tonnes per day	CO2 & PFCs
A5	Production of pig iron or steel	2000	tonnes per day	CO2

	Emissions (fossil) t CO2e	Energy content (fossil) TJ	*Memo-Items: Emissions (biomass)* t CO2	*Energy content (biomass)* TJ	*Emissions (non-sust.biomass)* t CO2
Source Streams	**848.820**	**10.459,00**	*2188*	*31,25*	*0*
Combustion	899.383	11.683,75	*2188*	*31,25*	*0*
Process Emissions	10.641	0,00	*0*	*0,00*	*0*
Mass balance	-100.884	-1.224,75	*0*	*0,00*	*0*
PFC Emissions	39.681	0,00			
Measurement	**-434.691**	**0,00**	*0*	*0,00*	*0*
CO2					
N2O	20.309	0,00			
CO2 transfer	-455.000	0,00	*0*	*0,00*	*0*
Fall-back	**2.850**	**45,00**	*340*	*5,00*	*0*
Sum	**416.979**	**10.504,00**	*2528*	*36,25*	*0*

Total emissions from the installation: **416.979 t CO2e**

This is the amount of allowances to be surrendered by the operator.

Memo-Item: Total (sustainable) biomass emissions	*2.528 t CO2e*
Memo-Item: Total non-sustainable biomass emissions	*0 t CO2e*

3.5 Sheet J: Accounting

This sheet contains an overview of the important parameters for each source stream, emission source and fall-back approach. The main purpose of this sheet is to help competent authorities extract key data into summary reports or overall databases. It can also assist completeness and consistency checks.

Source Streams (excluding PFC emissions)

#	Method	Name	Activity Data	AD Unit	NCV	NCV Unit	EF	EF Unit	C-Content	C-Content Unit	Oxid.factor	OxF Unit	Conv.factor	ConvF Unit	Biomass content
1	Mass balance	F1. Material - Formaldehyde; purum	-71.000,00	t	17,25	GJ/t	0,00		0,3878	tC/t	100,00	%	100,00	%	0,00
2	Combustion	F4. Liquid - Other liquid biomass; Mixed bi	5.000,00	t	25,00	GJ/t	70,00	tCO2/TJ	0		100,00	%	100,00	%	25,00
3	Combustion	F3. Liquid - Heavy fuel oil; Northeast type	252.000,00	t	45,00	GJ/t	73,00	tCO2/TJ	0		100,00	%	100,00	%	0,00
4	Process Emissions	F5. Material - Clay; Pit B	121.000,00	t	0,00		0,09	tCO2/t	0		100,00	%	100,00	%	0,00

4 FREQUENTLY ASKED QUESTIONS

4.1 How can the reporting of CRF (Common Reporting Format) be rendered mandatory by a Competent Authority in the Annual Emissions Report?

This can be done by changing cell B6 in the sheet "MSParameters" from FALSE to TRUE and should only be done by the Competent Authority. As a first step, open the AER template and click on the "Review" ribbon and then "unprotect the workbook" (see screenshot in question 4.7). Unhide sheet "MSParameters" and then unprotect this sheet. Then change the value in cell B6 to TRUE.

Subsequently, protect sheet „MSParameters" again, hide the sheet and protect again the whole „workbook" under the „Review" section.

Please note that this approach implies that a new version of the annual emissions report template is produced, requiring to label it with a new version number in the hidden sheet "VersionDocumentation". Moreover, this new version has to be "rolled out", i.e. operators can no longer directly start preparing the emissions report starting from the previous year's report.

4.2 How are relevant CRF (Common Reporting Format) categories to be reported in the Annual Emissions Report?

Article 73 of the MRR requires that "*each activity listed in Annex I to Directive 2003/87/EC that is carried out by an operator or aircraft operator shall be labelled using the codes […], from the following reporting schemes: (a) the Common Reporting Format for national greenhouse gas inventory systems as approved by the respective bodies of the United Nations Framework Convention on Climate Change; [..]*"

This is reflected in section 6 of the Annual Emissions Report template. For reporting annual emissions the template re-endorsed in December 2015 is based on the 2006 IPCC guidelines for CRF reporting. Guidance on how to find the appropriate categories for energy (category 1) and process emissions (category 2) can be found on the IPCC website[4]. Please make sure that reporting here is consistent with the reporting of economic activities (e.g. NACE codes) and other reporting obligations for national statistics.

4.3 How can further fuels be considered commercial standard fuels and how do they qualify as such?

This can be done by changes to the sheet "MSParameters" and should only be done by the Competent Authority.

There are two reasons that justify such amendment:

- A fuel satisfies the criteria for a commercial standard fuel as defined in Article 3(31)[5]

[4] Guidance on categorisation can be downloaded from **http://www.ipcc-nggip.iges.or.jp/public/2006gl/**

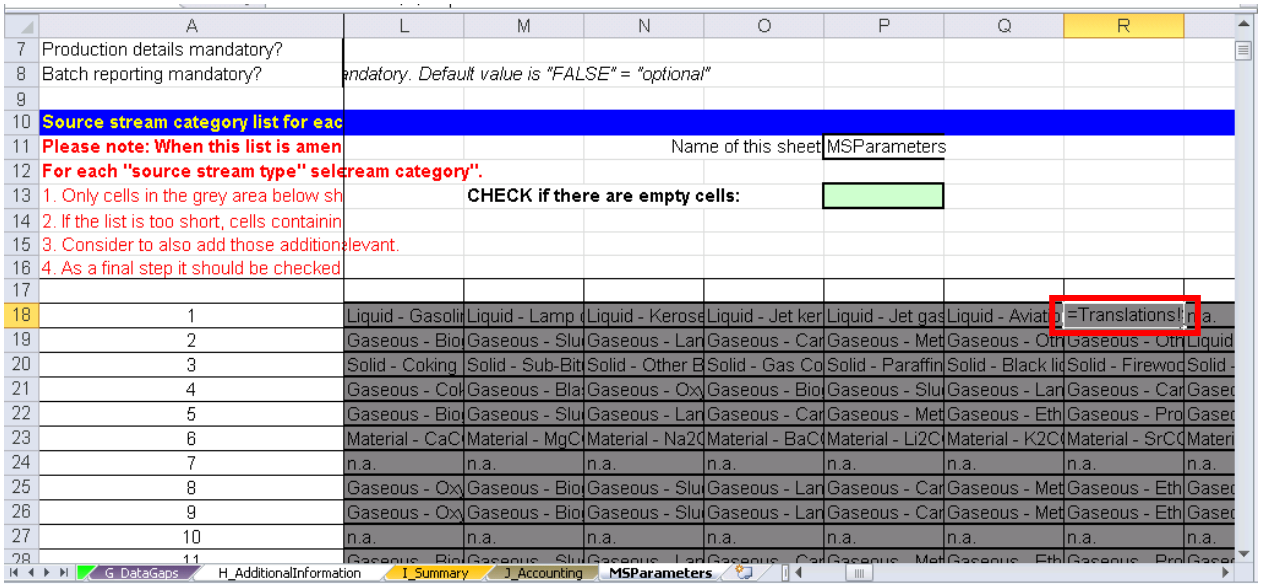
[5] Article 3(31): "*'commercial standard fuel' means the internationally standardised commercial fuels which exhibit a 95 % confidence interval of not more than 1 % for their specified calorific value, including gas oil, light fuel oil, gasoline, lamp oil, kerosene, ethane, propane, butane, jet kerosene (jet A1 or jet A), jet gasoline (Jet B) and aviation gasoline (AvGas)*"

- A fuel satisfies the criteria in Article 31(4)[6]

The identification of commercial standard fuels in accordance with Article 3(31) can be difficult for the Competent Authority, in particular to take this decision that it is an “internally standardised fuel”. Therefore, it may be more common to identify fuels that can be treated like commercial standard fuels in accordance with Article 31(4) where the criteria of this Article are satisfied on a regional or even national level (for further details see question 1.8 of the FAQ Monitoring and Reporting document which can be downloaded from the Commission’s website).

For the amendment of the commercial standard fuel list in the AER template the Competent Authority has to take the following steps: as a first step, open the AER template and click on the “Review” ribbon and then “unprotect the workbook” (see screenshot in question 4.7). Unhide sheet “MSParameters” and then unprotect this sheet.

Unprotect sheet „MSParameters“ and add further commercial standard fuels to the table in row 18 (cell R18) by entering the fuel’s name (e.g. “Gaseous – Natural gas”), as shown in the screenshot below.



If the added fuel was part of another category (e.g. other gaseous and liquid fuels) you may want to simply copy the reference to the translation sheet (e.g. “Translastions!B999”) to row 18 and remove the same fuel from the other list to avoid any confusion. The fuel will then be on the drop-down list in column “source stream category” in section 7(b) of sheet B where “Combustion: commercial standard fuel” is selected as source stream type.

Subsequently, protect sheet „MSParameters“ again, hide the sheet and protect again the whole „workbook“ under the „Review“ section.

Please note that this approach implies that a new version of the annual emissions report template is produced, requiring to label it with a new version number in the hidden sheet “VersionDocumentation”. Moreover, this new version has to be “rolled out”, i.e. operators can no longer directly start preparing the emissions report starting from the previous year’s report.

[6] Article 31(4): “*Upon application by the operator, the competent authority may allow that the net calorific value and emission factors of fuels are determined using the same tiers as required for commercial standard fuels provided that the operator submits, at least every three years, evidence that the 1 % interval for the specified calorific value has been met during the last three years*”

4.4 Are non-carbonate process emissions (e.g. urea) also to be monitored and reported and if yes, how?

Yes, they are. Although the MRR only mentions process material for flue gas desulphurisation, i.e. carbonates input/gypsum output, according to the EU ETS Directive any kind of carbon containing material involved in the flue/waste gas scrubbing has to be considered as part of the combustion installation, i.e. it needs to be monitored and reported. Article 3(t) of the EU ETS Directive states:

"*'combustion' means any oxidation of fuels, regardless of the way in which the heat, electrical or mechanical energy produced by this process is used, and any other directly associated activities, including waste gas scrubbing;*"

The Guidance Document for the Interpretation of Annex I is also explicit, the guidance on page 9 stating: "*This clarifies that process emissions may occur as part of combustion activities, especially CO_2 emissions from desulphurisation, from deNO_x units (e.g. when urea is used as reductant) etc.*".

Monitoring and reporting of such non-carbonate process emissions should however follow the same approaches and apply the same tier requirements as carbonate-based process emissions.

How should urea consumption be reported in the AER?

For the reasons given above and although urea is not explicitly listed in the MRR or the AER template as waste gas scrubbing material, it is most appropriate to fill in the AER in a similar way as for e.g. limestone used for waste gas scrubbing. This is achieved by selecting "*Combustion: Scrubbing (carbonate)*" → "*Material – Other materials*" → "*Urea*" in section 7(b):

ID	Source stream type	Source stream category	Source stream Name	error
F1	Combustion: Scrubbing (carbonate)	Material - Other materials	Urea	

In the corresponding source stream box in sheet C, data for activity data and the emission factor need to be entered. As stated in Annex IV, section 1(C) of the MRR, the emission factor related to input materials for flue gas scrubbing is to be determined by application of method A, i.e. based on stoichiometric ratios (0.7328 t CO_2 / t urea[7]) and amount of urea in the input material to be determined using best industry practice guidelines.

1	F1. Material - Other materials; Urea	Process Emissions	CO2 fossil:	513,0	t CO2e
	Combustion: Scrubbing (carbonate)		*CO2 bio:*	*0,0*	*t CO2e*

Detailed instructions for data entries in this tool can be found at the top of this sheet.

i.	AD:	Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?					WAHR		
ii.	AD:	Open:	2.000,00	Close:	2.100,00	Import:	800,00	Export:	0,00
		Tier		**tier description**		**Unit**		**Value**	**error**
iii.	AD:	1		± 7,5%		t		700,00	
iv.	(prelim) EF:	1		Type I & best practice		tCO2/t		0,73	
v.	NCV:								
vi.	OxF:								
vii.	ConvF:								
viii.	CarbC:								
ix.	BioC:								
x.	non-sust. BioC:								

Tiers valid from: until: Waste catalogue number (if relevant):

ID that has been used in the monitoring plan for this source stream:

Comments:

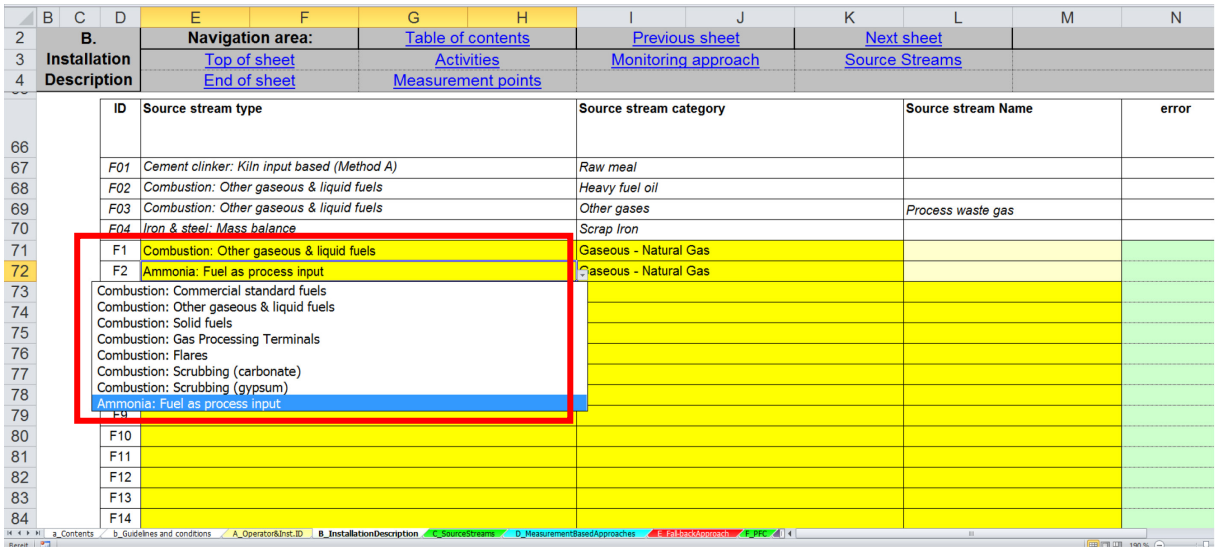
[7] Note that for EF the template is only displaying two digits after the decimal point. However, calculation of emissions is done using the same accuracy as data is entered (in this case the four digits in 0.7328 t CO_2 / t urea).

4.5 How can a distinction be made between fuels used for combustion and fuels used as process input in the annual emissions report?

This can be done by selecting the appropriate source streams in sheet B of the Annual Emissions Report template.

For some activities fuels are used in combustion processes as well as for input for processes, e.g. in ammonia production, part of the natural gas consumed is combusted to produce heat for the process and the other part is fed into the steam reforming reactor, i.e. process input. For inventory purposes and for the Member States' reporting requirements under Article 21 of the EU ETS Directive a clear distinction between those two types of fuel use is necessary.

To reflect this situation in the Annual Emissions Report, both source stream types can be selected from the drop-down list in section 7.b of sheet "B_InstallationDescription", as shown in the following screen shot (for the example of natural gas in ammonia production).



The Annual Emissions Report template will list both selections as emissions from "combustion" acitivities in sheet "I_Summary". Therefore, in order to extract distinct emissions data for combustion and process input data they have to be extracted from sheet "C_SourceStreams".

Please note that for a correct and consistent monitoring methodology the monitoring plan should be updated accordingly to reflect this approach.

4.6 How can the import and export of inherent CO_2 be reported in the Annual Emissions Report template?

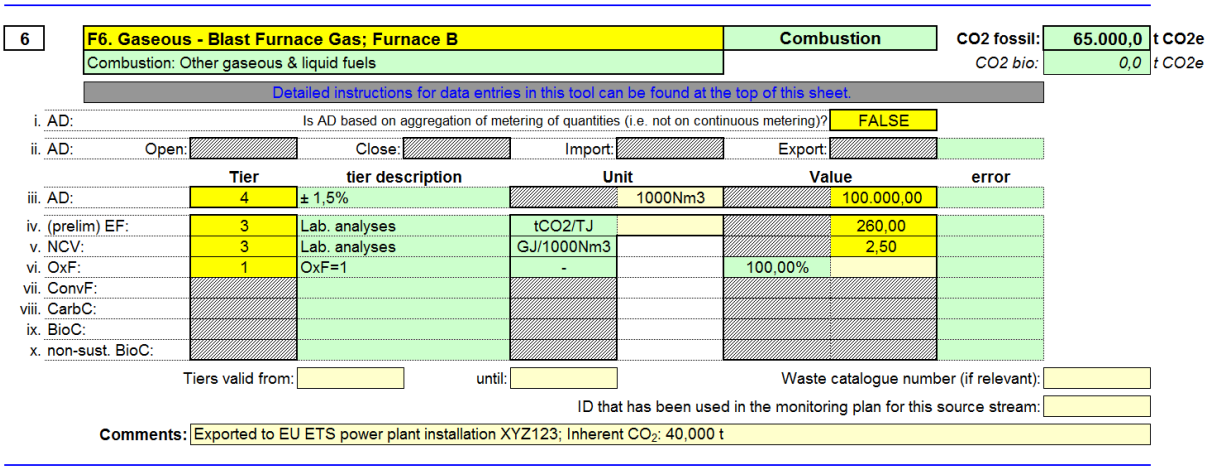
Articles 3(40) and 48 of the MRR lay down that any CO_2 contained in a fuel is to be considered part as the fuel and to be taken into account in its emission factor. Furthermore, Annex X, clause 1(8)(f) of the MRR requires the following information to be reported as memo item in the Annual Emissions Report: "*inherent CO_2 transferred to an installation or received from an installation, where Article 48 is applicable, expressed in t CO_2*".

The Annual Emissions Report template allows for entry of appropriate data where inherent CO_2 transferred between installations is monitored by a measurement-based methodology. However, this is in many cases not the approach taken, e.g. where blast furnace gas from a steel installation is exported to connected power plants, and the emissions are most commonly covered by a mass balance ap-

proach. For such an approach fuels containing inherent CO_2 received from or exported to other installations is usually a distinct source stream, with positive associated emissions for ingoing and negative associated emissions for outgoing fuels.

Therefore, transferred inherent CO_2 can be annotated by adding appropriate comments in the comment field in sheet C for each relevant source stream. Such comment should contain:

- the name of the transferring and receiving installations and identification codes of these installations and
- inherent CO_2 imported or transferred expressed in t CO_2.



6	F6. Gaseous - Blast Furnace Gas; Furnace B				Combustion		CO2 fossil:	65.000,0	t CO2e
	Combustion: Other gaseous & liquid fuels						CO2 bio:	0,0	t CO2e
	Detailed instructions for data entries in this tool can be found at the top of this sheet.								
i. AD:		Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?					FALSE		
ii. AD:	Open:		Close:		Import:		Export:		
	Tier	tier description		Unit			Value	error	
iii. AD:	4	± 1,5%			1000Nm3		100.000,00		
iv. (prelim) EF:	3	Lab. analyses		tCO2/TJ			260,00		
v. NCV:	3	Lab. analyses		GJ/1000Nm3			2,50		
vi. OxF:	1	OxF=1		-		100,00%			
vii. ConvF:									
viii. CarbC:									
ix. BioC:									
x. non-sust. BioC:									
Tiers valid from:		until:				Waste catalogue number (if relevant):			
						ID that has been used in the monitoring plan for this source stream:			
Comments:	Exported to EU ETS power plant installation XYZ123; Inherent CO_2: 40,000 t								

4.7 How can activity data for gaseous fuels be entered as "1000Nm³" instead of "t" in sheet C of the Annual Emissions Report template?

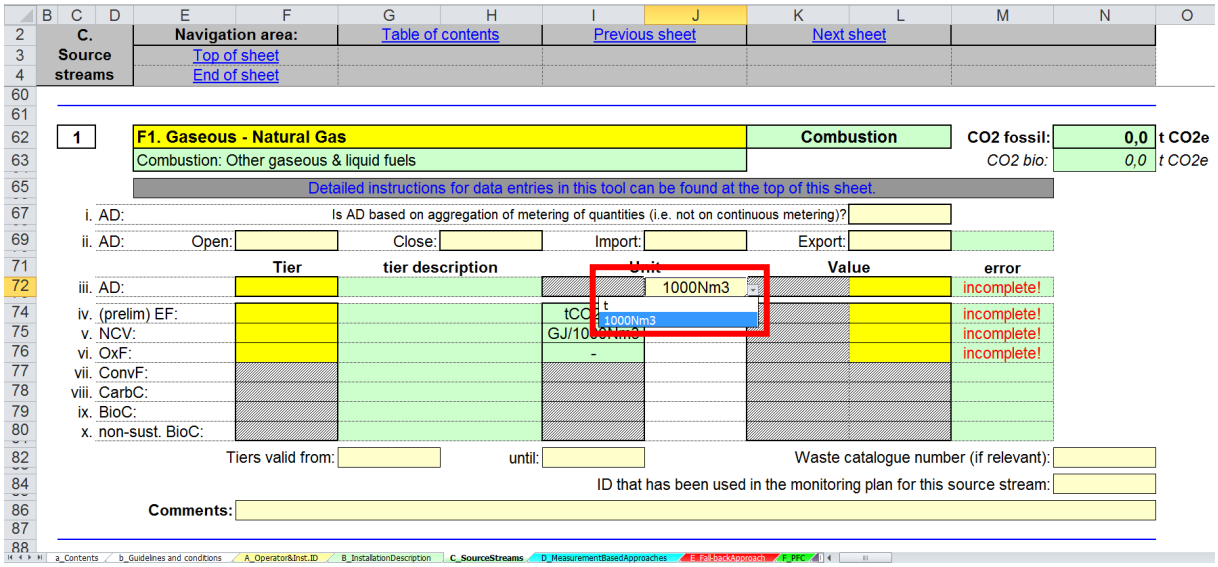
There are two ways to enter activity data in "1000Nm³"[8]:

1. Select "1000Nm³" from the drop-down list in the source stream box in sheet C (this has to be done by each operator), OR
2. Make "1000Nm³" the default option for each gaseous fuel (this has to be done by each CA but only once)

Option 1:

The operator has to select "1000Nm³" from the drop down list in the source stream box in sheet C of the Annual Emissions Report template. For the example of natural gas, this procedure is displayed in the screenshot below.

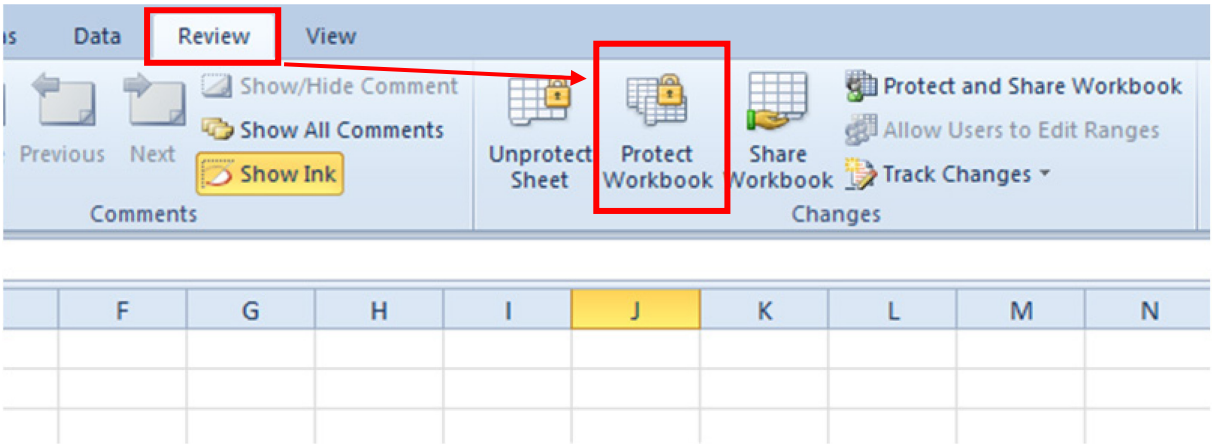
[8] Please note that entry of data as volumes (i.e. 1000Nm³) implies that the NCV default values from Annex VI MRR are no longer automatically displayed for tier 1, since these are provided there as "per mass" values (e.g. 48 TJ/Gg for natural gas) and not "per volume".



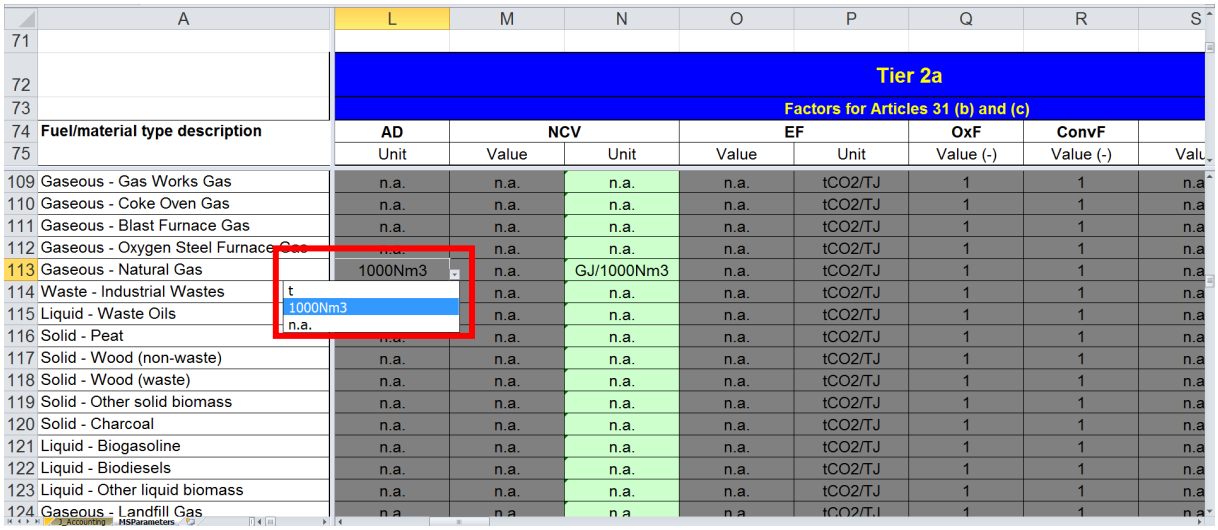
Please note that the operator can use the Annual Emissions Report from the previous year as template for emissions reporting for the current year, unless a Member State has set out specific requirements for using templates from previous years. Therefore, the operator has to do make this selection only once per source stream and the correct unit will then already be used for all subsequent years.

Option 2:

The CA has to start from an empty latest version of the Annual Emissions Report template published on their website. As a first step, open this template and click on the "Review" ribbon and then "unprotect the workbook" (see screenshot below).

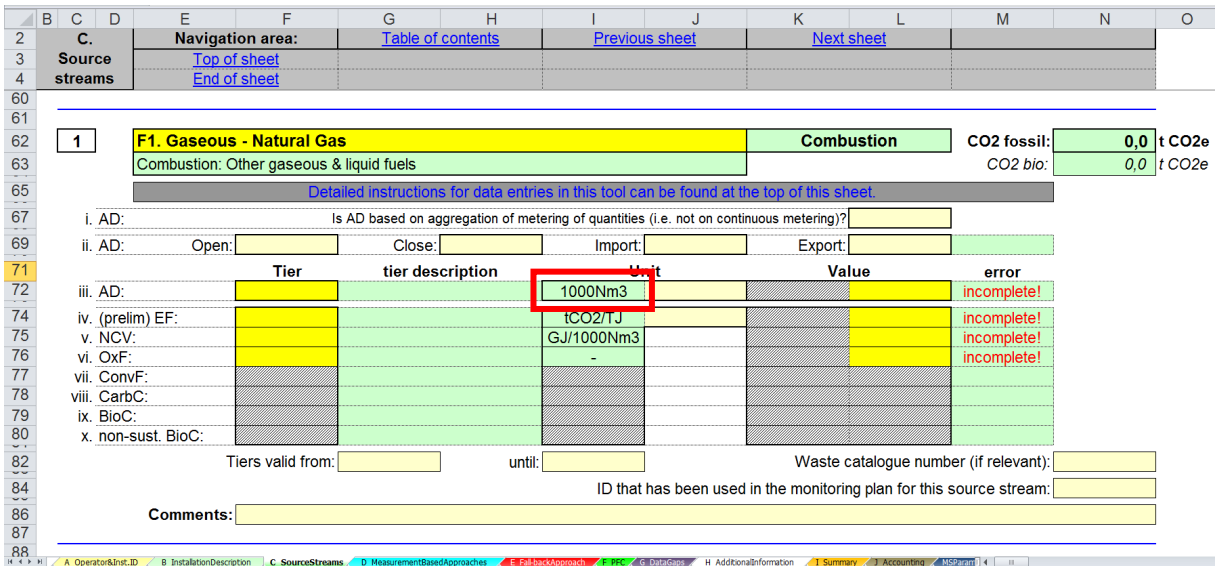


Unhide and unprotect sheet "MSParameters" and change the activity data units for Tier 2a from "n.a." to "1000Nm³" (e.g. in cell L113 for natural gas) for each relevant gaseous fuel, as shown in the screenshot below.



	Fuel/material type description	AD Unit	NCV Value	NCV Unit	EF Value	EF Unit	OxF Value (-)	ConvF Value (-)
		Tier 2a						
		Factors for Articles 31 (b) and (c)						
109	Gaseous - Gas Works Gas	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
110	Gaseous - Coke Oven Gas	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
111	Gaseous - Blast Furnace Gas	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
112	Gaseous - Oxygen Steel Furnace Gas	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
113	Gaseous - Natural Gas	1000Nm3	n.a.	GJ/1000Nm3	n.a.	tCO2/TJ	1	1
114	Waste - Industrial Wastes	t	n.a.	n.a.	n.a.	tCO2/TJ	1	1
115	Liquid - Waste Oils	1000Nm3	n.a.	n.a.	n.a.	tCO2/TJ	1	1
116	Solid - Peat	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
117	Solid - Wood (non-waste)	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
118	Solid - Wood (waste)	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
119	Solid - Other solid biomass	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
120	Solid - Charcoal	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
121	Liquid - Biogasoline	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
122	Liquid - Biodiesels	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
123	Liquid - Other liquid biomass	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1
124	Gaseous - Landfill Gas	n.a.	n.a.	n.a.	n.a.	tCO2/TJ	1	1

Subsequently, protect sheet „MSParameters“ again, hide the sheet and protect again the whole „workbook“ under the „Review“ section. The default unit for activity data is now “1000Nm³” for each of the gaseous fuels changed in “MSParameters” (see screeenshot below).



C. Source streams — Navigation area: Table of contents | Previous sheet | Next sheet; Top of sheet; End of sheet

1 — F1. Gaseous - Natural Gas — Combustion — CO2 fossil: 0,0 t CO2e

Combustion: Other gaseous & liquid fuels — CO2 bio: 0,0 t CO2e

Detailed instructions for data entries in this tool can be found at the top of this sheet.

i. AD: Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)?

ii. AD: Open: Close: Import: Export:

	Tier	tier description	Unit	Value	error
iii. AD:			1000Nm3		incomplete!
iv. (prelim) EF:			tCO2/TJ		incomplete!
v. NCV:			GJ/1000Nm3		incomplete!
vi. OxF:			-		incomplete!
vii. ConvF:					
viii. CarbC:					
ix. BioC:					
x. non-sust. BioC:					

Tiers valid from: until: Waste catalogue number (if relevant):

ID that has been used in the monitoring plan for this source stream:

Comments:

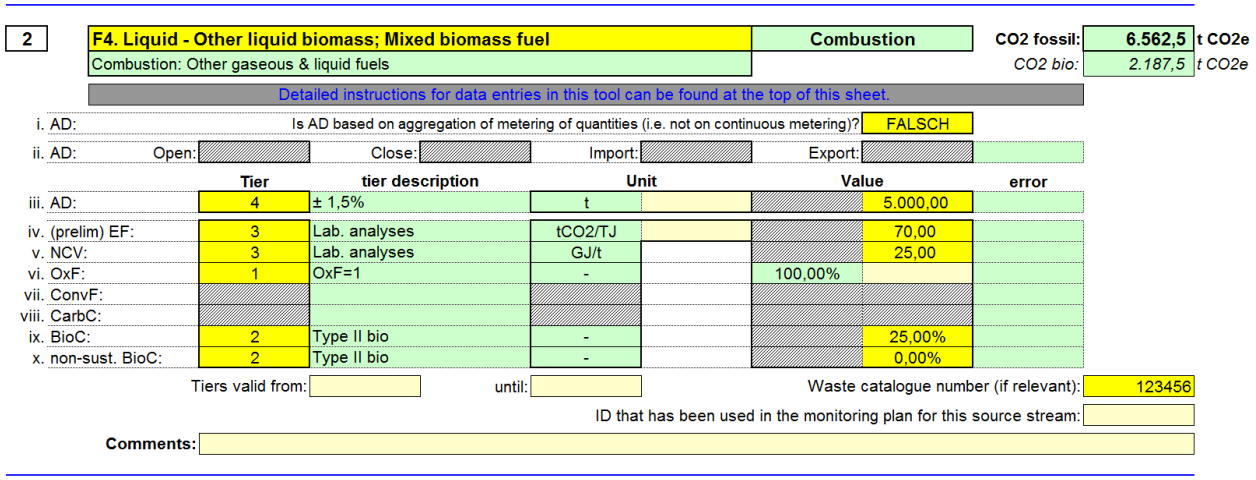
Please note that this approach implies that a new version of the annual emissions report template is produced, requiring to label it with a new version number in the hidden sheet “VersionDocumentation”. Moreover, this new version has to be “rolled out”, i.e. operators can no longer directly start preparing the emissions report starting from the previous year’s report.

4.8 How do biomass-containing source streams have to be reported, in particular if sustainability criteria are not met?

In the following example, it is assumed that the source stream is a mixed fossil-biomass liquid fuel. 25% of the carbon contained in the fuel is stemming from biomass, 75% is fossil. The NCV is determined by analyses as 25 GJ/t. The preliminary emissions factor, which accounts for both types of car-

bon – fossil and biomass – and does not rate biomass carbon as zero, is 70 t CO_2/TJ (as also obtained by analysis).

Since this source stream is a liquid fuel, the biomass emissions can only be rated as zero if the operator can provide evidence that the sustainability criteria are met. If this is the case, the 25% biomass share is to be entered in row ix, as shown in the following screenshot. Accordingly this 75/25 split will be applied to the calculation of the fossil and biomass emissions (see right-top of the screenshot)



2	F4. Liquid - Other liquid biomass; Mixed biomass fuel		Combustion		CO2 fossil:	6.562,5	t CO2e
	Combustion: Other gaseous & liquid fuels				CO2 bio:	2.187,5	t CO2e

Detailed instructions for data entries in this tool can be found at the top of this sheet.

i. AD: Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)? FALSCH

ii. AD: Open: Close: Import: Export:

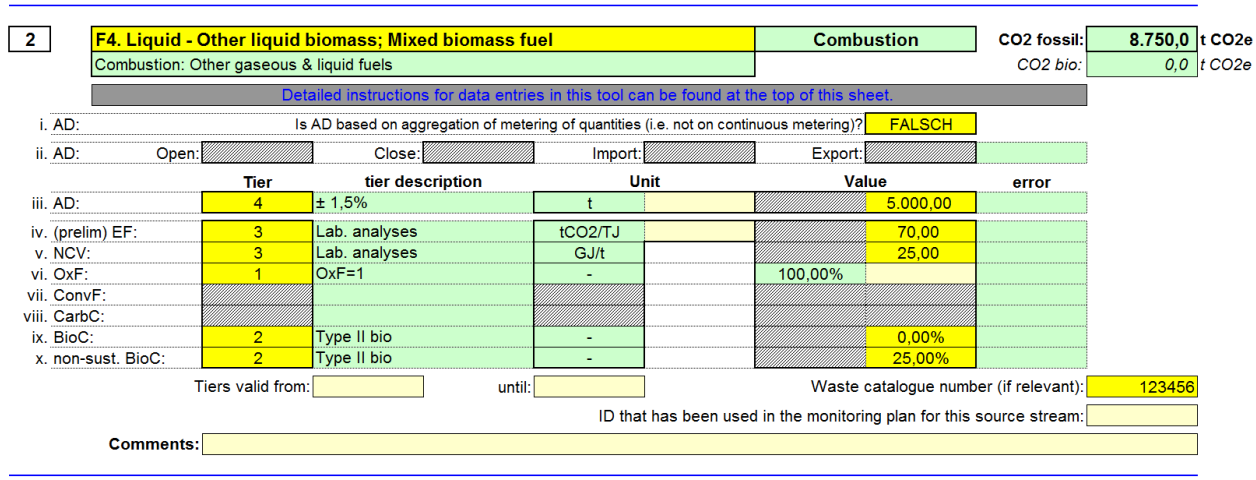
	Tier	tier description	Unit		Value		error
iii. AD:	4	± 1,5%	t			5.000,00	
iv. (prelim) EF:	3	Lab. analyses	tCO2/TJ			70,00	
v. NCV:	3	Lab. analyses	GJ/t			25,00	
vi. OxF:	1	OxF=1	-		100,00%		
vii. ConvF:							
viii. CarbC:							
ix. BioC:	2	Type II bio	-			25,00%	
x. non-sust. BioC:	2	Type II bio	-			0,00%	

Tiers valid from: until: Waste catalogue number (if relevant): 123456

ID that has been used in the monitoring plan for this source stream:

Comments:

If the sustainability criteria are not met, or the operator cannot provide evidence for that, the biomass cannot be rated as zero. In this case, the value to be entered in row ix is 0%. However, in row x, which refers to the non-sustainable biomass content, the 25% does have to be entered (see screenshot below). As a result, all emission will be counted as fossil (see right-top of the screenshot)



2	F4. Liquid - Other liquid biomass; Mixed biomass fuel		Combustion		CO2 fossil:	8.750,0	t CO2e
	Combustion: Other gaseous & liquid fuels				CO2 bio:	0,0	t CO2e

Detailed instructions for data entries in this tool can be found at the top of this sheet.

i. AD: Is AD based on aggregation of metering of quantities (i.e. not on continuous metering)? FALSCH

ii. AD: Open: Close: Import: Export:

	Tier	tier description	Unit		Value		error
iii. AD:	4	± 1,5%	t			5.000,00	
iv. (prelim) EF:	3	Lab. analyses	tCO2/TJ			70,00	
v. NCV:	3	Lab. analyses	GJ/t			25,00	
vi. OxF:	1	OxF=1	-		100,00%		
vii. ConvF:							
viii. CarbC:							
ix. BioC:	2	Type II bio	-			0,00%	
x. non-sust. BioC:	2	Type II bio	-			25,00%	

Tiers valid from: until: Waste catalogue number (if relevant): 123456

ID that has been used in the monitoring plan for this source stream:

Comments:

4.9 How does the GHG concentration, flue gas flow etc. for measurement-based approaches (CEMS) have to be determined and reported in the annual emissions report?

The annual emissions of the emitted GHG are calculated by the equation provided in Annex VIII, Section 3 (equation 1) of the MRR:

$$Emissions_{annual}[t] = \sum_i GHG\ conc_{hour\ i}[g/Nm^3] \cdot flue\ gas\ flow_i\ [Nm^3/h] \cdot 10^{-6}[t/g]$$

where:

GHG conc$_{hour\ i}$ ..... concentrations of GHG in the flue gas flow measured during operation hour i

Flue gas flow$_i$ ..... flue gas flow determined for each hour i

For reporting corresponding total annual emissions in the Annual Emissions Report template Annex X, clause 1(9)(b) of the MRR requires to report "*the measured greenhouse gas concentrations and the flue gas flow expressed as an annual hourly average, and as an annual total value*".

The template therefore requires entry of those values and calculates the annual amount of the GHG emitted by:

$$Emissions_{annual}[t] = GHG\ conc_{annual\ hourly\ average}[mg/Nm^3] \cdot flue\ gas\ flow_{annual\ hourly\ average}\ [Nm^3/h] \cdot hours_{operation}\ [h] \cdot 10^{-9}$$

In order to obtain the same results from both equations above, averages have to be calculated on a weighted basis (each hourly average weighted against the corresponding hourly flue gas flow, before obtaining the overall average for the whole year).

The following example helps to explain how to determine and enter data.

Example:
An installation is only emitting N_2O and determines emissions by means of CEMS. For simplicity reasons it is assumed that the installation is only operating for four hours during the reporting year with the following values for concentration and flue gas flow for each hour:

hour	N_2O conc. [mg/Nm³]	Flow [kNm³/h]	Resulting N_2O emissions [kg]
1	60	250	15.00
2	100	280	28.00
3	45	270	12.15
4	50	260	13.00
	Sum (= total N_2O emitted)		**68.15**

Data in the Annual Emissions Report has to be entered as follows:

Flue gas flow [annual hourly average, kNm³/h]:

$$flue\ gas\ flow_{annual\ hourly\ average} = \frac{\sum_i flow_{hour\ i}}{hours_{operation}} = \frac{1{,}060}{4} = 265.00\ kNm^3/h$$

The annual hourly average of concentration [mg/Nm³] then has to be determined as the average weighted against the flue gas flow[9]:

$$GHG\ conc_{annual\ hourly\ average} = \frac{\sum_i conc_i \cdot flow_i}{\sum_i flow_i} = \frac{68{,}150 \cdot 10^3 [mg/year]}{1{,}060 \cdot 10^3 [Nm^3/year]} = 64.29\ mg/Nm^3$$

Hours of operation: 4 h

The annual emissions, expressed as tonnes of N_2O, are calculated by the following equation to obtain the same results as in the table above:

$$Emissions = 64.29 \cdot 10^{-9} \cdot 265 \cdot 10^3 \cdot 4 = 0.06815\ t\ N_2O\ (= 68.15\ kg)$$

4.10 How does the biomass fraction for measurement-based approaches (CEMS) have to be determined and reported in the annual emissions report?

Article 43(4) of the MRR states: "*Where relevant, the operator shall determine separately any CO_2 amount stemming from biomass using calculation-based monitoring methodologies and subtract it from the total measured CO_2 emissions*"

Therefore, for biomass source streams the biogenic emissions are determined by:

$$Emissions_{bio} = FQ \cdot NCV \cdot EF_{pre} \cdot OF \cdot (1 - FF)$$

where:

FQ..... Quantity of fuel [t]

NCV.... Net calorific value [TJ/t]

EF..... Preliminary emission factor [t CO_2/TJ][10]

OF..... Oxidation factor

FF ..... Fossil fraction

The same tier requirements have to be followed for those biomass source streams as specified for this specific installation category (A, B or C) and source stream category (de-minimis, minor or major). Note that for exclusive biomass this source stream may always be de-minimis since no fossil carbon is emitted.

[9] Note where concentrations and gas flows are available for shorter reference period (half-hours, minutes,..) appropriate weighting already has to be done to obtain hourly averages

[10] The preliminary emission factor is the emission factor if biomass carbon was not counted as zero

Annex X, section 1(9)(a) of the MRR does not require the operator to provide all of the calculation factors listed above but only details (including factors) in relation to the annual fossil CO_2 emissions and the annual CO_2 emissions from biomass use. Therefore, the Annual Emissions Report template requires the entry of a biomass fraction. This fraction will simply be calculated as the ratio of "CO_2 emissions from biomass use (as determined by abovementioned formula)" and the "total CO_2 emissions (sum of fossil and biogenic CO_2 emitted)". This ratio will then be entered as the biomass fraction in section 9.1.a.ii in sheet D of the template.

Please note that the calculation steps applied for the determination of the CO_2 emissions from biomass do not have to be provided in the template unless stated otherwise by your Competent Authority. However, it is recommended to add the calculation steps and parameters used in the comment boxes for each emission source. In any event, those have to be made available to the verifier for the verification procedure.

In no case should the calculation-based determination of biomass emissions be determined by defining a dedicated source stream and entering relevant data in sheet C. This would lead to double counting of emissions and is therefore not allowed.

4.11 How do corroborating calculations for measurement-based approaches (CEMS) have to be determined and reported in the annual emissions report?

Article 46 of the MRR states: "*The operator shall corroborate emissions determined by a measurement-based methodology, with the exception of nitrous oxide (N_2O) emissions from nitric acid production and greenhouse gases transferred to a transport network or a storage site, by calculating the annual emissions of each considered greenhouse gas for the same emission sources and source streams. The use of tier methodologies shall not be required*."

Those corroborating calculations do not have to be based on tier compliant methodology. However, in many cases default values or metering of source streams will be available anyway. In such cases it is already recommended in section 4 of Guidance Document 7 on CEMS to use, to the extent possible, the standard or mass balance methodology pursuant to Articles 24 and 25 of the MRR. Article 46 is further supported by point (iii) of Article 62(1)(c) which requires the internal review and validation of data associated with the comparison of the results obtained by CEMS and corroborating calculations to be covered by a written procedure pursuant to Article 58(3)(d). A summary of this procedure has to be included in the monitoring plan.

Annex X does however not mention any obligation to report the results from corroborating calculations in the Annual Emissions Report. Still, the template provided by the European Commission allows for entering corresponding results, expressed as tonnes of CO_2 in section 9 in sheet D_MeasurementBasedApproaches.

Also the corroborating calculation steps do not have to be provided in the template unless stated otherwise by your Competent Authority. Nevertheless, it is recommended to add for each emission source the calculation steps and parameters used in the annual emissions report in the comment boxes or reference external documents attached to the report containing those calculations.

In any event, corroborating calculations have to be made available to the verifier for the purpose of data verification in accordance with Article 16(2)(g) of the AVR[11].

4.12 How does data for reporting emissions from catalytic cracking in refineries have to be reported in the annual emissions report?

This can either be done by reporting emissions under a measurement-based approach, where this is applied, or by entering appropriate data under a mass balance (calculation-based approach).

Fluid catalytic cracking is used in refineries to convert high-boiling hydrocarbons into lower-molecular weight but higher value products. During this catalytic reaction part of the carbon-containing feedstock forms carbonaceous deposits on the catalyst that causes its inactivation. Therefore, the catalyst has to be regenerated by burning off the deposited carbon using air in a separated reactor, called the regenerator. The carbon in the flue gas formed from this regeneration is converted into CO_2 either already during the regeneration or during a subsequent post-combustion.

For the monitoring of emissions stemming from catalytic cracker regeneration section 2 of Annex IV states: "*[..] by way of derogation from Article 24 and 25, emissions from catalytic cracker regeneration, other catalyst regeneration and flexi-cokers shall be monitored using a mass balance, taking into account the state of the input air and the flue gas. All CO in the flue gas shall be accounted for as CO_2, applying the mass relation: t CO_2 = t CO * 1,571. The analysis of input air and flue gases and the choice of tiers shall be in accordance with the provisions of Articles 32 to 35. The specific calculation methodology shall be approved by the competent authority*." This provision clarifies that the determination of emissions from catalytic cracker regeneration in general requires the use of appropriate analytical standards and accredited laboratories following the provisions in Articles 32 to 35.

Option 1 (application of CEMS)

One way to satisfy those criteria can be by application of continuous emissions monitoring systems (CEMS) following the rules set out in Articles 40 to 46 of the MRR. For such approach emissions are to be reported in sheet D of the Annual Emissions Report template, accordingly.

It has to be noted that the mass balance mentioned in Annex IV, section 2 is not a 'real' mass balance as defined in Article 25 but rather a flue gas volume balance according to Article 43(5)(a). According to Annex IV, section 2, the determination of the annual emissions from the regeneration of catalytic converters from cracking and reforming processes shall be monitored using a balance, taking into account the CO_2, CO, NO_x and SO_2 contents in the flue gas from the regeneration and in the amount of air supplied in accordance with Article 43(5)(a). In the subsequent processes, a complete conversion of CO to CO_2 is assumed:

$$E_{total,Coke} = GHG_{conc} \cdot V_{flue,dry}$$

$$GHG_{conc} = (a_{CO_2} + b_{CO}) \cdot \frac{44}{22.4 \cdot 1000}$$

$E_{total,coke}$ .....overall CO_2 emissions from coke burned off in t CO_2

GHG_{conc} .....greenhouse gas (CO_2) concentration in the dry flue gas in g/Nm³

[11] Article 16(2)(g) AVR: "*where a measurement based methodology referred to in Article 21(1) of Regulation (EU) No 601/2012 is applied by an operator, the measured values using the results of the calculations performed by the operator in accordance with Article 46 of that Regulation*"

$V_{flue,dry}$ .....calculated annual volume of the dry flue gas (see calculation below) in Nm³

aCO_2 .....measured carbon dioxide content in dry flue gas in % by volume

bCO .....measured carbon monoxide content in dry flue gas in % by volume

The volume flow rate of the flue gas to be used in the equation above is usually not measured, thus it must be calculated by a balance. In the regeneration, the coke-loaded catalyst is regenerated by an air supply and all combustible constituents are converted to CO_2, CO, H_2O, NO_x and SO_2. The calculation of the amount of dry flue gas from the amount of air supplied is done according to the following formula, assuming a constant inert gas content of 79.07% by volume:

$$V_{\text{flue,dry}} = \frac{79.07}{100 - a_{\text{CO}_2} - b_{\text{CO}} - c_{\text{O}_2} - d_{NO_x} - e_{SO_2}} \cdot V_{\text{air, dry}}$$

$V_{air,\ dry}$.....volume of dry air supplied in Nm³

aCO_2 .....measured carbon dioxide concentration in dry flue gas in % by volume

bCO .....measured carbon monoxide concentration in dry flue gas in % by volume

cO_2 .....measured oxygen concentration in dry flue gas in % by volume

dNO_x .....measured NO_x concentration in dry flue gas in % by volume

eSO_2 .....measured SO_2 concentration in dry flue gas in % by volume

A prerequisite for the balance shown is that coke contains hardly any nitrogen compounds or they are converted into NO_x (which is usually the case). Furthermore, if NO_x and SO_2 cannot be determined individually in the flue gas at reasonable cost, conservative estimates for those concentrations should be assumed.

In any case, the necessary 'balancing', according to the equations above, has to be done outside the AER template in a separate document. Nevertheless, it is recommended to provide relevant calculation steps in a comment box in the AER template. The values to be entered in sheet D of the template for the calculation of emissions are:

- *GHG_{conc}* as the 'annual hourly average concentration' under a), letter i., and
- *$V_{flue,dry}$*, expressed as the 'annual hourly average flue gas flow" (converted to the average flow in Nm³/h) under a), letter v.

Option 2 (alternative application of a mass balance)

As an alternative, where other methods or standards than those mentioned in Article 42 of the MRR are applied and subject to the Competent Authorities approval of this approach, emissions may be reported in the Annual Emissions Report under mass balance source streams in sheet C. By this, it is assumed that e.g. the flue gas is a source stream, expressed as the annual amount of kNm³ with a carbon content determined by following the provisions of Articles 32 to 35.