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REPUBLIC OF TÜRKİYE
MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

Promoting Enhanced EU ETS Alignment in Türkiye's Emerging ETS:

This activity is part of the European Union Climate Dialogues Project (EUCDs)

Technical session with focus on EU ETS implementation and management: aluminium sector

Fabio Romani, Matias Franke

November 27th 2024

ghg management institute

kataclima CATALYZING ENERGIES

- Day 1: Introducing the EU ETS regulatory framework → focus on allocation methods and fall-back benchmarks
- Day 2: Technical session with focus on EU ETS iron steel sector
- Day 3: Technical session with focus on EU ETS cement sector
- Day 4: Technical session with focus on EU ETS aluminium sector
- Day 5: Technical session with focus on EU ETS electricity and fertilizers

- Reminder on process benchmark
- Aluminium: overview of product benchmarks
- Product benchmarks on BDR
- Definition and boundaries of production from electrolysis
- From theory to actual implementation: ETS layout of an alluminium plant
- From theory to actual implementation: production data on BDR (activity data, electricity, Prodcom codes, CN codes etc.)
- From theory to actual implementation: emissions at sub-installation level for benchmark update
- From theory to actual implementation: summary and calculation

Standard methodology

1. **Combustion emissions**[36]:

$$Em = AD \cdot EF \cdot OF$$

Where:

Em ...... Emissions [t CO_2]

AD....... Activity data [TJ, t or Nm^3]

EF .... Emission factor [t CO_2/TJ, t CO_2/t or t CO_2/Nm^3]

OF....... Oxidation factor [dimensionless]

2. **Process emissions**[37] are calculated as:

$$Em = AD \cdot EF \cdot CF$$

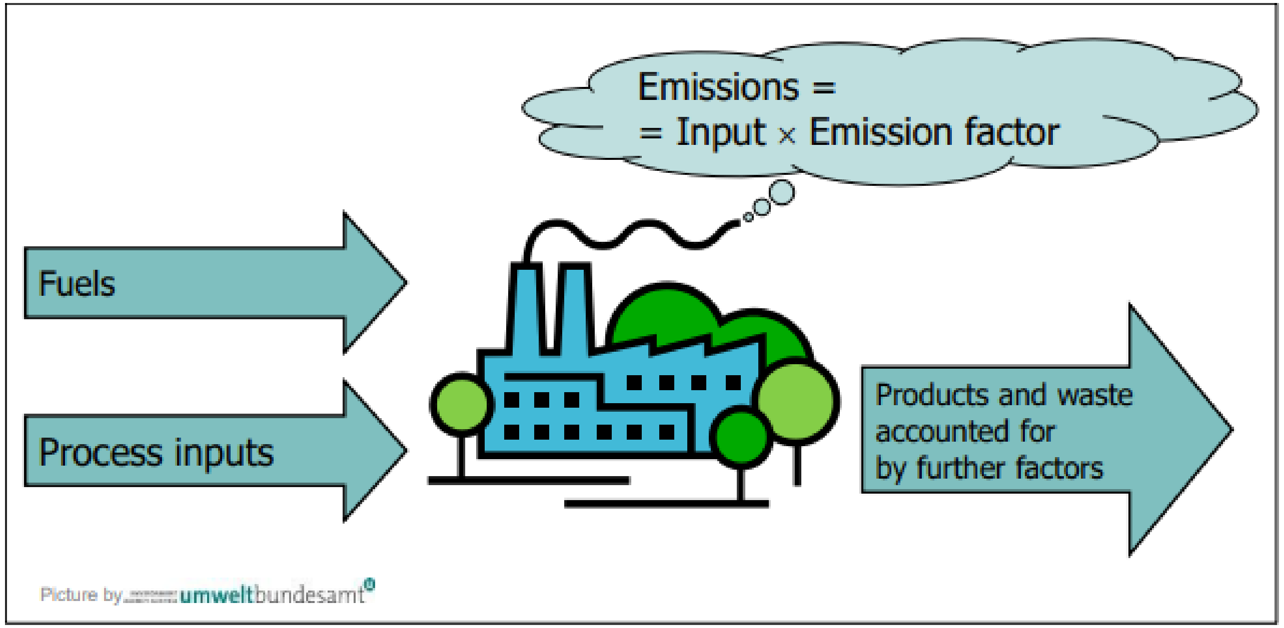
Where:

Em ...... Emissions [t CO_2]

AD....... Activity data [t or Nm^3]

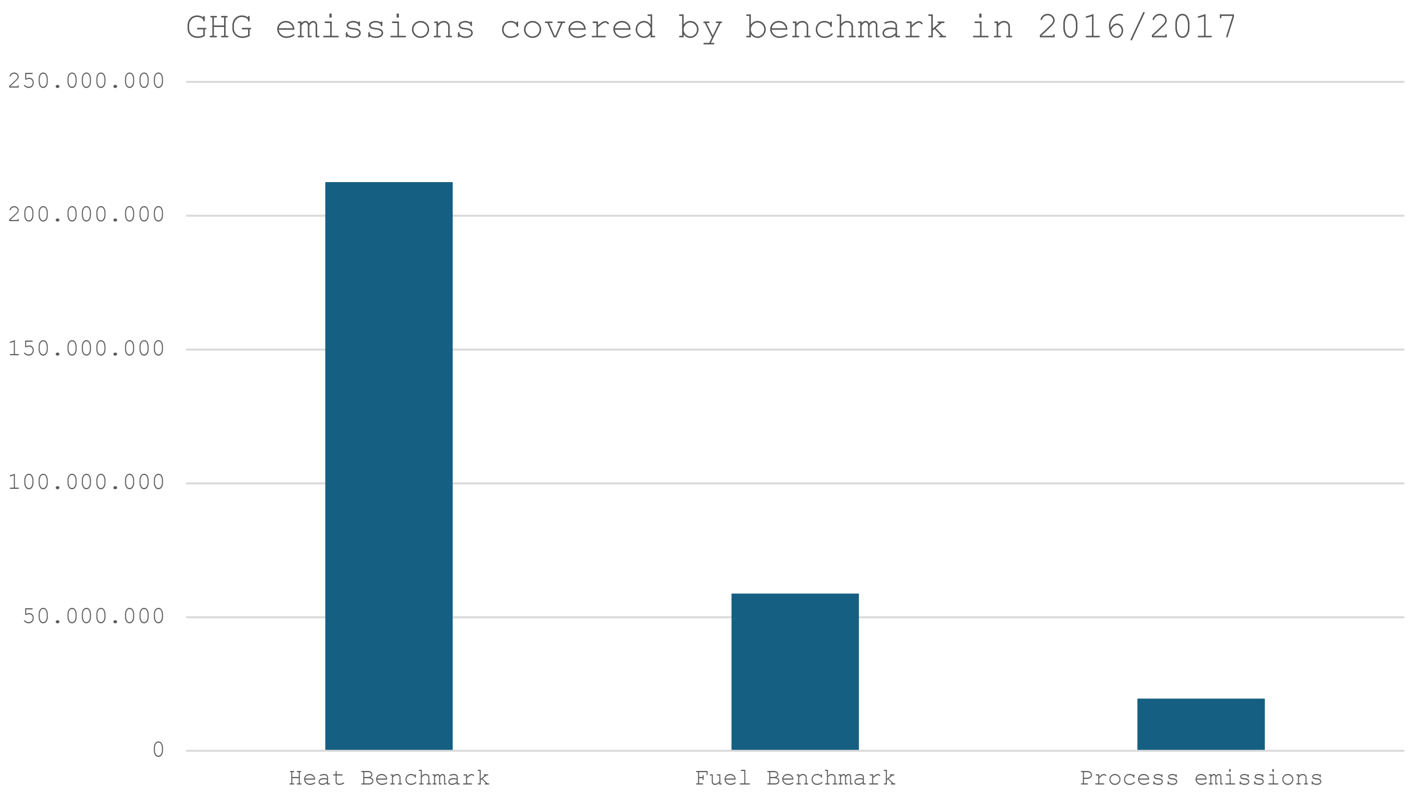
EF .... Emission factor [t CO_2/t or t CO_2/Nm^3]

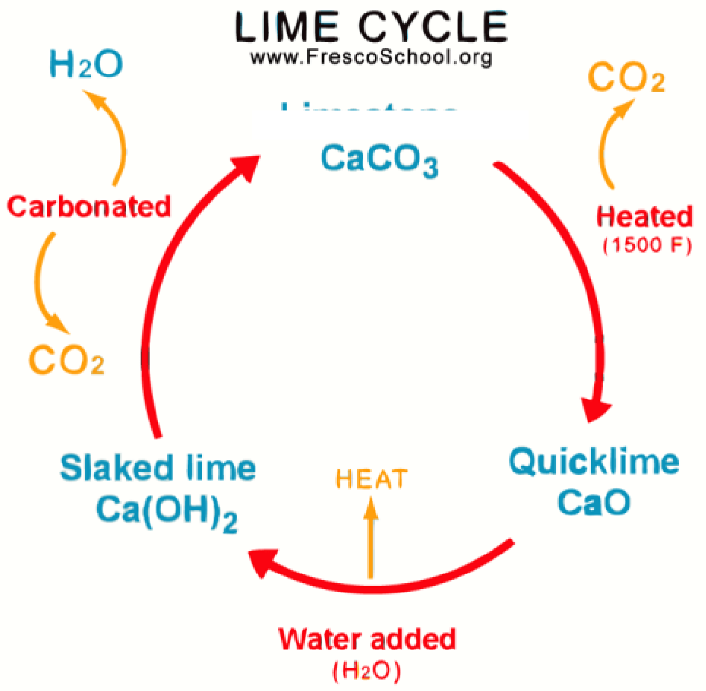
CF....... Conversion factor [dimensionless].



Reminder on process benchmark

Processes Benchmark





Reminder on process benchmark

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Method	Source stream name	Activity Data	AD Unit	NCV	NCV Unit	EF	EF Unit	CO2e fossil (t)
Process Emissions	Lime	821.054,10	t	0,00		0,66	tCO2/t	544.977,2

2. **Process emissions**[37] are calculated as:

$$Em = AD \cdot EF \cdot CF$$

Where:

Em ...... Emissions [t CO_2]

AD .... Activity data [t or Nm^3]

EF .... Emission factor [t CO_2/t or t CO_2/Nm^3]

CF .... Conversion factor [dimensionless].

$$Emissions = 821054,1\ \mathbf{t}\ \ x\ 0,66\ \frac{tCO_2}{t} = 544.977,2\ tCO_2$$

Method	Source stream name	Activity Data	AD Unit	NCV	NCV Unit	EF	EF Unit
Process Emissions	Clinker and cement	947.738	t	-		0,54	tCO2/t
Process Emissions	Raw meal (carbon not derived from carbonates) TOC	1.159.964	t	-		0,00	tCO2/t
Process Emissions	CKD (Cement Kiln Dust)	23.693	t	-		0,06	tCO2/t

Reminder on process benchmark

Processes Emissions

greenhouse gas emissions other than combustion emissions occurring as a result of intentional and unintentional reactions between substances or their transformation, for a primary purpose other than the generation of heat, including from the following processes:

(a) ***the chemical, electrolytic or pyrometallurgical reduction of metal compounds in ores,*** *concentrates and secondary materials for a primary purpose other than the generation of heat;*

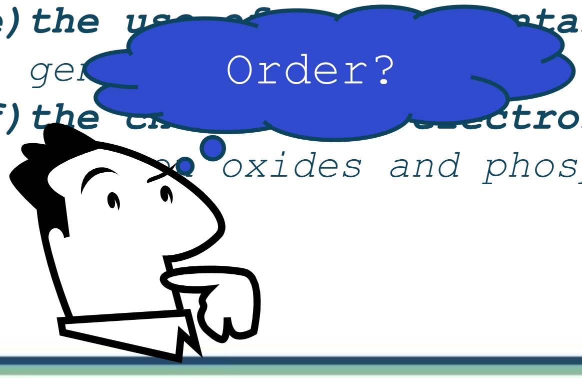
(b) ***the removal of impurities from metals and metal compounds*** *for a primary purpose other than the generation of heat;*

(c) ***the decomposition of carbonates,*** *excluding those for flue gas scrubbing for a primary purpose other than the generation of heat;*

(d) ***chemical syntheses of products and intermediate products where the carbon bearing material participates in the reaction,*** *for a primary purpose other than the generation of heat;*

(e) ***the us… taining additives or raw materials*** *for a primary purpose other than the ge…*

(f) ***the ch… lectrolytic reduction of metalloid oxides or non-metal oxides*** *such as … oxides and phosphate*



1) *Product Benchmark*
2) *Heat Benchmark*
3) *Fuel Benchmark*
4) *Process emissions*

Reminder on process benchmark

Process emissions sub-installation

The preliminary annual number of emission allowances allocated free of charge for a given year shall correspond to the process-related historical activity level multiplied by:

- *0,97 for the years until 31 December 2027*
- *0,91 for the years 2028 and onwards.*

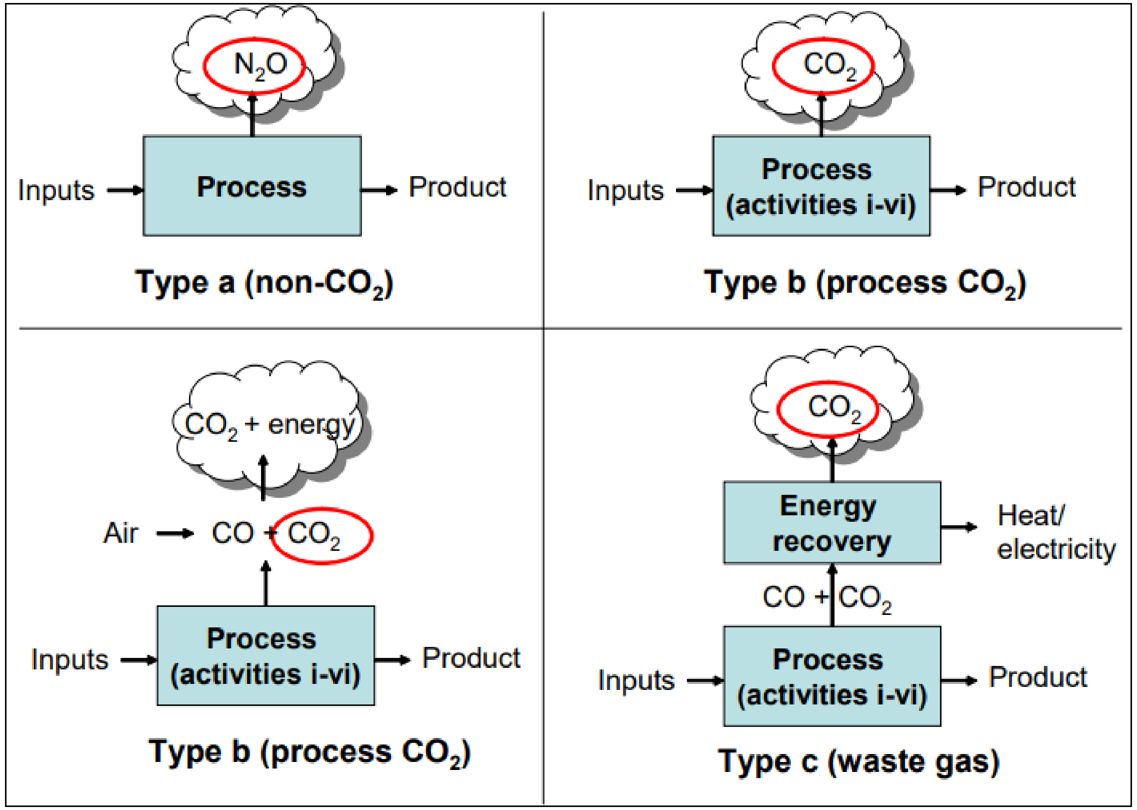


Figure 1 Overview of process emissions sub-installations (the emissions covered by the sub-installations are marked by the red ellipses; the bottom-left box illustrates the example of type b process emissions described in the text)

2.2 Definition of waste gases

The definition of a **waste gas** in Art.2(11) of the FAR states that:

'waste gas' means a gas containing incompletely oxidised carbon in a gaseous state under standard conditions which is a result of any of the processes listed in point (10), where 'standard conditions' means temperature of 273,15 K and pressure conditions of 101 325 Pa defining normal cubic meters (Nm^3) according to Article 3(50) of Commission Regulation (EU) No 601/2012

To be considered a waste gas, a gas must therefore satisfy all of the following three conditions:

1. Contain incompletely oxidised carbon;
2. Be in a gaseous state under standard conditions;
3. Occur as a result of one of the processes listed in the definition of process emissions.

Carbon reacts with oxygen according to the following chemical equations:

$C + O_2 \rightarrow CO_2$ (completely oxidised)

$2\,C + O_2 \rightarrow 2\,CO$ (incompletely oxidised)

Incompletely oxidised carbon may also consist of partially oxidised organic products according to the following (simplified) reaction:

$C_xH_y + zO_2 \rightarrow CO_2 + CO + C + C_mH_nO_o + H_2 + H_2O$

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3. Occur as a result of one of the processes listed in the definition of process emissions.

***Meeting condition 2*: Be in a gaseous state under standard conditions**

This means that the waste gas must be in a gaseous state under standard conditions. This does not exclude that fractions of the organic material in the waste gas might condense under these conditions. The sum of the fractions should on average not exceed 10 weight percent of the total gas. However, if any part of the waste gas is condensated and separated from the waste gas, this part ceases to be considered (part of) a waste gas.

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Reminder on process benchmark

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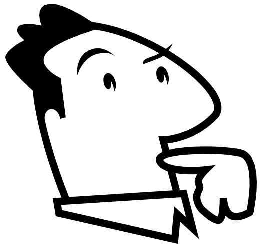

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Reminder on process benchmark

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

Prosses Emissions

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(b) ***the removal of impurities from metals and metal compounds*** *for a primary purpose other than the generation of heat;*

(c) ***the decomposition of carbonates,*** *excluding those for flue gas scrubbing for a primary purpose other than the generation of heat;*

(d) ***chemical syntheses of products and intermediate products where the carbon bearing material participates in the reaction,*** *for a primary purpose other than the generation of heat;*

(e) ***the us*** … ***ining additives or raw materials*** *for a primary purpose other than the ge* …

(f) ***the*** … ***ectrolytic reduction of metalloid oxides or non-metal oxides*** *such as* … *oxides and phosphate*

Reminder on process benchmark

Or……. .

In other words, the process emissions sub-installation can be any of the following, when the emissions occur within an ETS installation, but outside the boundaries of a product benchmark:

Type a) Non-CO_2 greenhouse gas emissions (i.e. N_2O for specific sectors; see Annex I of the Directive for the list of activities for which N_2O emissions are included in the EU ETS for Phase 4)

Type b) CO_2 emissions from any of the activities listed in this definition [(a) to (f)]

Type c) Emissions from the combustion of incompletely oxidised carbon such as CO emitted by any of these activities [(a) to (f)], if it is combusted to produce heat or electricity. Only emissions which are **additional** to the emissions that would occur if natural gas was used are taken into account. In calculating the additional emissions, the "technically usable energy content" should be considered. Compared to other fuels, most waste gases have a higher emission intensity and can therefore be used less efficiently compared to other fuels. A correction therefore needs to be applied for the difference in efficiencies between the use of waste gas and the use of natural gas as reference fuel.

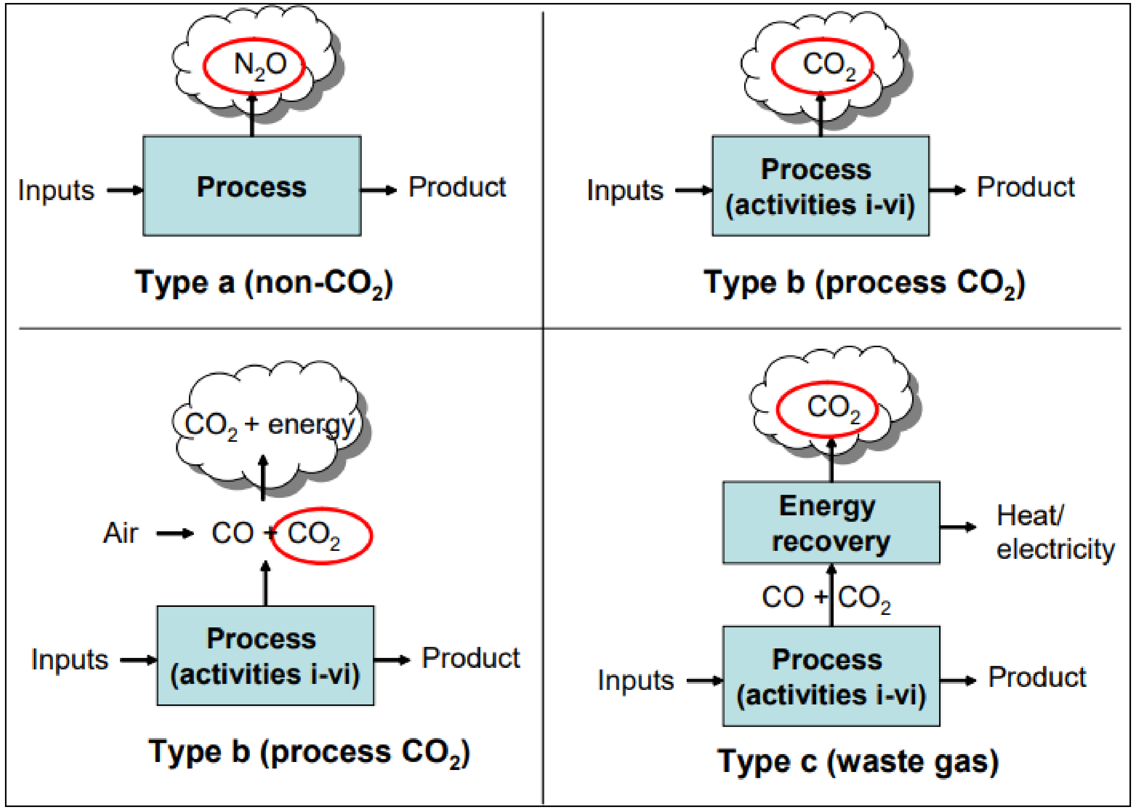
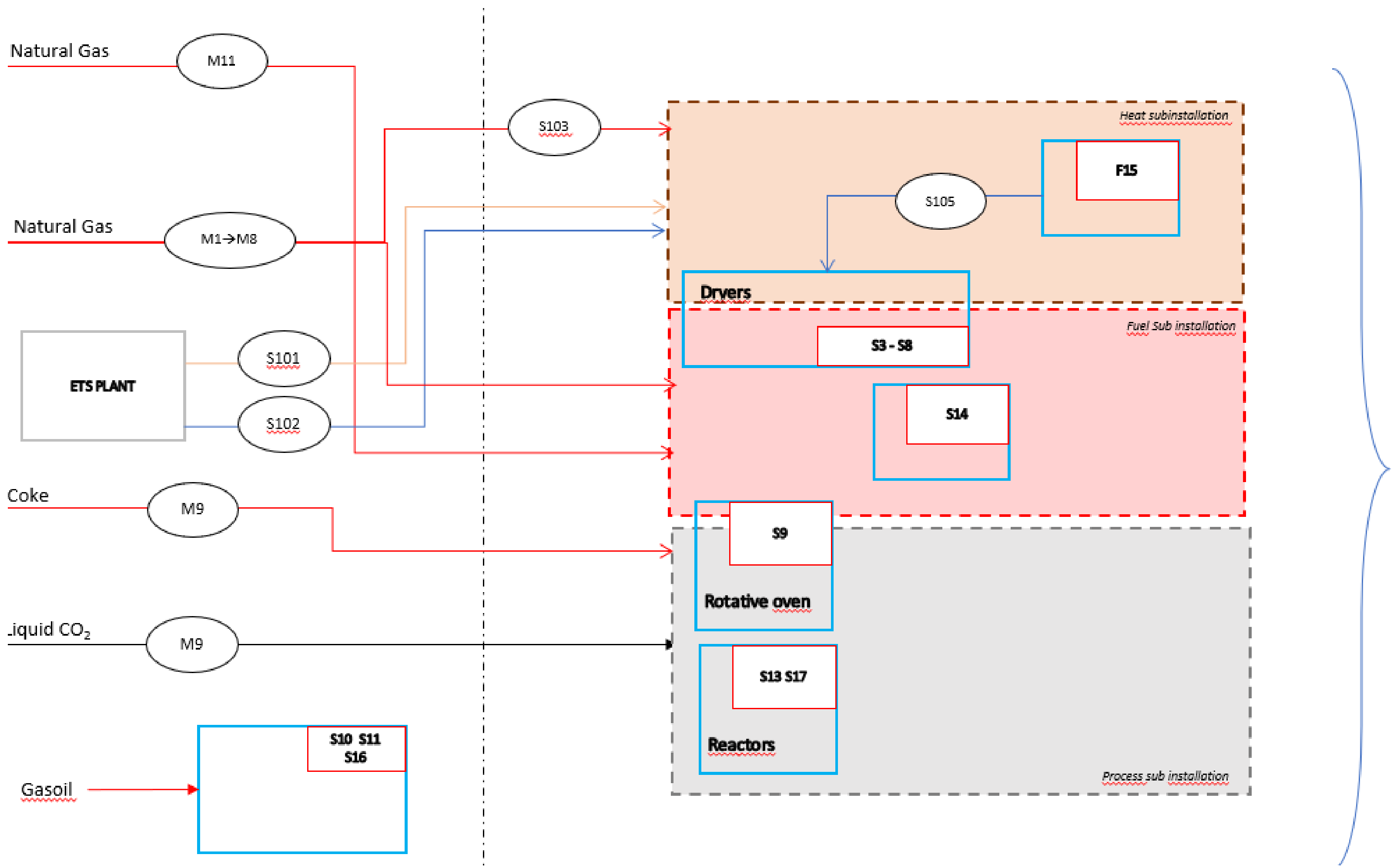


Figure 1 **Overview of process emissions sub-installations (the emissions covered by the sub-installations are marked by the red ellipses; the bottom-left box illustrates the example of type b process emissions described in the text)**

Reminder on process benchmark



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G. Sheet "Fall-back" - SUB-INSTALLATION DATA RELATING TO FALL-BACK SUB-INSTALLATIONS

The navigation bar above only contains links to sub-installations that are selected as "relevant" in section A.III.2.

I Historic Activity levels and disaggregated production details

8 Fall-Back sub-installation: **Process emissions sub-installation (CL | non-** | **relevant**

Please enter data in this section!

Detailed instructions for data entries in this tool can be found at the first copy of this tool. (G.I.1)

(a) Historic activity levels

Values entered here should include eligible emissions from any waste gases as determined in section D.IV.

Main activity level:	Unit	2019	2020	2021	2022	2023
Process emissions sub-installation (CL | non-CBAM)	t CO2e	81.559	62.373	76.695	72.962	61.615

BDR

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G. Sheet "Fall-back" - SUB-INSTALLATION DATA RELATING TO FALL-BACK SUB-INSTALLATIONS

The navigation bar above only contains links to sub-installations that are selected as "relevant" in section A.III.2.

I Historic Activity levels and disaggregated production details

Production details

(b) Identification of relevant products or services associated with this sub-installation

This type of sub-installation always relates to production of goods not covered by product benchmarks within the installation.

	Process emission type	Product name or service type	PRODCOM 2010	CN codes
1	chemical synthesis	Barium Carbonates	20134390	2836 60 00
2	chemical synthesis	Strontium Carbonates	20134390	2836 92 00
3	chemical synthesis	Calcium Carbonates	20134340	2836 50 00
4				
5				
6				
7				
8				
9				
10				

(c) Production levels:

	Product name or service type	Unit	2019	2020	2021	2022	2023
1	Barium Carbonates	t	15.602,14	11.026,61	17.311,71	14.230,76	7.833,97
2	Strontium Carbonates	t	271,44	448,39	0,00	639,75	620,99
3	Calcium Carbonates	t	744,38	300,90	537,48	226,08	361,26
4							
5							
6							
7							
8							
9							
10							
	Sum of production levels		16.617,96	11.775,90	17.849,19	15.096,59	8.816,22

Reminder on process benchmark

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IV Sub-installation data relevant for allocation and benchmark update purposes

Calculation of the indicative number of allowances

The following abbreviations are used in the tables below:

CL-exposed	*Carbon leakage exposure. "True" if the sub-installation serves a sector deemed to be exposed to a significant risk of carbon leakage.*
CBAM	*CBAM coverage (Annex I of Regulation (EU) 2023/956). "True" means the sub-installation is covered by CBAM.*
No. of BM	*Number of the Benchmark*
Started	*Start of operation of the sub-installation*
BM value	*Value of the benchmark according to Annex I of the FAR. For the draft preliminary application, values used are either the indicative minimum or the maximum values as shown included in each sub-installation's overview table below.*
15(7).3?	*Is the third sub-paragraph of Article 15(7) of the FAR relevant (i.e. has the sub-installation been operated less than one year in the baseline period)?*
non-ETS heat	*Amount to be deducted from the preliminary annual amount of allowances in accordance with Article 21 of the FAR*

18 Fall-Back sub-installation 8: **Process emissions sub-installation (CL | non-CBAM)** **relevant**

	CL-exposed	Started	15(7).3?		No. of BM	BM value (min/max/actual)	
Process emissions sub-installation (CL | non-CE	VERO	00/01/1900	FALSO		8	0,97	EUA/t CO2e
	CBAM					0,97	EUA/t CO2e
	FALSO						EUA/t CO2e

	Unit	2019	2020	2021	2022	2023	
HAL (Historic activity level) reported	t CO2e	81.559	62.373	76.695	72.962	61.615	Median
Values used for HAL calculation:	t CO2e	81.559	62.373	76.695	72.962	61.615	72.962

HAL total	Prelim Alloc Year 1 (min)	Prelim Alloc Year 1 (max)	Prelim Alloc Year 1 (actual)
72.962 t CO2e / year	**70.773** EUA / year	**70.773** EUA / year	EUA / year

	Unit	2019	2020	2021	2022	2023
Total attributed emissions	**t CO2e/year**	**81.559,00**	**62.372,99**	**76.694,86**	**72.962,22**	**61.614,75**

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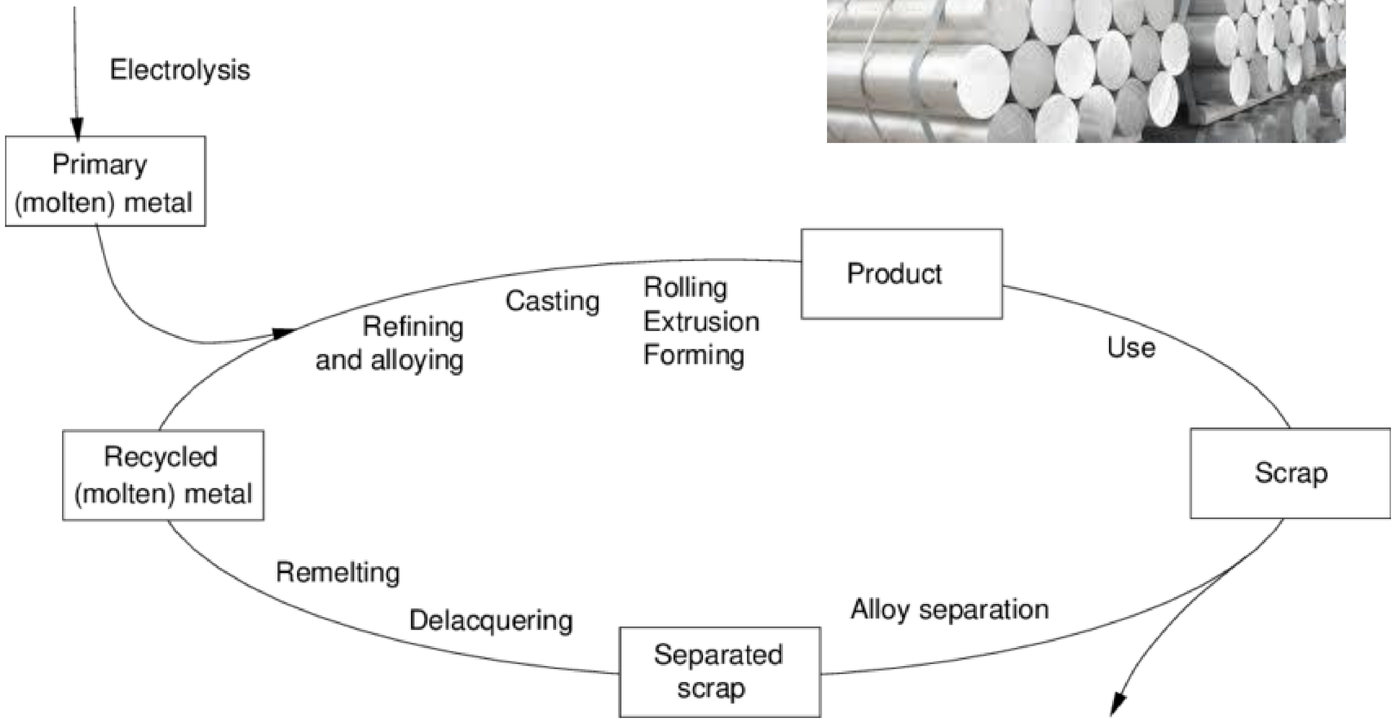
Aluminum: overview of product benchmarks

Aluminium is highly recyclable ***without any loss of quality****, and recycling helps conserve energy and natural resources, reducing the demand for primary aluminium production.*

Recycled aluminium accounts for 60.3% of produced raw aluminium in Europe.

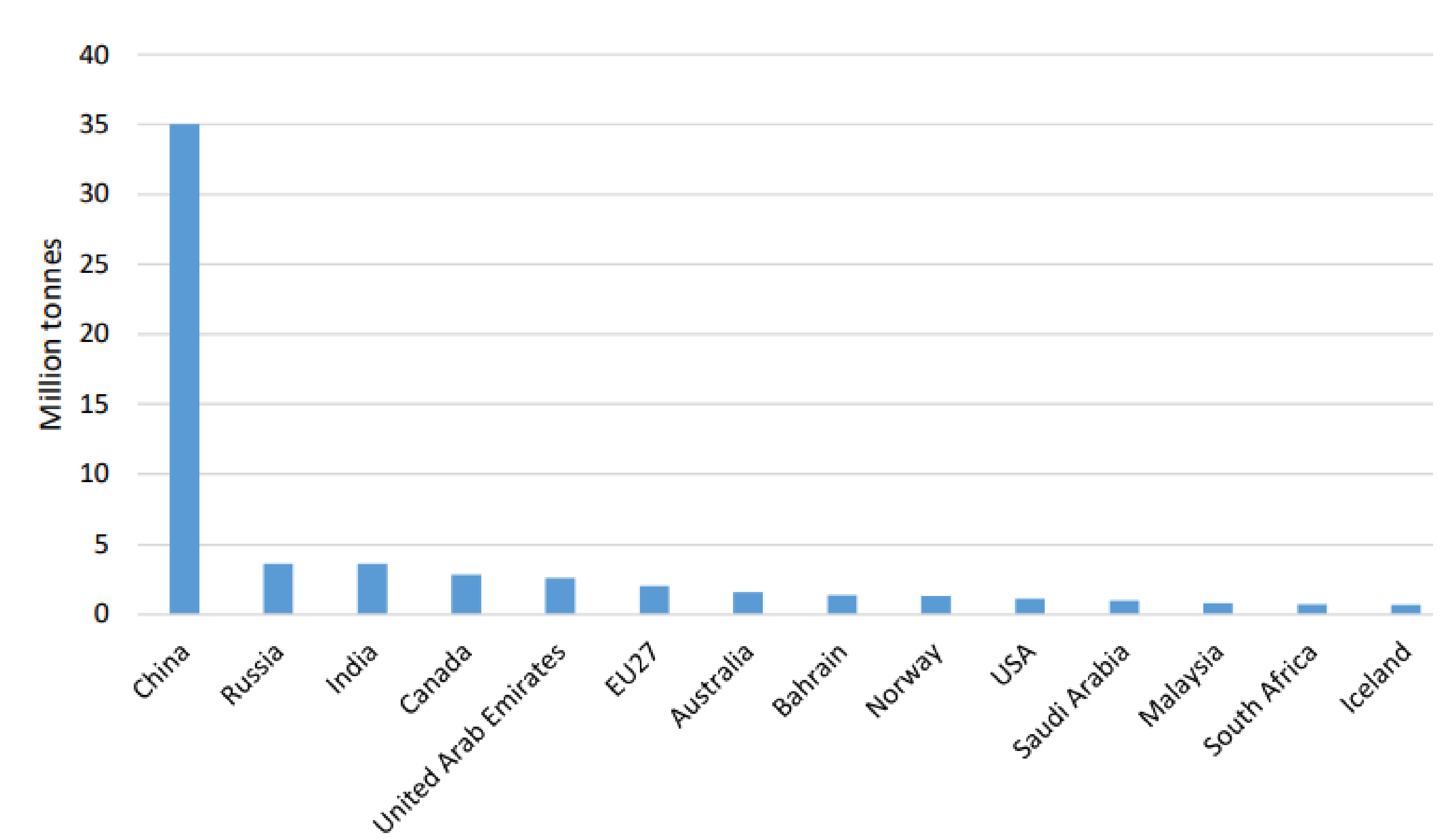
Recycling rates in the automotive and building sectors are over 90%, while aluminium beverage cans have a recycling rate of 76%.

Europe has the highest recycling efficiency rate of any region in the world, recycling 81% of the aluminium scrap potentially available in the region



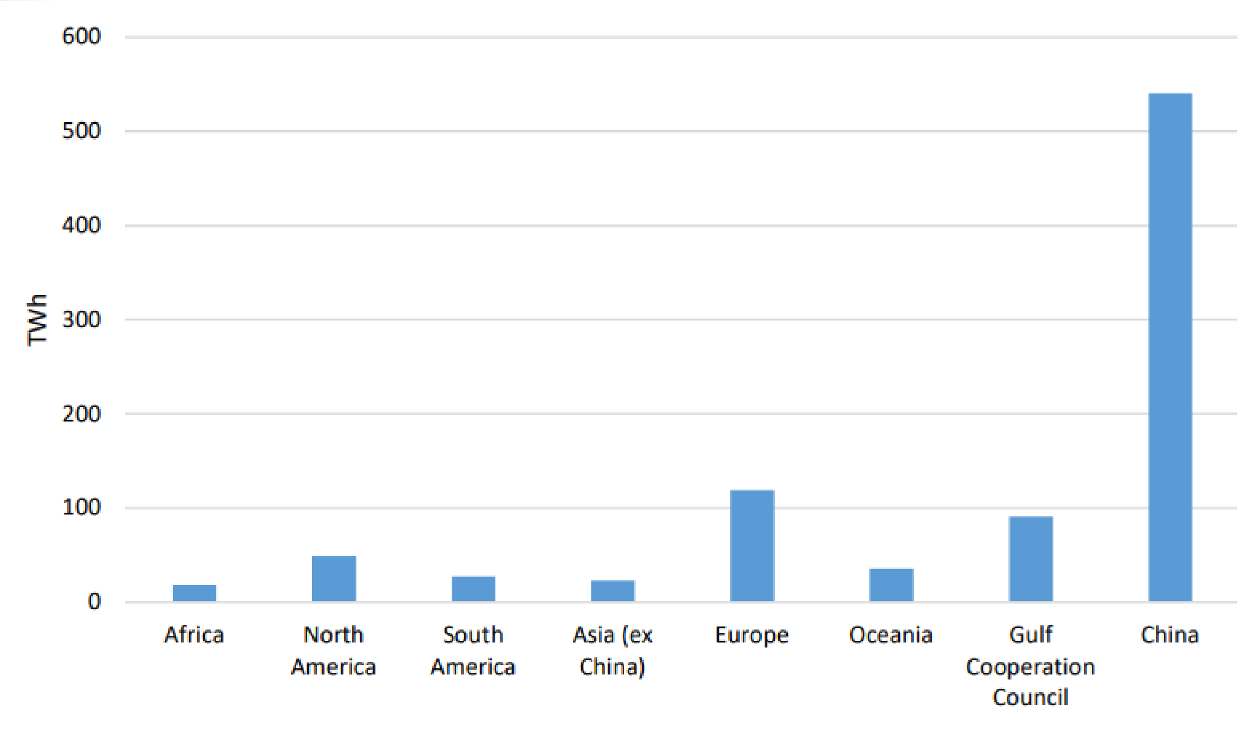
Aluminum: overview of product benchmarks

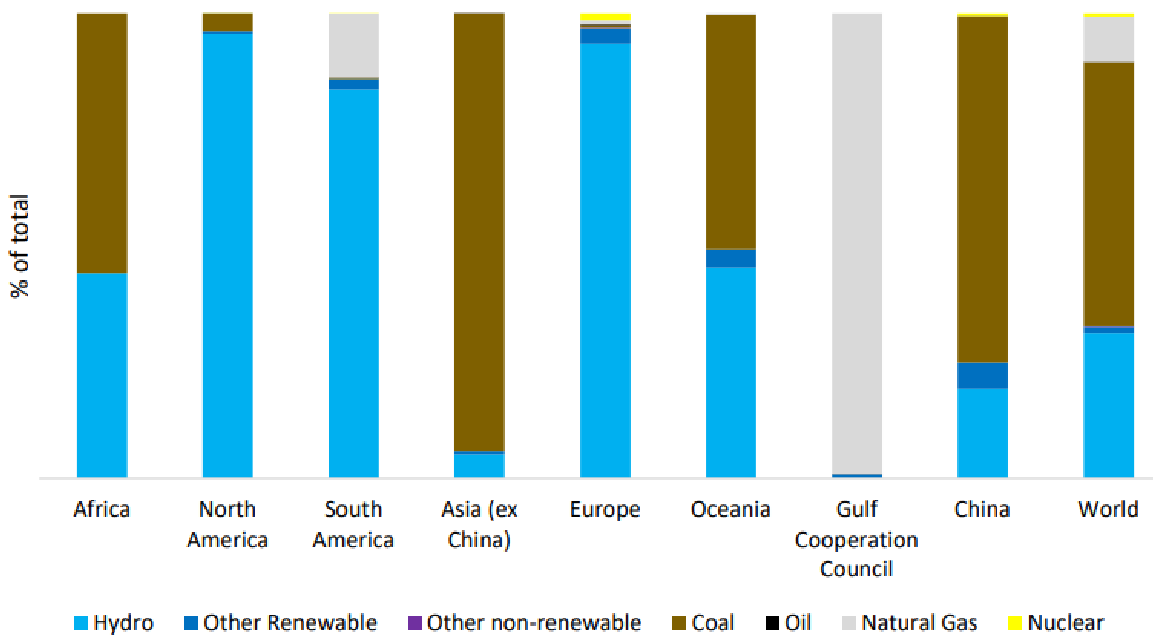
Production of Primary aluminium



Aluminum: overview of product benchmarks

Energy consumption Primary aluminium





Source: JRC based on (International Aluminium, 2023d)

Aluminum: overview of product benchmarks

Primary aluminium production is conducted in basically two process steps:

1. production of the intermediate product aluminium oxide or alumina (Al_2O_3) in the Bayer chemical process
2. conversion to aluminium by electrolysis.

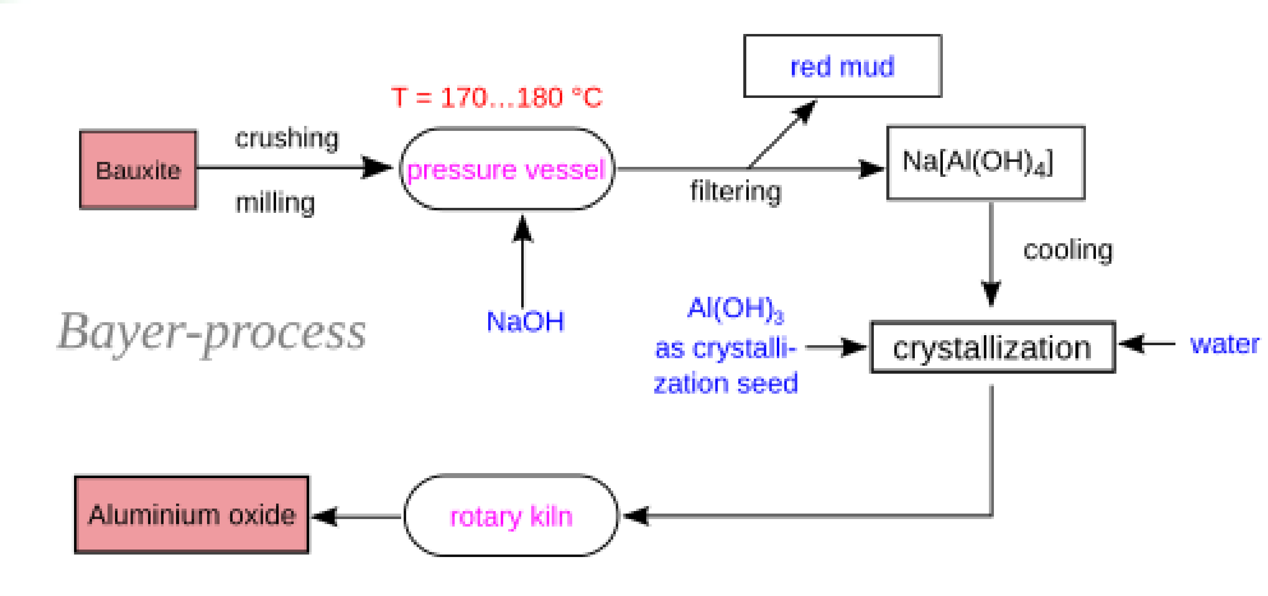


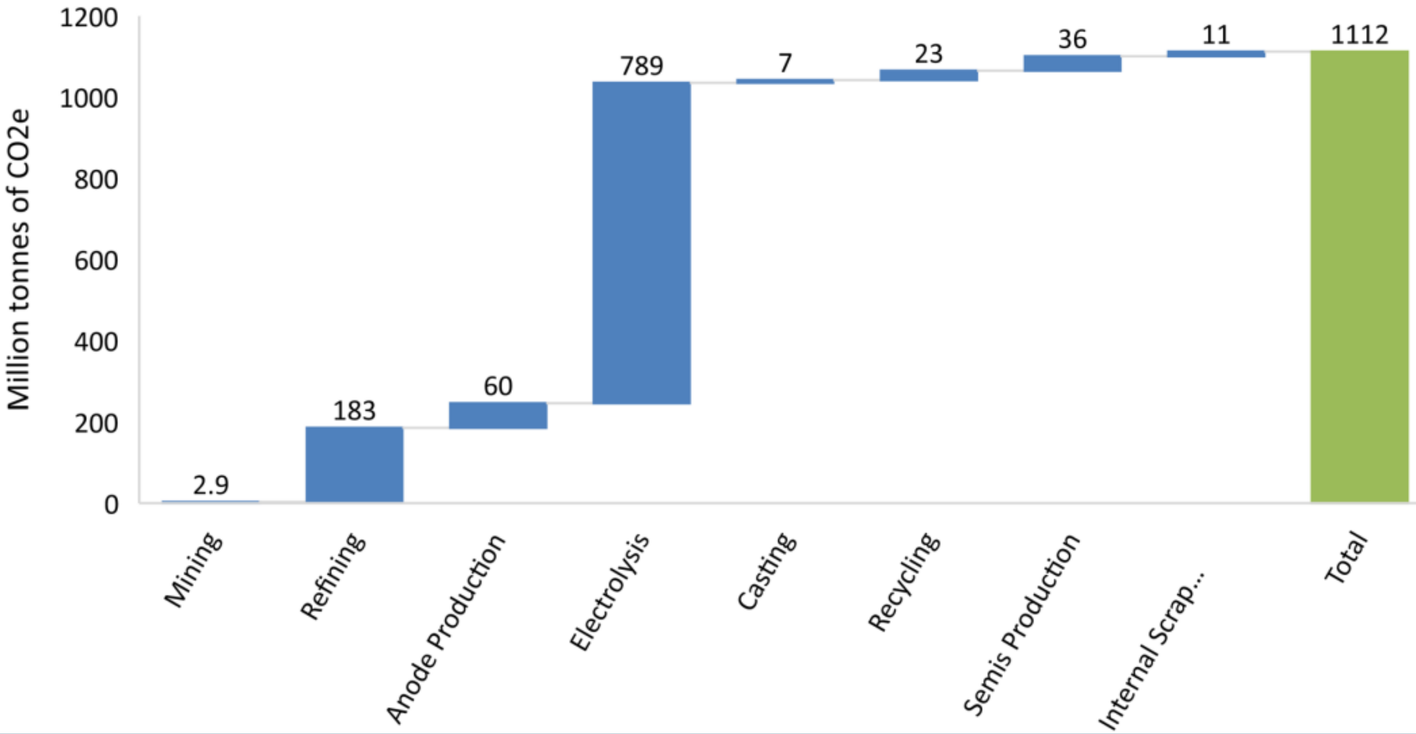
Figure 8. Location of EU alumina refineries.

Aluminum: overview of product benchmarks

In the case of **primary aluminium production,** CO_2 emissions are related to fuel combustion and anode consumption, and PFC emissions are related to anode effects.

In secondary aluminium productions CO_2 emissions are related to fuel consumption.

PFC emissions: Gases to be taken into consideration are CF_4 and C_2F_6.



The Hall-Héroult process is the primary method used for the production of aluminium metal from alumina

The main steps of the Hall-Héroult process are:

1. the process takes place in an **electrolytic cell**. The cell is divided into two compartments by a carbon lining called the "cell cathode."
2. the electrolyte used in the process is a molten salt mixture, mainly composed of **cryolite (Na_3AlF_6) and aluminium fluoride (AlF_3)**. This mixture reduces the melting point of alumina, making the process more energy-efficient.
3. Anodes and cathodes: carbon blocks, which act as anodes, are suspended above the cell cathode. Alumina is fed into the cell and settles on the cell cathode. As the alumina melts, it dissolves in the electrolyte.
4. Electrolysis: when an electric current is passed through the cell, electrolysis takes place.

At the anode (carbon), oxygen ions from the alumina combine with carbon to form carbon dioxide gas:

$$2Al_2\ O_3 \rightarrow 4Al_3 + 6O_2$$

$$3C + 3O_2 \rightarrow 3CO2 + 6e$$

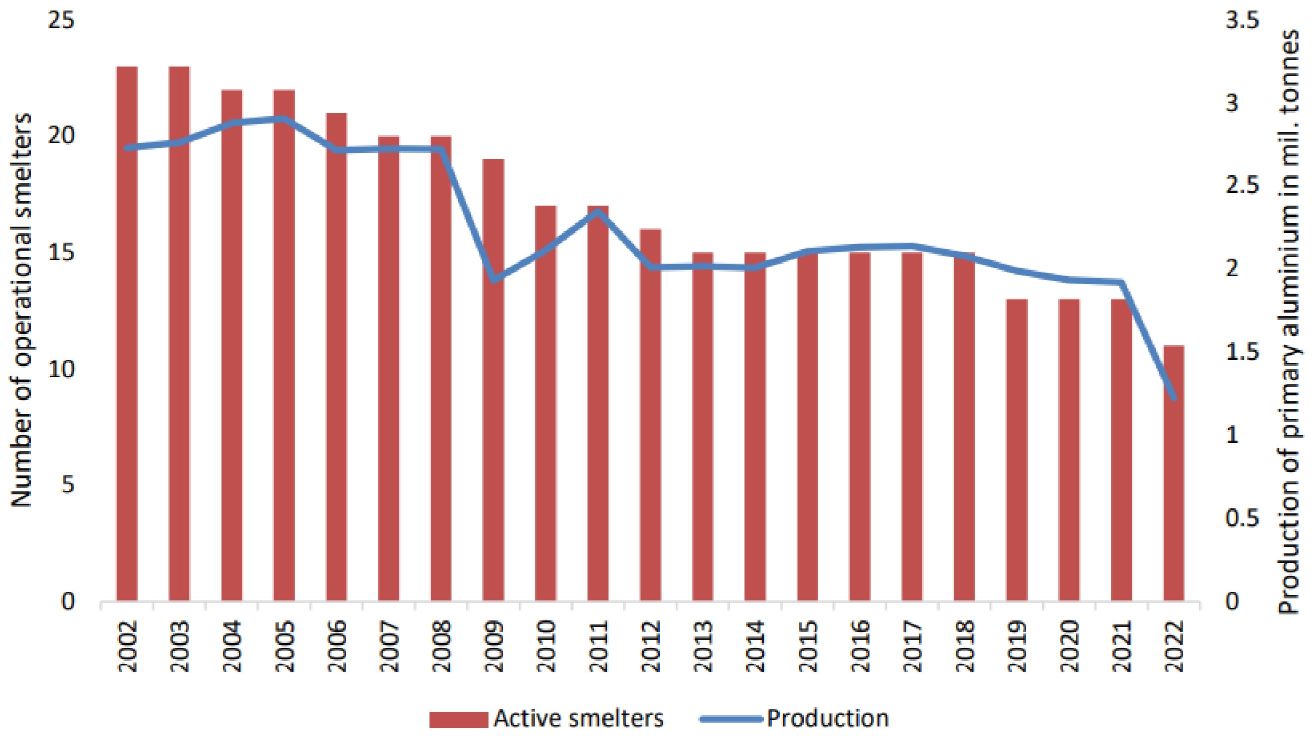
At the cathode (cell lining), aluminium ions from the alumina gain electrons and form molten aluminium:

$$4Al_3 + + 12e^- \rightarrow 4Al \text{ (molten)}$$

5. Molten aluminium collection

Aluminum: overview of product benchmarks

Figure 9. Primary aluminium production quantity and number of active smelters in the EU.



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4 Further installation data:

(a) Activities according to Annex I of the EU ETS Directive:

This information is important for the competent authorities because changes compared to previous ETS phases may have taken place.

To the extent feasible, please sort the list with regard to the direct emissions, starting with the activity causing the highest direct emissions.

Number	Name of activity (Annex I of the ETS Directive)	Total rated thermal input (MW)
1	Production or processing of ferrous metals (including ferro-alloys) where combustion units with a total rated thermal input exceeding 20 MW are operated. Processing includes, inter alia, rolling mills, re-heaters, annealing furnaces, smitheries, foun	
2	Production of primary aluminium or alumina	
3	Production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated	

No.	Product type	<average of 10% best?	>80% performer?	Start of operation	CL exposed?	CBAM?
1	Pre-bake anode				VERO	FALSO
2	[Primary] Aluminium				VERO	VERO

8. Pre-bake anode

Benchmark name:	Pre-bake anode
Benchmark number:	8
Unit:	Tonnes of pre-bake anode
Carbon leakage exposure:	Yes (CLEF to be used is 1)
Under the CBAM scope:	No (CBAM factor to be used is 1)
Associated Annex I activity:	Production of primary aluminium or alumina
Special provisions:	-

No PPRDCOM code

Anodes for aluminium electrolysis use consisting of petrol coke, pitch and normally recycled anodes, which are formed to shape specifically intended for a particular smelter and baked in anode baking ovens to a temperature of around 1150°C. Söderberg anodes are not covered by this product benchmark

The production of Söderberg anodes should be covered by fall-back approaches.

9. Aluminium

Benchmark name:	**Aluminium**
Benchmark number:	9
Unit:	Tonnes of unwrought non-alloy liquid aluminium Reference point for the measurement of the amount unwrought non-alloy liquid aluminium is between the electrolysis section and the holding furnace of the cast house before alloys and secondary aluminium are added.
Carbon leakage exposure:	Yes (CLEF to be used is 1)
Under the CBAM scope:	Yes (CBAM factor of the relevant year is to be used)
Associated Annex I activity:	Production of primary aluminium or alumina

Unwrought non-alloy liquid aluminium from electrolysis. Expressed in tonnes measured between the electrolysis section and the holding furnace of the cast house, before alloys and secondary aluminium are added.

All processes directly or indirectly linked to the production step electrolysis are included. Emissions resulting from holding furnaces and casting, and emissions related anode productions are excluded

PRODCOM code	**Description**
24.42.11.30	Unwrought non-alloy aluminium (excluding powders and flakes)

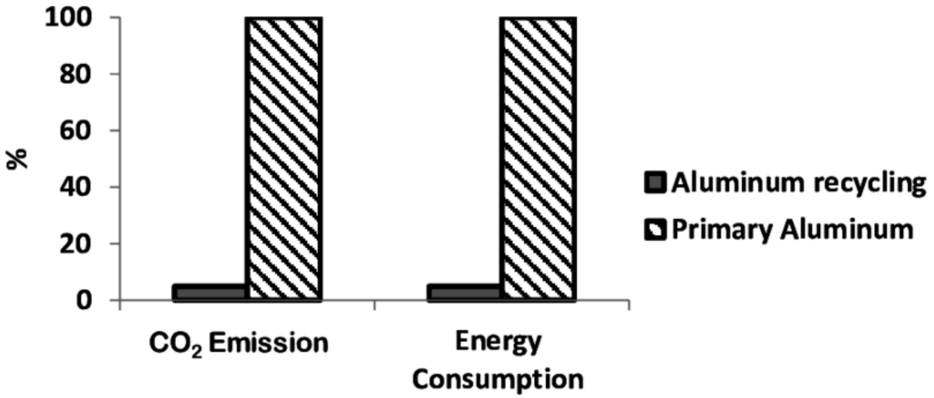
Emissions included:

- *CO_2 emissions resulting from the reaction between the carbon anode oxygen from the alumina*
- *CO_2 emissions resulting from the reaction of the carbon anode with other sources of oxygen, primarily from air*
- *All formed carbon monoxide is assumed to be converted to CO_2.*
- *Two PFCs, CF_4 and C_2F_6 emissions formed during brief upset conditions known as the "Anode Effect", when aluminia levels drop to low and the electrolytic bath itself undergoes electrolysis.*

*The **anode effect** is a process upset condition, where an insufficient amount of alumina is dissolved in the electrolyte bath. This causes the voltage in the pot to be elevated above the normal operating range, resulting in the emission of gases containing the PFCs tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6).*

For secondary aluminium production…

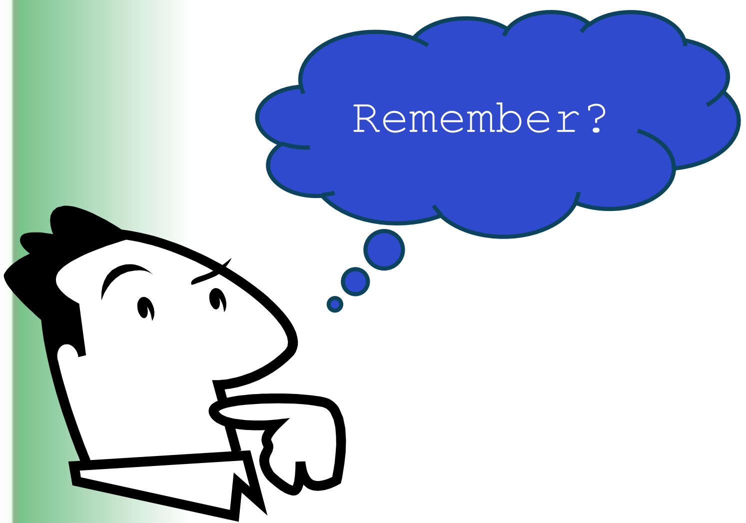
- There is no product benchmark
- The activity level is related to the fuel use
- Emissions are related with combustion of fuels and process emissions



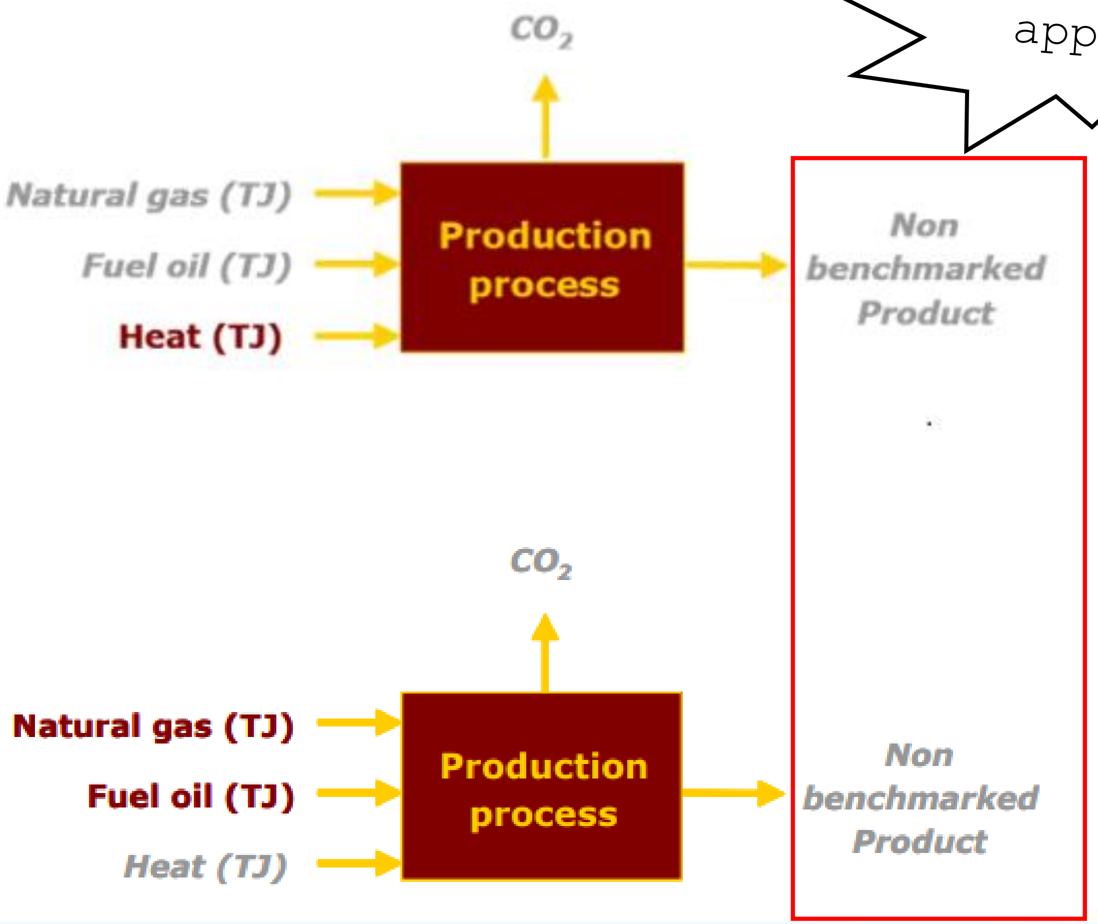
Focus on fall-back approaches fuel benchmark

Necessary for fall back approache s

Heat and fuel sub-install



Fuel sub-installatic



Focus on fall-back approaches: fuel benchmark

Recapping

FAR – Definitions

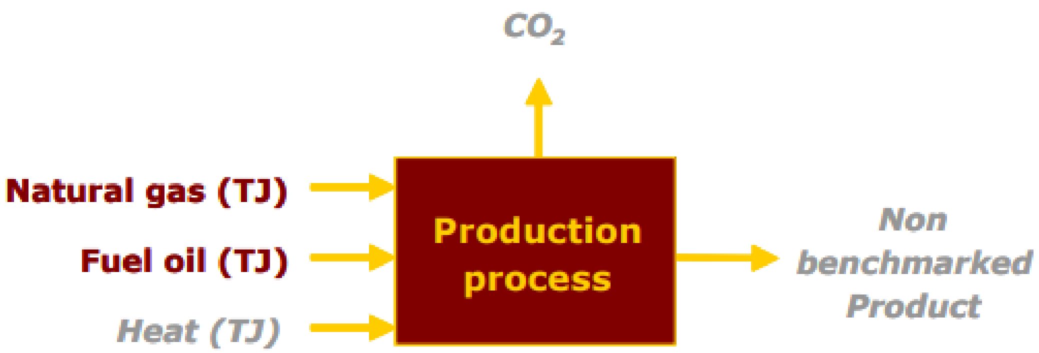
1. **Product benchmark sub-installation** means inputs, outputs and corresponding emissions relating to the production of a product for which a benchmark has been set in Annex I;

2. **Heat benchmark sub-installation** means inputs, outputs and corresponding emissions not covered by a product benchmark sub-installation relating to the production other than produced from electricity, the import from an installation covered by the EU ETS, or both, of measurable heat;

3. **Fuel benchmark sub-installation** means inputs, outputs and corresponding emissions not covered by a product benchmark sub-installation, relating to the production of non-measurable heat by fuel combustion consumed for the production of products, for the production of mechanical energy other than used for the production of electricity, for heating or cooling with the exception of the consumption for the production of electricity, including safety flaring.

Focus on fall-back approaches: fuel benchmark

Fuel sub-installation



The secondary aluminium production is typically counted in a fuel sub-installation

Focus on fall-back approaches: fuel benchmark

$F_{f,k} = BM_f \times HAL_f \times CLEF_{f,k} \times CBAM_{f,k}$

Where:

- $\boldsymbol{F_{f,k}}$ Preliminary annual allocation for the sub-installation in year k (expressed in EUAs/yr);
- $\boldsymbol{BM_f}$ Fuel benchmark; set at XX EUAs / TJ;
- $\boldsymbol{HAL_f}$ Historical activity level, i.e., the median annual consumption of energy of the sub-installation in the baseline period as determined and verified in the baseline data collection (expressed in TJ/yr);
- $\boldsymbol{CELF_{f,k}}$ Carbon Leakage Exposure Factor for the fuel sub-installation in year k.
- $\boldsymbol{CBAM_{f,k}}$ Carbon Border Adjustment Mechanism Factor for the fuel sub-installation in year k, if relevant.

Combustion of fuels

Information of "combustion of fuels" (not fuel benchmark) published a week ago…

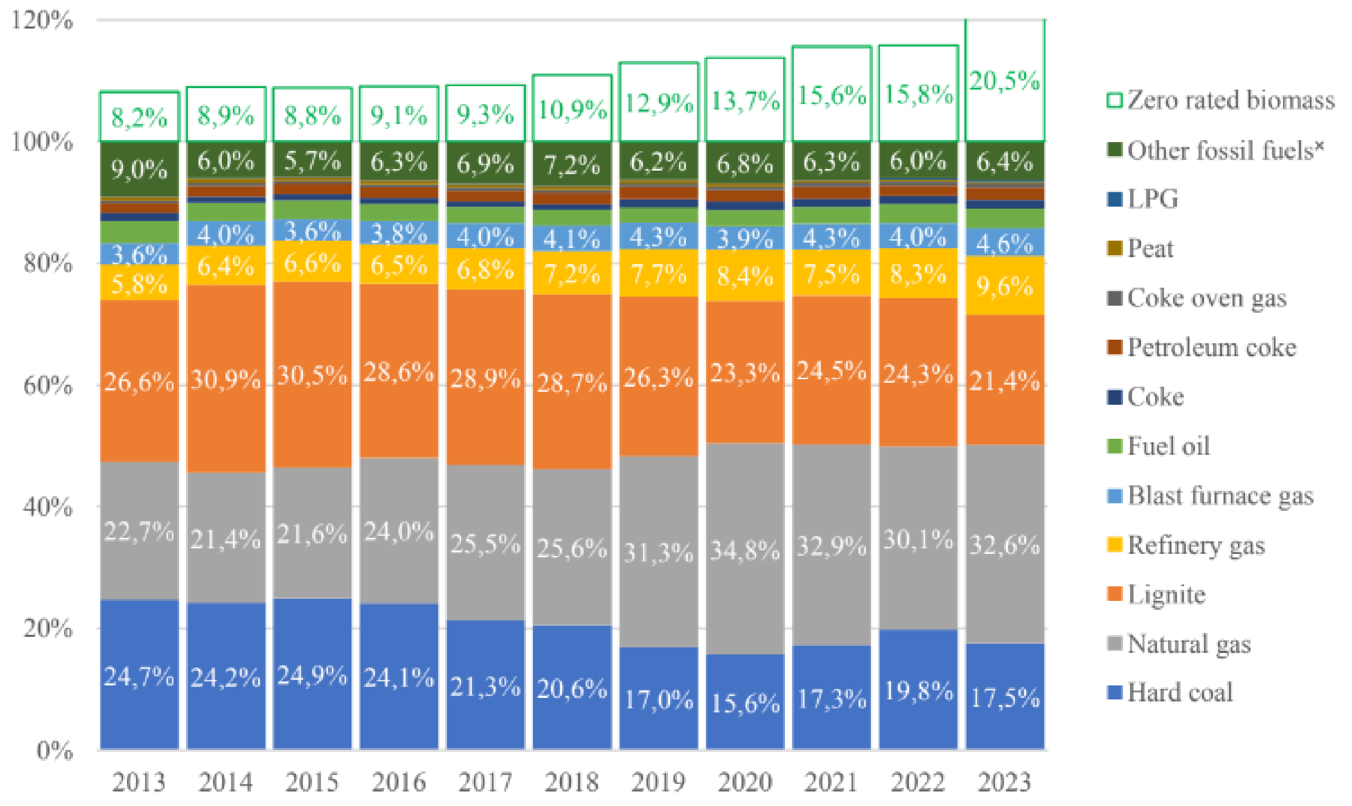


Figure 6. Trend in the share of emissions from the combustion of different fuels in installations covered by the EU ETS (2013-2023). Labels show the %-share of installations' total combustion emissions. Labels are not shown if emissions from the combustion of a particular fuel never exceed a 3%-share.

- ➢Reminder on process benchmark
- ➢Aluminium: overview of product benchmarks
- ➢Product benchmarks on BDR
- ➢Definition and boundaries of production from electrolysis
- ➢From theory to actual implementation: ETS layout of an alluminium plant
- ➢From theory to actual implementation: production data on BDR (activity data, electricity, Prodcom codes, CN codes etc.)
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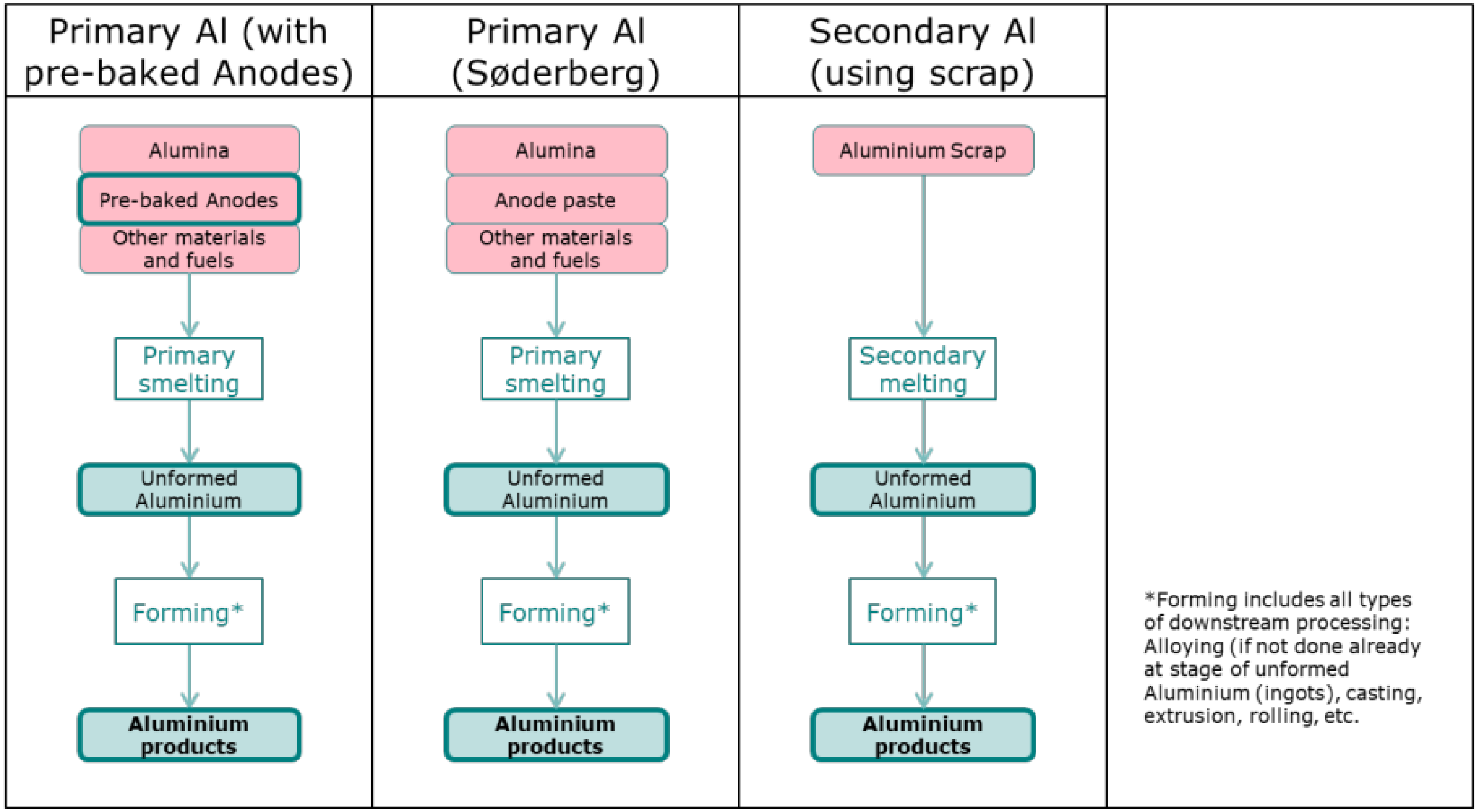
Funded by the European Union

Production from electrolysis

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

imary aluminium cell systems vary according to the type of anode used…

System boundaries and value chain of aluminium products

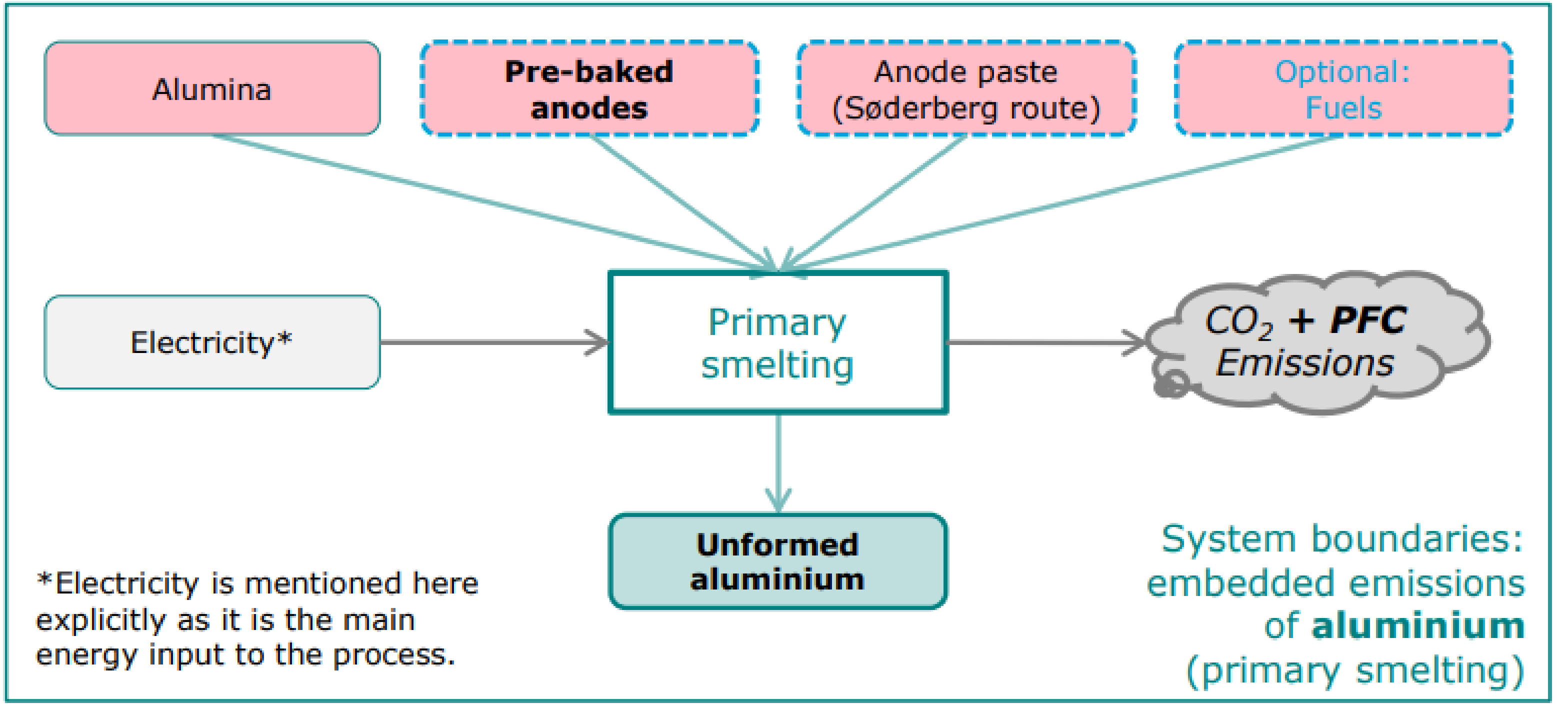


Production from electrolysis

The 'Pre-baked' electrolytic cell *uses multiple pre-baked carbon anodes that must be regularly replaced.*

The 'Søderberg' electrolytic cell *uses a single continuous carbon anode, which is self baked in situ within the cell by means of the heat released during the electrolytic process within the smelter; 'green' anode paste briquettes are added at the top while the anode is consumed at the bottom.*

Unwrought aluminium – Primary smelting



Production from electrolysis

The anode effect

ing the 1990s, the industry came to realise that perfluorocarbon gases formed during anode effects (primarily CF_4 and to a lesser extent C_2F_6) were potent and detrimental greenhouse gases.

$$Na_3AlF_6 + 3/4C \Rightarrow Al + 3NaF + 3/4CF_4$$
$$Na_3AlF_6 + C \Rightarrow Al + 3NaF + +1/2C_2F_6$$

There are several causes of anode effects, including:

1. ***Accumulation of Impurities:*** *Accumulation of impurities, such as metals or oxides, on the surface of the anode can interfere with the normal reaction and lead to reduced current efficiency.*

2. ***Variations in Electrolyte Composition:*** *Changes in the composition of the electrolyte, such as an excess of alumina or other impurities, can disrupt the anode reaction and trigger an anode effect.*

3. ***Variations in Voltage:*** *Rapid fluctuations in cell voltage, often due to operational changes, can induce anode effects.*

4. ***Electrode Configuration:*** *In Söderberg cells, where anodes are made in the own smelter from a pastelike mixture, variations in the paste composition can lead to localised anode effects.*

5. ***Electrode Wear:*** *Gradual wear of the anode surface over time can expose new areas of carbon, leading to local variations in reaction rates and potential anode effects.*

Production from electrolysis

Aspect	Søderberg (Self-Baking)	Pre-Baked
Anode Type	Continuous; baked in situ by heat from the process.	Pre-baked before installation.
Replacement	Continuous; green paste added at the top.	Periodic; requires process interruption.
Advantages	More cost-effective and continuous.	Better process control.
Disadvantages	Higher risk of emissions and anode effect.	Higher operational costs.

Inert anodes could reduce almost all emissions arising from the smelting process and increase the smelting efficiency by 25%.

Secondary aluminium

Secondary aluminium production involves the recycling of used aluminium products and scrap to create n aluminium alloys and products.

1/5 → *of the global aluminium supply today*

5 % → *of the energy required for primary aluminium production*

35 % → *global recycling rate* → *Although it varies a lot by region – 60.3% in Europe, 60.1% in South America, 58.4% in North America, 55.9% in Asia (ex. China), 24.7% in China*

Scrap and post-consumer scrap…

New scrap *refers to aluminum waste or scrap generated during the manufacturing process before the product reaches the consumer.*

Advantages:

- *characteristics that facilitate efficient processing and segregation.*
- *easily separated into their respective alloy types*
- *they typically lack attachments or contaminants*
- *reducing the risk of introducing impurities into the recycling process*

Post-consumer scrap *refers to aluminum products that have already been used by consumers and are then discarded after their life cycle. It is also known as "end-of-life" scrap.*

varying lifespans: *ranging from as short as a few weeks for used beverage cans to approximately 12 years for sources like automotive parts. In some cases, such as construction materials, the life span can extend beyond 30 years.*

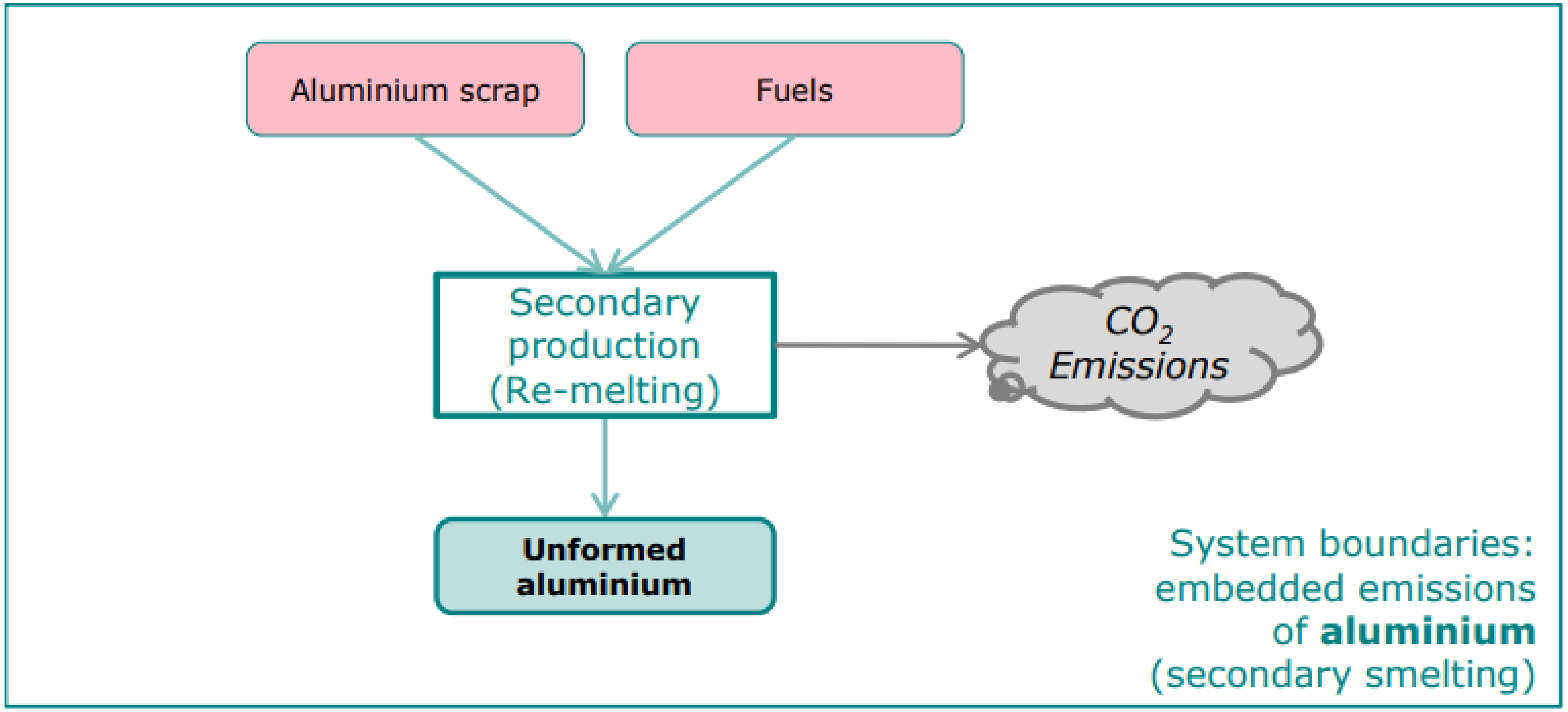
Recycling rate of 60.3% in Europe

In 2021

- *30.7% was new scrap, while*
- *69.3% was post-consumer scrap*

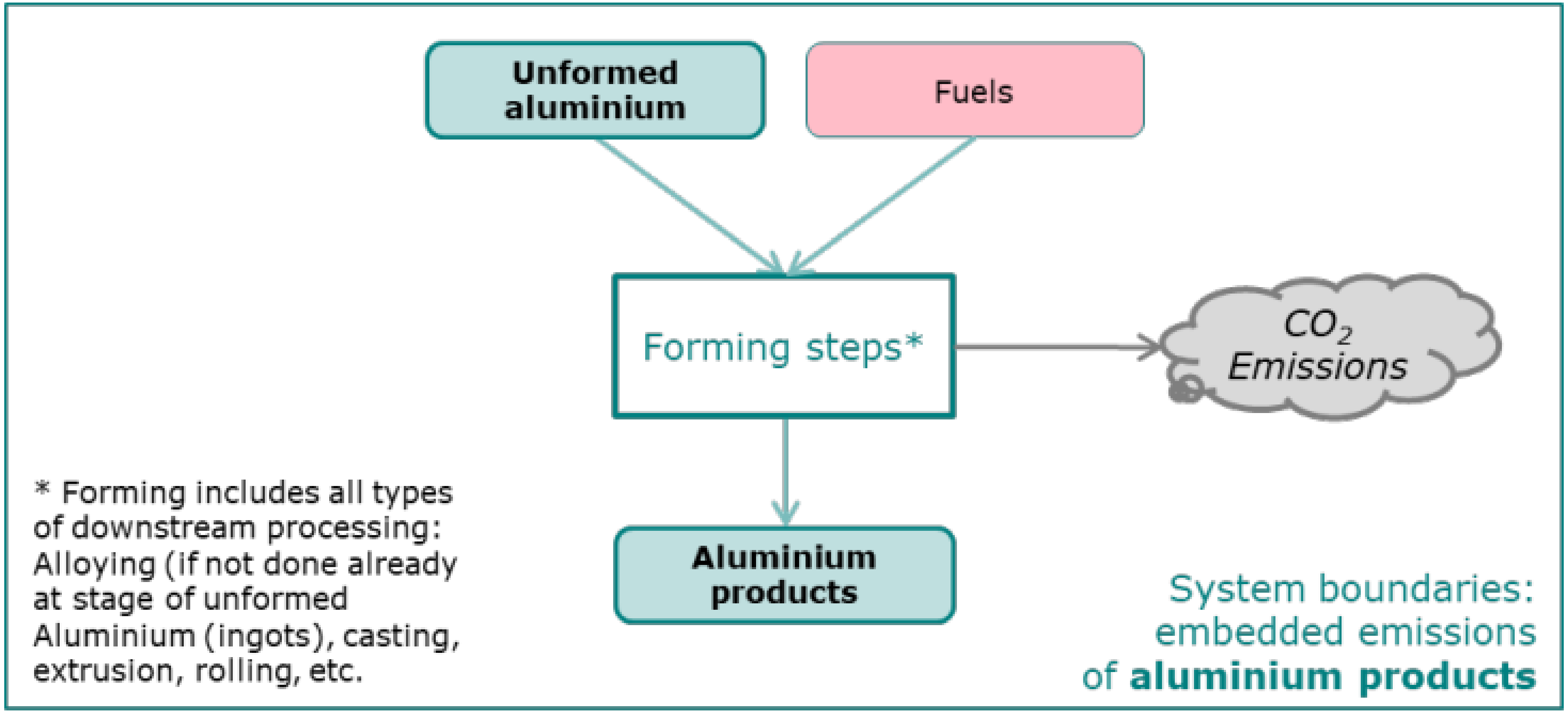
Secondary aluminium

Unwrought aluminium – Secondary melting



Secondary aluminium

Aluminium products production process



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(secondary alluminium)

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A. Sheet "InstallationData" - GENERAL INFORMATION ON THIS REPORT

I Identification of the Installation

4 Further installation data:

(a) Activities according to Annex I of the EU ETS Directive:

This information is important for the competent authorities because changes compared to previous ETS phases may have taken place.

To the extent feasible, please sort the list with regard to the direct emissions, starting with the activity causing the highest direct emissions.

Number	Name of activity (Annex I of the ETS Directive)	Total rated thermal input (MW)
1	Production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated	225,3027

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2 Sub-installations with fall-back approaches

Please indicate here which fall-back sub-installations are relevant at your installation, if any:

For each type of fall-back approach, a maximum of three sub-installations may exist, subject to the carbon leakage and CBAM status.

As an exception to that rule, for measurable heat a fourth sub-installation is defined for the delivery of district heating.

The CBAM status of the sub-installation depends on whether the CN codes of the goods produced are listed in Annex I of Regulation (EU) 2023/956.

Please select for each type of sub-installation, if it is relevant in your installation or not. Don't leave the yellow fields empty.

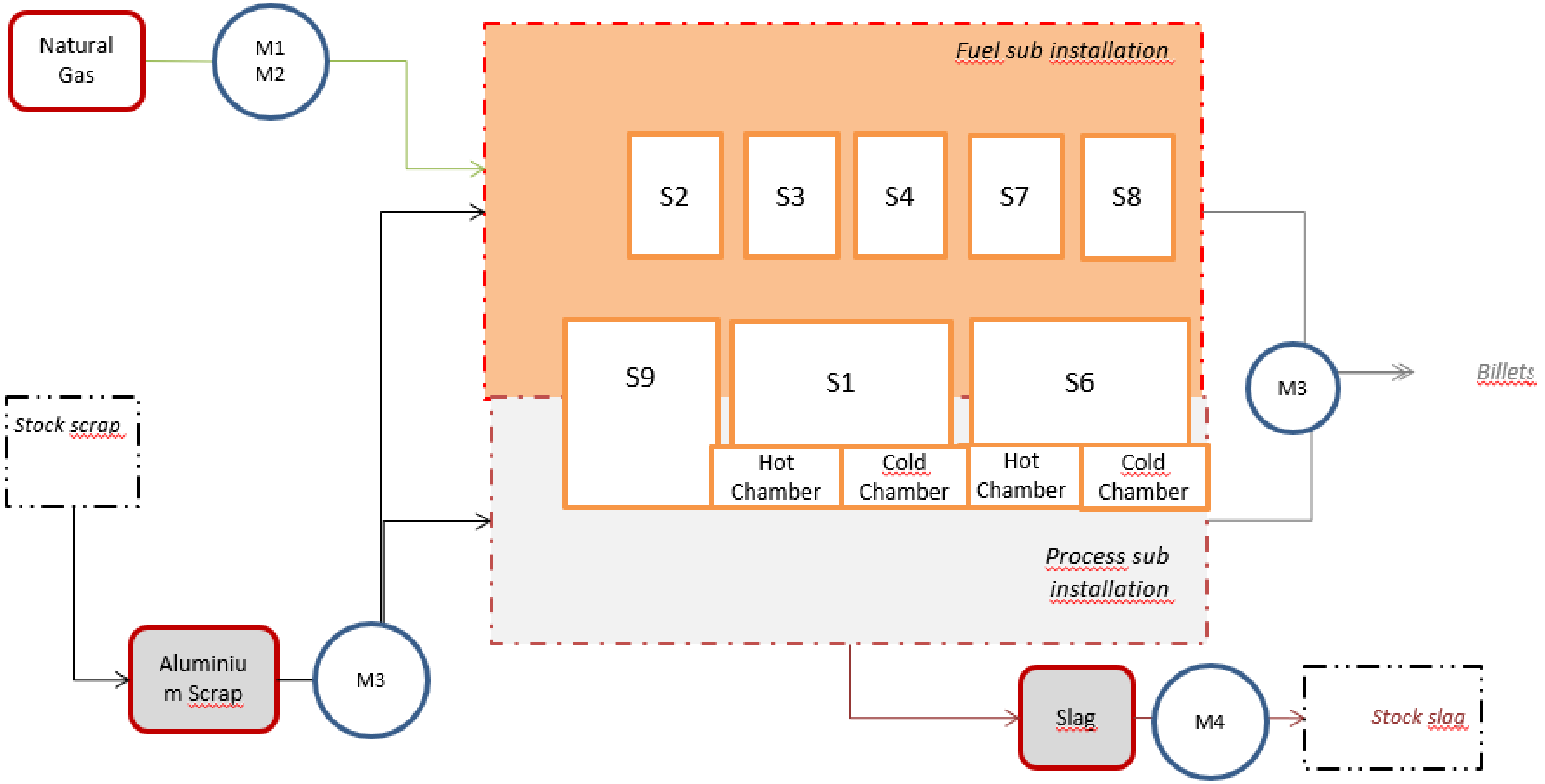
In column I please indicate whether the relevant sub-installation had greenhouse gas emission levels below the average of the 10 % most efficient for the relevant benchmark in 2021/2022. Please note that this question can only be answered after the updated benchmark values will have been determined. Until then this column is greyed out. Please therefore follow the instructions of your competent authority after the initial submission of this baseline data report.

In column K you have to provide the start of normal operation pursuant to Article 2(12) of the FAR for each sub-installation. This information is relevant to identify which years have to be taken into account for the determination of the historic activity level pursuant to Article 15(7) in sheets F and G. This input is only relevant if the sub-installation, has started operation on 1 January 2019 or thereafter.

Please note that the correct entries here are essential for all subsequent inputs dealing with sub-installations.

No.	Sub-installation type	<average of 10% best?	relevant?	Start of operation	CL exposed?	CBAM?
11	Heat benchmark sub-installation (CL | non-CBAM)		FALSO		VERO	FALSO
12	Heat benchmark sub-installation (non-CL | non-CBAM)		FALSO		FALSO	FALSO
13	Heat benchmark sub-installation (CL | CBAM)		FALSO		VERO	VERO
14	District heating sub-installation		FALSO		FALSO	FALSO
15	Fuel benchmark sub-installation (CL | non-CBAM)		FALSO		VERO	FALSO
16	Fuel benchmark sub-installation (non-CL | non-CBAM)		FALSO		FALSO	FALSO
17	Fuel benchmark sub-installation (CL | CBAM)		VERO		VERO	VERO
18	Process emissions sub-installation (CL | non-CBAM)		FALSO		VERO	FALSO
19	Process emissions sub-installation (non-CL | non-CBAM)		FALSO		FALSO	FALSO
20	Process emissions sub-installation (CL | CBAM)		VERO		VERO	VERO

ETS layout of an alluminium plant



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B+C Sheet "Annual Emissions Data" for the Year: 2019

I General guidance for source stream data

Member State requires detailed source stream data generally to be reported mandatorily: VERO

If this is set to "false", entries here are optional and only provide annual total emissions in section D.I.

Please continue with the next points below

II Source streams and emission sources

The tables below are identical to sheet "Accounting" in the Annual Emissions Report template provided by the Commission.

You can therefore copy data for each table from the Annual Emissions Report template without further entries and also find further guidance there.

If the Commission's template is not used in your Member State, or you prefer to enter data manually, each table contains example data at the top (white fields).

Please note that no calculations are made in this sheet. Therefore, totals in columns AU to AY need to be entered correctly as these data will be further used in this template!

Source Streams (excluding PFC emissions)

#	Method	Source stream name	Activity Data	AD Unit	NCV	NCV Unit	EF	EF Unit	C-Content	C-Content Unit
Ex.1	Combustion	Heavy fuel oil	252.000,00	t	45,00	GJ/t	73,00	tCO2/TJ		
Ex.2	Process Emissions	Clay	121.000,00	t			0,09	tCO2/t		
Ex.3	Mass balance	Steel	-1.808.226,00	t			0,00		0,3878	tC/t
1	Combustion	Natural Gas	65.734,96	1000Nm3	36,86	Gj/1000nm3	55,54	tCO2/TJ	0	
2	Combustion	Diesel oil	6,67	t	42,88	GJ/t	73,76	tCO2/TJ	0	
3	Process Emissions	Aluminum scraps	313.488,48	t	0,00		0,00		0,0018	tC/t
4	Process Emissions	Blast furnace slags	-43.766,40	t	0,00		0,00		0,005	tC/t

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B+C Sheet "Annual Emissions Data" for the Year: **2019**

I General guidance for source stream data

Member State requires detailed source stream data generally to be reported mandatorily: VERO

If this is set to "false", entries here are optional and only provide annual total emissions in section D.I.

Please continue with the next points below

II Source streams and emission sources

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Please note that no calculations are made in this sheet. Therefore, totals in columns AU to AY need to be entered correctly as these data will be further used in this template!

Source Streams (excluding PFC emissions)

#	Method	Source stream name	Activity Data	CO2e fossil (t)	CO2e bio (t)	CO2e non-sust. bio (t)	Energy content (fossil), TJ	Energy content (bio), TJ
Ex.1	Combustion	Heavy fuel oil	252.000,00	827.820,0	0,0	0,0	11.340,00	0,00
Ex.2	Process Emissions	Clay	121.000,00	10.640,7	0,0	0,0	0,00	0,00
Ex.3	Mass balance	Steel	-1.808.226,00	-2.569.306,9	0,0	0,0	0,00	0,00
1	Combustion	Natural Gas	65.734,96	134.553,7	0,0	0,0	2.422,82	0,00
2	Combustion	Diesel oil	6,67	21,1	0,0	0,0	0,29	0,00
3	Process Emissions	Aluminum scraps	313.488,48	2.067,5	0,0	0,0	0,00	0,00
4	Process Emissions	Blast furnace slags	-43.766,40	-801,8	0,0	0,0	0,00	0,00

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E. Sheet "EnergyFlows" - DATA ON ENERGY INPUT, MEASURABLE HEAT AND ELECTRICITY

I Total energy input

1 Overview and split into use categories

	Usage type of fuel input	Unit	2019	2020	2021	2022	2023
i.	Energy input to product BM sub-installations	TJ / year					
ii.	Energy input for production of measurable heat	TJ / year	0,00	0,00	0,00	0,00	0,00
iii.	Fuel benchmark sub-installation (CL | non-CBA	TJ / year					
iv.	Fuel benchmark sub-installation (non-CL | non-	TJ / year					
v.	Fuel benchmark sub-installation (CL | CBAM)	TJ / year	2.422,82	2.497,76	3.206,00	3.015,86	2.759,00
vi.	Energy input for electricity production	TJ / year	0,00	0,00	0,00	0,00	0,00
vii.	Rest	TJ / year	0,29	0,29	0,18	0,67	0,00

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7 Fall-Back sub-installation:

Fuel benchmark sub-installation (CL | CBAM)	relevant
Please enter data in this section!	

Detailed instructions for data entries in this tool can be found at the first copy of this tool. (G.I.1)

(a) Historic activity levels

The following data is taken automatically from sheet "E_EnergyFlows", section E.I.c. Thus, data input is mandatory there

Main activity level:	Unit	2019	2020	2021	2022	2023
Fuel benchmark sub-installation (CL | CBAM)	TJ	2.422,82	2.497,76	3.206,00	3.015,86	2.759,00

Production details

(b) Identification of relevant products or services associated with this sub-installation

Please list here to which production processes or services this sub-installation relates. This may include the following items:

- *Production of goods not covered by product benchmarks within the installation (please provide types of product);*
- *production of mechanical energy, heating or cooling (all uses excluding production of electricity).*

	Use type	Product name or service type	PRODCOM 2010	CN codes
1	Production of goods	Aluminum billets	24421155	7601 20 40
2				

Production levels:

	Product name or service type	Unit	2019	2020	2021	2022	2023
1	Aluminum billets	t	715.024,00	727.072,00	944.420,00	848.990,00	731.258,00
2							

NACE 24.42: Aluminium production

CPA 24.42.11: Aluminium, unwrought

24.42.11.30	Unwrought non-alloy aluminium (excluding powders and flakes)	7601 10 00	kg	T
24.42.11.53	Unwrought aluminium alloys in primary form (excluding aluminium powders and flakes)	7601 20 10	kg	T
24.42.11.55	Unwrought aluminium alloys in secondary form (excluding aluminium powders and flakes)	7601 [20 (91 + 99)]	kg	T

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10 **Fall-Back sub-installation:**

Process emissions sub-installation (CL | CBAM)	**relevant**
Please enter data in this section!	

Detailed instructions for data entries in this tool can be found at the first copy of this tool. (G.I.1)

(a) **Historic activity levels**

Values entered here should include eligible emissions from any waste gases as determined in section D.IV.

Main activity level:	Unit	2019	2020	2021	2022	2023
Process emissions sub-installation (CL | CBAM)	t CO_2e	1.266	1.305	1.564	1.493	1.174

Production details

(b) **Identification of relevant products or services associated with this sub-installation**

	Process emission type	Product name or service type	PRODCOM 2010	CN codes
1	carbon containing materials	Aluminum billets	24421155	7601 20 40
2				

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7 **Fall-Back sub-installation:** **Fuel benchmark sub-installation (CL | CBAM)** | relevant

Please enter data in this section!

Detailed instructions for data entries in this tool can be found at the first copy of this tool. (G.I.1)

(a) **Historic activity levels**

The following data is taken automatically from sheet "E_EnergyFlows", section E.I.c. Thus, data input is mandatory there.

Main activity level:	Unit	2019	2020	2021	2022	2023
Fuel benchmark sub-installation (CL | CBAM)	TJ	2.422,82	2.497,76	3.206,00	3.015,86	2.759,00

Data required for the determination of the benchmark improvement rate pursuant to Article 10a(2) of the EU ETS Directive

Fall-Back sub-installation: **Fuel benchmark sub-installation (CL | CBAM)**

(c) **Directly attributable emissions (DirEm*) to this sub-installation**

Detailed instructions for data entries here can be found under point 4.c above.

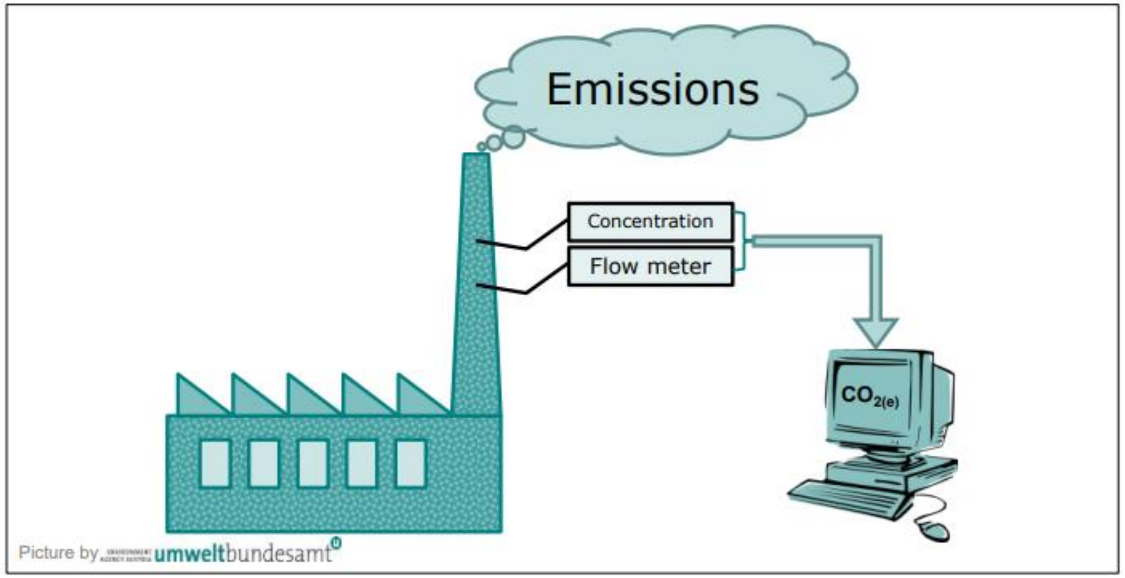
Total direct emissions	Unit	2019	2020	2021	2022	2023
Fuel benchmark sub-installation (CL | CBAM)	t CO2e/year	134.554	138.715	178.659	168.935	155.338

(d) **Energy input to this sub-installation and relevant emission factor**

Detailed instructions for data entries here can be found under point 4.d above.

		Unit	2019	2020	2021	2022	2023
i.	Energy input entered under (a)	TJ / year	2.422,82	2.497,76	3.206,00	3.015,86	2.759,00
ii.	Weighted emission factor (=c./d.)	t CO2 / TJ	55,54	55,54	55,73	56,02	56,30
iii.	Fuel input from waste gases	TJ / year					
iv.	Specific EF (waste gas)	t CO2 / TJ					
v.	Electricity input for heat production	TJ / year					
vi.	Weighted emission factor	t CO2 / TJ					
(e)	**Net heat exported**	TJ / year					
	Specific EF (heat export)	t CO2 / TJ					

Measurement-based approaches



This is **difficult in installations with many emission points** (stacks) or indeed impossible where fugitive emissions have to be taken into account.

On the other hand, the strength of the measurement-based methodologies is the independence of the number of different fuels and materials used (e.g. where many different waste types are combusted), and their independence of stoichiometric relationships (**this is why N_2O emissions have to be monitored in this way**).

Measurement-based approaches

The application of **CEMS (Continuous Emission Measurement Systems)** always requires two elements:

- Measurement of the GHG concentration
- Volumetric flow of the gas stream where the measurement takes place.

According to Article 43 of the MRR: *<< the emissions are first to be determined for each hour of measurement from the hourly average concentration and the hourly average flow rate>>*

- The measurement-based emissions must be corroborated using a calculation-based approach. However, no specific tiers are required for this calculation.
- Due to the non-stoichiometric nature of N_2O emissions from nitric acid production, no corroborating calculation is required for those emissions.
- Carbon monoxide (CO) emitted to the atmosphere shall be treated as the molar equivalent amount of CO_2 (Article 43(1)).
- The operator must ensure that the measurement equipment is suitable for the environment in which it is used, and regularly maintained and calibrated.

Measurement-based approaches

Operators must apply **EN 14181** ("Stationary source emissions – Quality assurance of automated measuring systems") for quality assurance. This standard requires several activities:

- QAL 1: Testing whether the CEMS is meeting the specified requirements. For this purpose, EN ISO 14956 ("Air quality. Evaluation of the suitability of a measurement procedure by comparison with a required uncertainty measurement") is to be used.
- QAL 2: Calibration and validation of the CEM;
- QAL 3: Ongoing quality assurance during operation;
- AST: Annual surveillance test

According to the standard, QAL 2 and AST are to be performed by accredited laboratories, QAL 3 is performed by the operator. Competence of the personnel carrying out the tests must be ensured. This standard does not cover quality assurance of any data collection or processing system (i.e. IT systems). For those the operator has to ensure appropriate quality assurance by separate means.

Other two standards to be applied:

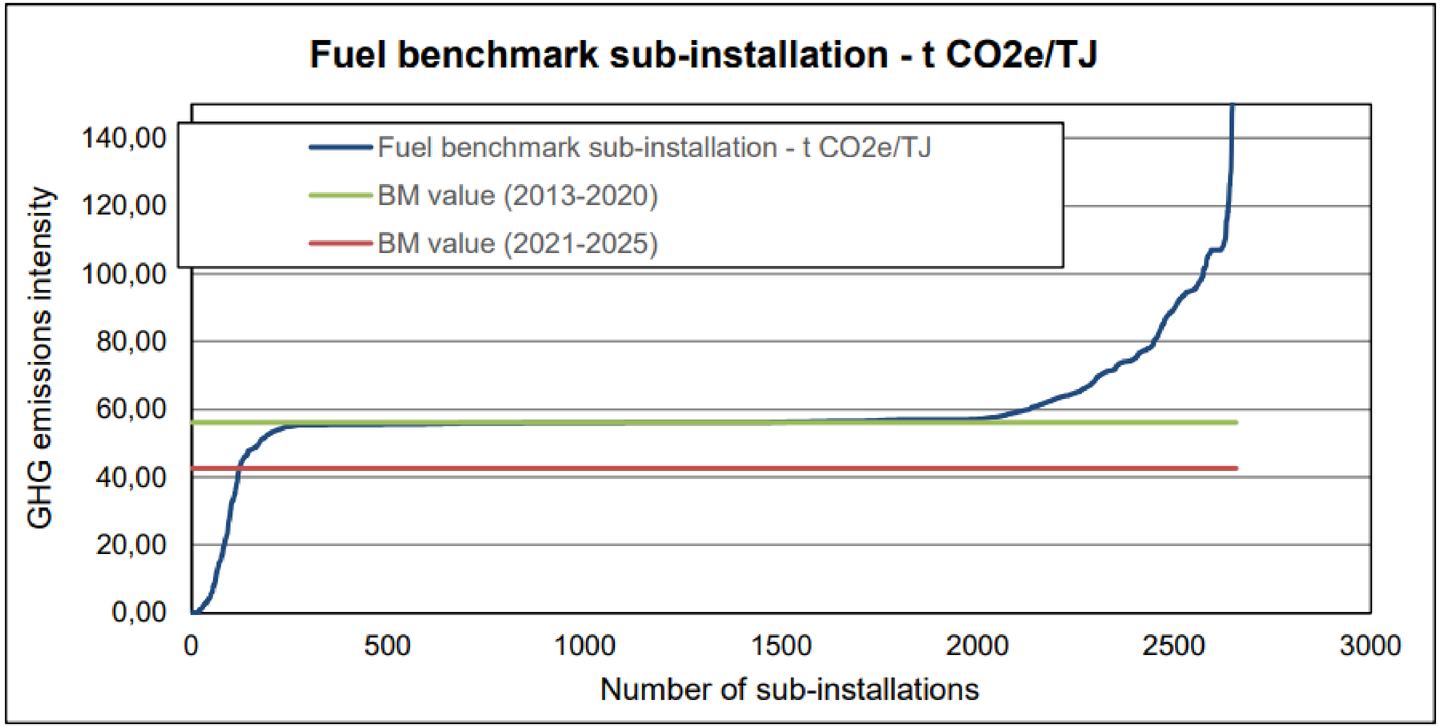
- EN 15259 ("Air quality – Measurement of stationary source emissions – Requirements for measurement sections and sites and for the measurement objective, plan and report")
- EN ISO 16911-2 ("Stationary source emissions – Manual and automatic determination of velocity and volume flow rate in ducts")

The operator shall ensure that laboratories carrying out measurements, calibrations and relevant equipment assessments for CEMS shall be accredited in accordance with EN ISO/IEC 17025 for the relevant analvtical methods or calibration acti

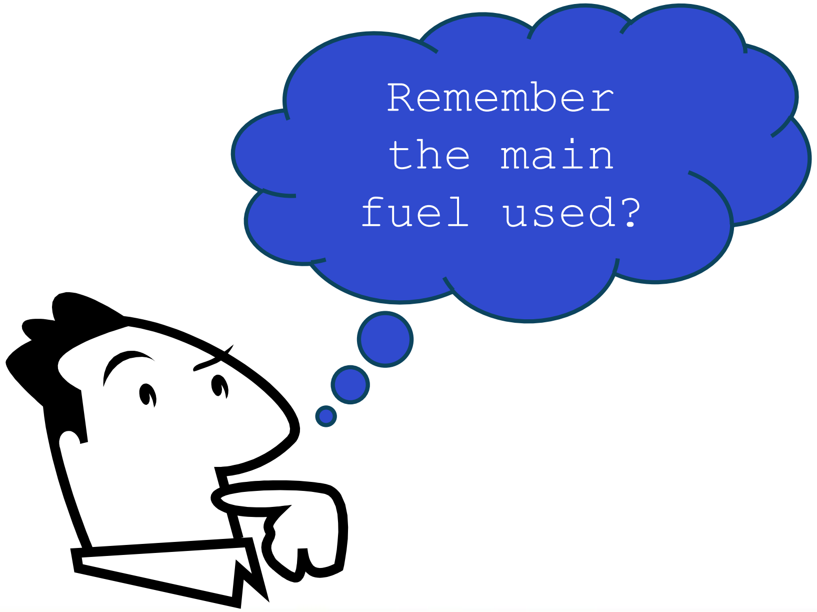
Table 11: Tiers defined for CEMS (see section 1 of Annex VIII of the MRR), expressed using the maximum permissible uncertainties for the annual average hourly emissions.

	Tier 1	Tier 2	Tier 3	Tier 4
CO_2 emission sources	± 10%	± 7.5%	± 5%	± 2.5%
N_2O emission sources	± 10%	± 7.5%	± 5%	N.A.
CO_2 transfer	± 10%	± 7.5%	± 5%	± 2.5%
N_2O transfer *New!*	± 10%	± 7.5%	± 5%	N.A.

Emissions at sub-installation level for benchmark update



In the example given, the GHG emission intensity was about 56 (t CO_2 / TJ) in average for the years 2016 – 2017.



Everything clear???

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Funded by the European Union

Summary and calculation

REPUBLIC OF TURKEY MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

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17 Fall-Back sub-installation 7: **Fuel benchmark sub-installation (CL | CBAM)** **relevant**

	CL-exposed	Started	15(7).3?	No. of BM	BM value (min/max/actual)	
Fuel benchmark sub-installation (CL | CBAM)	VERO	00/01/1900	FALSO	7	28,05	EUA/TJ
	CBAM				52,73	EUA/TJ
	VERO					EUA/TJ

	Unit	2019	2020	2021	2022	2023	
HAL (Historic activity level) reported	TJ	2.423	2.498	3.206	3.016	2.759	Median
Values used for HAL calculation:	TJ	2.423	2.498	3.206	3.016	2.759	2.759

HAL total	Prelim Alloc Year 1 (min)	Prelim Alloc Year 1 (max)	Prelim Alloc Year 1 (actual)
2.759 TJ / year	**77.390** EUA / year	**145.493** EUA / year	EUA / year

	Unit	2019	2020	2021	2022	2023
Total attributed emissions	**t CO2e/year**	**134.553,74**	**138.715,20**	**178.659,00**	**168.935,00**	**155.337,55**
Total energy input	TJ / year	2.422,82	2.497,76	3.206,00	3.015,86	2.759,00
Weighted emission factor	t CO2 / TJ	55,54	55,54	55,73	56,02	56,30
Fuel input from waste gases	TJ / year					
Weighted emission factor	t CO2 / TJ					
Electricity input for heat production	TJ / year					
Weighted emission factor	t CO2 / TJ					
Direct emissions	t CO2 / year	134.553,74	138.715,20	178.659,00	168.935,00	155.337,55
Net heat exported	TJ / year					
Specific EF (heat export)	TJ / year					

Summary and calculation

BDR

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20 Fall-Back sub-installation 10:

		Process emissions sub-installation (CL | CBAM)				**relevant**	
	CL-exposed	Started	15(7).3?		No. of BM	BM value (min/max/actual)	
Process emissions sub-installation (CL | CBA	VERO	00/01/1900	FALSO		10	0,97	EUA/t CO2e
	CBAM					0,97	EUA/t CO2e
	VERO						EUA/t CO2e
	Unit	2019	2020	2021	2022	2023	
HAL (Historic activity level) reported	t CO2e	1.266	1.305	1.564	1.493	1.174	Median
Values used for HAL calculation:	t CO2e	1.266	1.305	1.564	1.493	1.174	1.305

HAL total	Prelim Alloc Year 1 (min)	Prelim Alloc Year 1 (max)	Prelim Alloc Year 1 (actual)
1.305 t CO2e / year	1.266 EUA / year	1.266 EUA / year	EUA / year

	Unit	2019	2020	2021	2022	2023
Total attributed emissions	t CO2e/year	1.265,72	1.304,86	1.564,00	1.493,47	1.174,30

Summary and calculation

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(c) **CBAM factors:**

	2026	2027	2028	2029	2030
CBAM factors for products covered by CBAM	0,9750	0,9500	0,9000	0,7750	0,5150

(d) **Calculation in accordance with Article 16(1) to (7) of the FAR:**

	Sub-installation	2026	2027	2028	2029	2030	< avg. 10%?
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11	Heat benchmark sub-installation (CL | non-CBAM)						
12	Heat benchmark sub-installation (non-CL | non-CBAM)						
13	Heat benchmark sub-installation (CL | CBAM)						
14	District heating sub-installation						
15	Fuel benchmark sub-installation (CL | non-CBAM)						
16	Fuel benchmark sub-installation (non-CL | non-CBAM)						
17	Fuel benchmark sub-installation (CL | CBAM)	75.455	73.521	69.651	59.977	39.856	
18	Process emissions sub-installation (CL | non-CBAM)						
19	Process emissions sub-installation (non-CL | non-CBAM)						
20	Process emissions sub-installation (CL | CBAM)	1.234	1.203	1.069	920	612	
	Total preliminary free allocation	**76.689**	**74.724**	**70.720**	**60.897**	**40.468**	

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Back-up slides