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Directorate B - European and International Carbon Markets

Guidance Document n°9
on the harmonised free allocation methodology for the EU-ETS post 2020

Sector-specific guidance

Final version issued on 15 February 2019 and updated on 29 July 2019

The guidance does not represent an official position of the Commission and is not legally binding. However, this guidance aims to clarify the requirements established in the EU ETS Directive and the FAR and is essential to understanding those legally binding rules.

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0 Introduction

This guidance document is part of a group of documents, which are intended to support Member States, and their Competent Authorities, in the consistent implementation throughout the Union of the allocation methodology for the fourth trading period of the EU ETS (post 2020), established by the Delegated Regulation of the Commission (EU) 2019/331 on "Transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of the EU ETS Directive" (FAR)[1]. *Guidance Document 1 on General Guidance to the Allocation Methodology* provides an overview of the legislative background to the group of guidance documents. It also explains how the different Guidance Documents relate to each other and provides a glossary of important terminology used throughout the guidance[2].

This guidance document 9 gives the following information for each product referred to by the 52 product benchmarks:

- Name and number of the product benchmark, the unit in which it is expressed and the associated Annex I activity
- Carbon leakage exposure in 2021-2030
- Definition of the unit of production
- Definition and explanation of products covered
- Definition and explanation of processes and emissions covered (see *Guidance Document 3 on data collection* for more information on system boundaries of product benchmarks)
- Calculation of preliminary allocation
- Determination of the historical activity level (where relevant[3]).

Products covered by product benchmarks

One of the first important steps in the data collection is the check if product benchmarks apply to an installation. For this purpose, the products produced by the installation including the characteristics of the product, the composition of product mixes and/ or the fields of application need to be checked against the definition of the relevant product benchmark. This assessment is further described in *Guidance Document 3 on data collection*. PRODCOM codes can be a useful indicator for identification, however selection of a benchmark should the never solely rely on PRODCOM codes. PRODCOM 2010[4] that are associated with benchmarks are listed in the relevant section and in Annex A.

[1] Note that this document only covers the transitional harmonised free allocation to industry under Article 10a of the EU ETS Directive. Any allocation under Article 10c ("Option for transitional free allocation for the modernisation of the energy sector") is outside the scope of this document.

[2] All Guidance Documents available at https://ec.europa.eu/clima/policies/ets/allowances_en#tab-0-1

[3] i.e. HAL referred to in Annex III of the FAR

[4] The full 2010 list of PRODCOM codes can be found at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0860&from=EN

System boundaries and double counting

Double allocation in respect of the same emissions should be avoided. Double allocation could occur in case system boundaries of benchmarks are not properly respected. Double counting occurs when processes covered by a product benchmark also receive allocation based on a fall-back approach or other product benchmark.

Example A: Emissions from safety flaring are always covered by product benchmarks. Therefore, no additional allocation for such safety flaring via process emissions sub-installations (for details please consult *Guidance Document 8 on waste gases and process emissions*) must be granted.

Caution is particularly important if the production of a benchmarked product involves the production of an intermediate product that is later used for the production of a benchmarked product. Whenever a product benchmark includes the production of intermediate products, the production of the intermediate products alone should not be allocated.

Example B:

The production of the intermediate product ethylene dichloride (EDC) is included in the VCM benchmark. The VCM benchmark should therefore not be applied to dedicated EDC plants not producing VCM. Such plants should not be allocated any free allowances, neither using the VCM benchmark nor using fall-back approaches. Alternatively, the EDC production might be granted free allocation based on applicable fall-back approaches if the same amount of free allowances is deducted from the free allocation to the VCM producer.

For the determination of free allocation based on product benchmarks, any import of measurable heat from heat production not covered by the ETS needs to be deducted (according to Art. 21 of the FAR). Please consult section 2.3 of *Guidance Document 6 on cross-boundary heat flows* for details.

1 Refinery products

Benchmark name:	**Refinery products**
Benchmark number:	1
Unit:	CO_2 weighted tonne (CWT)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Refining of mineral oil
Special provisions:	Exchangeability of electricity; provisions in Annexes II and III of the FAR PRODCOM 2010 not available, use PRODCOM 2004

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mix of refinery products with more than 40% light products (motor spirit (gasoline) including aviation spirit, spirit type (gasoline type) jet fuel, other light petroleum oils/ light preparations, kerosene including kerosene type jet fuel, gas oils) expressed as CO_2 weighted tonne (CWT). Refineries with other product mixes are not covered by this product benchmark"

The refineries with other product mixes referred to in the definition are the so-called atypical sites producing e.g. mainly lubricants or bitumen. For these cases, the allocation will be based on fall-back approaches.

The table below shows relevant products according to definitions in PRODCOM 2004 statistics. PRODCOM 2010 does not include a respective code for coke-oven coal.

PRODCOM code	**Description**
23.20.11.40	Aviation gasoline
23.20.11.50	Motor gasoline, unleaded
23.20.11.70	Motor gasoline, leaded
23.20.12.00	Gasoline type jet fuel
23.20.13.50	Light naphtha
23.20.16.50	Medium naphtha
23.20.13.70	White spirit, industrial spirit
23.20.14.00	Kerosene-type jet fuel and other kerosene
23.20.15.50	Derv fuel (diesel)
23.20.15.70	Heating gas-oil

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the refinery products product benchmark as follows:

"All processes of a refinery matching the definition of one of the CWT process units as well as ancillary non-process facilities operating inside the refinery fence-line such as tankage, blending, effluent treatment, etc. are included. Lube oils and bitumen processing units located in mainstream refineries are also included in the refinery CWT and emissions envelope.
Process units pertaining to other sectors, such as petrochemicals, are sometimes physically integrated with the refinery. Such process units and their emissions are excluded from the CWT approach.
For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

CWT units are defined in the section in the chapter on the determination of historical activity level.

The allocation for the process units pertaining to other sectors (e.g. petrochemicals) should be determined on the basis of other product benchmark (if available) or fall-back approaches (heat benchmark, fuel benchmark or process emissions approach).

In particular, steam cracker complexes are not included in the scope of the CWT methodology as they are handled as part of the chemical sector. Whenever a steam cracker is physically integrated into a refinery it does not give rise to any CWT contribution while the corresponding CO_2 emissions are subtracted from the amount of refineries emissions used in the CWT methodology.

Processes defined by the CWT methodology only receive allocation according to that approach if they are part of a refinery. When such processes occur outside a refinery, most of them should receive allocation based on fall-back approaches. Some can however be covered by other product benchmarks; e.g. aromatics or hydrogen.

Processes defined by the CWT methodology that are part of the aromatics benchmark sub-installation but carried out within the refinery, should also be treated within the refinery products benchmark sub-installation as aromatics are included.

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS or a non-ETS consumer. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
   a) The fuels necessary to keep a pilot flame running
   b) The fuels required to successfully combust the flared gas.

Preliminary allocation

The product benchmark for refineries is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a refinery product benchmark sub-installation in year k (expressed in EUAs).

BM_P: Benchmark for refineries (expressed in EUAs / CWT).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data report (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions of the CWT units over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed by CWT units. Direct emissions should (by definition) exclude any emissions from electricity

generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import by CWT units from other ETS installations and non-ETS entities over the baseline period by the refinery product benchmark sub-installation, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption by CWT units over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonnes CO_2 are calculated as follows:

$$Em_{indirect} = Elec.use \times 0.376$$

With:

$Elec.use$: Total electricity consumption by CWT units over the baseline period, expressed in MWh.

Determination of historical activity level

Although all refineries process crude oil to make a broadly similar range of products (LPG, gasolines, and kerosene, gasoil/diesel and fuels oils), they are all different in terms of types of process units, relative and absolute size. A refinery will use different routes with different CO_2 footprints to make a certain product, and production routes and products are interdependent, i.e. a refinery cannot produce only gasoline. Also, refineries with a relatively simple configuration unable to process certain heavy fractions being part of their output, ship these substances to more complex refineries for further processing. As a result, energy consumption and CO_2 emissions do not readily correlate with simple indicators such as crude throughput, final product mix or the like.

The concept of CO_2 Weighted Tonne (CWT) overcomes this difficulty by defining the activity of a refinery not simply as input or output, but as a function of activity levels of the process units that are part of the refinery. Thereby the single product of the refinery is the CWT and its production has been calculated on the basis of defined generic process unit each of which has been weighted with an emission factor relative to crude distillation. That factor is denoted as the CWT factor and is representative of the CO_2 emission intensity at an average level of energy efficiency, for the same standard fuel type for each process unit for production, and for average process emissions of the process units. Additional corrections are applied for so-called off-sites [5] and electricity production/consumption.

The historical activity level in terms of CWT should be determined according to the formula below:

[5] Off-sites are ancillary non-process facilities operating inside the refinery fence-line such as tankage, blending, effluent treatment, etc

$$HAL_{CWT} = arithmetic\ mean\left(1.0183 \times \sum_{i=1}^{n}\left(TP_{i,k} \times CWT_i\right) + 298 + 0.315 \times TP_{AD,k}\right)$$

With:

$TP_{i,k}$: historical activity level of process unit *i* in year k of the baseline period as defined for the purpose of the CWT approach (see Table 2).

CWT_i : CWT factor for process unit *i* as defined by for the purpose of the CWT approach (see Table 2).

$TP_{AD,k}$: Throughput of the Atmospheric Crude Distillation in year k of the baseline period defined as fresh feed (kt) per year.

Table 1 provides a calculation of the basic historical activity level. The yellow cells require input data. Process units for the purpose of the CWT approach are called CWT 'functions'. Since not all CWT functions will be performed on a single refinery, the majority of yellow fields will have the value zero. It is recommended to use the calculation tool provided by Concawe for the benchmark data collection exercise and to copy the results into the general data collection template provided by the European Commission.

The appropriate measures of activity for a CWT function are shown in Table 1 and Table 2. With some exceptions, the activity is entered in kilotonnes per annum (kt/a) of either fresh feed (F) or product (P). Fresh feed is to be understood as water free and excluding slops processing.

The reported throughput must be the actual figure for the year, even if the unit was not in operation during the whole year (e.g. new unit started-up during the year, unit idle during part of the year). Figures must be generated from either actual flow measurements and/or refinery material balance records.

Accuracy

In order to meet the desired accuracy for CWT, throughputs must be entered in kt/a with a certain number of decimals depending on the magnitude of the CWT factor:

- For factors up to 1.99: 0 decimals
- For factors between 2.00 and 19.99: 1 decimal
- For factors between 20.00 and 99.99: 2 decimals
- For factors above 100.00: 3 decimals.

The following accuracy must be adhered to in the calculation of parameters that may be necessary to calculate direct and indirect emissions of the (sub)installation:

- Steam flows: ±5%
- Electricity production: ±5%

- Steam conditions: for steam enthalpies an accuracy of ±10 GJ/t is sufficient which is consistent with conditions accurate within ± 5 ºC and ± 5 bar. Note that these conditions are not used in the calculation in this document, but may nevertheless be used in the calculation of the amount of imported and exported steam.

Table 1. Calculation of basic historic activity level in year k

CWT function	Historical level of activity Basis*	(kt in year k)		CWT factor (-)		CWT (ktin year k)
Atmospheric Crude Distillation	F	..	×	1.00	=	..
Vacuum Distillation	F	..	×	0.85	=	..
Solvent Deasphalting	F	..	×	2.45	=	..
Visbreaking	F	..	×	1.40	=	..
Thermal Cracking	F	..	×	2.70	=	..
Delayed Coking	F	..	×	2.20	=	..
Fluid Coking	F	..	×	7.60	=	..
Flexicoking	F	..	×	16.60	=	..
Coke Calcining	P	..	×	12.75	=	..
Fluid Catalytic Cracking	F	..	×	5.50	=	..
Other Catalytic Cracking	F	..	×	4.10	=	..
Distillate/Gasoil Hydrocracking	F	..	×	2.85	=	..
Residual Hydrocracking	F	..	×	3.75	=	..
Naphtha/Gasoline Hydrotreating	F	..	×	1.10	=	..
Kerosene/Diesel Hydrotreating	F	..	×	0.90	=	..
Residual Hydrotreating	F	..	×	1.55	=	..
VGO Hydrotreating	F	..	×	0.90	=	..
Hydrogen Production	P	..	×	300.00	=	..
Catalytic Reforming	F	..	×	4.95	=	..
Alkylation	P	..	×	7.25	=	..
C4 Isomerisation	R	..	×	3.25	=	..
C5/C6 Isomerisation	R	..	×	2.85	=	..
Oxygenate Production	P	..	×	5.60	=	..
Propylene Production	F	..	×	3.45	=	..
Asphalt Manufacture	P	..	×	2.10	=	..
Polymer-Modified Asphalt Blending	P	..	×	0.55	=	..
Sulphur Recovery	P	..	×	18.60	=	..
Aromatic Solvent Extraction	F	..	×	5.25	=	..
Hydrodealkylation	F	..	×	2.45	=	..
TDP/TDA	F	..	×	1.85	=	..
Cyclohexane production	P	..	×	3.00	=	..
Xylene Isomerisation	F	..	×	1.85	=	..
Paraxylene Production	P	..	×	6.40	=	..
Metaxylene production	P	..	×	11.10	=	..
Phtalic anhydride production	P	..	×	14.40	=	..
Maleic anhydride production	P	..	×	20.80	=	..
Ethylbenzene production	P	..	×	1.55	=	..
Cumene production	P	..	×	5.00	=	..
Phenol production	P	..	×	1.15	=	..
Lube solvent extraction	F	..	×	2.10	=	..

Table 1. Calculation of basic historic activity level in year k (continued)

CWT function	Historical level of activity Basis*	(kt in year k)		CWT factor (-)		CWT (ktin year k)
Lube solvent dewaxing	F	..	×	4.55	=	..
Catalytic Wax Isomerisation	F	..	×	1.60	=	..
Lube Hydrocracking	F	..	×	2.50	=	..
Wax Deoiling	P	..	×	12.00	=	..
Lub & Wax Hydrotreating	F	..	×	1.15	=	..
Solvent Hydrotreating	F	..	×	1.25	=	..
Solvent Fractionation	F	..	×	0.90	=	..
Mol sieve for C10+ paraffins	P	..	×	1.85	=	..
Partial Oxidation of Residual Feeds (POX) for fuel	SG	..	×	8.20	=	..
Partial Oxidation of Residual Feeds (POX) for Hydrogen or Methanol	SG	..	×	44.00	=	..
Methanol from syngas	P	..	×	-36.20	=	..
Air Separation	P (kNm^3O_2)	..	×	8.80	=	..
Fractionation for purchased NGL	F	..	×	1.00	=	..
Flue gas treatment	F (MNm^3)	..	×	0.10	=	..
Treatment and Compression of Fuel Gas for Product Sales	Elec. consumption (kW)	..	×	0.15	=	..
Seawater Desalination	P (km^3)	..	×	1.15	=	..
Sum						**HAL_{Basic}**
Historical activity level (= 1.0183 x HAL_{Basic} + 0.315 x TP_{AD} + 298) (for TD_{AD} see first line in table)						**HAL_{CWT}**

* Measure for activity level: net fresh feed (F), reactor feed (R, includes recycle), product feed (P), Synthesis gas production for POX units (SG)

Table 2. Process units distribution

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Atmospheric Crude Distillation Mild Crude Unit Standard Crude Unit	CDU	 MCU SCU	Fresh feed	1.00	Primary atmospheric distillation of crude oil and other feedstocks. The factor includes ancillary equipment such as crude desalter, naphtha splitting, gas plant and wet treatment of light streams for mercaptan removal. Some units may have more than one main distillation column. The classification between MCU and SCU unit depends on the TBP cut point of the bottom product. The unit is classified as an SCU if this cutpoint is >316°C, otherwise it is classified as an MCU.	Crude oil, other feedstocks	Full range of distillates from light gases to heavy gasoil, atmospheric residue
Vacuum Distillation Mild Vacuum Fractionation Standard Vacuum Column Vacuum Fractionating Column	VAC	 MVU VAC VFR	Fresh feed	0.85	Distillation of atmospheric residues under vacuum. The process line up must include a heater. Some units may have more than one main distillation column. VAC and MVU represent different levels of vacuum. VFR is typically used for lubes production and include a higher level of fractionation between distillate products.	Atmospheric residue	Vacuum gasoils, vacuum residue
Vacuum Flasher Column		*VFL*	***n.c.***	***n.c.***	*Normally associated with a visbreaker (VBR) or a thermal cracker (TCR). It does not include a heater. Its contribution is included in the CWT factor of the VBR and TCR units*		
Heavy Feed Vacuum Unit		*HFV*	***n.c.***	***n.c.***	*Additional column taking feed from the bottom of an MVU. Its contribution is included in the generic CWT factor for VAC.*		
Solvent Deasphalting Conventional Solvent Supercritical Solvent	SDA	 CONV SCRT	Fresh feed	2.45	Separation of the lighter fraction of a vacuum or cracked residue by means of a solvent such as propane, butane or heavier.	Vacuum or cracked residue	Deasphalted oil (DAO), asphalt
Visbreaking Atmospheric Residuum (w/o a Soaker Drum) Atmospheric Residuum (with a Soaker Drum) Vacuum Bottoms Feed (w/o a Soaker Drum) Vacuum Bottoms Feed (with a Soaker Drum)	VBR	 VAR VARS VBF VBFS	Fresh feed	1.40	Mild thermal cracking of residual feedstocks to produce some distillates and reduce the viscosity of the cracked residue. The different types represent different feedstocks and process configurations. May include a vacuum flasher (VFL).	Atmospheric or vacuum residue, asphalt	Full range of cracked distillates from light gases to heavy gasoil, cracked residue
Thermal Cracking	TCR		Fresh feed	2.70	Thermal cracking of distillate feedstocks. May include a vacuum flasher (VFL). Units that combine visbreaking and distillate cracking generate a contribution for both processes based on the residue and the distillate throughput respectively.	Virgin vacuum or cracked gasoils	Full range of cracked distillates from light gases to heavy distillate
Coking	COK		Fresh feed		Severe thermal cracking of residual feedstocks producing coke as an intermediate or final process residue.	Vacuum residue, asphalt	Full range of cracked distillates

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Delayed Coking		DC	Fresh feed	2.20	Semi-continuous process, similar in line-up to a VBR, where the heat of reaction is supplied by a fired heater. Coke is produced in alternate drums that are swapped at regular intervals. Coke is cut out of full coke drums and disposed of as a product. Facilities include coke handling and storage.		from light gases to heavy gasoil, coke or low BTU gas
Fluid Coking		FC	Fresh feed	7.60	Proprietary continuous process where the fluidised powder-like coke is transferred between the cracking reactor and the coke burning vessel and burned for process heat production. Surplus coke is drawn off and disposed of as a product.		
Flexicoking		FX	Fresh feed	16.60	Proprietary process incorporating a fluid coker and where the surplus coke is gasified to produce a so-called "low BTU gas" which is used to supply the refinery heaters.		
Coke calcining Vertical-Axis Hearth Horizontal-Axis Rotary Kiln	CALCIN	 HRTH KILN	Product	12.75	Process whereby so-called "green coke" from a DC is stripped of residual light hydrocarbons by heating in a kiln to produced calcined coke.	Green coke	Waste gases, calcined coke
Fluid Catalytic Cracking Fluid Catalytic Cracking Mild Residuum Catalytic Cracking Residual Catalytic Cracking	FCC	 FCC MRCC RCC	Fresh feed	5.5	Cracking of vacuum gasoil and residual feedstocks over a catalyst. The finely divided catalyst is circulated in a fluidised state from the reactor where it becomes coated with coke to the regenerator where coke is burned off. The hot regenerated catalyst returning to the reactor supplies the heat for the endothermic cracking reaction and for most of the downstream fractionation of cracked products. Splitting of the gasoline product has been included in the FCC CWT factor.	Vacuum gasoils, atmospheric residues, deasphalted oils	Full range of cracked distillates from light gases to heavy cracked distillate. Coke is not a product as it is fully combusted within the process.
Other catalytic cracking Houdry Catalytic Cracking Thermofor Catalytic Cracking		 HCC TCC	Fresh feed	4.1	Early catalytic cracking processes on fixed catalyst beds.	Vacuum gasoils	
Distillate/gasoil Hydrocracking Mild Hydrocracking Severe Hydrocracking	HYC	 HMD HSD	Fresh feed	2.85	Cracking of vacuum gasoils and cracked heavy distillates over a fixed catalyst bed, at high pressure and in the presence of hydrogen. The process combines cracking and hydrogenation reactions. HMD and HSD represent different severities resulting in different levels of conversion and hydrogen consumption. Higher severity generally requires higher operating pressures. In order to qualify for the HMD (or HSD) status a plant needs to comply with both of the following criteria: • Total operating reactor pressure: ≥ 70 barg • Conversion (defined as the % of feed material	Vacuum gasoils and cracked heavy distillates, deasphalted oils, hydrogen	Full range of hydrocracked distillates from light gases to gasoil, hydrocracked bottoms

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
					boiling over 350°C that is upgraded to lighter products): ≥20% mass on feed		
Naphtha Hydrocracking		HNP			Special hydrocracking process for converting naphtha into C3-C4 hydrocarbons.	Naphtha, hydrogen	Saturated C3-C4 hydrocarbons
Residual Hydrocracking H-Oil LC-Fining™ and Hycon		HOL LCF		3.75	Hydrocracking of residual feedstocks. Different Proprietary processes involve continuous or semi-continuous catalyst replenishment. The HYC unit must be designed to process feed containing at least 50%mass of vacuum residue (defined as boiling over 550°C) for it to qualify as a Residue HC unit (H-Oil, LC-Fining or Hycon).	Atmospheric or vacuum residues, hydrogen	Full range of hydrocracked distillates from light gases to vacuum gasoil, unconverted residue
Naphtha/Gasoline Hydrotreating	NHYT		Fresh feed	1.10	A number of processes involving treating and upgrading of naphtha/gasoline and lighter streams.		Various gasoline blending components
Benzene Saturation		BSAT			Selective hydrogenation of benzene in gasoline streams over a fixed catalyst bed at moderate pressure.	Various gasoline streams, hydrogen	
Desulfurization of C4–C6 Feeds		C4C6			Desulphurisation of light naphthas over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Light naphtha, hydrogen	
Conventional Naphtha H/T		CONV			Desulphurisation of virgin and cracked naphthas over a fixed catalyst bed at moderate pressure and in the presence of hydrogen. For cracked naphthas also involves saturation of olefins.	Virgin and cracked naphthas/gasolines, hydrogen	
Diolefin to Olefin Saturation		DIO			Selective saturation of diolefins over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen, to improve stability of thermally cracked and coker gasolines.	Thermally cracked or coker gasolines	
Diolefin to Olefin Saturation of Alkylation Feed		DIO			Selective saturation of diolefins in C4 streams for alkylation over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Thermally cracked or coker LPG streams, hydrogen	
Naphtha/Gasoline Hydrotreating (continued) FCC gasoline hydrotreating with minimum octane loss		GOCT			Selective desulphurisation of FCC gasoline cuts with minimum olefins saturation, over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	FCC gasoline cuts, hydrogen	

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Olefinic Alkylation of Thio S		OATS			A gasoline desulphurisation process in which thiophenes and mercaptans are catalytically reacted with olefins to produce higher-boiling sulphur compounds removable by distillation. Does not involve hydrogen.	FCC gasoline cuts	
S-Zorb™ Process		ZORB			Desulphurisation of naphtha/gasoline streams using a proprietary fluid-bed hydrogenation adsorption process in the presence of hydrogen.	Various naphthas /gasolines	
Selective H/T of Pygas/Naphtha Pygas/Naphtha Desulfurization Selective H/T of Pygas/Naphtha		PYGC PYGD PYGS			Selective or non-selective desulphurisation of pyrolysis gasoline (by-product of light olefins production) and other streams over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Pyrolysis gasoline, hydrogen	
Reactor for Selective Hydrotreating		*RXST*	n.c.	n.c.	*Special configuration where a distillation/fractionation column containing a solid catalyst that converts diolefins in FCC gasoline to olefins or when the catalyst bed is in a preheat train reactor vessel in front of the column. Contribution for this configuration is included in the generic NHYT CWT factor.*		
Kerosene/Diesel Hydrotreating Kerosene Hydrotreating	KHYT		Fresh feed	0.90	A number of processes involving treating and upgrading of kerosene and gasoil streams.	Kerosene, hydrogen	Kerosene blending components
Aromatic Saturation		ASAT			Saturation of aromatic rings over a fixed catalyst bed at low or medium pressure and in the presence of hydrogen. This process includes the desulphurisation step which should therefore not be accounted for separately.		
Conventional H/T		CONV/ KUS			Desulphurisation of virgin kerosene over a fixed catalyst bed at low or medium pressure and in the presence of hydrogen.		
Solvent aromatics hydrogenation					Aromatics saturation of kerosene cuts over a fixed catalyst bed at low or medium pressure and in the presence of hydrogen for solvent manufacture.		
Kerosene/Diesel Hydrotreating (continued) Diesel Hydrotreating	DHYT						
Aromatic Saturation		ASAT			Saturation of aromatic rings over a fixed catalyst bed at low or medium pressure and in the presence of hydrogen. This process includes the desulphurisation step which should therefore not be accounted for separately.	Virgin and cracked gasoils, hydrogen	Gasoil blending components,small quantities of naphtha and lighter products
Conventional Distillate H/T High Severity DistillateH/T Ultra-High Severity H/T		CONV DHS DUS			Desulphurisation of virgin and cracked gasoils over a fixed catalyst bed in the presence of hydrogen. CONV, DHS and DUS correspond to different depths of desulphurisation.		

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Middle Distillate Dewaxing		MDDW			Cracking of long paraffinic chains in gasoils to improve cold flow properties over a fixed catalyst bed at low or medium pressure and in the presence of hydrogen. This process includes the desulphurisation step which should therefore not be accounted for separately.		
S-Zorb™ Process		ZORB			Desulphurisation of gasoil using a proprietory absorbtion process. Does not involve hydrogen.	Gasoils	
Selective Hydrotreating of Distillates		DIST			Hydrotreatment of distillates for conversion of diolefins to olefins	Cracked gasoils	
Residual Hydrotreating Desulfurization of Atmospheric Resid Desulfurization of Vacuum Resid	RHYT	 DAR DVR	Fresh feed	1.55	Desulphurisation of residues over a fixed catalyst bed at high pressure and in the presence of hydrogen. Results in a limited degree of conversion of the residue feed into lighter products.	Atmospheric and vacuum residues, hydrogen	Desulphurised residue and relatively small quantities of lighter hydrocarbon liquids and fuel gas
VGO Hydrotreating (or cracking feed Hydrotreating) Hydrodesulphurisation/ denitrification Hydrodesulphurisation	VHYT	 VHDN VHDS	Fresh feed	0.90	Desulphurisation of vacuum gasoils usually destined to be used as FCC feed, over a fixed catalyst bed at medium or high pressure and in the presence of hydrogen. Although these processes involve some conversion of the VGO feed to lighter products, they generally operate at lower pressure, consume less hydrogen, require less sophisticated fractionation equipment and therefore are much less energy intensive than hydrocrackers.	Vacuum gasoils	Desulphurised vacuum gasoils and relatively small quantities of lighter hydrocarbon liquids and fuel gas
Hydrogen production Gas feeds *Steam Methane Reforming* *Partial Oxidation Units of Light Feeds* Steam Naphtha Reforming	HYG	 HSM POX HSN	Product	300.00	 Hydrogen production from light hydrocarbons through either steam reforming or partial oxidation. Includes hydrogen purification. Hydrogen production by steam reforming of naphtha.	 C1 to C4 hydrocarbons Naphtha	Hydrogen, CO2
Hydrogen Purification *Cryogenic Unit* *Membrane Separation Unit* *Pressure Swing Absorption Unit*	*H2PURE*	 *CRYO* *PRSM* *PSA*		***n.c.***	*Purification of hydrogen-rich streams for use in hydrogen consuming units. These processes are not associated with a hydrogen-producing unit. The contribution of these processes is included in the offsites CWT.*		
Catalytic Reforming (inc. AROMAX) Continuous Regeneration Cyclic	REF	 RCR RCY	Fresh feed	4.95	Improvement of the octane rating of naphtha by dehydrogenation of naphthenic rings and paraffin isomerisation over a noble metal catalyst at low pressure and high temperature. The process also produces hydrogen. RCR, RCY and RSR represent different configurations of	Desulphurised naphtha	Reformate for gasoline blending or aromatics

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Semi-Regenerative		RSR			the process. CWT factor includes contribution for special fractionation linked with reforming (naphtha and reformate splitters, DIP etc) on an average EU-27 basis .		production, hydrogen
AROMAX	U60				Special application of catalytic reforming for the specific purpose of producing light aromatics		
Alkylation/Polymerisation/Dimersol			Product	7.25	A range of processes transforming C3/C4 molecules into C7/C8 molecules over an acidic catalyst. CWT factor includes contribution for special fractionation linked with such processes and acid regeneration where applicable on an average EU-27 basis.		C6 to C8 high octane gasoline blending components
Alkylation with HF Acid Alkylation with Sulfuric Acid	ALKY	AHF ASA				C3 and C4 olefins, isobutane	
Polymerization C3 Olefin Feed	POLY	PC3				C3 olefins	
Polymerization C3/C4 Feed		PMIX				C3/C4 hydrocarbons	
Dimersol	DIM					C3 olefins	
Sulphuric Acid Regeneration	*ACID*				*Contribution included in ALKY/POLY*		
C4 Isomerisation	C4ISOM		Reactor feed inc. recycle	3.25	Conversion of normal butane into isobutane over a fixed catalyst bed and in the presence of hydrogen at low to moderate pressure. CWT factor includes contribution for special fractionation linked with C4 isomerisation on an average EU-27 basis .	n-butane, hydrogen	iso-butane
C5/C6 Isomerisation	C5ISOM		Reactor feed inc. recycle	2.85	Conversion of normal paraffins into isoparaffins over a fixed catalyst bed and in the presence of hydrogen at low to moderate pressure. CWT factor applies to both once-through and recycle units and includes contribution for mole sieve separation and special fractionation linked with C5/C6 isomerisation on an average EU-27 basis.	Light virgin naphtha, hydrogen	Isomerate for gasoline blending
Mol sieve separation	*U18*	*ISOSIV*	*n.c.*	*n.c.*	*Contribution included in C5ISOM*		
Oxygenate production			Product	5.60	Production of ethers by reacting an alcohol with olefins		
MBTE Distillation Units MTBE Extractive Units	MTBE	DIST EXT				Methanol, isobutene	Oxygenates for gasoline blending
ETBE	ETBE					Ethanol, isobutene	
TAME	TAME					Methanol, C5 olefins	
Isooctene Production	IOCT				Combination of two isobutene molecules. Although this process does not produce oxygenates, it is included under the same CWT factor as it can be produced in virtually the	Isobutene	Isooctene

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
					same unit with very similar associated emissions.		
Propylene Production Chemical Grade Polymer grade	C3S	 CHEM POLY	Fresh feed	3.45	Separation of propylene from other mostly olefinic C3/C4 molecules generally produced in an FCC. "Chemical" and "polymer" are two grades with different purities.	C3/C4 FCC cut	Propylene
Asphalt & Bitumen Manufacture	ASP		Product	2.10	This CWT function represents the equipment and processing required to produce asphalts and bitumen, including bitumen oxidation (mostly for road paving). Asphalt later modified with polymers is included.	Vacuum and cracked residues	Asphalts and bitumen
Polymer-Modified Asphalt Blending	U77		Product	0.55	Additional asphalt processing step to produce special polymer-modified grades. This CWT function is in addition to the previous one.	Asphalt, polymers	Polymer modified asphalt
Sulphur Recovery	SRU		Product	18.60	Partial oxidation of hydrogen sulphide into elemental sulphur. This CWT function represents the main process (Claus) and the tail gas units for enhanced recovery. It also includes hydrogen sulphide separation from refinery sour gas process streams using amines and amine regeneration.	Refinery sour gas process streams	Sulphur
AROMATICS							
Aromatics Solvent Extraction ASE: Extraction Distillation ASE: Liquid/Liquid Extraction ASE: Liq/Liq w/ Extr. Distillation	ASE	 ED LLE LLED	Fresh feed	5.25	Extraction of light aromatics from reformate and/or hydrotreated pyrolysis gasoline by means of a solvent. The CWT factor for this refinery function includes all columns and associated equipment required to purify individual aromatic products as well as solvent regeneration.	Reformate, hydrotreated pyrolysis gasoline	Mixed aromatics or purified benzene, toluene, mixed xylenes, C9+ aromatics, paraffinic raffinate
Benzene Column *Toluene Column* *Xylene Rerun Column* *Heavy Aromatics Column*		*BZC* *TOLC* *XYLC* *HVYARO*	*n.c.* *n.c.* *n.c.* *n.c.*	*n.c.* *n.c.* *n.c.* *n.c.*	*The contribution of all columns and associated equipement required to purify individual aromatics is included in ASE.*		
Hydrodealkylation	HDA		Fresh feed	2.45	Dealkylation of toluene and xylenes into benzene over a fixed catalyst bed and in the presence of hydrogen at low to moderate pressure.	Toluene, Xylenes, hydrogen	Benzene
Toluene Disproportionation / Dealkylation	TDP		Fresh feed	1.85	Fixed-bed catalytic process for the conversion of toluene to benzene and xylene in the presence of hydrogen		
Cyclohexane production	CYC6		Product	3.00	Hydrogenation of benzene to cyclohexane over a catalyst at high pressure.	Benzene, hydrogen	Cyclohexane
Xylene Isomerisation	XYISOM		Fresh feed	1.85	Isomerisation of mixed xylenes to paraxylene	Mixed xylenes	Paraxylene-rich

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
							mixed xylenes
Paraxylene Production Paraxylene Adsorption Paraxylene Crystallization	PXYL	 ADS CRY	Product	6.40	Physical separation of para-xylene from mixed xylenes.	Paraxylene-rich mixed xylenes	Paraxylene, other mixed xylenes
Xylene Splitter *Orthoxylene Rerun Column*		*XYLS* *OXYLRC*			*The contribution of these columns and associated equipment is included in PXYL.*		
Metaxylene production	U82		Product	11.10	Production of metaxylene from mixed xylenes	Mixed xylenes	Metaxylene
Phthalic anhydride production			Product	14.40	Production of phthalic anhydride from orthoxylene and naphthalene	Orthoxylene, naphthalene	Phthalic anhydride
Maleic anhydride production			Product	20.80	Production of maleic anhydride by oxidation of n-butane or benzene	n-butane, benzene, oxygen	Maleic anhydride
Ethylbenzene production	EBZ		Product	1.55	Combination of benzene and ethylene	Benzene, ethylene	Ethylbenzene
Ethylbenzene Distillation		*EBZD*			*The contribution of this column and associated equipment is included in EBZ.*		
Cumene production	CUM		Product	5.00	Alkylation of benzene with propylene	Benzene, propylene	Cumene
Phenol production			Product	1.15	Production of phenol from benzene and propylene		
LUBRICANTS AND WAXES							
Lube Solvent Extraction Solvent is Furfural Solvent is NMP Solvent is Phenol Solvent is SO2	SOLVEX	 FUR NMP PHE SDO	Fresh feed	2.10	Solvent extraction of aromatic compounds from intermediate streams in the manufacture of base luboils. Includes solvent regeneration. Different Proprietary processes use different solvents.	Various luboil intermediate streams	Dearomatised intermediate luboil streams, aromatic extract
Lube Solvent Dewaxing Solvent is Chlorocarbon Solvent is MEK/Toluene Solvent is MEK/MIBK Solvent is Propane	SDWAX	 CHL MEK MIB PRP	Fresh feed	4.55	Solvent removal of long paraffinic chains (wax) from intermediate streams in the manufacture of luboils. Includes solvent regeneration. Different Proprietary processes use different solvents.	Various luboil intermediate streams	Dewaxed intermediate luboil streams, wax
Catalytic Wax Isomerisation Catalytic Wax Isomerization and Dewaxing Selective Wax Cracking	CDWAX	 ISO SWC	Fresh feed	1.60	Catalytic breakdown of long paraffinic chains in intermediate streams in the manufacture of luboils.	Various luboil intermediate streams	Dewaxed intermediate luboil streams
Lube Hydrocracker Lube Hydrocracker w/ Multi-Fraction Distillation	LHYC	HCM	Fresh feed	2.50	Hydrocracking of heavy feedstocks for the manufacture of luboils	Vacuum Gas Oils	Full range of hydrocracked

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Lube Hydrocracker w/ Vacuum Stripper Lube H/F w/ Vacuum Stripper Lube H/T w/ Multi-Fraction Distillation Lube H/T w/ Vacuum Stripper	LHYFT	HCS HFS HTM HTS					products from light gases to gasoil, luboil intermediate streams
Wax Deoiling Solvent is Chlorocarbon Solvent is MEK/Toluene Solvent is MEK/MIBK Solvent is Propane	WDOIL	 CHL MEK MIB PRP	Product	12.00	Solvent removal of lighter hydrocarbons from wax obtained from lube dewaxing (SDWAX)	Raw wax	Deoiled wax, light oil
Lube /Wax Hydrotreating Lube H/F w/ Vacuum Stripper Lube H/T w/ Multi-Fraction Distillation Lube H/T w/ Vacuum Stripper Wax H/F w/ Vacuum Stripper Wax H/T w/ Multi-Fraction Distillation Wax H/T w/ Vacuum Stripper	 LHYFT WHYFT 	 HFS HTM HTS HFS HTM HTS	Fresh feed	1.15	Hydrotreating of luboil fractions and wax for quality improvement	Luboil intermediate streams, wax, hydrogen	Hydrotreated luboil fractions, wax
SOLVENTS							
Solvent Hydrotreating	U1		Fresh feed	1.25	Hydrotreating of various distillate cuts for solvent manufacture	Distillate cuts, hydrogen	Hydrotreated solvent cuts
Solvent Fractionation	SOLVF		Fresh feed	0.90	Fractionation of various distillate cuts for solvent manufacture	Distillate cuts	Solvent cuts
Mol sieve for C10+ n-paraffins	U88		Product	1.85	Separation of heavy paraffins from kerosene/light gasoil cuts for solvent manufacture	Kerosenes/light gasoils	Solvent cuts
RESID GASIFICATION							
POX Syngas for Fuel	U73		Syngas	8.20	Production of synthesis gas by gasification (partial oxidation) of heavy residues. Includes syngas clean-up.	Heavy residues, oxygen	Syngas, CO_2
POX Syngas for Hydrogen or Methanol	U72		Syngas	44.00	Production of hydrogen by gasification of heavy residues and conversion of syngas to hydrogen via the shift reaction. Includes syngas clean up and CO_2 separation.	Heavy residues, oxygen, steam	Hydrogen, CO_2. Also, CO if methanol synthesis occurs downstream.

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Methanol	U70		Product	-36.20	Recombination of CO_2 and hydrogen for methanol synthesis. *This factor can only be applied in combination with U72 above.*	Hydrogen, CO, CO_2	Methanol
Air Separation	U79		Oxygen (MN m^3/a)	8.80	Separation of air into its components including oxygen. Usually cryogenic but factor applies to all processes.	Air	Oxygen, other air components
MISCELLANEOUS							
Fractionation of Purchased NGL			Purchased Fresh feed	1.00	Fractionation of NGL (light liquid hydrocarbons obtained as by-product of natural gas production) into usable fractions. Includes all columns for production of separate cuts**, but only to the extent that they are used to fractionate purchases of NGL**..	NGL	Various light fractions
De-ethaniser	*DETH*		*n.c.*	*n.c.*	*The CWT factor refers to fresh NGL feed, therefore no separate contribution from individual columns*		
De-propaniser	*DPRO*		*n.c.*	*n.c.*			
De-butaniser	*DBUT*		*n.c.*	*n.c.*			
Special Fractionation					*These fractionation columns are found in various locations in refineries. Their contribution has been included in the CWT factors of appropriate units or in the offsite factor on a statistical basis. They therefore do not give rise to additional CWT.*		
Deethanizer							
Depropanizer							
Delsobutanizer		*DIB*					
Debutanizer							
Deisopentanizer		*DIP*					
Depentanizer							
Deisohexanizer							
Dehexanizer							
Deisoheptanizer							
Deheptanizer							
Naphtha Splitter							
Conventional Splitter		*CONV*					
Splitter with single Heartcut		*HC1*					
Splitter with two Heartcuts		*HC2*					
Standard Column with Heartcut Draw		*HCD*					
Alkylate Splitter							
Conventional Splitter		*CONV*					
Special Fractionation (continued)							
Splitter with single Heartcut		*HC1*					
Splitter with two Heartcuts		*HC2*					
Standard Column with Heartcut Draw		*HCD*					
Reformate Splitter							

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Conventional Splitter *Splitter with single Heartcut* *Splitter with two Heartcuts* *Standard Column with Heartcut Draw*		*CONV* *HC1* *HC2* *HCD*					
Flue gas treatment	U35/U89		MNm^3/a	0.10	Desulphurisation and clean-up of flue gases from refinery heaters and boilers. Includes all such processes.	Refinery flue gases	Cleaned flue gases
Treatment and Compression of Fuel Gas for Sales	U31		Compressor power consumption (kW)	0.15	Treatment and compression of refinery fuel gas for sale to third party.	Refinery fuel gas	Treated refinery fuel gas
Seawater Desalination	DESAL		Product (Water)	1.15	Desalination of sea water. Includes all such processes.	Sea water	Desalinated water

2 Coke

Benchmark name:	**Coke**
Benchmark number:	2
Unit:	Tonne of dry coke The amount of dry coke is the amount at the discharge of the coke oven or gas-works plant.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of coke
Special provisions:	PRODCOM 2010 not available, use PRODCOM 2004

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Coke-oven coke (obtained from the carbonization of coking coal, at high temperature) or gas-works coke (by-product of gas-works plants) expressed as tonnes of dry coke, determined at the discharge of the coke oven or gas-works plant. Lignite coke is not covered by this benchmark. Coking in refineries is not included but covered by the CWT methodology for refineries.*"*

The table below shows relevant products according to definitions in PRODCOM 2004 statistics. PRODCOM 2010 does not include a respective code for coke-oven coal.

PRODCOM code	**Description**
23.10.10.30	Coke-oven coke (obtained from the carbonisation of coking coal, at high temperature), gas-works coke (by-product of gas-works plants)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the process units

- *coke ovens,*
- *H2S/NH3 incineration,*
- *coal preheating (defreezing),*
- *coke gas extractor,*
- *desulphurization unit,*

- *distillation unit,*
- *steam generation plant,*
- *pressure control in batteries,*
- *biological water treatment,*
- *miscellaneous heating of by-products and*
- *hydrogen separator*

are included.
Coke oven gas cleaning is included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer[6] or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing coke is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing coke in year k (expressed in EUAs).

BM_P: Benchmark for coke (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection.

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

[6] In this case, the allocation would go to the consumer of the heat. See Guidance document 6 on Cross-boundary heat flows for more information.

3 Sintered ore

Benchmark name:	**Sintered ore**
Benchmark number:	3
Unit:	Tonne of sintered ore
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Metal ore (including sulphide ore) roasting or sintering, including pelletisation
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Agglomerated iron-bearing product containing iron ore fines, fluxes and iron-containing recycling materials with the chemical and physical properties such as the level of basicity, mechanical strength and permeability required to deliver iron and necessary flux materials into iron ore reduction processes. Expressed in tonnes of sintered ore as leaving the sinter plant."

Reference product is merchant sinter sent to reduction furnace as leaving the sinter plant. In case a significant screening operation is carried out at the – reduction furnace, this volume may be corrected to take account of the screening ratio after the bunkers.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
07.10.10.00	Iron ores and concentrates (excluding roasted iron pyrites)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

According to the NACE methodology, companies are classified under the code of their main activity. For this reason, activities such as sintering, coking of coal, casting, etc. are registered under NACE 24.10 when carried out in a steel plant.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the process units:
- *sinter strand,*

- *ignition,*
- *feedstock preparation units,*
- *hot screening unit,*
- *sinter cooling unit,*
- *cold screening unit and*
- *steam generation*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing sintered ore is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing sintered ore in year k (expressed in EUAs).

BM_P: Benchmark for sintered ore (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

4 Hot metal

Benchmark name:	**Hot metal**
Benchmark number:	4
Unit:	Tonne of hot metal *Liquid iron at the exit point of the blast furnace (for the calculation of HAL)*
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Liquid iron saturated with carbon for further processing, considered as product of blast furnaces, and expressed in tonnes of liquid iron at the exit point of the blast furnace. Similar products such as ferroalloys are not covered by this product benchmark. Residual material and by-products are not to be considered as part of the product."

The liquid iron is considered as product of blast furnaces. With the given system boundaries it also covers indirectly steel produced by the blast furnace route.
Similar products such as ferroalloys are not covered by this product benchmark.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the process units

- *Blast furnace,*
- *Hot metal treatment units,*
- *Blast furnace blowers,*
- *Blast furnace hot stoves,*
- *Basic oxygen furnace,*
- *Secondary metallurgy units,*
- *Vacuum ladles,*
- *Casting units (including cutting),*
- *Slag treatment unit,*
- *Burden preparation,*
- *Blast furnace gas treatment unit,*
- *Dedusting units,*
- *Scrap pre-heating,*

- *Coal drying for pulverized coal injection (PCI),*
- *Vessels preheating stands,*
- *Casting ingots preheating stands,*
- *Compressed air production,*
- *Dust treatment unit (briquetting),*
- *Sludge treatment unit (briquetting),*
- *Steam injection in blast furnace unit,*
- *Steam generation plant,*
- *Converter basic oxygen furnace (BOF) gas cooling and*
- *Miscellaneous*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing hot metal is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing hot metal in year k (expressed in EUAs).

BM_P: Benchmark for hot metal (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

5 EAF carbon steel

Benchmark name:	**EAF carbon steel**
Benchmark number:	5
Unit:	Tonne of crude secondary steel ex-caster
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Steel containing less than 8% metallic alloying elements and tramp elements to such levels limiting the use to those applications where no high surface quality and processability is required and if none of the criteria for the content of the metal alloying elements and the steel quality for high alloy steel are met. Expressed in tonnes of crude secondary steel ex-caster."

The relatively low surface quality and processability is due to alloy elements that have been carried over from the scrap input, and which cannot be simply separated from the steel. Hence, EAF carbon steels are used for products that have a relatively low sensitivity to the material quality, e.g. concrete reinforcing bars.

The terms 'high surface quality' and 'processability' are further defined in section 6.

Only to the extent none of the criteria for the content of the metal alloying elements and the steel quality for high alloy steel are met, the EAF carbon steel benchmark should be applied.

The table below shows a non-exhaustive list of relevant products associated with EAF carbon steel products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
24.10.21.10	Flat semi-finished products (of non-alloy steel)
24.10.21.21	Ingots, other primary forms and long semi-finished products for seamless tubes (of non-alloy steel)
24.10.21.22	Other ingots, primary forms and long semi-finished products including blanks (of non-alloy steel)

The PRODCOM products listed in the table above list refer to final products, however not to the product after casting, which is further transformed in the downstream process steps. This benchmark covers the cast steel and not the final products defined by the PRODCOM codes.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics. Furthermore, the PRODCOM codes for the steel sector do not distinguish between primary (hot metal benchmark, see section 4) and secondary steel (EAF carbon and EAF high alloy steel) and does not allow to differentiate between carbon and high alloy steel.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the EAF carbon steel product benchmark as follows:

"All processes directly or indirectly linked to the process units

- *electric arc furnace*
- *secondary metallurgy*
- *casting and cutting*
- *post-combustion unit*
- *dedusting unit*
- *vessels heating stands*
- *casting ingots preheating stands*
- *scrap drying and*
- *scrap preheating*

are included.
Processes downstream of casting are not included.
For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

Processes downstream of casting cover rolling and reheating for hot rolling.

For the determination of indirect emissions from electricity consumption, the total electricity consumption within the system boundaries shall be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product

benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for EAF carbon steel is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing EAF carbon steel in year k (expressed in EUAs).

BM_P: Benchmark for EAF carbon steel (expressed in EUAs / unit of product)

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of EAF carbon steel over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed within the system boundaries of the EAF carbon steel production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing EAF carbon steel, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of EAF carbon steel over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect}$ = *Elec.use x 0.376*

With:

Elec. use : Total electricity consumption within the relevant system boundaries of the production of EAF carbon steel over the baseline period, expressed in MWh.

6 EAF high alloy steel

Benchmark name:	**EAF high alloy steel**
Benchmark number:	6
Unit:	Tonne of crude secondary steel ex-caster
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Steel containing 8% or more metallic alloying elements or where high surface quality and processability is required. Expressed in tonnes of crude secondary steel ex-caster."

According to this definition, all EAF steels with at least 8 mass-% of metallic alloying elements should be considered as 'EAF high ally steel'. High alloy steel production needs ferro-alloys (ferro-chrome, ferro-nickel and others) as input in order to introduce the alloy elements to the product. They are introduced to improve the steel characteristics with respect to certain uses, e.g. added strength and wear resistance for tools and jet engines, weather resistance for bridges and containers, or their ferromagnetic properties for electric motors and transformers.

Furthermore, high quality steel for applications with high requirements on the 'high surface quality' (to guarantee the absence of defects) and 'processability' (for downstream processes) are covered by this product benchmark. In this context, EAF steel should be regarded as high quality steel if at least one of the following criteria is met:

- hydrogen content max 0,0003%
- sulphur content max 0,003%
- phosphorus content max 0,01%
- micro cleanliness:
    - K3 (Oxide) < 40; K4 < 50 according to DIN 50602 (or any equivalent international standard)
    - sulfide: Athin 2,0; Aheavy 1,5 according to ISO 4967
    - oxide: Bthin 1,5; Bheavy 0,5 according to ISO 4967
    - ASTME 45: procedure B,C, D max. 2
    - SEP 1920: ultrasonic examination: core examination - KSR max. 2 mm
- macro cleanliness: blue shortness: max. 2,5 mm / dm^2

The alloy content criterion or the five listed criteria above must be applied to steel casts separately. Only amounts matching at least one of these criteria should be regarded as "high alloy steel" and aggregated at an annual basis for all years of the relevant baseline period. If this application of the criteria is not possible at cast level (smallest unit of production), it should be assessed at a higher level of aggregation, i.e. at the steel grade level (in this case average annual values could be considered for each grade separately).

Alternatively, steel could be regarded as of high surface quality and processability if for more than 10% of the production output one of the following technological no destructive testing is required:

- Infrasound inspection following either ASTM E213 or EN 10246-6,7,14
- Magnetic Particles inspection following either ASTM E709 or EN 10246-12
- Dye Penetrant inspection following ASTM E165
- Electromagnetic Inspection
    a. Eddy Currents. ASTM E309
    b. Flux leakage. ASTM E570

To the extent none of the criteria for the content of the metal alloying elements and the steel quality are met, the EAF carbon steel benchmark (see section 5) should be applied. The table below shows a non-exhausting list of relevant products associated with EAF high alloy steel products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
24.10.23.10	Flat semi-finished products (of alloy steel other than of stainless steel)
24.10.23.21	Ingots, other primary forms and long semi-finished products for seamless tubes (of alloy steel other than of stainless steel)
24.10.23.22	Other ingots, primary forms and long semi-finished products including blanks (of alloy steel other than of stainless steel)
24.10.22.10	Flat semi-finished products (slabs) (of stainless steel)
24.10.22.21	Ingots, other primary forms and long semi-finished products for seamless tubes (of stainless steel)
24.10.22.22	Other ingots, primary forms and long semi-finished products including blanks (of stainless steel)

The PRODCOM products listed in the table above list refer to final products, however not to the product after casting, which is further transformed in the downstream process steps. This benchmark covers the cast steel and not the final products defined by the PRODCOM codes.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics. Furthermore, the PRODCOM codes for the steel sector do not distinguish between primary (hot metal benchmark, see section 4) and secondary steel (EAF carbon and EAF high alloy steel) and does not allow to differentiate between carbon and high alloy steel.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the EAF high alloy steel product benchmark as follows:

"All processes directly or indirectly linked to the following process units

- *electric arc furnace*
- *secondary metallurgy*
- *casting and cutting*
- *post-combustion unit*
- *dedusting unit*
- *vessels heating stands*
- *casting ingots preheating stands*
- *slow cooling pit*
- *scrap drying*
- *scrap preheating*

are included.

Processes downstream of casting are not included. The process units FeCr converter and cryogenic storage of industrial gases are not included. Processes downstream of casting include rolling and rehearing for hot rolling.

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

For crude steel produced via the EAF route, direct CO_2 emissions result from fuel and carbon from electrodes and scrap that is oxidised in the electric arc furnace. As regards the production of high alloy steels, CO_2 emissions stem from ferro-alloys rather than from scrap. (Scrap grades usually fed in the EAF for this type of production have low carbon contents.)

For the determination of indirect emissions from electricity consumption, the total electricity consumption within the system boundaries shall be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR*

for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.

Preliminary allocation

The product benchmark for EAF high alloy steel is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing EAF high alloy steel in year k (expressed in EUAs).

BM_P: Benchmark for EAF high alloy steel (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of EAF high alloy steel over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed within the system boundaries of the EAF high alloy steel production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing EAF high alloy steel, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of EAF high alloy steel over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

Elec. use: Total electricity consumption within the system boundaries of the production of EAF high alloy steel over the baseline period, expressed in MWh.

7 Iron casting

Benchmark name:	**Iron casting**
Benchmark number:	7
Unit:	Tonne of liquid iron
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	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
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Casted iron expressed as tonnes of liquid iron ready alloyed, skinned, and ready for casting."

This product benchmark refers to the intermediate product liquid iron and not to the final products of the casting process which are included in the NACE groups 24.51 and 24.52. Therefore, no PRODCOM codes are available for the benchmarked product.
However, the PRODCOM 2010 codes listed in the table below might help to identify processes using the benchmarked intermediate product.

PRODCOM code	**Description**
24.51.20.00	Tubes, pipes and hollow profiles of cast iron excluding tubes, pipes, hollow profiles made into identifiable parts of articles, such as sections of central heating radiators and machinery parts
24.51.30.30	Tube or pipe fittings, of non-malleable cast iron
24.51.30.50	Tube or pipe fittings of malleable cast iron
24.52.30.00	Tube or pipe fittings of cast steel
24.51.11.10	Malleable iron castings for land vehicles, piston engines and other machinery and mechanical appliances
24.51.11.90	Parts for other utilisation (malleable iron casting)
24.51.12.10	Parts of land vehicles (nodular iron castings)
24.51.12.20	Ductile iron castings for transmission shafts, crankshafts, camshafts, cranks, bearing housings and plain shaft bearings (excluding for bearing housings incorporating ball or roller bearings)
24.51.12.40	Other parts of piston engines and mechanical engineering (nodular iron castings)
24.51.12.50	Ductile iron castings for machinery and mechanical appliances excluding for piston engines
24.51.12.90	Ductile iron castings for locomotives/rolling stock/parts, use other than in land vehicles, bearing housings, plain shaft bearings, piston engines, gearing, pulleys, clutches, machinery

24.51.13.10	Grey iron castings for land vehicles (excluding for locomotives or rolling stock, construction industry vehicles)
24.51.13.20	Grey iron castings for transmission shafts, crankshafts, camshafts, cranks, bearing housings and plain shaft bearings (excluding bearing housings incorporating ball or roller bearings)
24.51.13.40	Other parts of piston engines and mechanical engineering (cast iron: not ductile)
24.51.13.50	Grey iron castings for machinery and mechanical appliances excluding for piston engines
24.51.13.90	Grey iron castings for locomotives/rolling stock/parts, use other than in land vehicles, bearing housings, plain shaft bearings, piston engines, gearing, pulleys, clutches, machinery

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the iron casting product benchmark as follows:

"All processes directly or indirectly linked to the process steps

- *melting shop*
- *casting shop*
- *core shop and*
- *finishing*

are included.

The process step 'finishing' refers to operations like fettling and not general machining, heat treatment or painting which are not covered by the system boundaries of this product benchmark.

For the determination of indirect emissions, only the electricity consumption of melting processes within the system boundaries shall be considered."

The emissions related to 'melting electricity' are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for iron casting is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation casting iron in year k (expressed in EUAs).

BM_P: Benchmark for iron casting (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of iron casting over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the iron castingproduction process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation for iron casting, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from melting electricity consumption within the system boundaries of iron casting over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

$Elec.use$: Consumption of melting electricity within the system boundaries of iron casting over the baseline period, expressed in MWh. Note from the definition of system boundaries and processes covered that only the electricity consumption of melting processes within the system boundaries should be considered.

8 Pre-bake anode

Benchmark name:	**Pre-bake anode**
Benchmark number:	8
Unit:	Tonne of pre-bake anode
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of primary aluminium
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"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.

No PRODCOM code for pre-baked anodes nor any other industry standard or classification number for the product is available.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of pre-bake anodes are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing pre-baked anode is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing pre-baked anode in year k (expressed in EUAs).

BM_P: Benchmark for pre-baked anode (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

9 Aluminium

Benchmark name:	**Aluminium**
Benchmark number:	9
Unit:	Tonne 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.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of primary aluminium
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"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"

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

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

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"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."

These include in particular:

- 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.

Emissions related to the production and the consumption of electricity are excluded from the system boundaries, irrespective of where and how this electricity is produced.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing aluminium is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing aluminium in year k (expressed in EUAs).

BM_P: Benchmark for aluminium (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

10 Grey cement clinker

Benchmark name:	Grey cement clinker
Benchmark number:	10
Unit:	Tonne of grey cement clinker
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Grey cement clinker as total clinker produced"

The table below shows the relevant product according to definition in PRODCOM 2010 statistics. Note that this PRODCOM code also applies to white cement clinker (see section 11).

PRODCOM code	Description
23.51.11.00	Cement clinker

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of grey cement clinker are included."

The emissions related to the production of grey cement clinker include the emissions from the calcination process and fuel-related emissions to provide thermal energy for the production process (including heat losses).

Blast furnace slag does not fall under the product definition for the grey clinker benchmark. Although blast furnace slag can substitute clinker in cement production, the slag is not identical to clinker. The CaO content of blast furnace slag is related to the use

of limestone in the blast furnace. The use of this limestone leads to emissions that have been taken into account in the hot metal benchmark.

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing grey cement clinker is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing grey cement clinker in year k (expressed in EUAs).

BM_P: Benchmark for grey cement clinker (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

11 White cement clinker

Benchmark name:	**White cement clinker**
Benchmark number:	11
Unit:	Tonne of white cement clinker (as 100% clinker)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"White cement clinker for use as main binding component in the formulation of materials such as joint filers, ceramic tile adhesives, insulation, and anchorage mortars, industrial floor mortars, ready mixed plaster, repair mortars, and water-tight coatings with maximum average contents of 0.4 mass-% Fe_2O_3, 0.003 mass-% Cr_2O_3 and 0.03 mass-% Mn_2O_3. Expressed in tonnes of white cement clinked (as 100% clinker)."

In other words, cement clinker needs to fulfil all of the following quantitative criteria regarding the content of certain substances:

1. content Fe_2O_3 of equal or lower than 0.4 mass-%
2. content Cr_2O_3 of equal or lower than 0.003 mass-%
3. content Mn_2O_3 of equal or lower than 0.03 mass-%

The three criteria are to be applied to individual batches (smallest unit of production) of clinker. Only amounts matching all these criteria can be regarded as "white cement clinker" and should be aggregated at an annual basis for all years of the relevant baseline period. If the application of the criteria is not possible at batch level, the assessment should be carried out at a higher level of aggregation, but at least for the total annual production.

Alternatively, the three quantitative criteria for the composition should be regarded are met if the clinker has a reflection (R_y) of at least 87% measured according to ISO 7724 (DIN 5033) using a $BaSO_4$ standard.

Furthermore, the definition of the white cement clinker benchmark refers to the use as main binding component for certain products. As the above list of application is comprehensive but not exhaustive and no quantitative thresholds are given, compliance

with this criterion should simply be confirmed by the operator in the methodology report accompanying the data collection template.

To the extent the criteria for the composition and applications are not met the grey cement clinker benchmark should be applied.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Note that this PRODCOM code also applies to grey cement clinker (see section 10).

PRODCOM code	Description
23.51.11.00	Cement clinker

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of white cement clinker are included."

Blast furnace slag does not fall under the product definition for the white clinker benchmark. Although blast furnace slag can substitute clinker in cement production, the slag is not identical to clinker. The CaO content of blast furnace slag is related to the use of limestone in the blast furnace. The use of this limestone leads to emissions that have been taken in to account in the hot metal benchmark.

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing white cement clinker is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing white cement clinker (expressed in EUAs).

BM_P: Benchmark for white cement clinker (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production, in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

12 Lime

Benchmark name:	**Lime**
Benchmark number:	12
Unit:	Tonne of standard pure lime The reference product standard pure lime is defined as lime with a free CaO content of 94.5% (see comment on allocation methodology).
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day
Special provisions:	Provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Quicklime: calcium oxide (CaO) produced by the decarbonation of limestone ($CaCO_3$). Expressed in tonnes of 'standard pure' defined as lime with a free CaO content of 94.5%. Lime produced and consumed in the same installation for purification processes is not covered by this product benchmark. The internal lime production of the pulp sector is already covered by the respective pulp benchmarks and is therefore not eligible for additional allocation based on the lime benchmark."

This product benchmark only covers quicklime which is sold on the market or used for other purposes than purification processes. Therefore, the production of lime for purification processes (e.g. in the sugar sector) is not covered by this product benchmark.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
23.52.10.33	Quicklime (or lime): Calcium oxide (CaO) produced by decarbonising limestone (CaCO3)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of lime are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Figure 1 gives a graphical representation of the system boundaries.

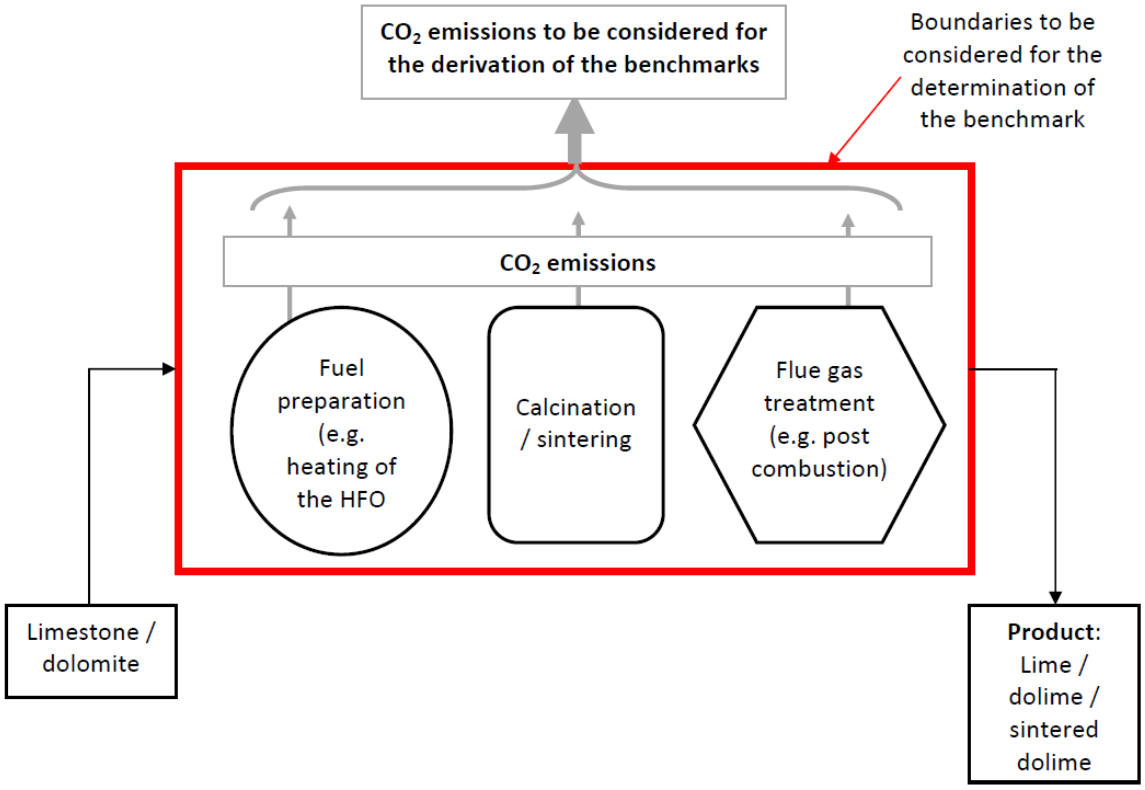

Figure 1. System boundaries (Sector Rule book for the development of CO_2 benchmarks for the European lime sector, 2010)

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing lime is calculated as follows:

$$F_{p,k} = BM_p \times HAL_{Lime,standard} \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing lime in year k (expressed in EUAs).

BM_P: Benchmark for lime (expressed in EUAs / unit of product).

$HAL_{Lime,standard}$: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Given the wide range of product qualities that can be achieved, the product benchmark for lime refers to a standard composition concerning calcium oxide and magnesium oxide. The historical activity level to be used in the determination of free allocation therefore needs to be corrected for the calcium oxide and magnesium oxide content of the produced lime:

$$HAL_{Lime,standard} = Arithmetic\ mean\left(\frac{785 \times m_{CaO,k} + 1092 \times m_{MgO,k}}{751.7} \times HAL_{lime,uncorrected,k}\right)$$

With:

$HAL_{lime,standard}$: Historical activity level for lime production expressed in tonnes of standard pure lime

$m_{CaO,k}$: Content of free CaO in the produced lime in year k of the baseline period expressed in mass-%Best available data should be used; in order of preference:

1) Composition data determined in accordance with Annex I.13.3 to the MRG
2) Conservative estimate not lower than 85% based on other data than composition data determined in accordance with Annex I.13.3 to the MRG
3) Default value of 85%

$m_{MgO,k}$: Content of free MgO in the produced lime in year k of the baseline period expressed in mass-%; Best available data should be used; in order of preference:

1) Composition data determined in accordance with Annex I.13.3 to the MRG

2) Conservative estimate not lower than 0.5% based on other data than composition data determined in accordance with Annex I.13.3 to the MRG
3) Default value of 0.5%

$HAL_{lime,uncorrected,k}$: Uncorrected historical activity level for lime production in year k expressed in tonnes of lime.

If possible, composition data should be based on applicable European standards such as EN 459-2, EN 12485 and EN ISO12677.

Conservative estimates might be determined by calculation of the content of free CaO and MgO in the product from the composition of the raw material using the carbonates method.
The content of free CaO and MgO in the produced lime in year k of the baseline period expressed in mass-% could be calculated as follows:

$m_{CaO,k}$ = (A / (100 - ((A – B x 56,08 / 40,31) x 44,01 / 56,08 + B x 88,02 / 40,31 – F))) x 100

$m_{MgO,k}$ = (B / (100 - ((A – B x 56,08 / 40,31) x 44,01 / 56,08 + B x 88,02 / 40,31 – F))) x 100

With

A: total CaO content in stone (in %)
B: total MgO content in stone (in %)
F: residual CO_2 in burnt lime (in %).

13 Dolime

Benchmark name:	Dolime
Benchmark number:	13
Unit:	Tonne of standard pure dolime Standard pure dolime has a free CaO content of 57.4% and a free MgO content of 38.0% (see comment on allocation methodology).
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day
Special provisions:	Provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Dolime or calcined dolomite as mixture of calcium and magnesium oxides produced by the decarbonation of dolomite ($CaCO_3.MgCO_3$) with

- *a residual CO_2 exceeding 0.25%,*
- *a free MgO content between 25% and 40% and*
- *a bulk density of the commercial product below 3.05 g/cm³.*

Dolime shall be expressed as 'standard pure dolime' quality with a free CaO content of 57.4% and a free MgO content of 38.0%."

The table below shows relevant 2010 PRODCOM code. The definition covers the benchmarked product dolime, but also the products ultra low carbon dolime and sintered dolime (see section 14) which have different characteristics and are not covered by this product benchmark.

PRODCOM code	Description
23.52.30.30	Calcined and sintered dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of dolime are included, in particular:

- *Fuel preparation*
- *Calcination/sintering and*
- *Flue gas treatment."*

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Figure 2 gives a graphical representation of the system boundaries

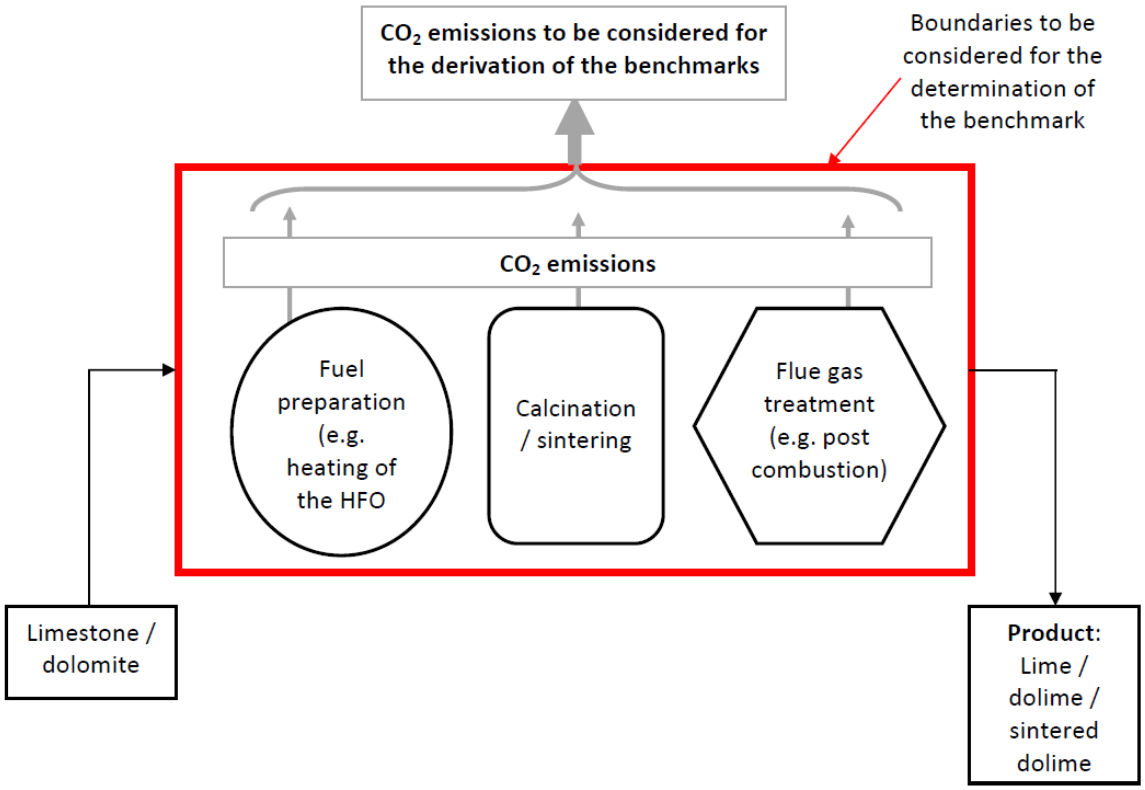

Figure 2. System boundaries (Sector Rule book for the development of CO_2 benchmarks for the European lime sector, 2010)

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing dolime is calculated as follows:

$$F_{p,k} = BM_p \times HAL_{dolime,standard} \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing dolime in year k (expressed in EUAs).

BM_P: Benchmark for dolime (expressed in EUAs / unit of product).

$HAL_{Dolime,standard}$: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Given the wide range of product qualities that can be achieved, the product benchmark for dolime refers to a standard composition concerning calcium oxide and magnesium oxide. The historical activity level to be used in the determination of free allocation therefore needs to be corrected for the calcium oxide and magnesium oxide content of the produced dolime:

$$HAL_{dolime,standard} = ArithmeticMean\left(\frac{785 \times m_{CaO,k} + 1092 \times m_{MgO,k}}{865.6} \times HAL_{dolime,uncorrected,k}\right)$$

With

$HAL_{dolime,standard}$: historical activity level for dolime production expressed in tonnes of standard pure dolime

$m_{CaO,k}$: content of free CaO in the produced dolime in year k of the baseline period expressed in mass-%. Best available data should be used; in order of preference:

2) Composition data determined in accordance with Annex I.13.3 to the MRG
3) Conservative estimate not lower than 52% based on other data than composition data determined in accordance with Annex I.13.3 to the MRG
4) Default value of 52%

$m_{MgO,k}$: content of free MgO in the produced dolime in year k of the baseline period expressed in mass-%. Best available data should be used; in order of preference:

1) Composition data determined in accordance with Annex I.13.3 to the MRG

2) Conservative estimate not lower than 33% based on other data than composition data determined in accordance with Annex I.13.3 to the MRG
3) Default value of 33%

$HAL_{dolime,uncorrected,k}$: uncorrected historical activity level for dolime production in year k expressed in tonnes of dolime.

If possible, composition data should be based on applicable European standards such as EN 459-2, EN 12485 and EN ISO12677.

Conservative estimates might be determined by calculation of the content of free CaO and MgO in the product from the composition of the raw material using the carbonates method.
The content of free CaO and MgO in the produced dolime in year k of the baseline period expressed in mass-% could be calculated as follows:

$m_{CaO,k}$ = (A / (100 - ((A – B x 56,08 / 40,31) x 44,01 / 56,08 + B x 88,02 / 40,31 – F))) x 100

$m_{MgO,k}$ = (B / (100 - ((A – B x 56,08 / 40,31) x 44,01 / 56,08 + B x 88,02 / 40,31 – F))) x 100

With

A: total CaO content in stone (in %)
B: total MgO content in stone (in %)
F: residual CO_2 in burnt dolime (in %).

14 Sintered dolime

Benchmark name:	**Sintered dolime**
Benchmark number:	14
Unit:	Tonnes of sintered dolime (as saleable product)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mixture of calcium and magnesium oxides used solely for the production of refractory bricks and other refractory products with a minimum bulk density of 3.05 g/cm³. Expressed in tonnes of saleable sintered dolime."

This weight density threshold is used to distinguish Sintered dolime from Dolime. For sintered dolime no correction for the CaO and MgO contents is needed.

The table below shows the relevant PRODCOM 2010 code. The definition covers the benchmarked product sintered dolime, but also the products ultra low carbon dolime and ordinary dolime (see section 13) which have different characteristics and are not covered by this product benchmark.

PRODCOM code	**Description**
23.52.30.30	Calcined and sintered dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of sintered dolime are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Figure 3 gives a graphical representation of the system boundaries

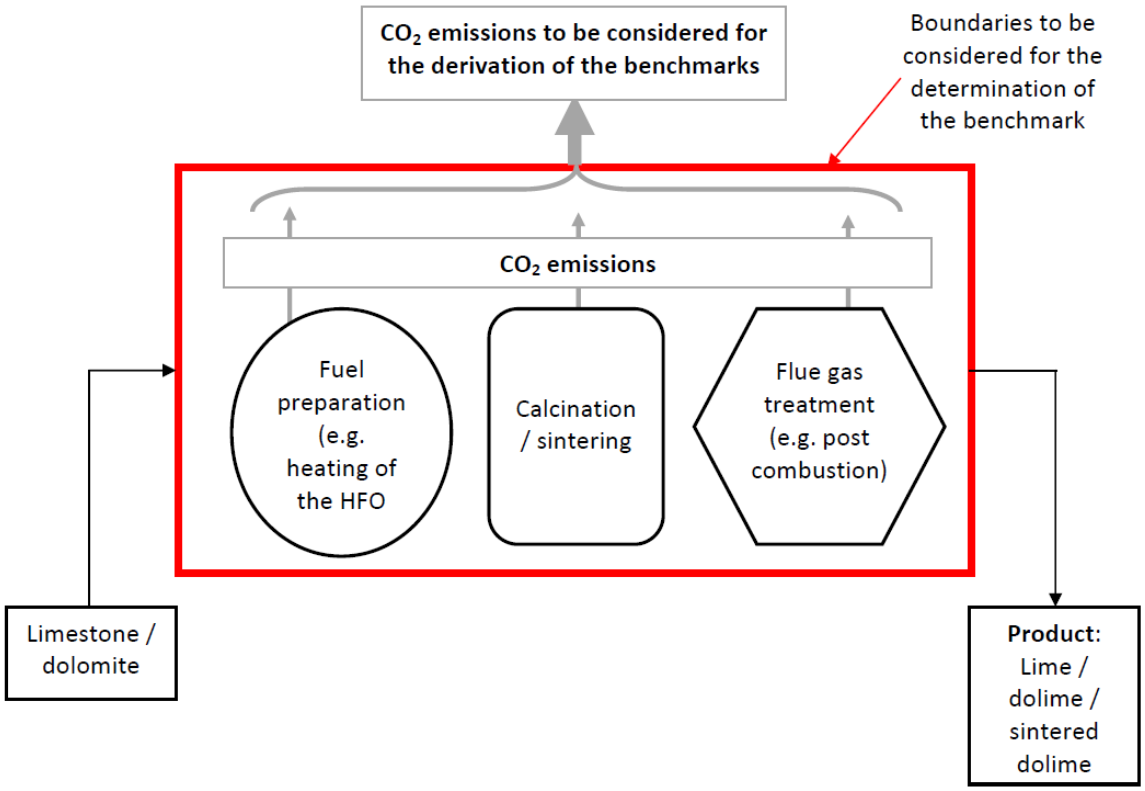

Figure 3. System boundaries (Sector Rule book for the development of CO_2 benchmarks for the European lime sector, 2010)

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing sintered dolime is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing sintered dolime in year k (expressed in EUAs).

BM_P: Benchmark for sintered dolime (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

15 Float glass

Benchmark name:	**Float glass**
Benchmark number:	15
Unit:	Tonnes of glass exiting the lehr. 'Glass exiting the lehr' is to be understood as melted glass. Quantities of melted glass are calculated from the quantity of raw material input into the furnace after subtraction of the volatile gaseous emissions, i.e. CO_2, SO2, H20, NO, etc.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Float / ground / polish glass (as tonnes of glass exiting the lehr)."

The table below shows a list of relevant products associated with float glass products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
23.11.12.14	Non-wired sheets of float glass and surface ground or polished glass, having an absorbent or reflective layer, of a thickness ≤ 3.5 mm
23.11.12.17	Non-wired sheets of float glass and surface ground or polished glass, having an absorbent or reflective layer, of a thickness ≤ 3.5 mm
23.11.12.30	Non-wired sheets, of float, surface ground or polished glass, coloured throughout the mass, opacified, flashed or merely surface ground
23.11.12.90	Other sheets of float/ground/polished glass, n.e.c.

The PRODCOM products listed in the table above list refer to final products. This benchmark however covers all the melted glass exiting the lehr and not the final products defined by the PRODCOM codes which are processed from the melted glass in the downstream process steps.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production steps
- *melter,*
- *refiner,*
- *working end,*
- *bath and*
- *lehr*

are included.
Finishing workshops that can be physically separated from the upstream process, such as offline coating, laminating and toughening are excluded."

In particular, the following production steps are included:
- Furnace (includes process emissions and associated pollution control equipments (incinerator, carbonate scrubber))
- Bath
- Lehr (a temperature-controlled kiln for annealing objects made of glass)
- Batch plant
- On-line coating
- Chemical reduction by fuel (DeNox)
- Oxygen generating plant
- Nitrogen and hydrogen generation plant
- Bath atmosphere plant (storage)

Emissions related to the production of the consumed electricity are excluded from the system boundaries

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumers not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing float glass is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing float glass in year k (expressed in EUAs).

BM_P: Benchmark for float glass (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

16 Bottles and jars of colourless glass

Benchmark name:	**Bottles and jars of colourless glass**
Benchmark number:	16
Unit:	Tonne of packed product
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Bottles of colourless glass of a nominal capacity < 2.5 litres, produced in a furnace where there is no deliberate addition of colour for beverages and foodstuffs (excluding bottles covered with leather or composition leather; infant's feeding bottles) except extra-white flint products with an iron oxide content expressed as percent Fe_2O_3 by weight lower than 0.03% and colour co-ordinates of L in the range 100 to 87, of a in the range 0 to -5 and of b in the range 0 to 3 (using the CIELAB advocated by the Commission Internationale d'Éclairage) expressed as tonnes of packed product."

Colourless glass is produced in a furnace where there is no deliberate addition of colour [into the furnace] either through the use of colouring agents as separate raw material (e.g. iron chromite ($Fe_2O_3.Cr_2O_3$), iron oxide (Fe_2O_3), titanium oxide, cobalt oxide) or coloured cullet to achieve a required specification. Colourless glass raw material batch may contain an incidental presence of external coloured cullet and decolourising agents.

Apart from the exclusion of extra-flint products, this definition is identical to the definition in PRODCOM 2010 statistics as shown in the table below.

PRODCOM code	**Description**
23.13.11.40	Bottles of colourless glass of a nominal capacity < 2.5 litres, for beverages and foodstuffs (excluding bottles covered with leather or composition leather, infant's feeding bottles)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production steps

- *materials handling*
- *melting*
- *forming*
- *downstream processing*
- *packaging and*
- *ancillary processes*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing bottles and jars of colourless glass is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing bottles and jars of colourless glass in year k (expressed in EUAs).

BM_P: Benchmark for bottles and jars of colourless glass (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

17 Bottles and jars of coloured glass

Benchmark name:	**Bottles and jars of coloured glass**
Benchmark number:	17
Unit:	Tonne of packed product
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Bottles of coloured glass of a nominal capacity < 2.5 litres, for beverages and foodstuffs (excluding bottles covered with leather or composition leather; infant's feeding bottles), not meeting the definition of the product benchmark for bottles and jars of colourless glass, expressed as tonnes of packed product."

This definition is identical to the definition in PRODCOM 2010 statistics as shown in the table below.

PRODCOM code	**Description**
23.13.11.50	Bottles of coloured glass of a nominal capacity < 2.5 litres, for beverages and foodstuffs (excluding bottles covered with leather or composition leather, infant's feeding bottles)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production steps
- *materials handling*
- *melting*
- *forming*
- *downstream processing,*
- *packaging*
- *ancillary processes*

are included"

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumers not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing bottles and jars of coloured glass is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing bottles and jars of coloured glass in year k (expressed in EUAs).

BM_P: Benchmark for bottles and jars of coloured glass (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

18 Continuous filament glass fibre products

Benchmark name:	**Continuous filament glass fibre products**
Benchmark number:	18
Unit:	Tonne of melted glass exiting the forehearth 'Melted glass exiting the forehearth' is to be understood as melted glass. Quantities of melted glass are calculated from the quantity of raw material input into the furnace after subtraction of the volatile gaseous emissions, i.e. CO_2, SO2, H20, NO, etc.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Melted glass for the production of continuous filament glass fibre products namely chopped strands, rovings, yarns and staple glass fibre and mats, expressed as tonnes of melted glass exiting the forehearth calculated from the quantity of raw material input into the furnace after subtraction of the volatile gaseous emissions.
Mineral wool products for thermal, acoustic and fire insulation are not covered by this benchmark."

The table below shows relevant products associated with continuous filament glass fibre (CFGF) products according to definitions in PRODCOM 2010 statistics.
PRODCOM products 26.14.12.10 and 26.14.12.30 could also be covered by the benchmark for mineral wool. Therefore, it needs to be carefully analysed which product benchmark applies, in particular by considering the different applications of both benchmarked products (the mineral wool benchmarks applies only to products for thermal, acoustic and fire applications, see Section 23).

PRODCOM code	**Description**
23.14.11.10	Glass fibre threads cut into lengths of at least 3 mm but ≤ 50 mm (chopped strands)
23.14.11.30	Glass fibre filaments (including rovings)
23.14.11.50	Slivers; yarns and chopped strands of filaments of glass fibres (excluding glass fibre threads cut into lengths of at least 3 mm but ≤ 50 mm)
23.14.11.70	Staple glass fibre articles
23.14.12.10	Glass fibre mats (including of glass wool) (also used for Definition and explanation of products covered by the benchmark for Mineral Wool)

23.14.12.30	Glass fibre voiles (including of glass wool)(also used for Definition and explanation of products covered by the benchmark for Mineral Wool)
23.14.12.50	Nonwoven glass fibre webs; felts; mattresses and boards

The PRODCOM products listed in the table above list refer to final products, however not to molten glass, which is an intermediate material output which is further transformed in the downstream process steps. This benchmark covers the molten glass and not the final products defined by the PRODCOM codes.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production processes

- *Glass melting in the furnaces and*
- *Glass refining in the forehearths*

are included, in particular direct CO_2 emissions associated to these process CO_2 emissions resulting from the decarbonatisation of the glass mineral raw materials during the melting process.
Downstream processes to convert the fibres into sellable products are not included in this product benchmark. Supporting processes such as material handling are regarded as utilities and are outside the system boundaries."

Figure 4 gives a graphical representation of the system boundaries. Supporting processes such as material handling are regarded as utilities and are not covered by the system boundaries of this product benchmark.

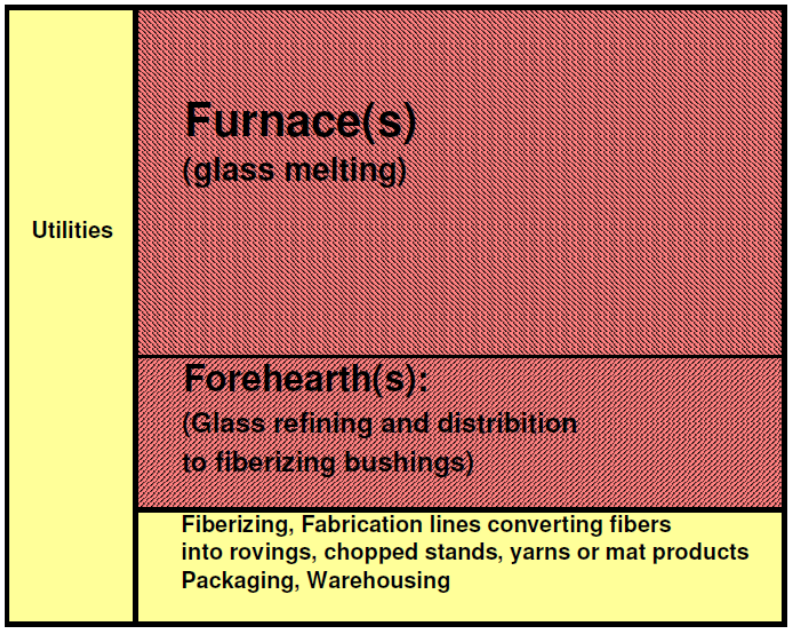

Figure 4. System boundaries; processes within the system boundaries are depicted red (dark shade) (Rule book for Continuous Filament Glass Fibre (CFGF), 2010)

This product benchmark includes the following emissions in particular:

- Direct CO_2 emissions associated with fossil fuel combustion of the process steps:
  - Glass melting in the furnaces
  - Glass refining and distribution through the forehearths to the fiberizing bushings.
- Process CO_2 emissions resulting from the decarbonatation of the glass mineral raw materials during the melting process.

Emissions related to the production of the consumed electricity are excluded from the system boundaries

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing continuous filament glass fibre products is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing continuous filament glass fibre products (expressed in EUAs).

BM_P: Benchmark for continuous filament glass fibre products (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

19 Facing bricks

Benchmark name:	**Facing bricks**
Benchmark number:	19
Unit:	Tonne of facing bricks
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Facing bricks with a density > 1000 kg/m^3 used for masonry based on EN 771-1, excluding pavers, clinker bricks and blue braised facing bricks."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Note that this PRODCOM code also includes products such as clay blocks that are not covered by the definition of the benchmarked product.

PRODCOM code	**Description**
23.32.11.10	Non-refractory clay building bricks (excluding of siliceous fossil meals or earths)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Facing bricks are used for the outer leaf of buildings with cavity walls. Facing Bricks exist in different colours.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production processes
- *Raw material preparation,*
- *Component mixing,*
- *Forming and shaping of ware,*
- *Drying of ware,*
- *Firing of ware,*
- *Product finishing and*

- *Flue gas cleaning,*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries as well as emissions related to the fuel used for lorries and other vehicles to transport the clay and other raw material.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing facing bricks is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing facing bricks in year k (expressed in EUAs).

BM_P: Benchmark for facing bricks (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

20 Pavers

Benchmark name:	Pavers
Benchmark number:	20
Unit:	Tonne of pavers as (net) saleable product
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Clay bricks of any colour used for flooring according to EN 1344. Expressed in tonnes of pavers as net saleable product."

Pavers exist in different colours such as red, yellow, and blue braised. They are all covered by this product benchmark.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. The PRODCOM product also covers roof tiles which are covered by as separate benchmark (see section 21).

PRODCOM code	Description
23.32.11.30	Non-refractory clay flooring blocks, support or filler tiles and the like (excluding of siliceous fossil meals or earths)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production processes
- *raw material preparation,*
- *component mixing,*
- *forming and shaping of ware,*
- *drying of ware,*
- *firing of ware,*

- *product finishing, and*
- *flue gas cleaning*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing pavers is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing pavers in year k (expressed in EUAs).

BM_P: Benchmark for pavers (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

21 Roof tiles

Benchmark name:	**Roof tiles**
Benchmark number:	21
Unit:	Tonne of roof tiles (saleable production)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Clay roofing tiles as defined in EN 1304:2005 excluding blue braised roof tiles and accessories. Expressed in tonnes of saleable roof tiles".

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Accessories defined by PRODCOM 2010 code 26 40 12 70 should be excluded.

PRODCOM code	**Description**
23.32.12.50	Non-refractory clay roofing tiles
Excluding: 23.32.12.70	Non-refractory clay constructional products (including chimneypots, cowls, chimney liners and flue-blocks, architectural ornaments, ventilator grills, clay-lath; excluding pipes, guttering and the like)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production processes
- *raw material preparation*
- *component mixing*
- *forming and shaping of ware*
- *drying of ware*
- *firing of ware*
- *product finishing and*
- *flue gas cleaning*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing roof tiles is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing roof tiles in year k (expressed in EUAs).

BM_P: Benchmark for roof tiles (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

22 Spray dried powder

Benchmark name:	**Spray dried powder**
Benchmark number:	22
Unit:	Tonne of powder produced
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Spray-dried powder for the production of dry-pressed wall and floor tiles. Expressed in tonnes of powder produced."

In this context, dry-pressed wall and floor tiles (PRODCOM code 2010 is 23.31.10) are understood as thin slabs made from clay and/ or other inorganic raw materials, generally used as coverings for floor and walls, glazed or unglazed.

There are no codified standards for this intermediate product.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of spray-dried powder are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing spray dried powder is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing spray dried powder in year k (expressed in EUAs).

BM_P: Benchmark for spray dried powder (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

23 Mineral wool

Benchmark name:	**Mineral wool**
Benchmark number:	23
Unit:	Tonne of mineral wool (saleable product)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Manufacture of mineral wool insulation material using glass, rock or slag with a melting capacity exceeding 20 tonnes per day
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mineral wool insulation products for thermal, acoustic and fire applications manufactured using glass, rock or slag. Expressed in tonnes of mineral wool (saleable product)".

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. PRODCOM 2010 products 23.14.12.10 and 23.14.12.30 could also be covered by the benchmark for Continuous Filament Glass Fibre benchmark (see section 18). Therefore, it needs to be carefully analysed which product benchmark applies, in particular by considering the different applications of both benchmarked products (the mineral wool benchmarks applies only to products for thermal, acoustic and fire applications).

PRODCOM code	**Description**
23.14.12.10	Glass fibre mats (including of glass wool)
23.14.12.30	Glass fibre voiles (including of glass wool)
23.99.19.10	Slag wool, rock wool and similar mineral wools and mixtures thereof, in bulk, sheets or rolls

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the mineral wool product benchmark as follows:

"All processes directly or indirectly linked to the production steps

- *melting*
- *fiberizing and injection of binders*
- *curing and drying and*
- *forming*

are included.

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

The latter emissions are not eligible for free allocation but are used in the calculation of free allocation (see below). The indirect emissions include all electricity used by processes directly or indirectly linked to the production steps: melting, fiberizing and injection of binders, curing and drying and forming. The system boundaries do not include packaging.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for mineral wool is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing mineral wool in year k (expressed in EUAs).

BM_P: Benchmark for mineral wool(expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct} : Direct emissions within the system boundaries of the production of mineral wool over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed within the system boundaries of the mineral wool production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing mineral wool, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of mineral wool over the baseline period. These emissions expressed in tonne CO_2 are calculated as follows:

$$Em_{indirect} = Elec.use \times 0.376$$

With:

Elec.use : Total electricity consumption within the system boundaries of the production of mineral wool over the baseline period, expressed in MWh.

24 Plaster

Benchmark name:	**Plaster**
Benchmark number:	24
Unit:	Tonne of stucco (saleable production) Stucco also known as 'Plaster of Paris' is hemi-hydrate plaster (CaSO4.1/2H2O) produced by heating ('calcining') raw gypsum at 150°C to 165°C thereby removing three-quarters of chemically combined water.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Plasters consisting of calcined gypsum or calcium sulphate (including for use in building, for use in dressing woven fabrics or surfacing paper, for use in dentistry, for use in land remediation) in tonnes of stucco (saleable production).
Alpha plaster, plaster that is further processed to plasterboard and the production of the intermediate product dried secondary gypsum, are not covered by this product benchmark."

Plaster that is further processed to plasterboard is not covered by this benchmark but by the plasterboard benchmark (see next chapter).

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. The definition of these products does not necessarily coincide with the product definition for the purpose of this benchmark: a benchmarked product may be covered by more than one PRODCOM code and vice versa.

PRODCOM code	**Description**
08.11.20.30	Gypsum and anhydrite
23.52.20.00	Plasters consisting of calcined gypsum or calcium sulphate (including for use in building, for use in dressing woven fabrics or surfacing paper, for use in dentistry)
23.64.10.00	Factory made mortars

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production steps
- *Milling,*
- *Drying, and*
- *Calcining*

are included."

The plaster benchmark covers the same activities as the plasterboard benchmark (see next chapter), except board drying. The production of the intermediate product dried secondary gypsum (see section 25) is not covered by the plaster benchmark.

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing plaster is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing plaster in year k (expressed in EUAs).

BM_P: Benchmark for plaster (expressed in EUAs / unit of product).

HAL_P : Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

25 Dried secondary gypsum

Benchmark name:	Dried secondary gypsum
Benchmark number:	25
Unit:	Tonne of dry secondary gypsum product
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Dried secondary gypsum (synthetic gypsum produced as a recycled by-product of the power industry or recycled material from construction waste and demolition) expressed as tonnes of product."

Dry secondary gypsum is an intermediate product in the production of plasters (see section 24) or plasterboard (see section 26). Dry secondary gypsum is produced by recycling:

- Secondary gypsum: a by-product of flue gas desulphurization plants (FGD or DSG) produced by the power generation industry
- Waste generated by the factory due to rejects or damage that is recycled internally by the factory and not sent to landfill;
- Any waste material returned to the factory by the building sector;
- Any waste gypsum products received from demolition of existing buildings.
- Any other recycled material processed separately by the plant

The table below shows relevant product according to definition in PRODCOM 2010 statistics. The definition of this product also covers plaster (see section 24).

PRODCOM code	Description
23.52.20.00	Plasters consisting of calcined gypsum or calcium sulphate (including for use in building, for use in dressing woven fabrics for surfacing paper, for use in dentistry)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the drying of secondary gypsum are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing dried secondary gypsum is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing dried secondary gypsum in year k (expressed in EUAs).

BM_P: Benchmark for dried secondary gypsum (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

26 Plasterboard

Benchmark name:	**Plasterboard**
Benchmark number:	26
Unit:	Tonne of stucco (saleable production) Stucco also known as 'Plaster of Paris' is hemi-hydrate plaster (CaSO4.1/2H2O) produced by heating ('calcining') raw gypsum at 150°C to 165°C thereby removing three-quarters of chemically combined water.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"The benchmark covers boards, sheets, panels, tiles, similar articles of plaster/ compositions based on plaster, (not) faced/ reinforced with paper/ paperboard only, excluding articles agglomerated with plaster, ornamented (in tonnes of stucco, saleable product).
High-density gypsum fibreboards are not covered by this product benchmark."

The benchmark covers the products of based on plaster. The benchmark covers both faced and non faced products, both reinforced and non-reinforced products, such as:

- Boards
- Sheets
- Panels
- Tiles,
- Similar articles of plaster/compositions
- Plasterboard
- Glass Reinforced Plasterboard
- Gypsum Blocks
- Gypsum Coving
- Gypsum Ceiling Tiles.

The benchmark excludes

- Articles agglomerated with plaster ornamented
- High-density fibreboards

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	Description
23.62.10.50	Boards, sheets, panels, tiles, similar articles of plaster/compositions based on plaster, faced/reinforced with paper/paperboard only, excluding articles agglom. with plaster, ornamented
23.62.10.90	Boards, sheets, panels, tiles, similar articles of plaster/compositions based on plaster, not faced/reinforced with paper/paperboard only, excluding articles agglom. with plaster, ornamented

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

The tonnes of stucco used to make the final product can be verified by using one or more of the following methods:

1. Measurement of the weight of stucco going into the mixer from the weigh belt feeding the mixer (in the gypsum industry the weigh belt is a highly calibrated measuring device with an accuracy of +/- 0.5%);
2. Calculation of the amount of stucco used to make the board from recipe data used to make each individual plasterboard product;
3. Measurement of the amount of stucco made in the separate calcination step;
4. Back calculation to the amount of raw gypsum material entering the plant (this is used for verification of the plant's mass balance).

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the plasterboard product benchmark as follows:

"All processes directly or indirectly linked to the production steps

- *milling,*
- *drying,*
- *calcining, and*
- *board drying*

are included.
For the determination of indirect emissions, only the electricity consumption of heat pumps applied in the drying stage shall be considered.
The production of the intermediary product dried secondary gypsum is not covered by this benchmark."

The plasterboard benchmark covers the same activities as the plaster benchmark, but covers board drying as an additional production step.

For the determination of indirect emissions, only the electricity consumption of heat pumps applied in the drying stage shall be considered.These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for plasterboard is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing plasterboard in year k (expressed in EUAs).

BM_P: Benchmark for plasterboard (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of plasterboard over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the plasterboard production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-

installation producing plasterboard, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption of heat pumps applied in the drying stage over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$$Em_{indirect} = Elec.use \times 0.376$$

With:

Elec. use : Electricity consumption of heat pumps applied in the drying stage over the baseline period, expressed in MWh.

27 Short fibre kraft pulp

Benchmark name:	**Short fibre kraft pulp**
Benchmark number:	27
Unit:	Net saleable production in Adt (Air Dried Tonnes) The production of an installation is defined as the net saleable production of air dried metric tonnes (Adt) measured at the end of the production process. In case of pulp production, the production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. Air dry metric tonne of pulp meaning dry solids content of 90%.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pulp from timber or other fibrous materials
Special provisions:	Special provision on allocation to integrated pulp & paper: activity levels only takes into account pulp that is placed on the market and not processed into paper.

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Short fibre kraft pulp is a wood pulp produced by the sulphate chemical process using cooking liquor, characterised by fibre lengths of 1 – 1,5 mm, which is mainly used for products which require specific smoothness and bulk, as tissue and printing paper, expressed as net saleable production in air dried tonnes, measured at the end of the productin process. Air dry metric tonne of pulp meaning dry solids content of 90%."

Long fibre kraft pulp is not included in this benchmark (see section 28).

The table below show relevant products according to definitions in PRODCOM 2010 statistics. The codes also cover long fibre kraft pulp (see section 28).

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	**Description**
17.11.12.00	Chemical wood pulp, soda or sulphate, other than dissolving grades

For all pulp production except recovered paper pulp, free allocation is only granted to pulp placed on the market and not processed into paper in the same installation or a

technically connected installation (FAR, Art. 16(6)[Error! Bookmark not defined.]). This also applies to heat recovered from any pulp benchmark other than recovered paper pulp.

Example: if a pulp mill produces 100 tonne of pulp and only 1 Adt (Air Dried Tonne) is sold on the market, then only 1 Adt is eligible for free allocation under this benchmark.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the pulp production process (in particular
- *the pulp mill,*
- *recovery boiler,*
- *pulp drying section,*
- *lime kiln and*
- *Connected energy conversion units (boiler/CHP)*

are included.

Other activities on site that are not part of this process such as
- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling)),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing short fibre kraft pulp is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing short fibre kraft pulp in year k (expressed in EUAs).

BM_P: Benchmark for short fibre kraft pulp (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

28 Long fibre kraft pulp

Benchmark name:	**Long fibre kraft pulp**
Benchmark number:	28
Unit:	Net saleable production in Adt (Air Dried Tonnes) The production of an installation is defined as the net saleable production of air dried metric tonnes (Adt) measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids content of 90%.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pulp from timber or other fibrous materials
Special provisions:	Special provision on allocation to integrated pulp & paper: activity levels only takes into account pulp that is placed on the market and not processed into paper.

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Long fibre kraft pulp is a wood pulp produced by the sulphate chemical process using cooking liquor, characterised by fibre lengths of 3 – 3,5 mm, including bleached and unbleached pulp, expressed as net saleable production in Air Dried Tonnes, measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids content of 90%."

The product group encompasses the production of both bleached and unbleached (brown) pulp. Bleached pulp is particularly used for graphic papers, tissue and carton boards. Unbleached pulp is commonly used in products for which strength is important, such as packaging paper, liner for corrugated board, wrappings, sack and bag papers, envelopes and other unbleached speciality papers.

Short fibre kraft pulp is not included in this benchmark (see section 27).

The tables below show relevant products according to definitions in PRODCOM 2010 statistics. The codes also cover short fibre kraft pulp (see section 27).

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	Description
17.11.12.00	Chemical wood pulp, soda or sulphate, other than dissolving grades

For all pulp production except recovered paper pulp, free allocation is only granted to pulp placed on the market and not processed into paper in the same installation or a technically connected installation (FAR, Art. 16(6)). This also applies to heat recovered from any pulp benchmark other than recovered paper pulp.

Example: if a pulp mill produces 100 tonne of pulp and only 1 Adt (Air Dried Tonne) is sold on the market, then only 1 Adt is eligible for free allocation under this benchmark.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the pulp production process (in particular:
- *the pulp mill,*
- *recovery boiler,*
- *pulp drying section,*
- *lime kiln and*
- *connected energy conversion units (boiler/CHP))*

are included.

Other activities on site that are not part of this process such as
- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

With possibly a single exemption, unbleached Kraft pulp production is always integrated with kraftliner production. Care should therefore be taken that no double allocation occurs (see introduction).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumers not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation

only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing long fibre kraft pulp is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing long fibre kraft pulp in year k (expressed in EUAs).

BM_P: Benchmark for long fibre kraft pulp (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

29 Sulphite pulp, thermo-mechanical and mechanical pulp

Benchmark name:	**Sulphite pulp, thermo-mechanical and mechanical pulp**
Benchmark number:	29
Unit:	Net saleable production in Adt (Air Dried Tonnes) The production of an installation is defined as the net saleable production of air dried metric tonnes (Adt) measured at the end of the production process. In case of pulp production. Air dry metric tonne of pulp meaning dry solids content of 90%.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pulp from timber or other fibrous materials
Special provisions:	Special provision on allocation to integrated pulp & paper: activity levels only takes into account pulp that is placed on the market and not processed into paper.

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Sulphite pulp produced by a specific pulp making process, e.g. pulp produced by cooking wood chips in a pressure vessel in the presence of bisulphite liquor expressed as net saleable production in air dried metric tonnes measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids contents of 90%. Sulphite pulp can be either bleached or unbleached.
Mechanical pulp grades: TMP (thermomechanical pulp) and groundwood as net saleable production in air dried metric tonnes measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids contents of 90%. Mechanical pulp can be either bleached or unbleached.
Not covered by this group are the smaller subgroups of semichemical pulp CTMP – chemi-thermomechanical pulp and dissolving pulp."

The following types of pulp are included in this benchmark:

- Bleached or unbleached sulphite pulp produced by the sulphite pulping process
- Bleached or unbleached mechanical pulp grades: thermomechanical pulp (TMP) and groundwood pulp

The following sub-types are excluded from this benchmark:

- Semichemical pulp
- Chemithermomechanical pulp (CTMP)
- Dissolving pulp

The table below show relevant products according to definitions in PRODCOM 2010 statistics.
These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	**Description**
17.11.13.00	Chemical wood pulp, sulphite, other than dissolving grades
PRODCOM code partially covered by product benchmark 29	**Descriptions**
17.11.14.00	*Part covered:* Mechanical wood pulp *Part **not** covered:* Semi-chemical wood pulp (this part is not covered by any product benchmark). Pulps of fibrous cellulosic material other than wood (this part is covered by the product benchmark Recovered paper pulp, see section 30).

For all pulp production except recovered paper pulp, free allocation is only granted to pulp placed on the market and not processed into paper in the same installation or a technically connected installation (FAR, Art. 16(6)). This also applies to heat recovered from any pulp benchmark other than recovered paper pulp.

Example: if a pulp mill produces 100 tonne of pulp and only 1 Adt (Air Dried Tonne) is sold on the market, then only 1 Adt is eligible for free allocation under this benchmark.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the pulp production process (in particular
- *the pulp mill,*
- *recovery boiler,*
- *pulp drying section and lime kiln and*
- *connected energy conversion units (boiler/CHP))*

are included.

Other activities on site that are not part of this process such as
- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*

- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing sulphite pulp, thermo-mechanical and mechanical pulp is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing sulphite pulp, thermo-mechanical and mechanical pulp in year k (expressed in EUAs).

BM_P: Benchmark for sulphite pulp, thermo-mechanical and mechanical pulp (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

30 Recovered paper pulp

Benchmark name:	**Recovered paper pulp**
Benchmark number:	30
Unit:	Net saleable production in Adt (Air Dried Tonnes). The production of an installation is defined as the net saleable production of air dried metric tonnes (Adt) measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids content of 90%. In case of pulp production, the production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. The produced recovered paper pulp will in most cases be transported from the pulper to the paper machine in the form of a slurry. It has to be calculated back to Adt. The production amount can either be defined by measuring the amount of pulp from the pulper (if meters in place) or by calculation from the recovered paper input minus impurities removed or from a full mass balance.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of pulp from timber or other fibrous materials
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Pulps of fibres derived from recovered (waste and scrap) paper or paperboard or of other fibrous cellulosic material expressed in tonnes of saleable production in air dried metric tonnes measured at the end of the production process. Air dry metric tonne of pulp meaning dry solids contents of 90%.
In case of pulp production, the production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code partially covered by product benchmark 30	Description
17.11.14.00	*Part covered:* Pulps of fibrous cellulosic material other than wood *Part **not** covered:* Semi-chemical wood pulp (this part is not covered by any product benchmark). Mechanical wood pulp (this part is covered by the product benchmark Sulphite pulp, thermo-mechanical and mechanical pulp, see section 29).

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.
Both deinked and non-deinked recycled pulp are covered by the benchmark.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the production of pulp from recovered paper and connected energy conversion units (boiler/CHP)) are included. Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR*

for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing recovered paper pulp is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing recovered paper pulp in year k (expressed in EUAs).

BM_P: Benchmark for recovered paper pulp (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

31 Newsprint

Benchmark name:	**Newsprint**
Benchmark number:	31
Unit:	Net saleable production in Adt (Air Dried Tonnes) The production is defined as the net saleable production of air dried metric tonnes (Adt) measured at the end of the production process. Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Specific paper grade (in rolls or sheets) expressed as net saleable production in air dried tonnes, defined as paper with 6% moisture content."

Those papers are used for printing newspapers produced from groundwood and/or mechanical pulp or recycled fibres or any percentage of combinations of these two.
Weights usually range from 40 to 52 g/m² but can be as high as 65 g/m².
Newsprint is machine-finished or slightly calendered, white or slightly coloured and is used in reels for letterpress, offset or flexo-printing.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM 2007 code	**Description**
17.12.11.00	Newsprint in rolls or sheets

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular

- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing newsprint is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing newsprint in year k (expressed in EUAs).

BM_P: Benchmark for newsprint (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, a newsprint producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the newsprint producing sub-installation.

32 Uncoated fine paper

Benchmark name:	**Uncoated fine paper**
Benchmark number:	32
Unit:	Net saleable production in Adt (Air Dried Tonnes) Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Uncoated fine paper, covering both uncoated mechanical and uncoated woodfree expressed as net saleable production in air dried tonnes, defined as paper with 6% moisture content:

1. *Uncoated woodfree papers covers papers suitable for printing or other graphic purposes made from a variety of mainly virgin fibre furnishes, with variable levels of mineral filler and a range of finishing processes.*
2. *Uncoated mechanical papers cover the specific paper grades made from mechanical pulp, used for packaging or graphic purposes/magazines."*

The uncoated woodfree papers includes most office papers, such as business forms, copier, computer, stationery and book papers.

The tables below show relevant products according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	**Description**
17.12.12.00	Hand-made paper and paperboard in rolls or sheets (excluding newsprint)
17.12.13.00	Paper and paperboard used as a base for photo-sensitive, heat-sensitive or electro-sensitive paper; carbonising base paper; wallpaper base
17.12.14.10	Graphic paper, paperboard : mechanical fibres ≤ 10%, weight < 40 g/m²
17.12.14.35	Graphic paper, paperboard : mechanical fibres ≤ 10%, weight 4802.55 ≥ 40 g/m² but ≤ 150 g/m², in rolls
17.12.14.39	Graphic paper, paperboard : mechanical fibres ≤ 10%, weight ≥ 40 g/m² but ≤ 150 g/m², sheets

17.12.14.50	Graphic paper, paperboard : mechanical fibres ≤ 10%, weight > 150 g/m²
17.12.14.70	Graphic paper, paperboard: mechanical fibres > 10%

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular
- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as
- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling)),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumers not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing uncoated fine paper is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing uncoated fine paper in year k (expressed in EUAs).

BM_P: Benchmark for uncoated fine paper (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, an uncoated fine paper producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the uncoated fine paper producing sub-installation.

33 Coated fine paper

Benchmark name:	Coated fine paper
Benchmark number:	33
Unit:	Net saleable production in Adt (Air Dried Tonnes) Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Coated fine paper covering both
- *coated mechanical and*
- *coated woodfree papers*

expressed as net saleable production in air dried tonnes, defined as paper with 6% moisture content."

More specifically coated fine paper covers:
1. Coated woodfree papers made of fibres produced mainly by a chemical pulping process which are coated in process for different applications and are also known as coated freesheet. This group focuses mainly on publication papers.
2. Coated mechanical papers made from mechanical pulp, used for graphic purposes/magazines. The group is also known as coated groundwood.

The tables below show relevant saleable products also according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	Description
17.12.73.35	Coated base for paper..., for photo-, heat-, electro-sensitive paper, weight <= 150 g/m², m.f. <= 10%
17.12.73.37	Coated paper, for writing, printing, graphic purposes (excluding coated base, weight <= 150 g/m²)
17.12.73.60	Light-weight coated paper for writing, printing, graphic purposes, m.f. > 10%
17.12.73.75	Other coated mech. graphic paper for writing, printing, graphic purposes, m.f. > 10%, rolls

17.12.73.79	Other coated mech. graphic paper for writing, printing, graphic purposes, m.f. > 10%, sheets
17.12.76.00	Carbon paper, self-copy paper and other copying or transfer paper, in rolls or sheets

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular

- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing coated fine paper is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing coated fine paper in year k (expressed in EUAs).

BM_P: Benchmark for coated fine paper (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, a coated fine paper producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the coated fine paper producing sub-installation.

34 Tissue

Benchmark name:	**Tissue**
Benchmark number:	34
Unit:	Net saleable production of parent reel in Adt (Air Dried Tonne) Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Tissue papers, covering a wide range of tissue and other hygienic papers for use in households or commercial and industrial premises such as

- *toilet paper and facial tissues,*
- *kitchen towels,*
- *hand towels and*
- *industrial wipes,*
- *the manufacture of baby nappies,*
- *sanitary towels, etc.*

TAD - Through Air Dried Tissue is not part of this group.
Expressed as tonnes of net saleable production of parent reel in air dried tonnes, defined as paper with 6% moisture content."

Not all production process steps are included for the manufacture of each product (see below for definitions and explanation of processes covered). The conversion of parent reel weight to finished products is not part of this product benchmark.

The tables below show relevant saleable products also according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	Description
17.12.20.30	Cellulose wadding for household or sanitary purposes, in rolls of a width > 36 cm or in rectangular (including square sheets) with at least one side > 36 cm in an unfolded state
17.12.20.55	Creped paper and webs of cellulose fibres for household/ sanitary purposes, in rolls, width > 36 cm, rectangular sheets min. one side > 36cm in unfolded state, weight <= 25 g/m²/ply
17.12.20.57	Creped paper and webs of cellulose fibres for household/sanitary purposes, in rolls, width > 36 cm, rectangular sheets min. one side > 36 cm in unfolded state, weight > 25 g/m²/ply
17.12.20.90	Paper stock for household : others
17.22.11.20	Toilet paper
17.22.11.40	Handkerchiefs and cleansing or facial tissues of paper pulp, paper, cellulose wadding or webs of cellulose fibres
17.22.11.60	Hand towels of paper pulp, paper, cellulose wadding or webs of cellulose fibres
17.22.11.80	Tablecloths and serviettes of paper pulp, paper, cellulose wadding or webs of cellulose fibres
17.22.12.20	Sanitary towels, tampons and similar articles of paper pulp, paper, cellulose wadding or webs of cellulose fibres
17.22.12.30	Napkins and napkin liners for babies and similar sanitary articles of paper pulp, paper, cellulose wadding or webs of excluding toilet paper, sanitary towels, tampons and similar articles
17.22.12.50	Articles of apparel and clothing accessories of paper pulp; paper; cellulose wadding or webs of cellulose fibres (excluding handkerchiefs, headgear)
17.22.12.90	Household, sanitary or hospital articles of paper, etc, n.e.c.

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular

- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling)),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases and*
- *district heating*

are not included.

The conversion of parent reel weight to finished products is not part of this product benchmark."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing tissue is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing tissue in year k (expressed in EUAs).

BM_P: Benchmark for tissue (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, a tissue producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the tissue producing sub-installation.

35 Testliner and fluting

Benchmark name:	Testliner and fluting
Benchmark number:	35
Unit:	Net saleable production in Adt (Air Dried Tonne) Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Testliner and fluting expressed as net saleable production in air dried tonnes defined as paper with 6% moisture content:

1. *Testliner covers types of paperboard that meet specific tests adopted by the packaging industry to qualify for use as the outer facing layer for corrugated board, from which shipping containers are made.*
2. *Fluting refers to the centre segment of corrugated shipping containers, being faced with linerboard (testliner/kraftliner) on both sides. Fluting covers mainly papers made from recycled fibre but this group also holds paperboard that is made from chemical and semichemical pulp.*

Kraftliner is not included in this product benchmark."

Testliner is made primarily from fibers obtained from recycled fibres.

The tables below show relevant products according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	Description
17.12.33.00	Semi-chemical fluting
17.12.34.00	Recycled fluting and other fluting
17.12.35.20	Uncoated testliner (recycled liner board), weight ≤ 150 g/m², in rolls or sheets
17.12.35.40	Uncoated testliner (recycled liner board), weight > 150 g/m², in rolls or sheets

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular
- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.
Other activities on site that are not part of this process such as
- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases, and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation
The preliminary free allocation for a product benchmark sub-installation producing testliner and fluting is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing testliner and fluting in year k (expressed in EUAs).

BM_P: Benchmark for testliner and fluting (expressed in EUAs / unit of product).

HAL_P : Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, a testliner/ fluting producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the testliner/ fluting producing sub-installation.

36 Uncoated carton board

Benchmark name:	**Uncoated carton board**
Benchmark number:	36
Unit:	Net saleable production in Adt (Air Dried Tonnes) Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Various uncoated products (expressed as net saleable production in air dried tonnes, defined as paper with 6% moisture content) which may be single or multiply.

- *Uncoated carton board is mainly used for packaging applications which the main needed characteristic is strength and stiffness, and for which the commercial aspects as information carrier are of a second order of importance.*
- *Carton board is made from virgin and/or recovered fibres, has good folding properties, stiffness and scoring ability. It is mainly used in carton for consumer products such as frozen food, cosmetics and for liquid containers; also known as solid board, folding box board, boxboard or carrier board or core board."*

The tables below show relevant products according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	**Description**
17.12.31.00	Uncoated, unbleached kraftliner in rolls or sheets (excluding for writing, printing or other graphic purposes, punch card stock and punch card tape paper)
17.12.32.00	Uncoated kraftliner in rolls or sheets (excluding unbleached, for writing; printing or other graphic purposes, punch card stock and punch card tape paper
17.12.42.60	Other uncoated paper and paperboard, in rolls or sheets, weight > 150 g/m² and < 225 g/m² (excluding products of HS 4802, fluting paper, testliner, sulphite wrapping paper, filter or felt paper and paperboard)

17.12.42.80	Other uncoated paper and paperboard, in rolls or sheets, weight ≥ 225 g/m² (excluding products of HS 4802, fluting paper, testliner, sulphite wrapping paper, filter or felt paper and paperboard)
17.12.51.10	Uncoated, inside grey paperboard
17.12.59.10	Other uncoated paperboard

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular

- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling)),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases and*
- *district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing uncoated carton board is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing uncoated carton board in year k (expressed in EUAs).

BM_P: Benchmark for uncoated carton board (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, an uncoated carton board producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the uncoated carton board producing sub-installation.

37 Coated carton board

Benchmark name:	Coated carton board
Benchmark number:	37
Unit:	Air Dried Tonnes (Adt) The production of an installation is expressed as the net saleable production of air dried metric tonnes measured at the end of the production process. Air dry metric tonne of paper is defined as paper with 6% moisture content.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"This benchmark covers a wide range of coated products (expressed as net saleable production in air dried tonnes, defined as paper with 6% moisture content) which may be single or multiply. Coated carton board is mainly used for commercial applications that need to bring commercial information printed on the packaging to the shelf in the store in applications such as food, pharma, cosmetics, and other. Carton board is made from virgin and/or recovered fibres, and has good folding properties, stiffness and scoring ability. It is mainly used in cartons for consumer products such as frozen food, cosmetics and for liquid containers; also known as solid board, folding box board, boxboard or carrier board or core board."

Coated carton board products are mainly used:

- for commercial applications that need to bring commercial information printed on the packaging to the shelf in the store
- in cartons for consumer products such as frozen food, cosmetics and for liquid containers.

The carton board products have the following characteristics:

- They are made from virgin and/or recovered fibres
- They have good folding properties, stiffness and scoring ability.
- They are also known as solid board, folding box board, boxboard or carrier board or core board.
- They may be single or multiply

The tables below show relevant products according to definitions in PRODCOM 2010 statistics.

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

PRODCOM code	Description
17.12.75.00	Kraft paperboard (other than that of a kind used for writing, printing or other graphic purposes), coated with kaolin or with other inorganic substances
17.12.77.55	Bleached paper and paperboard in rolls or sheets, coated, impregnated or covered with plastics weighing > 150 g/m² (excluding adhesives)
17.12.77.59	Paper and paperboard in rolls or sheets, coated, impregnated or covered with plastics (excluding adhesives, bleached and weighing > 150 g/m²)
17.12.78.20	Kraft paper and paperboard, coated on one or both sides with kaolin or other inorganic substances, in rolls or in square or rectangular sheets, of any size (excluding that for writing, printing or other graphic purposes; paper and paperboard bleached uniformly in the mass and containing > 95% chemically processed wood fibres by weight in relation to the total fibre content)
17.12.78.50	Multi-ply paper and paperboard, coated, others
17.12.79.53	Multi-ply paper and paperboard, coated, of which each layer in bleached
17.12.79.55	Multi-ply paper and paperboard, coated, with 1 bleached outer layer

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

"All processes which are part of the paper production process (in particular

- *paper or board machine and*
- *connected energy conversion units (boiler/CHP) and*
- *direct process fuel use)*

are included.

Other activities on site that are not part of this process such as

- *sawmilling activities,*
- *woodworking activities,*
- *production of chemicals for sale,*
- *waste treatment (treating waste onsite instead of offsite (drying, pelletising, incinerating, landfilling),*
- *PCC (precipitated calcium carbonate) production,*
- *treatment of odorous gases,*
- *and district heating*

are not included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing coated carton board is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing coated carton board in year k (expressed in EUAs).

BM_P: Benchmark for coated carton board (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

In integrated mills that produce both pulp and paper, a coated carton board producing sub-installation may use excess heat from the pulp production process. This has no effect on the allocation to the coated carton board producing sub-installation.

38 Carbon black

Benchmark name:	Carbon black
Benchmark number:	38
Unit:	Tonne of furnace carbon black (saleable unit, purity >96%)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of carbon black involving the carbonisation of organic substances such as oils, tars, cracker and distillation residues, where combustion units with a total rated thermal input exceeding 20 MW are operated
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Furnace carbon black, expressed in tonnes of furnace carbon black, saleable product, purity above 96%. Gas- and lamp black products are not covered by this benchmark."

Carbon black is pure elemental carbon (>96%) in the form of colloidal particles that are produced by incomplete combustion or thermal decomposition of gaseous or liquid hydrocarbons under controlled conditions.

Table 3 and Figure 5 below show key characteristics of carbon blacks and primary particle diameters, respectively. These characteristic should be used to decide if the carbon black product benchmark applies or not.

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. The PRODCOM 2010 product does not only cover the benchmarked product but also gas- and lamp black.

PRODCOM code	Description
20.13.21.30	Carbon (carbon blacks and other forms of carbon, n.e.c.)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Table 3. Characteristics of carbon blacks; Carbon black for the purpose of the product benchmark corresponds to furnace black (Rulebook for Carbon Black, 2010)

		Lamp black	Degussa gas black	Furnace black
Nitrogen surface area	m^2/g	16–24	90–500	15–450
Iodine adsorption	mg/g	23–33	n.a.	15–450
Particle size (arithm. mean)	nm	110–120	10–30	10–80
OAN	ml/100g	100–120	n.a.	40–200
Oil absorption (FP)	g/100g	250–400	220–1100	200–500
Jetness	M_V	200–220	230–300	210–270
Tinting strength		25–35	90–130	60–130
Volatile matter	%	1–2.5	4–24	0.5–6
pH (**)		6–9	4–6	6–10

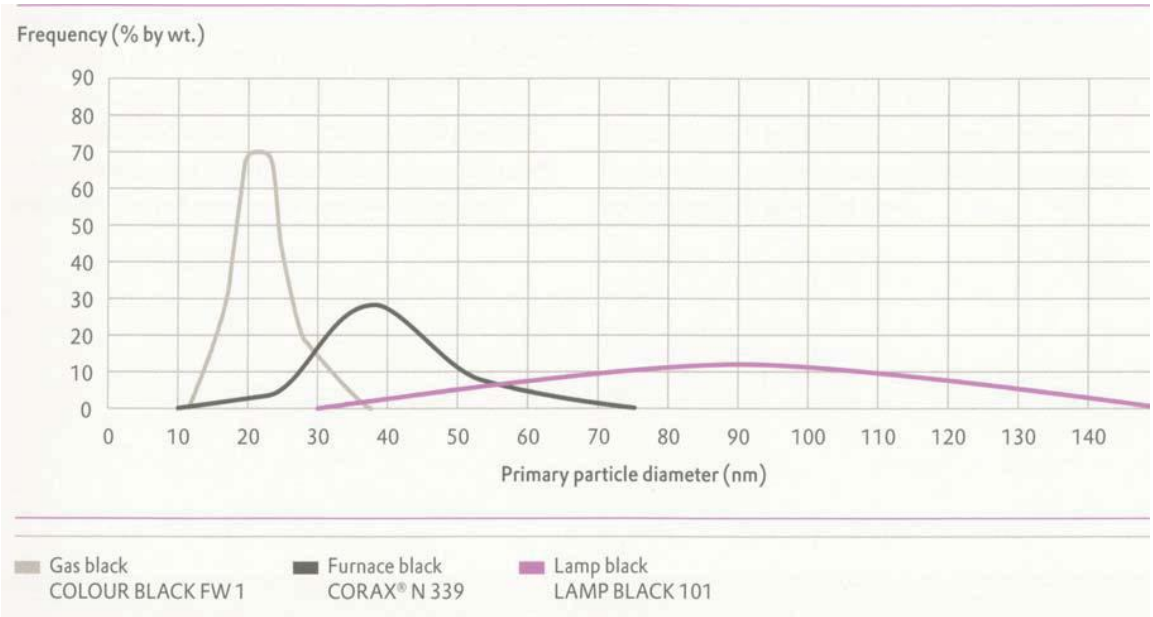

Figure 5. Primary particle diameters of carbon blacks (Rule book for Carbon Black, 2010)

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the carbon black product benchmark as follows:

"All processes directly or indirectly linked to the production of furnace carbon black as well as finishing, packaging and flaring are included.
For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered.

Exchangeability factor should be calculated considering electricity driven devices like pumps and compressors with a rated power of 2 MW or more."

In particular the following emissions are included:

- CO_2 emissions related due to the combustion of the tail gas. An oxidation factor of 100% is assumed for the tail gas combustion. Emissions due to flaring of tail gas from the furnace black production are also included in the system boundaries.
- CO_2 emissions due to the combustion of fuels used e.g. for co-firing in dryers and production of heat as well as for keeping the flare in standby.
- Emissions related to purchased heat (e.g. steam, hot water, hot air) from external suppliers. Heat in this context always means net heat, e.g. steam energy minus energy of condensate reflux.

For the determination of indirect emissions from electricity consumption, the total electricity consumption within the system boundaries refers to the total electricity consumption which is exchangeable with heat, considering in particular electricity driven devices like large pumps, compressors, etc. which could be replaced by steam-driven units. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    c) The fuels necessary to keep a pilot flame running
    d) The fuels required to successfully combust the flared gas.

Preliminary allocation

The product benchmark for carbon black is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the

benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing carbon black in year k (expressed in EUAs).

BM_P: Benchmark for carbon black (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of carbon black over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the carbon black production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing carbon black, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from exchangeable electricity consumption within the system boundaries of the production of carbon black over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

Elec.use: Exchangeable electricity consumption (see above for more details) within the system boundaries of the production of carbon black over the baseline period, expressed in MWh.

39 Nitric acid

Benchmark name:	**Nitric acid**
Benchmark number:	39
Unit:	Tonne of HNO_3 of 100% purity Nitric acid is produced in different concentrations: - weak acid 30-65 mass-% HNO_3 - strong acid 70 mass-% or more The production needs to be divided by nitric acid content in mass-% to obtain the production to be used in the determination of the historical activity level.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of nitric acid
Special provisions:	Measurable heat delivered to other sub-installations is to be treated as non eligible for allocation.

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Nitric acid (HNO_3), to be recorded in tonnes HNO_3 (100% purity)."

The table below shows relevant the product according to definition in PRODCOM 2010 statistics. The PRODCOM product only matches with the definition of the benchmarked product insofar it covers nitric acid.

PRODCOM code	**Description**
20.15.10.50	Nitric acid; sulphonitric acids

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of the benchmarked product as well as the N_2O destruction process are included except the production of ammonia."

The production of ammonia as well as the production of the consumed electricity are excluded from the system boundaries.

No additional allocation must be granted for the export or use of heat stemming from the nitric acid production.

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing nitric acid is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing nitric acid in year k (expressed in EUAs).

BM_P: Benchmark for nitric acid (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

A special situation exists if a sub-installation receives measurable heat from sub-installations producing nitric acid[7]. In that case, the preliminary allocation to the heat receiving sub-installation needs to be reduced by:

$$Reduction\ in\ preliminary\ allocation = BM_H \cdot HAL_{H,HeatFromNitricAcid}$$

where:

BM_H: heat benchmark (expressed in EUAs/TJ)

$HAL_{H,HeatFromNitricAcid}$: annual historical import from a sub-installation producing nitric acid during the baseline period

[7] Art.16(2) of the FAR: "The preliminary annual number of emission allowances allocated free of charge for sub-installations that received measurable heat from sub-installations producing products covered by the nitric acid benchmark shall be reduced by the annual historical consumption of that heat during the relevant baseline periods, multiplied by the value of the heat benchmark for this measurable heat for the relevant allocation period, adopted in accordance with Article 10a(2)."

40 Adipic acid

Benchmark name:	Adipic acid
Benchmark number:	40
Unit:	Tonne of dry purified adipic acid stored in silos or packed in (big) bags
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of adipic acid
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:
"Adipic acid to be recorded in tonnes of dry purified adipic acid stored in silos or packed in (big)bags. Salts and esters of adipic acid are not covered by this product benchmark."

Purified adipic acid is the standard commercial grade which is suitable for all typical applications such as monomer for nylon production, raw material for production of polyester polyols, food industry, lubricants or plasticizers.

The table below shows relevant product according to the definition in PRODCOM 2010 statistics.

PRODCOM code	Description
20.14.33.85	Adipic acid; its salts and esters

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of the benchmarked product as well as the N_2O destruction process are included."

In particular, this means that the following emissions are covered:

- CO_2 & N_2O emission direct from assets:
  - Adipic acid manufacturing unit
  - N_2O abatement unit

- CO_2 emission from direct energy Fuels used for N_2O abatement unit

- CO_2 emission from indirect CO_2:
  - Net steam production (steam consumption minus steam recovery) for adipic acid manufacturing and N_2O abatement unit.

- CO_2 emissions from the processing of and handling of the side products Glutaric acid and Succinic acid

Emissions related to the production and the consumption of electricity are excluded from the system boundaries, irrespective of where and how this electricity is produced. Manufacture of KA-oil and nitric acid are also excluded.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Based on the above defined scope, Figure 6 illustrates which emissions are covered by the adipic acid benchmark. All emissions defined by yellow field are covered. Descriptions of those fields are provided in the text below the figure.

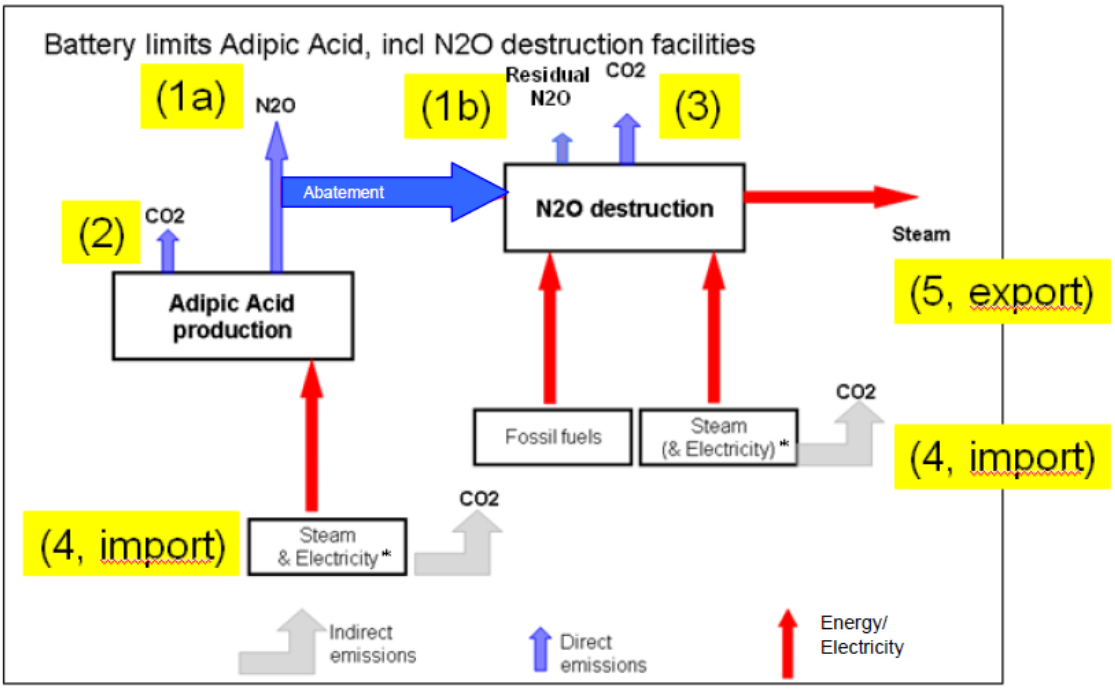

Figure 6. Emissions covered by the product benchmark for adipic acid (emissions defined by yellow field are covered; descriptions of those field are provide in the text (Rule book for Adipic Acid, 2010); *Emissions related to the production of consumed electricity are not included in the system boundaries

with:

(1a) Direct N_2O emission when adipic acid waste gas is disconnected from the N_2O abatement unit (classically calculated from chemical N_2O-emission factor x Adipic acid produced during this time, with 1 N_2O = 310 CO_2eq)

(1b) Direct N_2O emission after abatement (classically N_2O residual concentration is measured, with 1 N_2O = 310 CO_2eq)

(2) Direct CO_2 emission coming from adipic acid synthesis. In this box all unit operations of the adipic acid plant are:

- Oxidation Reaction and off gas treatment
- Crude grade Adipic acid crystallization and separation
- Adipic acid re-crystallization(s) and separation
- Adipic acid drying and cooling, conveying and storing
- Dry Adipic acid packaging and delivery
- Dewatering of the nitric acid mother liquor
- By-products purge and catalyst recovery
- Nitric acid work-up systems
- Storage of (volatile) raw materials, intermediates, and final products

(3) Direct CO_2 emission coming from fuels used in the N_2O abatement unit (specific emission factor x quantity of fuel)

(4) Indirect CO_2 emission coming from steam consumed with (5) steam export credited (net steam = difference between import and export 4-5)

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing adipic acid is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing adipic acid in year k (expressed in EUAs).

BM_P: Benchmark for adipic acid (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

41 Ammonia

Benchmark name:	**Ammonia**
Benchmark number:	41
Unit:	Tonne of ammonia produced as saleable (net) production and 100% purity.
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of ammonia
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Ammonia (NH_3), expressed in tonnes produced, 100% purity"

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. The definition of these products does not necessarily coincide with the product definition for the purpose of this benchmark: a benchmarked product may be covered by more than one PRODCOM code and vice versa.

PRODCOM code	**Description**
20.15.10.75	Anhydrous ammonia

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the ammonia product benchmark as follows:

"All processes directly or indirectly linked to the production of the ammonia and the intermediate product hydrogen are included. Ammonia production from other intermediate products is not covered. For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

The system boundary of an ammonia installation is defined to be all activities within the plant battery limit as well as processes outside the battery limit associated with steam and electricity import or export to the ammonia installation. The production of the

intermediate product hydrogen is also covered. Ammonia production from other intermediate products (such as syngas) is not covered by this product benchmark.

Indirect emissions from electricity consumption are not included in the system boundaries and not eligible for free allocation but are used in the calculation of free allocation (see below). For the determination of the indirect emissions, the total electricity consumption within the system boundaries shall be considered.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

The figure below shows the energy inputs and emissions associated with ammonia production. The production process leads to direct CO_2 emissions and to CO_2 that is used as feedstock in chemical production processes. Both emissions are included in the system boundaries. CO_2 emissions due to the production of consumed steam are included in the system boundaries.

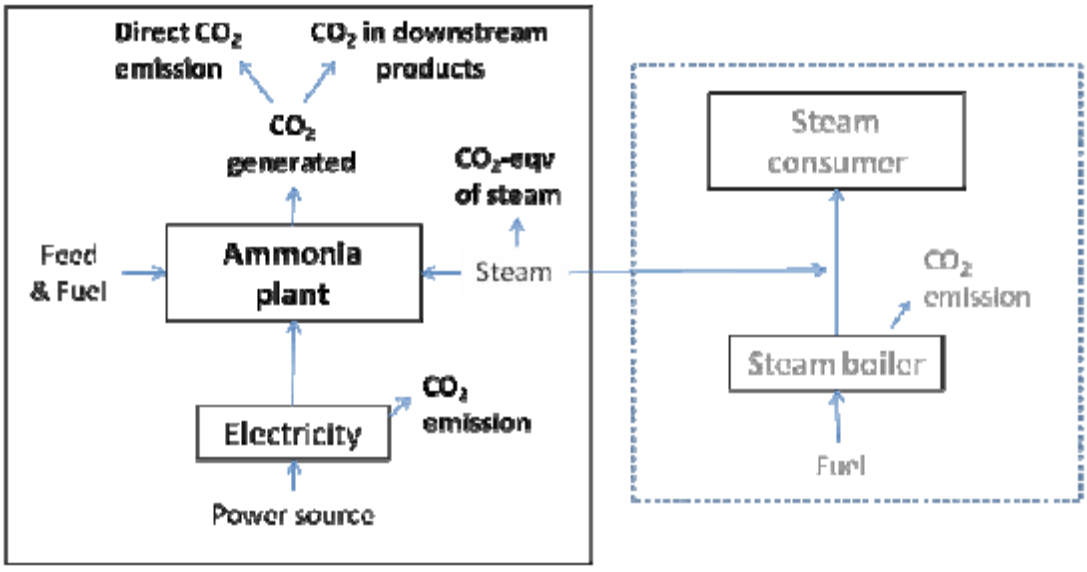

Figure 7. Energy inputs and emissions related to ammonia production. The emissions related to electricity production and consumption are not eligible for free allocation (Rule book for Ammonia, 2010).

Preliminary allocation

The product benchmark for ammonia is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing ammonia in year k (expressed in EUAs).

BM_P: Benchmark for ammonia (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of ammonia over the baseline period. (Note: the direct emissions meant here do not correspond to the direct emissions in the figure above). The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed within the system boundaries of the ammonia production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing ammonia, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of ammonia over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

Elec. use: Total electricity consumption within the system boundaries of the production of ammonia over the baseline period, expressed in MWh.

42 Steam cracking (high value chemicals)

Benchmark name:	**Steam cracking**
Benchmark number:	42
Unit:	Tonne of acetylene, ethylene, propylene, butadiene, benzene and hydrogen
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	Exchangeability of electricity; provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mix of high value chemicals (HVC) expressed in tonnes as total mass of acetylene, ethylene, propylene, butadiene, benzene and hydrogen exported out of the cracker perimeter excluding HVC from supplemental feed (hydrogen, ethylene, other HVC) with an ethylene content in the total product mix of at least 30 mass-percent and a content of HVC, fuel gas, butenes and liquid hydrocarbons of together at least 50 mass-percent of the total product mix."

In other words, the following chemicals can be part of the mix of high value chemicals (HVC):

- Acetylene
- Ethylene
- Propylene
- Butadiene
- Benzene
- Hydrogen (chemical grade hydrogen, that is separate from CH_4)

A product mix of these chemicals only matches the definition of this product benchmark if two conditions are fulfilled:

1. The ethylene content is at least 30 mass - percent of the total product mix[8] *and*
2. The product mix has a content of HVC, fuel gas, butenes and liquid hydrocarbons of together at least 50 mass - percent of the total product mix.

[8] This refers to the total HVC.

The benchmark excludes HVC from supplemental feed (hydrogen, ethylene, other HVC) that receive allocation on specific emission factors (see calculation of the preliminary allocation below).

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the steam cracking (HVC) product benchmark as follows:

"All processes directly or indirectly linked to the production of high value chemicals (HVC) as purified product or intermediate product with concentrated content of the respective HVC in the lowest tradable form (raw C4, unhydrogenated pygas) are included except C4 extraction (butadiene plant), C4-hydrogenation, hydrotreating of pyrolysis gasoline & aromatics extraction and logistics/storage for daily operation. For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered. "

All processes directly or indirectly linked to the production of the following products are included:

- High value chemicals as purified product
- Intermediate product with concentrated content of the respective HVC in the lowest tradable form (raw C4, unhydrogenated pygas)

Included in the benchmarking are all equipments, which are necessary to produce the HVC as purified product or intermediate product with concentrated content of the respective HVC in the lowest tradable form (raw C4, unhydrogenated pygas), in particular:

- Acetylene hydrogenation or if installed, acetylene extraction
- Ethylene splitter
- Propylene splitter
- Hydrogen (pressure swing adsorption)
- Cooling water tower & cooling pumps
- Continuous gas to cracker flare is included. Flaring is considered as a safety device.
- Metathesis add-on units
- Cracking furnace
- Primary fractionator
- Quench

The following processes are excluded:

- C4 extraction (butadiene plant)
- C4-hydrogenation
- hydrotreating of pyrolysis gasoline & aromatics extraction
- logistics/storage for daily operation

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

Figure 8 gives a graphical representation of the covered processes.

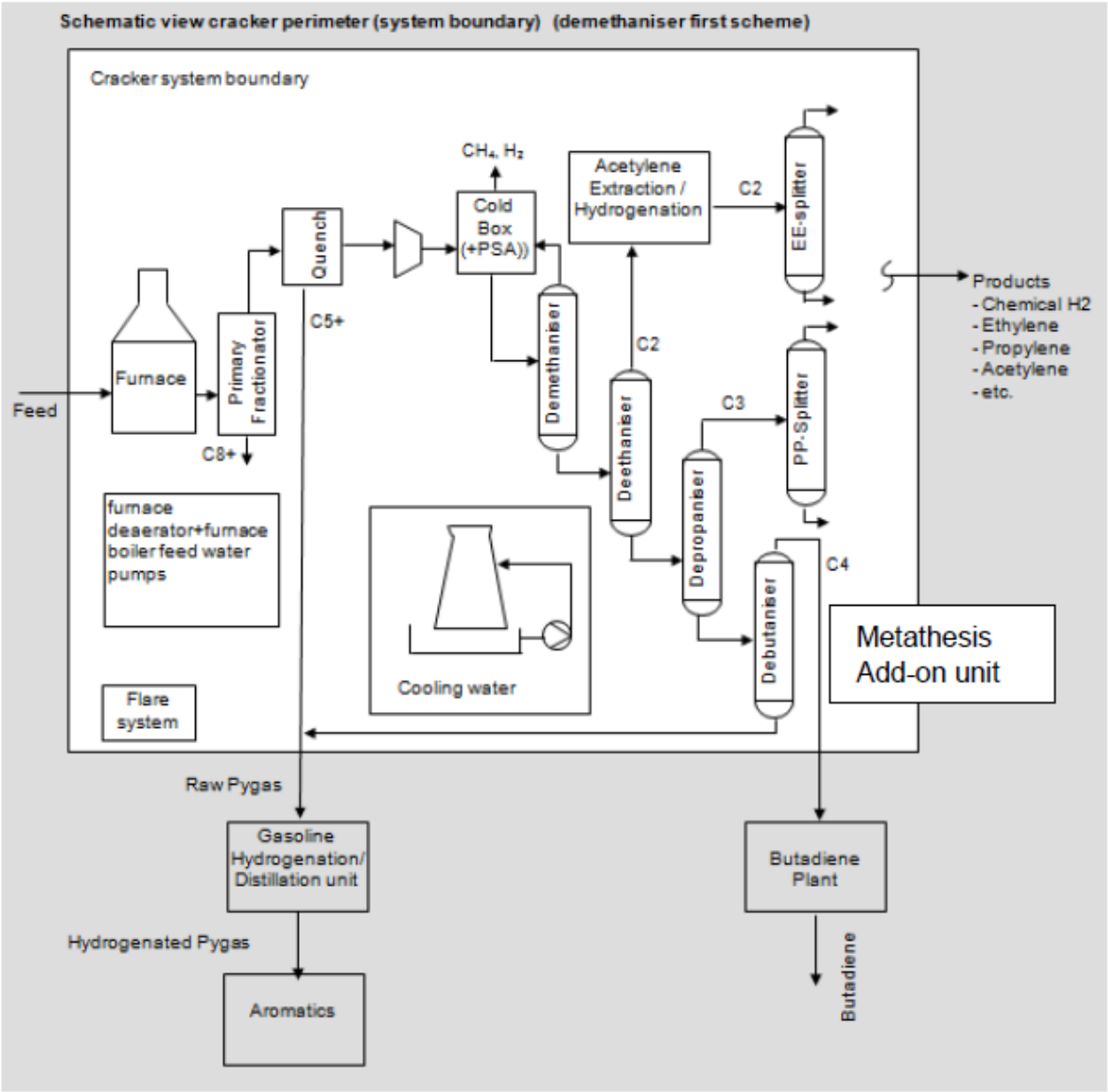

Figure 8. System boundaries of steam cracking benchmark (Rule book for Steam Cracking, 2010)

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product

benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    e) The fuels necessary to keep a pilot flame running
    f) The fuels required to successfully combust the flared gas.

Preliminary allocation

The product benchmark for steam cracking is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions.

The steam cracking benchmark does not cover the products made from so-called supplemental feed (high value chemicals that are not produced in the main process) as well as the related emissions. HVC products from supplemental feed are however considered for free allocation using specific emission factors.

Considering the above, the preliminary allocation for steam cracking should be determined by using the following specific formula:

$$F_{p,k} = [\frac{Em_{direct}+Em_{NetHeatImport}}{Em_{direct}+Em_{NetHeatImport}+Em_{indirect}} \times BM_{SteamCracking} \times arithmetic\ mean\left(HAL_{HVC,total,k} - HSF_{H,k} - HSF_{E,k} - HSF_{O,k}\right) + 1.78 \times arithmetic\ mean\left(HSF_{H,k}\right) + 0.24 \times arithmetic\ mean\left(HSF_{E,k}\right) + 0.16 \times arithmetic\ mean\left(HSF_{O,k}\right)] \text{ x } CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation performing the process of steam cracking in year k (expressed in EUAs).

BM_P: Benchmark for steam cracking (expressed in EUAs / unit of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of steam cracking over the baseline period. The direct emissions further include the emissions due to

the production of heat within the same ETS installation, that is consumed within the system boundaries of the steam cracking process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing HVC, irrespective of where and how the heat is produced

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of steam cracking over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

Elec.use : Total electricity consumption within the system boundaries of steam cracking over the baseline period, expressed in MWh.

$HAL_{HVC,total,k}$: Historical activity level for total high value chemicals production in year k of the baseline period expressed in tonnes of HVC.

$HSF_{H,k}$: Historical production of hydrogen from supplemental feed in year k of the baseline period expressed in tonnes of hydrogen.

$HSF_{E,k}$: Historical production of ethylene from supplemental feed in year k of the baseline period expressed in tonnes of ethylene.

$HSF_{O,k}$: Historical production of other high value chemicals from supplemental feed in year k of the baseline period expressed in tonnes of HVC. In this context, other high value chemicals are understood as the sum of acetylene, propylene, butadiene and benzene.

43 Aromatics

Benchmark name:	**Aromatics**
Benchmark number:	43
Unit:	CO_2 weighted tonne (CWT)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	Exchangeability of electricity; provisions in Annexes II and III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mix of aromatics expressed as CO_2 weighted tonne (CWT)"

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Note that further PRODCOM coded products might be covered by this benchmark.

PRODCOM code	**Description**
20.59.56.70	Mixed alkylbenzenes, mixed alkylnaphthalenes other than HS 2707 or 2902
20.14.12.13	Cyclohexane
20.14.12.23	Benzene
20.14.12.25	Toluene
20.14.12.43	o-Xylene
20.14.12.45	p-Xylene
20.14.12.47	m-Xylene and mixed xylene isomers
20.14.12.60	Ethylbenzene
20.14.12.70	Cumene
20.14.12.90	Biphenyl, terphenyls, vinyltoluenes, cyclic hydrocarbons excluding cyclanes, cyclenes, cycloterpenes, benzene, toluene, xylenes, styrene, ethylbenzene, cumene, naphthalene, anthracene
20.14.73.20	Benzol (benzene), toluol (toluene) and xylol (xylenes)
20.14.73.40	Naphthalene and other aromatic hydrocarbon mixtures (excluding benzole, toluole, xylole)

These classifications can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on classifications in statistics.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the aromatics product benchmark as follows:

"All processes directly or indirectly linked to aromatics sub-units

- *pygas hydrotreater*
- *benzene/toluene/xylene (BTX) extraction*
- *TDP*
- *HDA*
- *xylene isomerisation*
- *p-xylene units*
- *cumene production and*
- *cyclo-hexane production*

are included.

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

Indirect emissions from electricity consumption are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Processes defined by the CWT methodology only receive allocation according to that approach if they are part of the aromatics benchmark sub-installation. When such processes occur outside those boundaries, most of them should receive allocation based on fall-back approaches. Some can however be covered by other product benchmarks; e.g. refinery or hydrogen.

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    a) The fuels necessary to keep a pilot flame running
    b) The fuels required to successfully combust the flared gas.

Preliminary allocation

The product benchmark for aromatics is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing aromatics in year k (expressed in EUAs).

BM_P: Benchmark for aromatics (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of aromatics over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, which is consumed within the system boundaries of the aromatics production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing aromatics, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of aromatics. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

Elec. use: Total electricity consumption within the system boundaries of the production of aromatics over the baseline period, expressed in MWh.

Determination of historical activity level

The concept of CO_2 weighted tonne (CWT) is used for the determination of the historical activity level. The concept of CWT defines the activity of a production process not simply as input or output, but as a function of activity levels of different process levels. This concept was initially developed to determine the allocation to refineries (see section 1). In order to ensure a level playing field for the production of aromatics in refineries and chemical plants, the free allocation of emission allowances for aromatics should be based on the CWT approach.

The historical activity level in terms of CWT should be determined as follows:

$$HAL_{CWT} = arithmetic\ mean\left(\sum_{i=1}^{n}\left(TP_{i,k} - CWT_i\right)\right)$$

With:

$TP_{i,k}$: historical activity level of process unit *i* in year k as defined for the purpose of the CWT approach

CWT_i : CWT factor for process unit *i* as defined by for the purpose of the CWT approach (see Table 4 below).

Table 4 provides a calculation of the historical activity level for a certain year. The yellow cells require input data. Process units for the purpose of the CWT approach are called CWT 'functions'.

Not all CWT functions will be performed in each installation. For some CWT functions, the historical level of activity will therefore be zero.

The appropriate measures of activity for a CWT function are shown in Table 4 and Table 5. This measure can be the annual mass (expressed in kt/year) of net fresh feed (F), or product feed (P). Fresh feed is to be understood as water free and excluding slops processing.

The reported throughput must be the actual figure for the year, even if the unit was not in operation during the whole year (e.g. new unit started-up during the year, unit idle during part of the year). Figures must be generated from either actual flow measurements and/or material balance records.

Accuracy

In order to meet the desired accuracy for CWT, throughputs must be entered in kt/a with a certain number of decimals depending on the magnitude of the CWT factor:

- For factors up to 1.99: 0 decimals
- For factors between 2.00 and 19.99: 1 decimal
- For factors between 20.00 and 99.99: 2 decimals
- For factors above 100.00: 3 decimals.

The following accuracy must be adhered to in the calculation of parameters that may be necessary to calculate direct and indirect emissions of the (sub)installation:

- Steam flows: ±5%
- Electricity production: ±5%
- Steam conditions: for steam enthalpies an accuracy of ±10 GJ/t is sufficient which is consistent with conditions accurate within ± 5 ºC and ± 5 bar. Note that these conditions are not used in the calculation in this document, but may nevertheless be used in the calculation of the amount of imported and exported steam.

Table 4. Calculation of historical activity level in year k

CWT function	Historical level of activity			CWT factor		CWT
	Basis*	(kt in year k)		(-)		(kt in year k)
Naphtha/Gasoline hydrotreater	F	..	×	1.10	=	..
Aromatic Solvent Extraction	F	..	×	5.25	=	..
TDP/TDA	F	..	×	1.85	=	..
Hydrodealkylation	F	..	×	2.45	=	..
Xylene Isomerisation	F	..	×	1.85	=	..
Paraxylene production	P	..	×	6.40	=	..
Cyclohexane production	P	..	×	3.00	=	..
Cumene production	P	..	×	5.00	=	..
Historical activity level in year k (sum of CWT of processes)						$HAL_{CWT,k}$

* Measure for activity level: net fresh feed (F) or product feed (P)

Table 5. Process units distribution

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Naphtha/Gasoline Hydrotreating	NHYT		Fresh feed	1.10	A number of processes involving treating and upgrading of naphtha/gasoline and lighter streams.		Various gasoline blending components
Benzene Saturation		BSAT			Selective hydrogenation of benzene in gasoline streams over a fixed catalyst bed at moderate pressure.	Various gasoline streams, hydrogen	
Desulfurization of C4–C6 Feeds		C4C6			Desulphurisation of light naphthas over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Light naphtha, hydrogen	
Conventional Naphtha H/T		CONV			Desulphurisation of virgin and cracked naphthas over a fixed catalyst bed at moderate pressure and in the presence of hydrogen. For cracked naphthas also involves saturation of olefins.	Virgin and cracked naphthas/gasolines, hydrogen	
Diolefin to Olefin Saturation		DIO			Selective saturation of diolefins over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen, to improve stability of thermally cracked and coker gasolines.	Thermally cracked or coker gasolines	
Diolefin to Olefin Saturation of Alkylation Feed		DIO			Selective saturation of diolefins in C4 streams for alkylation over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Thermally cracked or coker LPG streams, hydrogen	
FCC gasoline hydrotreating with minimum octane loss		GOCT			Selective desulphurisation of FCC gasoline cuts with minimum olefins saturation, over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	FCC gasoline cuts, hydrogen	
Olefinic Alkylation of Thio S		OATS			A gasoline desulphurisation process in which thiophenes and mercaptans are catalytically reacted with olefins to produce higher-boiling sulphur compounds removable by distillation. Does not involve hydrogen.	FCC gasoline cuts	
S-Zorb™ Process		ZORB			Desulphurisation of naphtha/gasoline streams using a proprietary fluid-bed hydrogenation adsorption process in the presence of hydrogen.	Various naphthas/gasolines	
Selective H/T of Pygas/Naphtha Pygas/Naphtha Desulfurization Selective H/T of Pygas/Naphtha		PYGC PYGD PYGS			Selective or non-selective desulphurisation of pyrolysis gasoline (by-product of light olefins production) and other streams over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.	Pyrolysis gasoline, hydrogen	
Reactor for Selective Hydrotreating		*RXST*	n.c.	n.c.	*Special configuration where a distillation/fractionation column containing a solid catalyst that converts diolefins in FCC gasoline to olefins or when the catalyst bed is in a preheat train reactor vessel in front of the column. Contribution for this configuration is included in the generic NHYT CWT factor.*		

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
Aromatics Solvent Extraction (ASE) ASE: Extraction Distillation ASE: Liquid/Liquid Extraction ASE: Liq/Liq w/ Extr. Distillation	ASE	 ED LLE LLED	Fresh feed	5.25	Extraction of light aromatics from reformate and/or hydrotreated pyrolysis gasoline by means of a solvent. The CWT factor for this refinery function includes all columns and associated equipment required to purify individual aromatic products as well as solvent regeneration. CWT factor cover all feeds including Pygas after hydrotreatment. Pygas hydrotreating should be accounted under naphtha hydrotreatment.	Reformate, hydrotreated pyrolysis gasoline	Mixed aromatics or purified benzene, toluene, mixed xylenes, C9+ aromatics, paraffinic raffinate
Benzene Column *Toluene Column* *Xylene Rerun Column* *Heavy Aromatics Column*		*BZC* *TOLC* *XYLC* *HVYARO*	*n.c.* *n.c.* *n.c.* *n.c.*	*n.c.* *n.c.* *n.c.* *n.c.*	*The contribution of all columns and associated equipement required to purify individual aromatics is included in ASE.*		
Hydrodealkylation	HDA		Fresh feed	2.45	Dealkylation of toluene and xylenes into benzene over a fixed catalyst bed and in the presence of hydrogen at low to moderate pressure.	Toluene, Xylenes, hydrogen	Benzene
Toluene Disproportionation / Dealkylation (TDP/TDA)	TDP		Fresh feed	1.85	Fixed-bed catalytic process for the conversion of toluene to benzene and xylene in the presence of hydrogen		
Cyclohexane production	CYC6		Product	3.00	Hydrogenation of benzene to cyclohexane over a catalyst at high pressure.	Benzene, hydrogen	Cyclohexane
Xylene Isomerisation	XYISOM		Fresh feed	1.85	Isomerisation of mixed xylenes to paraxylene	Mixed xylenes	Paraxylene-rich mixed xylenes
Paraxylene Production Paraxylene Adsorption Paraxylene Crystallization	PXYL	 ADS CRY	Product	6.40	Physical separation of para-xylene from mixed xylenes.	Paraxylene-rich mixed xylenes	Paraxylene, other mixed xylenes
Xylene Splitter *Orthoxylene Rerun Column*		*XYLS* *OXYLRC*			*The contribution of these columns and associated equipment is included in PXYL.*		
Cumene production	CUM		Product	5.00	Alkylation of benzene with propylene	Benzene, propylene	Cumene

44 Styrene

Benchmark name:	Styrene
Benchmark number:	44
Unit:	Tonne of styrene (saleable product)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	Exchangeability of electricity

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Styrene monomer (vinyl benzene, CAS number: 100-42-5). Expressed in tonnes of styrene (saleable product)."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	Description
20.14.12.50	Styrene

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the styrene product benchmark as follows:

"All processes directly or indirectly linked to the production of
- *styrene as well as*
- *the intermediate product ethylbenzene (with the amount used as feed for the styrene production)*

are included.
For installations producing both propylene oxide and styrene monomer, the facilities exclusively dedicated to propylene and propylene oxide unit operations are excluded from this benchmark, and shared facilities are covered in proportion to the production in tonnes of the

styrene monomer production. For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

Installation boundaries include ethylbenzene and styrene production and all related equipment needed to produce these materials, such as raw material purification, product purification, waste water and waste gas treatment facilities, loading facilities and other directly related areas normally included in the plant production area including cooling water facilities, instrument air supply and nitrogen supply. Energy for these services is taken into account, whether supplied directly by the styrene producer or purchased from an on-site supplier.

In general, styrene monomer (SM) can be produced via two process routes: via dehydrogenation (conventional) and via the Propylene Oxide – Styrene Monomer (PO-SM) route. In the PO-SM route, a split of emissions is needed between SM related sections (included in product benchmark), PO related sections (excluded from product benchmark) and a section related to both PO and SM, "the oxidation section". The product benchmark covers 50% of the energy consumption of the oxidation section (a large EB recycle stream is included), 100% of the energy consumption related to the SM sections (including EB recovery, MBA distillation, hydrogenation and dehydration) and 0% of the energy consumption related to the PO section (including epoxidation, propylene distillation and PO purification).

For installations producing both propylene oxide and styrene monomer, the facilities exclusively dedicated to propylene and propylene oxide unit operations are excluded from this product benchmark.

Shared facilities such as for waste treatment are covered by the styrene benchmark insofar deemed appropriate. For instance if a waste water facility treats 30% waste water from styrene production and 70% waste water from other facilities on the same site, then 30% of the direct emissions for the waste water facility are covered by styrene production.

For the determination of indirect emissions, the total electricity consumption within the system boundaries refers to the total electricity consumption which is exchangeable with heat, considering heat pumps used in the distillation section. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for styrene is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing styrene in year k (expressed in EUAs).

BM_P: Benchmark for styrene (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of styrene over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the styrene production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing styrene, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of styrene over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$$Em_{indirect} = Elec.use \times 0.376$$

With:

$Elec.use$: Total electricity consumption within the system boundaries of the production of styrene over the baseline period, expressed in MWh.

45 Phenol/acetone

Benchmark name:	**Phenol/ acetone**
Benchmark number:	45
Unit:	Tonne of phenol, acetone and the byproduct alphamethyl styrene (saleable product, 100% purity)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Sum of phenol, acetone and the byproduct alpha-methyl styrene as total production, expressed in tonnes of saleable product at 100% purity."

Phenol and acetone are covered by the 2010 PRODCOM code listed in the table below. The production of phenol salts are not covered by this benchmark.

PRODCOM code	**Description**
20.14.24.10	Monophenols
20.14.62.11	Acetone

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of phenol and acetone are included, in particular:

- *Air compression*
- *Hydroperoxidation*
- *Cumene recovery from spent air*
- *Concentration & cleavage*
- *Production fractionation & purification*
- *Tar cracking*
- *Acetophenone recovery & purification*
- *AMS recovery for export*

- *AMS hydrogenation for ISB recycle*
- *Initial waste water purification (1st waste water stripper)*
- *Cooling water generation (e.g., cooling towers)*
- *Cooling water utilisation (circulation pumps)*
- *Flare & incinerators (even if physically located OSB) as well as*
- *Any support fuel consumption."*

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen). *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
   c) The fuels necessary to keep a pilot flame running
   d) The fuels required to successfully combust the flared gas.

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing phenol/acetone is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing phenol/acetone in year k (expressed in EUAs).

BM_P: Benchmark for phenol/acetone (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

46 Ethylene oxide (EO)/ethylene glycols (EG)

Benchmark name:	**Ethylene oxide/ ethylene glycols**
Benchmark number:	46
Unit:	Tonne of EO-equivalents (EOE), defined as the amount of EO (in mass) that is embedded in one mass unit of any of the specific glycols defined under this benchmark
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	Exchangeability of electricity; provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"The ethylene oxide/ ethylene glycol benchmark covers the products
- *Ethylene oxide (EO, high purity)*
- *Monoethylene glycol (MEG, standard grade + fiber grade (high purity))*
- *Diethylene glycol (DEG)*
- *Triethylene glycol (TEG)*

The total amount of products is expressed in terms of EO-equivalents (EOE), which are defined as the amount of EO (in mass) that is embedded in one mass unit of the specific glycol."

In installations, product ratios ranging from "EO-only" to "EG-only" can be encountered. The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Other polyether alcohols covered by PRODCOM 20.16.40.15 are not covered by this benchmark.

PRODCOM code	**Description**
20.14.63.73	Oxirane (ethylene oxide)
20.14.23.10	Ethylene glycol (ethanediol)
20.14.63.33	2,2-Oxydiethanol (diethylene glycol; digol)
20.16.40.15	Polyethylene glycols and other polyether alcohols, in primary forms

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the ethylene oxide (EO)/ethylene glycols (EG) product benchmark as follows:

"All processes directly or indirectly linked to the process units EO production, EO purification and glycol section are included. The total electricity consumption (and the related indirect emissions) within the system boundaries is covered by this product benchmark."

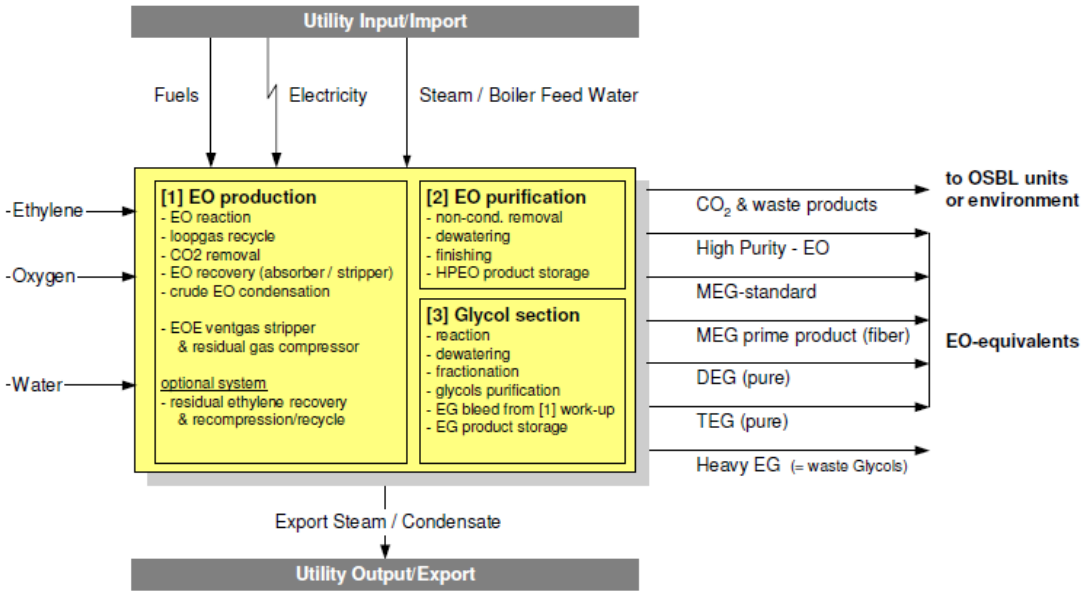

Figure 9: Inputs and outputs of EO and EG units that are covered by the benchmark. (PDC (2010), Rule Book for the Ethylene Oxide and Derivatives Sector)

The following process systems are included in the perimeter for the EO-EG benchmark[9][10]:

Unit-1
- EO reaction
- Loop gas recycle
- CO_2 removal
- EO recovery (absorber/stripper)
- Crude EO condensation

also included is:
- If the cooling water generation system is inside the EO-EG system boundary, the
- energy use of cooling water generation allocated to UNIT-1
- Electricity consumption of air coolers
- Energy use during start-up periods (e.g., start-up boilers) allocated to UNIT-1

[9] If process systems are shared with other systems (outside the EO-EG system boundary), e.g. shared cooling water systems, only their CO_2 emission allocated to EO-EG production is taken into account.
[10] Here and below: PDC (2010), Rule Book for the Ethylene Oxide and Derivatives Sector

- EOE vent gas scrubber & residual gas recycle compressor
- Residual ethylene recovery & recompression/recycle (if such a system is present)

Unit-2
- Non-condensables removal
- Dewatering
- Finishing
- HPEO product cooling (bringing & keeping HPEO to storage conditions)

also included is:
- Energy use during start-up periods allocated to UNIT-2
- Electricity consumption of air coolers
- If the cooling water generation system is inside the EO-EG system boundary, the energy use of cooling water generation allocated to UNIT-UNIT-2
- Electricity consumption of a refrigeration system that produces a cold-utility to bring & to keep HPEO product at storage temperature.

Unit-3
- Reaction
- Dewatering
- Fractionation
- Glycols purification
- Work-up/handling of the EG bleed originating from UNIT-1 work-up

also included is:
- Energy use during start-up periods allocated to UNIT-3
- Electricity consumption of air coolers
- If the cooling water generation system is inside the EO-EG system boundary, the energy use of cooling water generation allocated to UNIT-UNIT-3

Processes included in the overall system boundary encompassing all units are:
- Direct heat flows due to "process-to-process" heat-integration between UNIT-1, UNIT-2 and/or UNIT-3
- Direct heat flows due to "process-to-process" heat-integration between the EO-EG system and an OSBL system
- Storage of end-products

The system boundary does not include:
- Direct fuel consumption for incineration
- Energy use for (waste)water treatment

For the determination of indirect emissions from electricity consumption, the total electricity consumption within the system boundaries shall be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
   a) The fuels necessary to keep a pilot flame running
   b) The fuels required to successfully combust the flared gas.

Preliminary allocation

The product benchmark for ethylene oxide/ethylene glycols products is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing ethylene oxide/ethylene glycols products in year k (expressed in EUAs).

BM_P: Benchmark for ethylene oxide/ethylene glycols products (expressed in EUAs / unit of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of ethylene oxide/ethylene glycols products over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the ethylene oxide/ethylene glycols production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing ethylene oxide/ethylene glycols products, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of ethylene oxide/ethylene glycols products over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

$Elec.use$: Total electricity consumption within the system boundaries of the production of ethylene oxide/ethylene glycols products over the baseline period, expressed in MWh.

$HAL_{EO/EG}$: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product) (see below).

Determination of historical activity level

The unit of product is defined as EO-equivalents: the amount of EO (in mass) that is embedded in one mass unit of any of the specific glycols defined under the next heading. The following formula should be used to determine the historical activity level in terms of EO-equivalents:

$$HAL_{EO/EG} = ArithmeticMean\left(\sum_{i=1}^{n}\left(HAL_{i,k} \times CF_{EOE,i}\right)\right)$$

With:

$HAL_{EO/EG}$: Historical activity level for ethylene oxide/ethylene glycols production, expressed in tonnes of ethylene oxide equivalents.

$HAL_{i,k}$: Historical activity level for the production of ethylene oxide or glycol *i* in year *k* of the baseline period, expressed in tonnes.

$CF_{EOE,k}$: Conversion factor for the ethylene oxide or glycol *i* relative to ethylene oxide. The following conversion factors need to be applied:

- Ethylene oxide: 1.000
- Monoethylene glycol: 0.710
- Diethylene glycol: 0.830
- Triethylene glycol: 0.880

47 Vinyl chloride monomer (VCM)

Benchmark name:	**Vinyl chloride monomer**
Benchmark number:	47
Unit:	Tonne of vinyl chloride (saleable product, 100% purity)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	Article 20 of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Vinyl chloride (chloroethylene). Expressed in tonnes of vinyl chloride (saleable product, 100% purity)."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	**Description**
20.14.13.71	Vinyl chloride (chloroethylene)

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production steps
- *direct chlorination*
- *oxychlorination and*
- *EDC cracking to VCM*

are included.
Direct chlorination refers to chlorination of ethylene. Oxychlorination refers to chlorination of ethylene with hydrogen chloride (HCl) and oxygen.
The incineration of chlorinated hydrocarbons contained in the vent gases of EDC/VCM production is included in the benchmark.
The production of oxygen and compressed air used as raw materials in VCM manufacture are excluded from the benchmark."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Emissions related to safety flaring and other flaring of gases that are associated with the production are included, in particular:

1. Emissions from the combusted flared gas;
2. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    a) The fuels necessary to keep a pilot flame running
    b) The fuels required to successfully combust the flared gas.

Preliminary allocation

In the production of VCM, hydrogen can be used to some extent as fuel substituting conventional fuels such as natural gas, thus reducing the direct emission of the combustion process. Considering the very high greenhouse gas intensity of hydrogen production, the VCM benchmark value accounts for the use of hydrogen as if it was natural gas. The free allocation to each installation is therefore corrected for the actual share of direct emission in the emission covered by the benchmark (direct emissions and virtual emissions for hydrogen production):[11]

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{Hydrogen}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

[11] Art.20 of the FAR: "By way of derogation from Article 16(2)(a) and Article 18(1)(a), the preliminary annual number of emission allowances allocated free of charge for a sub-installation relating to the production of vinyl chloride monomer ("VCM") shall correspond to the value of the VCM benchmark for the relevant allocation period multiplied by the historical activity level for VCM production expressed as tonnes and multiplied by the quotient of the direct emissions for the production of VCM including emissions from net imported heat over the baseline period referred to in Article 15(2) or of the first calendar year after the start of normal operation referred to in Article 17(a), as appropriate, calculated in accordance with Article 22(2), expressed as tonnes of carbon dioxide equivalent and the sum of those direct emissions and the hydrogen-related emissions for the production of VCM over the baseline period referred to in Article 15(2) or of the first calendar year after the start of normal operation referred to in Article 17(a), as appropriate, expressed as tonnes of carbon dioxide equivalent calculated on the basis of the historical heat consumption stemming from hydrogen combustion expressed as terajoules times the value of the heat benchmark for the relevant allocation period."

$F_{p,k}$:	The annual preliminary allocation for a product benchmark sub-installation producing VCM in year k (expressed in EUAs).
Em_{direct} :	Historical direct emissions for production of VCM over the baseline period (expressed in t CO_2(e)).
$Em_{NetHeatImport}$:	Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing VCM, irrespective of where and how the heat is produced.
$Em_{hydrogen}$:	Hydrogen-related emissions for the production of VCM over the baseline period (historical hydrogen consumption for VCM production (expressed in t CO_2(e)) calculated on the basis of historical heat consumption stemming from hydrogen combustion (expressed in TJ) times the value of the heat benchmark for the relevant allocation period.
BM_P :	Benchmark for VCM (expressed in EUA per ton of VCM).
HAL_P :	Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).
$CLEF_{p,k}$:	Applicable Carbon Leakage Exposure Factor for product p in year k.

48 S-PVC

Benchmark name:	**S-PVC**
Benchmark number:	48
Unit:	Tonne of S-PVC (saleable product, 100% purity)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Polyvinyl chloride; not mixed with any other substances consisting of PVC particles with a mean size between 50 and 200 µm. Expressed in tonnes of S-PVC (saleable product, 100% purity)."

The table below shows the relevant product according to definition in PRODCOM 2010 statistics. This PRODCOM product also covers E-PVC (see section 49).

PRODCOM code	**Description**
20.16.30.10	Polyvinyl chloride, not mixed with any other substances, in primary forms.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of S-PVC are included except the production of VCM."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat

benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing S-PVC is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing S-PVC in year k (expressed in EUAs).

BM_P: Benchmark for S-PVC (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

49 E-PVC

Benchmark name:	**E-PVC**
Benchmark number:	49
Unit:	Tonne of E-PVC (saleable product, 100% purity)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Polyvinyl chloride; not mixed with any other substances consisting of PVC particles with a mean size between 0.1 and 3 µm. Expressed in tonnes of E-PVC (saleable product, 100% purity)."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics. Note that this PRODCOM code also includes S-PVC (see section 48).

PRODCOM code	**Description**
20.16.30.10	Polyvinyl chloride, not mixed with any other substances, in primary forms

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the production of E-PVC are included except the production of VCM."

Emissions in the production process of E-PVC usually stem from the use of steam, cooling, and fuels (light fuel oil, natural gas).

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing E-PVC is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing E-PVC in year k (expressed in EUAs).

BM_P: Benchmark for E-PVC (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

50 Hydrogen

Benchmark name:	**Hydrogen**
Benchmark number:	50
Unit:	Tonne of hydrogen (100% purity as net saleable production)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of hydrogen (H_2) and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tonnes per day
Special provisions:	Exchangeability of electricity; provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Pure hydrogen and mixtures of hydrogen and carbon monoxide having a hydrogen content >=60% mole fraction of total contained hydrogen plus carbon monoxide based on the aggregation of all hydrogen- and carbon-monoxide-containing product streams exported from the sub-installation concerned expressed as tonnes of 100% pure hydrogen, as net saleable product."

The following products are covered by the benchmark for hydrogen:

- Pure hydrogen
- Mixtures of hydrogen and carbon monoxide having a hydrogen content >=60% mole fraction of the total amount of hydrogen plus carbon monoxide. These mixtures are called synthesis gases or syngases, and differ from each other with regards to the hydrogen share in the total synthesis gas. The total amount of hydrogen plus carbon monoxide referred to is the sum of all hydrogen and carbon monoxide in all containing product streams exported from the installation.

Other mixtures of hydrogen and carbon monoxide (i.e. mixture having a hydrogen content <60% mole fraction of the total amount of hydrogen plus carbon monoxide) are not covered by the product benchmark for hydrogen, but by the product benchmark for synthesis gas (see section 51).

The table below shows the relevant product according to definition in PRODCOM 2010 statistics.

PRODCOM code	**Description**
20.11.11.50	Hydrogen

There is no single PRODCOM number for carbon monoxide (20.11.12.90 is inorganic oxygen compounds of non-metals) or synthesis gas.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered

In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the hydrogen product benchmark as follows:

"All relevant process elements directly or indirectly linked to the production of hydrogen and the separation of hydrogen and carbon monoxide are included. These elements lie between:

a) The point(s) of entry of hydrocarbon feedstock(s) and, if separate, fuel(s)
b) The points of exit of all product streams containing hydrogen and/or carbon monoxide
c) The point(s) of entry or exit of import or export heat.

For the determination of indirect emissions from electricity consumption, the total electricity consumption within the system boundaries shall be considered."

The system boundaries are visualised in Figure 10. In line with the above definition, the following production steps should in particular be regarded as being within the system boundaries:

- Chemical conditioning of feed
- H_2/CO generation with associated combustion air fans
- Water-gas shift (if present)
- Separation & purification functions as present: cryogenic (including liquid CO recycle duty); adsorption; absorption; membrane
- Related cooling and process water pumping duty.

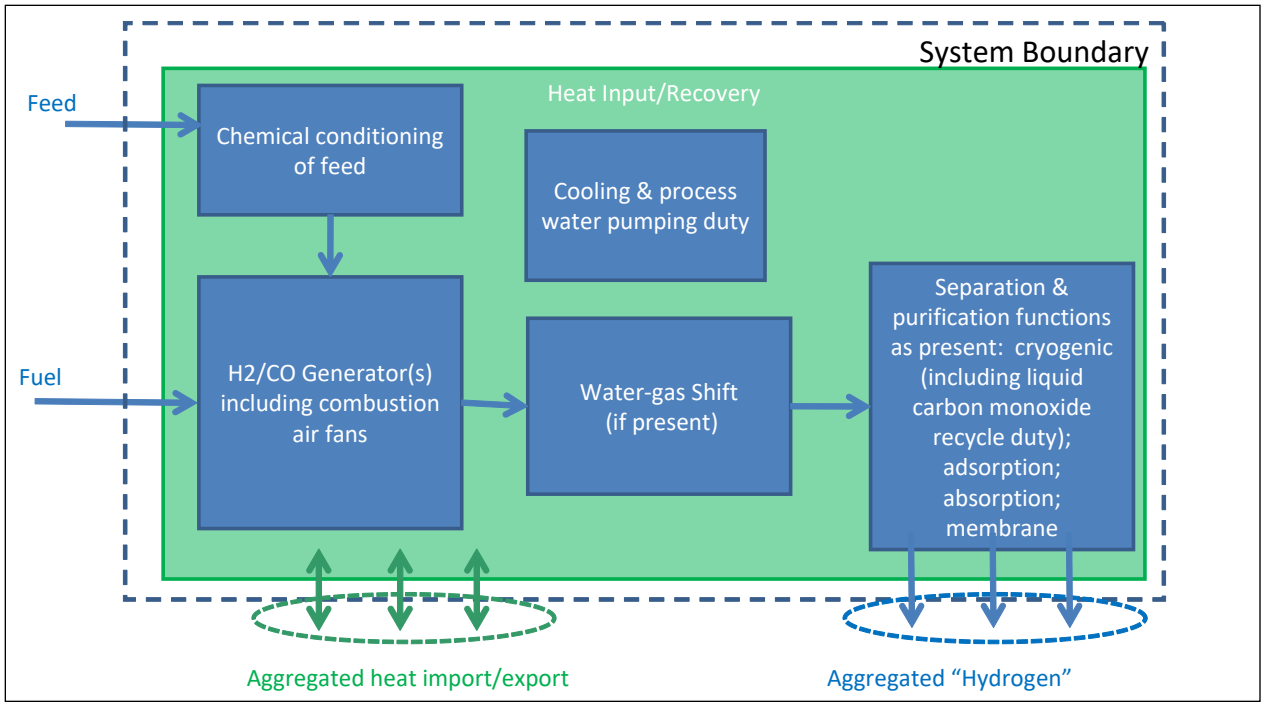

Figure 10. System boundaries of the hydrogen product benchmark (Sector Rule book for hydrogen and syngas, 2010)

The production of hydrogen that is covered by another product benchmark, e.g. the refinery products or syngas benchmark, cannot be covered by the hydrogen benchmark. In particular, this is the case for hydrogen extracted from a waste gas that is produced in a process covered by product benchmark as most product benchmarks include *'all processes directly or indirectly linked to the production'*.

Indirect emissions from electricity consumption are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for hydrogen is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on

direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing hydrogen (expressed in EUAs).

BM_P: Benchmark for hydrogen (expressed in EUAs / unit of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of hydrogen over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the hydrogen production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing hydrogen, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of hydrogen over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

$Elec.use$: Total electricity consumption within the system boundaries of the production of hydrogen over the baseline period, expressed in MWh.

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product) (see below).

Determination of historical activity level

In order to ensure a level playing field for the production of hydrogen in refineries and chemical plants, the free allocation of emission allowances for the production of hydrogen has been brought in line with the CWT approach for refineries by referring to a defined volumetric concentration of hydrogen. The historical activity level to be used in the determination of free allocation should be determined as follows:

$$HAL_{H_2} = arithmetic\ mean\left(HAL_{H_2+CO,k} \times \left(1 - \frac{1 - VF_{H_2,k}}{0.4027}\right) \times 0.00008987\right)$$

With:

HAL_{H2} :	Historical activity level for hydrogen production referred to 100% hydrogen
$HAL_{H2+CO,k}$:	Historical activity level for hydrogen production referred to historical hydrogen content expressed in norm cubic meters per year referring to 0°C and 101.325 kPa in year k of the baseline period
$VF_{H2,k}$:	Historical production volume fraction of pure hydrogen in year k of the baseline period.

51 Synthesis gas

Benchmark name:	**Synthesis gas**
Benchmark number:	51
Unit:	Tonne of synthesis gas referred to 47% hydrogen as net saleable production
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of hydrogen (H2) and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tonnes per day
Special provisions:	Exchangeability of electricity; provisions in Annex III of the FAR

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Mixtures of hydrogen and carbon monoxide having a hydrogen content <60% mole fraction of total contained hydrogen plus carbon monoxide based on the aggregation of all hydrogen- and carbon-monoxide-containing product streams exported from the sub-installation concerned. Expressed in tonnes of synthesis gas referred to 47 volume-percent hydrogen as net saleable product."

Other mixtures of hydrogen and carbon monoxide (i.e. mixture having a hydrogen content ≥60% mole fraction of the total amount of hydrogen plus carbon monoxide) are not covered by the product benchmark for synthesis gas, but by the product benchmark for hydrogen.

For the calculation of the historical activity levels, the hydrogen content needs to be at least 38.37% (mole fraction of the total amount of hydrogen plus carbon monoxide). For synthesis gases with lower hydrogen contents, the synthesis gas benchmark cannot be applied.

The production of synthesis gas belongs to NACE code 20.11 and the PRODCOM number of hydrogen is 20.11.11.50. There is no single PRODCOM number for carbon monoxide (20.11.12.90 is inorganic oxygen compounds of non metals) or synthesis gas.

Definition and explanation of processes and emissions covered
In their Annex I, point 2, referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity', the FAR define the system boundaries of the synthesis gas product benchmark as follows:

"All relevant process elements directly or indirectly linked to the production of syngas and the separation of hydrogen and carbon monoxide are included. These elements lie between:

a) The point(s) of entry of hydrocarbon feedstock(s) and, if separate, fuel(s)

b) The points of exit of all product streams containing hydrogen and/or carbon monoxide

c) The point(s) of entry or exit of import or export heat.

For the determination of indirect emissions, the total electricity consumption within the system boundaries shall be considered."

The system boundaries are visualised in Figure 11. In line with the above definition, the following production steps should in particular be regarded as being within the system boundaries:

- Chemical conditioning of feed
- H_2/CO generation with associated combustion air fans
- Water-gas shift (if present)
- Separation & purification functions as present: cryogenic (including liquid CO recycle duty); adsorption; absorption; membrane
- Related cooling and process water pumping duty.

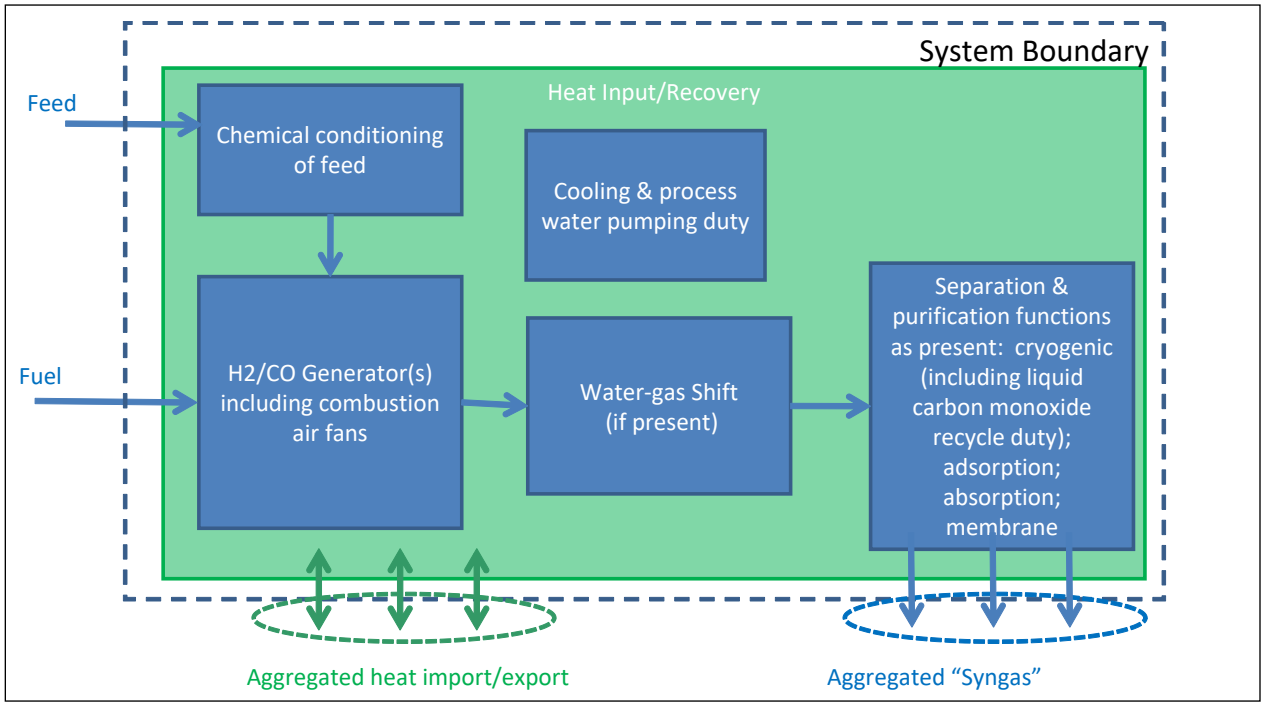

Figure 11. System boundaries of the synthesis gas product benchmark (Sector Rule book for hydrogen and syngas, 2010)

Indirect emissions from electricity consumption are not eligible for free allocation but are used in the calculation of free allocation (see below).

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The product benchmark for synthesis gas is based on total emissions since energy produced from fuels is exchangeable for energy from electricity. Allocation should however be based on direct emissions only. In order to achieve consistency between the benchmarks and the allocation, the preliminary allocation is calculated using a ratio of direct and total emissions:

$$F_{p,k} = \frac{Em_{direct} + Em_{NetHeatImport}}{Em_{direct} + Em_{NetHeatImport} + Em_{indirect}} \times BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing synthesis gas in year k (expressed in EUAs).

BM_P: Benchmark for synthesis gas (expressed in EUAs / unit of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Em_{direct}: Direct emissions within the system boundaries of the production of synthesis gas over the baseline period. The direct emissions further include the emissions due to the production of heat within the same ETS installation, that is consumed within the system boundaries of the synthesis gas production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other ETS installations or non-ETS entities.

$Em_{NetHeatImport}$: Emissions from any net measurable heat import from other ETS installations and non-ETS entities over the baseline period by a sub-installation producing synthesis gas, irrespective of where and how the heat is produced.

$Em_{indirect}$: Indirect emissions from electricity consumption within the system boundaries of the production of synthesis gas over the baseline period. These emissions expressed in tonne CO_2 are calculated as follows:

$Em_{indirect} = Elec.use \times 0.376$

With:

$Elec.use$: Total electricity consumption within the system boundaries of the production of synthesis gas over the baseline period, expressed in MWh.

HAL_P : Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product) (see below).

Determination of historical activity level

In order to ensure a level playing field for the production of synthesis gas in refineries and chemical plants, the free allocation of emission allowances for synthesis production has been brought in line with the CWT approach for refineries by referring to a defined volumetric concentration of hydrogen. The historical activity level to be used in the determination of free allocation should be determined as follows:

$$HAL_{Syngas} = ArithmeticMean\left(HAL_{H2+CO,k} \times \left(1 - \frac{0.47 - VF_{H2,k}}{0.0863}\right) \times 0.0007047\right)$$

With:

HAL_{Syngas} : Historical activity level for synthesis gas production referred to 47% hydrogen.

$HAL_{H2+CO,k}$: Historical activity level for synthesis gas production referred to historical hydrogen content expressed in norm cubic meters per year referring to 0°C and 101.325 kPa in year k of the baseline period.

$VF_{H2,k}$: Historical production volume fraction of pure hydrogen in year k of the baseline period.

52 Soda ash

Benchmark name:	Soda ash
Benchmark number:	52
Unit:	Tonne of soda ash (as total gross production)
Exposed to Carbon Leakage in 2021-2030?	TBD
Associated Annex I activity:	Production of soda ash (Na2CO3) and sodium bicarbonate (NaHCO3)
Special provisions:	-

Definition and explanation of products covered
According to the FAR this product benchmark covers:

"Disodium carbonate, expressed in tonnes of soda ash as total gross production except dense soda ash obtained as by-product in a caprolactam production network."

The table below shows relevant products according to definitions in PRODCOM 2010 statistics.

PRODCOM code	Description
20.13.43.10	Disodium carbonate

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Definition and explanation of processes and emissions covered
The FAR define the system boundaries as follows:

"All processes directly or indirectly linked to the process units
- *brine purification,*
- *limestone calcination and milk of lime production,*
- *absorption of ammonia,*
- *precipitation of $NaHCO_3$,*
- *filtration or separation of $NaHCO_3$ crystals from mother liquor,*
- *decomposition of $NaHCO_3$ to Na_2CO_3,*
- *recovery of ammonia and*
- *densification or production of dense soda ash*

are included."

Emissions related to the production of the consumed electricity are excluded from the system boundaries.

The export of measurable heat (steam, hot water, etc.) is not covered by this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to an ETS consumer or a consumer not covered by the ETS. However, when heat is exported to a consumer covered by the ETS, the consumer will get free allocation only in case a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In case of export to non-ETS consumers, the heat exporter receives free allocation and one or two heat benchmark sub-installations should be foreseen. *See FAR for a definition of measurable heat and Guidance Document 6 on Cross-Boundary Heat Flows for guidance on this topic.*

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing soda ash is calculated as follows:

$$F_{p,k} = BM_p \times HAL_p \times CLEF_{p,k}$$

With:

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing soda ash in year k (expressed in EUAs).

BM_P: Benchmark for soda ash (expressed in EUAs / unit of product).

HAL_P: Historical activity level, i.e. the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product).

$CLEF_{p,k}$: Applicable Carbon Leakage Exposure Factor for product p in year k.

Annex A List of PRODCOM codes per benchmark and comparison to 2011 version of Guidance Document 9

This annex lists the most relevant changes to the 2011 version of Guidance Document 9 in the current, 2019 version, including the PRODCOM codes per benchmark

The main changes compared to the previous version of this Guidance Document can be categorized as follows:

- The sections and therefore the benchmarked products have been reordered by their Annex I activity. No products or benchmarks have been added or deleted.
- The 2007 version of the PRODCOM codes and other codes have been replaced by the 2010 PRODCOM code.
- Benchmark definitions have been updated in line with Annex I of the FAR
- Some corrections and clarifications to the old guidance document have been made, however the underlying rules have remained unchanged.

The table below lists the PRODCOM 2010[12] codes that have been identified per product benchmark. This list is not exhaustive for all benchmarks. For comparison also the PRODCOM codes used in the 2011 version of Guidance Document 9 are listed.

PRODCOM codes can be useful in identifying and defining products. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

[12] The full 2010 list of PRODCOM codes can be found at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0860&from=EN

Benchmark name	BM number	PRODCOM code 2010	Could also be covered by:	PRODCOM description	PRODCOM code 2004	PRODCOM code 2007
Refinery products	1	None, use PRODCOM 2004		Aviation gasoline	23.20.11.40	
	1	None, use PRODCOM 2004		Motor gasoline, unleaded	23.20.11.50	
	1	None, use PRODCOM 2004		Motor gasoline, leaded	23.20.11.70	
	1	None, use PRODCOM 2004		Gasoline type jet fuel	23.20.12.00	
	1	None, use PRODCOM 2004		Light naphtha	23.20.13.50	
	1	None, use PRODCOM 2004		Medium naphtha	23.20.16.50	
	1	None, use PRODCOM 2004		White spirit, industrial spirit	23.20.13.70	
	1	None, use PRODCOM 2004		Kerosene-type jet fuel and other kerosene	23.20.14.00	
	1	None, use PRODCOM 2004		Derv fuel (diesel)	23.20.15.50	
	1	None, use PRODCOM 2004		Heating gas-oil	23.20.15.70	
Coke	2	None, use PRODCOM 2004		Coke-oven coke (obtained from the carbonisation of coking coal, at high temperature), gas-works coke (by-product of gas-works plants)	23.10.10.30	
Sintered ore	3	**07.10.10.00**		Iron ores and concentrates (excluding roasted iron pyrites)		13.10.10.50
	3	**Partially includes NACE rev2.0 24.10**		Manufacture of basic iron and steel and of ferro-alloys		NACE rev1.1 27.10
Hot metal	4	**No associated PRODCOM codes available**				
	5	**24.10.21.10**		Flat semi-finished products (of non-alloy steel)		27.10.31.10

EAF carbon steel	5	**24.10.21.21**		Ingots, other primary forms and long semi-finished products for seamless tubes (of non-alloy steel)		27.10.31.21
	5	**24.10.21.22**		Other ingots, primary forms and long semi-finished products including blanks (of non-alloy steel)		27.10.31.22
EAF high alloy steel	6	**24.10.23.10**		Flat semi-finished products (of alloy steel other than of stainless steel)		27.10.33.10
	6	**24.10.23.21**		Ingots, other primary forms and long semi-finished products for seamless tubes (of alloy steel other than of stainless steel)		27.10.33.21
	6	**24.10.23.22**		Other ingots, primary forms and long semi-finished products (of alloy steel other than of stainless steel)		27.10.33.22
	6	**24.10.22.10**		Flat semi-finished products (slabs) (of stainless steel)		27.10.32.10
	6	**24.10.22.21**		Ingots, other primary forms and long semi-finished products for seamless tubes (of stainless steel)		27.10.32.21
	6	**24.10.22.22**		Other ingots, primary forms and long semi-finished products (of stainless steel)		27.10.32.22
Iron casting	7	**Partially includes NACE rev2.0 24.51**		Manufacture of cast iron tubes		NACE rev1.1 27.21
	7	**Partially includes NACE rev2.0 24.52**		Casting of iron		NACE rev1.1 27.51
	7	**24.51.20.00**		Tubes, pipes and hollow profiles of cast iron excluding tubes, pipes, hollow profiles made into identifiable parts of articles, such as sections of central heating radiators and machinery parts		27.21.10.00
	7	**24.51.30.30**		Tube or pipe fittings, of non-malleable cast iron		27.21.20.33
						27.21.20.35
	7	**24.51.30.50**		Tube or pipe fittings of malleable cast iron		27.21.20.50
	7	**24.52.30.00**		Tube or pipe fittings of cast steel		27.21.20.70
	7	**24.51.11.10**		Malleable iron castings for land vehicles, piston engines and other machinery and mechanical appliances		27.51.11.10
						27.51.11.30
						27.51.11.40

						27.51.11.50
	7	**24.51.11.90**		Parts for other utilisation (malleable iron casting)		27.51.11.90
	7	**24.51.12.10**		Parts of land vehicles (nodular iron castings)		27.51.12.10
	7	**24.51.12.20**		Ductile iron castings for transmission shafts, crankshafts, camshafts, cranks, bearing housings and plain shaft bearings (excluding for bearing housings incorporating ball or roller bearings)		27.51.12.20
						27.51.12.30
	7	**24.51.12.40**		Other parts of piston engines and mechanical engineering (nodular iron castings)		27.51.12.40
	7	**24.51.12.50**		Ductile iron castings for machinery and mechanical appliances excluding for piston engines		27.51.12.50
	7	**24.51.12.90**		Ductile iron castings for locomotives/rolling stock/parts, use other than in land vehicles, bearing housings, plain shaft bearings, piston engines, gearing, pulleys, clutches, machinery		27.51.12.90
	7	**24.51.13.10**		Grey iron castings for land vehicles (excluding for locomotives or rolling stock, construction industry vehicles)		27.51.13.10
	7	**24.51.13.20**		Grey iron castings for transmission shafts, crankshafts, camshafts, cranks, bearing housings and plain shaft bearings (excluding bearing housings incorporating ball or roller bearings)		27.51.13.20
						27.51.13.30
	7	**24.51.13.40**		Other parts of piston engines and mechanical engineering (cast iron: not ductile)		27.51.13.40
	7	**24.51.13.50**		Grey iron castings for machinery and mechanical appliances excluding for piston engines		27.51.13.50
	7	**24.51.13.90**		Grey iron castings for locomotives/rolling stock/parts, use other than in land vehicles, bearing housings, plain shaft bearings, piston engines, gearing, pulleys, clutches, machinery		27.51.13.90
Pre-bake anode	8	**No associated PRODCOM codes available**				
Aluminium	9	**24.42.11.30**		Unwrought non-alloy aluminium (excluding powders and flakes)		27.42.11.30

Grey cement clinker	10	**23.51.11.00**	BM11	Cement clinker		26.51.11.00
White cement clinker	11	**23.51.11.00**	BM10	Cement clinker		26.51.11.00
Lime	12	**23.52.10.33**		Quicklime		26.52.10.33
Dolime	13	**23.52.30.30**	BM14	Calcined and sintered dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs		14.12.20.50
Sintered dolime	14	**23.52.30.30**	BM13	Calcined and sintered dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs		14.12.20.50
Float glass	15	**23.11.12.14**		Non-wired sheets, of float, surface ground or polished glass, having an absorbent or reflective layer, of a thickness <= 3.5 mm		26.11.12.14
	15	**23.11.12.17**		Non-wired sheets, of float, surface ground or polished glass, having an absorbent or reflecting layer, not otherwise worked, of a thickness > 3.5 mm		26.11.12.17
	15	**23.11.12.30**		Non-wired sheets, of float, surface ground or polished glass, coloured throughout the mass, opacified, flashed or merely surface ground		26.11.12.30
	15	**23.11.12.90**		Other sheets of float/ground/polished glass, n.e.c.		26.11.12.80
Bottles and jars of colourless glass	16	**23.13.11.40**		Bottles of colourless glass of a nominal capacity < 2.5 litres, for beverages and foodstuffs (excluding bottles covered with leather or composition leather, infant's feeding bottles)		26.13.11.28
Bottles and jars of coloured glass	17	**23.13.11.50**		Bottles of coloured glass of a nominal capacity < 2.5 litres, for beverages and foodstuffs (excluding bottles covered with leather or composition leather, infant's feeding bottles)		26.13.11.34
Continuous filament	18	**23.14.11.10**		Glass fibre threads cut into lengths of at least 3 mm but <= 50 mm (chopped strands)		26.14.11.10
	18	**23.14.11.30**		Glass fibre filaments (including rovings)		26.14.11.30

glass fibre products	18	**23.14.11.50**		Slivers; yarns and chopped strands of filaments of glass fibres (excluding glass fibre threads cut into lengths of at least 3 mm but <= 50 mm)		26.14.11.50
	18	**23.14.11.70**		Staple glass fibre articles		26.14.11.70
	18	**23.14.12.10**	BM23	Glass fibre mats (including of glass wool)		26.14.12.10
	18	**23.14.12.30**	BM23	Glass fibre voiles (including of glass wool)		26.14.12.30
	18	**23.14.12.50**		Nonwoven glass fibre webs; felts; mattresses and boards		26.14.12.50
Facing bricks	19	**23.32.11.10**		Non-refractory clay building bricks (excluding of siliceous fossil meals or earths)		26.40.11.10
Pavers	20	**23.32.11.30**		Non-refractory clay flooring blocks, support or filler tiles and the like (excluding of siliceous fossil meals or earths)		26.40.11.30
Roof tiles	21	**23.32.12.50**		Non-refractory clay roofing tiles		26.40.12.50
	21	**Excluded from BM21: 23.32.12.70**		Non-refractory clay constructional products (including chimneypots, cowls, chimney liners and flue-blocks, architectural ornaments, ventilator grills, clay-lath; excluding pipes, guttering and the like)		26.40.12.70
Spray dried powder	22	**No associated PRODCOM codes available, but is associated with 23.31.10**		Ceramic tiles and flags		26.30.10
Mineral wool	23	**23.14.12.10**	BM18	Glass fibre mats (including of glass wool)		26.14.12.10
	23	**23.14.12.30**	BM18	Glass fibre voiles (including of glass wool)		26.14.12.30
	23	**23.99.19.10**		Slag wool, rock wool and similar mineral wools and mixtures thereof, in bulk, sheets or rolls		26.82.16.10
Plaster	24	**08.11.20.30**		Gypsum and anhydrite		14.12.10.30
	24	**23.52.20.00**	BM25	Plasters consisting of calcined gypsum or calcium sulphate (including for use in building, for use in dressing woven fabrics or surfacing paper, for use in dentistry)		26.53.10.00
	24	**23.64.10.00**		Factory made mortars		26.64.10.00
Dried secondary gypsum	25	**23.52.20.00**	BM24	Plasters consisting of calcined gypsum or calcium sulphate (including for use in building, for use in dressing woven fabrics or surfacing paper, for use in dentistry)		26.53.10.00

Plasterboard	26	**23.62.10.50**		Boards, sheets, panels, tiles and similar articles of plaster or of compositions based on plaster, faced or reinforced with paper or paperboard only (excluding articles agglomerated with plaster, ornamented)		26.62.10.50
	26	**23.62.10.90**		Boards, sheets, panels, tiles and similar articles of plasteror of compositions based on plaster, not faced or reinforced with paper or paperboard only (excluding articles agglomerated with plaster, ornamented)		26.62.10.90
Short fibre kraft pulp	27	**17.11.12.00**	BM28	Chemical wood pulp, soda or sulphate, other than dissolving grades		21.11.12.13
						21.11.12.15
						21.11.12.53
						21.11.12.55
Long fibre kraft pulp	28	**17.11.12.00**	BM27	Chemical wood pulp, soda or sulphate, other than dissolving grades		21.11.12.13
						21.11.12.15
						21.11.12.53
						21.11.12.55
Sulphite pulp, thermo-mechanical and mechanical pulp	29	**17.11.13.00**		Chemical wood pulp, sulphite, other than dissolving grades		21.11.13.13
						21.11.13.15
						21.11.13.53
						21.11.13.55
	29	**17.11.14.00**		Part of PRODCOM covered: Mechanical wood pulp		21.11.14.15, 21.11.14.19, 21.11.14.30, 21.11.14.50
	29	**17.11.14.00**	BM30	Part of PRODCOM not covered: semi-chemical wood pulp ; pulps of fibrous cellulosic material other than wood		
Recovered paper pulp	30	**17.11.14.00**		Part of PRODCOM covered: pulps of fibrous cellulosic material other than wood		21.11.14.15, 21.11.14.19, 21.11.14.30, 21.11.14.50
	30	**17.11.14.00**	BM29	Part of PRODCOM not covered: Mechanical wood pulp; semi-chemical wood pulp		
Newsprint	31	**17.12.11.00**		Newsprint in rolls or sheets		21.12.11.50
Uncoated fine paper	32	**17.12.12.00**		Hand-made paper and paperboard in rolls or sheets (excluding newsprint)		21.12.12.00
	32	**17.12.13.00**				21.12.13.10

				Paper and paperboard used as a base for photo-sensitive, heat-sensitive or electro-sensitive paper; carbonising base paper; wallpaper base		21.12.13.55
						21.12.13.59
	32	**17.12.14.10**		Graphic paper, paperboard : mechanical fibres <= 10%, weight < 40 g/m²		21.12.14.10
	32	**17.12.14.35**		Graphic paper, paperboard : mechanical fibres <= 10%, weight >= 40 g/m² but <= 150 g/m², in rolls		21.12.14.35
	32	**17.12.14.39**		Graphic paper, paperboard : mechanical fibres <= 10%, weight >= 40 g/m² but <= 150 g/m², sheets		21.12.14.39
	32	**17.12.14.50**		Graphic paper, paperboard : mechanical fibres <= 10%, weight > 150 g/m²		21.12.14.50
	32	**17.12.14.70**		Graphic paper, paperboard : mechanical fibres > 10%		21.12.14.70
Coated fine paper	33	**17.12.73.35**		Coated base for paper..., for photo-, heat-, electro-sensitive paper, weight <= 150 g/m², m.f. <= 10%		(21.12.53.35)
	33	**17.12.73.37**		Coated paper, for writing, printing, graphic purposes (excluding coated base, weight <= 150 g/m²)		(21.12.53.37)
	33	**17.12.73.60**		Light-weight coated paper for writing, printing, graphic purposes, m.f. > 10%		(21.12.53.60)
	33	**17.12.73.75**		Other coated mech. graphic paper for writing, printing, graphic purposes, m.f. > 10%, rolls		(21.12.53.75)
	33	**17.12.73.79**		Other coated mech. graphic paper for writing, printing, graphic purposes, m.f. > 10%, sheets		(21.12.53.79)
	33	**17.12.76.00**		Carbon paper, self-copy paper and other copying or transfer paper, in rolls or sheets		(previously incorrect)
Tissue	34	**17.12.20.30**		Cellulose wadding for household or sanitary purposes, in rolls of a width > 36 cm or in rectangular (including square sheets) with at least one side > 36 cm in an unfolded state		(21.12.21.30)
	34	**17.12.20.55**		Creped paper and webs of cellulose fibres for household/ sanitary purposes, in rolls, width > 36 cm, rectangular sheets min. one side > 36cm in unfolded state, weight <= 25 g/m²/ply		(21.12.21.55)

	34	**17.12.20.57**		Creped paper and webs of cellulose fibres for household/sanitary purposes, in rolls, width > 36 cm, rectangular sheets min. one side > 36 cm in unfolded state, weight > 25 g/m²/ply		(21.12.21.57)
	34	**17.12.20.90**		Paper stock for household : others		(21.12.21.90)
	34	**17.22.11.20**		Toilet paper		(21.22.11.10)
	34	**17.22.11.40**		Handkerchiefs and cleansing or facial tissues of paper pulp, paper, cellulose wadding or webs of cellulose fibres		(21.22.11.33)
	34	**17.22.11.60**		Hand towels of paper pulp, paper, cellulose wadding or webs of cellulose fibres		(21.22.11.35)
	34	**17.22.11.80**		Tablecloths and serviettes of paper pulp, paper, cellulose wadding or webs of cellulose fibres		(21.22.11.50)
	34	**17.22.12.20**		Sanitary towels, tampons and similar articles of paper pulp, paper, cellulose wadding or webs of cellulose fibres		(21.22.12.10)
	34	**17.22.12.30**		Napkins and napkin liners for babies and similar sanitary articles of paper pulp, paper, cellulose wadding or webs of excluding toilet paper, sanitary towels, tampons and similar articles		(21.22.12.30)
	34	**17.22.12.50**		Articles of apparel and clothing accessories of paper pulp; paper; cellulose wadding or webs of cellulose fibres (excluding handkerchiefs, headgear)		(21.22.12.50)
	34	**17.22.12.90**		Household, sanitary or hospital articles of paper, etc, n.e.c.		(21.22.12.90)
Testliner and fluting	35	**17.12.33.00**		Semi-chemical fluting		21.12.24.00
	35	**17.12.34.00**		Recycled fluting and other fluting		
	35	**17.12.35.20**		Uncoated testliner (recycled liner board), weight <= 150 g/m², in rolls or sheets		21.12.25.20
	35	**17.12.35.40**		Uncoated testliner (recycled liner board), weight > 150 g/m², in rolls or sheets		21.12.25.40
Uncoated carton board	36	**17.12.31.00**		Uncoated, unbleached kraftliner in rolls or sheets (excluding for writing, printing or other graphic purposes, punch card stock and punch card tape paper)		21.12.22.50

	36	**17.12.32.00**		Uncoated kraftliner in rolls or sheets (excluding unbleached, for writing; printing or other graphic purposes, punch card stock and punch card tape paper		21.12.22.90
	36	**17.12.42.60**		Other uncoated paper and paperboard, in rolls or sheets, weight > 150 g/m² and < 225 g/m² (excluding products of HS 4802, fluting paper, testliner, sulphite wrapping paper, filter or felt paper and paperboard)		21.12.30.65
	36	**17.12.42.80**		Other uncoated paper and paperboard, in rolls or sheets, weight >= 225 g/m² (excluding products of HS 4802, fluting paper, testliner, sulphite wrapping paper, filter or felt paper and paperboard)		21.12.30.69
	36	**17.12.51.10**		Uncoated, inside grey paperboard		21.12.23.35
	36	**17.12.59.10**		Other uncoated paperboard		21.12.23.37
Coated carton board	37	**17.12.75.00**		Kraft paperboard (other than that of a kind used for writing, printing or other graphic purposes), coated with kaolin or with other inorganic substances		21.12.54.30
	37	**17.12.77.55**		Bleached paper and paperboard in rolls or sheets, coated, impregnated or covered with plastics weighing > 150 g/m² (excluding adhesives)		21.12.56.55
	37	**17.12.77.59**		Paper and paperboard in rolls or sheets, coated, impregnated or covered with plastics (excluding adhesives, bleached and weighing > 150 g/m²)		21.12.56.59
	37	**17.12.78.20**		Kraft paper and paperboard, coated on one or both sides with kaolin or other inorganic substances, in rolls or in square or rectangular sheets, of any size (excluding that for writing, printing or other graphic purposes; paper and paperboard bleached uniformly in the mass and containing > 95% chemically processed wood fibres by weight in relation to the total fibre content)		21.12.54.30
	37	**17.12.78.50**		Multi-ply paper and paperboard, coated, others		21.12.54.59
	37	**17.12.79.53**		Multi-ply paper and paperboard, coated, of which each layer in bleached		21.12.54.53
	37	**17.12.79.55**		Multi-ply paper and paperboard, coated, with 1 bleached outer layer		21.12.54.55

Carbon black	38	**20.13.21.30**		Carbon (carbon blacks and other forms of carbon, n.e.c.)		24.13.11.30
Nitric acid	39	**20.15.10.50**		Nitric acid; sulphonitric acids		24.15.10.50
Adipic acid	40	**20.14.33.85**		Adipic acid; its salts and esters		24.14.33.85
Ammonia	41	**20.15.10.75**		Anhydrous ammonia		24.15.10.75
Steam cracking	42	**No associated PRODCOM codes available**				
Aromatics	43	**20.59.56.70**		Mixed alkylbenzenes, mixed alkylnaphthalenes other than HS 2707 or 2902		24.66.46.70
	43	**20.14.12.13**		Cyclohexane		24.14.12.13
	43	**20.14.12.23**		Benzene		24.14.12.23
	43	**20.14.12.25**		Toluene		24.14.12.25
	43	**20.14.12.43**		o-Xylene		24.14.12.43
	43	**20.14.12.45**		p-Xylene		24.14.12.45
	43	**20.14.12.47**		m-Xylene and mixed xylene isomers		24.14.12.47
	43	**20.14.12.60**		Ethylbenzene		24.14.12.60
	43	**20.14.12.70**		Cumene		24.14.12.70
	43	**20.14.12.90**		Other cyclic hydrocarbons		24.14.12.90
	43	**20.14.73.20**		Benzol (benzene), toluol (toluene) and xylol (xylenes)		24.14.73.20
						24.14.73.30
	43	**20.14.73.40**		Naphthalene and other aromatic hydrocarbon mixtures (excluding benzole, toluole, xylole)		24.14.73.40
Styrene	44	**20.14.12.50**		Styrene		24.14.12.50
Phenol/ acetone	45	**20.14.24.10**		Monophenols		24.14.24.15
	45	**20.14.62.11**		Acetone		24.14.62.11
Ethylene oxide/ ethylene glycols	46	**20.14.63.73**		Oxirane (ethylene oxide)		24.14.63.73
	46	**20.14.23.10**		Ethylene glycol (ethanediol)		24.14.23.10
	46	**20.14.63.33**		2,2-Oxydiethanol (diethylene glycol; digol)		24.14.63.33
	46	**20.16.40.15**		Polyethylene glycols and other polyether alcohols, in primary forms		24.16.40.15

Vinyl chloride monomer	47	**20.14.13.71**		Vinyl chloride (chloroethylene)		24.14.13.71
S-PVC	48	**20.16.30.10**	BM49	Polyvinyl chloride, not mixed with any other substances, in primary forms		24.16.30.10
E-PVC	49	**20.16.30.10**	BM48	Polyvinyl chloride, not mixed with any other substances, in primary forms		24.16.30.10
Hydrogen	50	**20.11.11.50**	BM51	Hydrogen		24.11.11.50
Synthesis gas	51	**20.11.11.50**	BM50	Hydrogen		24.11.11.50
	51	**20.11.12.90**		Inorganic oxygen compounds of non metals (excluding sulphur trioxide (sulphuric anhydride); diarsenic trioxide, nitrogen oxides, silicon dioxide, sulphur dioxide, carbon dioxide)		24.11.12.90
Soda ash	52	**20.13.43.10**		Disodium carbonate		24.13.33.10