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UKETS18 FAR - Sector specific guidance

April 2025

Note

This document is intended to provide guidance for operators of installations. If there is any inconsistency between the guidance and legislation, the legislation prevails.

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Contents

Overview

This document provides guidance to operators of installations under the UK Emissions Trading Scheme (UK ETS) and provides information for each product referred to by the 52 product benchmarks.

The relevant legislation in this area is:

- **The Greenhouse Gas Emissions Trading Scheme Order 2020** (**The Order**) (https://www.legislation.gov.uk/uksi/2020/1265/contents) as amended from time to time
- **The Free Allocation Regulation** (**FAR**) (Commission Delegated Regulation (EU) 2019/331 of 19 December 2018) as it has effect in domestic law and as amended by the Order
- **The Monitoring and Reporting Regulation** (**MRR**) (Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018) on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council (disregarding any amendments adopted after 11 November 2020) as given effect for the purpose of the UK ETS by article 24 of the Order, subject to the modifications made for that purpose from time to time
- **The Verification Regulation** (**VR**) (Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council (disregarding any amendments adopted after 11 November 2020), as given effect for the purpose of the UK ETS by article 25 of the Order, subject to the modifications made for that purpose from time to time
- **PRODCOM codes 2019** https://www.legislation.gov.uk/eur/2019/1933/annexes are a unique identifier for each product within production processes and can be used as a guide to identify benchmarks.

Introduction

Products covered by product benchmarks

One of the first important steps in the data collection is checking to see if product benchmarks apply to an installation. The operator must check the products produced by the installation, including the characteristics of the product, the composition of product mixes, and/or the fields of application, against the definition of the relevant product benchmark. This assessment is further described in 'UKETS12 FAR - Guidance on completing the 2025 Baseline Data Collection'. **PRODCOM codes can be a useful indicator to confirm whether a product is covered under a product benchmark, however the selection of a benchmark should never solely rely on PRODCOM codes.**

This guidance document provides the following information for each product referred to in the 52 product benchmarks:

- name and number of the product benchmark, the unit in which it is expressed and the associated Schedule 2 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 'UKETS12 FAR - Guidance on completing the 2025 Baseline Data Collection and applying for HSE/USE status' for more information on system boundaries of product benchmarks)
- calculation of preliminary allocation
- determination of the historical activity level (where relevant).

System boundaries and double counting

Double allocation in respect of the same emissions must be avoided. Operators must ensure that they rigorously follow the system boundaries of each benchmark. The risk of double counting increases 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, there is no additional allocation for such safety flaring via fuel sub-installations (for details please consult 'UKETS17 FAR - Waste gases and process emissions sub-installations').

Care must be taken when a benchmarked product's production includes producing an intermediate product that is later used to produce the benchmarked product. Whenever a product benchmark includes the production of intermediate products, there is no separate allocation for production of the intermediate products.

Example B: The production of the intermediate product ethylene dichloride (EDC) is included in the vinyl chloride monomer (VCM) benchmark. The VCM benchmark should therefore not be applied to dedicated EDC plants that do not produce VCM. Such plants should not be allocated any free allowances, either by 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 number of free allowances is deducted from the free allocation to the VCM producer.

Example C: As for EDC and VCM, hydrogen used to produce ammonia is not eligible for free allocation, as the emissions are already covered by the ammonia product benchmark. This applies to both integrated plants, where hydrogen and ammonia are produced within the same plant, as well as standalone hydrogen production, where the hydrogen is exported to a plant producing ammonia.

To determine free allocation based on product benchmarks, any measurable heat imported from heat production not covered by the UK ETS needs to be deducted (according to Article 21 of the FAR). Please consult 'UKETS15 FAR - Cross-boundary heat flows' for more details.

As from 2027, in line with FAR Article 16(5), the flaring of waste gases resulting from processes covered by a product benchmark, except for safety flaring, and not used for the purpose of the production of measurable heat, non-measurable heat or electricity, will lead to a reduction of allocation. In this case, the preliminary annual allocation for the relevant product benchmark sub-installation will be reduced by the amount of annual historical emissions from the flaring of these waste gases (for details please consult 'UKETS17 FAR - Waste gases and process emissions sub-installations').

For product benchmarks defined on the basis of net saleable production, this should be interpreted as the quantity of product (e.g., paper) which can be theoretically sold, i.e., meeting the client specifications. "Marketable" should refer to a state of the product that is close to the production process, yet where clients could buy the product of the applicable product benchmark. Any waste returned to the process (including, e.g., scrubs and cuttings) should not be included in the historical activity level. Packaging and sleeves should not be included either, as they are not included in the production processes as defined in the respective sections here-after.

In all cases, to avoid any risk of double counting, operators must ensure that any products returned into the same production process are deducted from annual activity levels, as appropriate, in line with the production definitions laid down in the FAR.

1 Refinery products

Benchmark name	Refinery products
Benchmark number	1
Unit	CO2 weighted tonne (CWT)
CL exposed?	Yes
Associated Schedule 2 activity	Refining of mineral oil
Special provisions	• exchangeability of electricity; provisions in Annexes II and III of the FAR • PRODCOM 2019 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.*"

Refineries with other product mixes not referred to in the definition are the so-called atypical sites producing mainly lubricants or bitumen, for example. For these installations, the allocation will be based on fall-back approaches. If hydrogen or synthesis gas is produced in an atypical site, the corresponding product benchmarks must be applied.

The table below shows relevant products according to definitions in PRODCOM 2004 statistics. 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.

As no suitable PRODCOM 2019 codes exist for this benchmark, PRODCOM 2004 codes are used.

PRODCOM	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

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity' defines 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 below, in the section "Determination of historical activity level".

The allocation for the process units relating to other sectors (e.g. petrochemicals) should be determined using other product benchmarks (if available) or relevant fall-back approaches (i.e. heat benchmark, fuel benchmark, or process emissions approach).

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 CO2 emissions are subtracted from the refinery's 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 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.

To determine indirect emissions, the operator must consider the total electricity consumption within the system boundaries. 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 under this product benchmark and might be eligible for free allocation, regardless of whether heat is exported to a UK ETS or a non-UK ETS consumer. However, when heat is exported to a consumer covered by the UK ETS, the consumer will only get free allocation where a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In cases of export to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be foreseen. See 'UKETS15 FAR - Cross boundary heat flows' for more guidance on this topic.

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

- Emissions from the combusted flared gas
- Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    - The fuels necessary to keep a pilot flame running
    - 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. However, allocation should be based on direct emissions only. 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 UK allowances (UKAs)
BM_p	benchmark for refineries (expressed in UKAs / 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 from the CWT units over the baseline period. The direct emissions include the emissions due to the production of heat within the same

UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat import by CWT units from other UK ETS installations and non-UK 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 CO2 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, gasoline, 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 CO2 footprints to make a certain product, and production routes and products are interdependent, e.g. a refinery cannot produce only gasoline. Also, simple refineries unable to process certain heavy fractions as part of their output, will ship these substances to more complex refineries for further processing. As a result, energy consumption and CO2 emissions do not readily correlate with simple indicators such as crude throughput, final product mix, or similar.

The concept of CO2 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. Therefore, the single product of the refinery is the CWT, and its production is calculated on the basis of a defined generic process unit, each of which has been weighted with an emission factor relative to crude distillation.

The emission factor is known as the CWT factor. It represents the CO2 emission intensity at an average level of energy efficiency, for the same standard fuel type for each process unit of production, and for average process emissions of the process units. Additional corrections are applied for so-called off-sites[1] and electricity production/consumption.

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

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

below:

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

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 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 historic activity level (HAL). The yellow cells require inputted data. Process units for the purpose of the CWT approach are called CWT 'functions'. Since not all CWT functions will be performed at a single refinery, most yellow fields will have a value of 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 UK Authority.

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 should be considered water-free and excluding slops processing.

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

Accuracy

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 when calculating parameters necessary for

determining direct and indirect emissions of the (sub)installation:

- steam flows: ±5%
- electricity production: ±5%
- steam conditions: for steam enthalpies an accuracy of ±0.1 GJ/t (100 kJ/kg) 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 to calculate the amount of imported and exported steam.

Table 1 Calculation of basic historic activity level (HAL) in year K

CWT function	HAL			CWT factor		CWT (kt in year k)
	Basis*	(kt in 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	=	..

CWT function	HAL			CWT factor		CWT (kt in year k)
	Basis*	(kt in year k)				
Ethylbenzene production	P	..	×	1.55	=	..
Cumene production	P	..	×	5.00	=	..
Phenol production	P	..	×	1.15	=	..
Lube solvent extraction	F	..	×	2.10	=	..
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. Consumpt. (kW)	..	×	0.15	=	
Seawater desalination	P (km^3)	..	×	1.15	=	
Sum						$\boldsymbol{HAL_{Basic}}$
$\boldsymbol{HAL}$ $(= \mathbf{1.0183} \times \boldsymbol{HAL_{basic}} + \mathbf{298} + \mathbf{0.315} \times \boldsymbol{TP_{AD}})$ (for TP_{AD} see first line in table)						$\boldsymbol{HAL_{CWT}}$

*Measure for activity level: net fresh feed (F), reactor feed (R, includes recycle), product feed (P), Synthesis gas production for POX units (SG)
**Refers to 47 % Hydrogen - the calculation should be done in accordance with point 7 of Annex III to the FAR.

Table 2 Process unit distribution

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
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*	-	-	*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*	-	-	*Additional column taking feed from the bottom of an MVU. Its contribution is included in the generic CWT factor for VAC.*		
Solvent deasphalting	SDA		Fresh feed	2.45		Vacuum or cracked residue	Deasphalted oil (DAO), asphalt

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Conventional solvent Supercritical solvent		CONV SCRT			Separation of the lighter fraction of a vacuum or cracked residue by means of a solvent such as propane, butane or heavier.		
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 from light gases to heavy gasoil, coke or low BTU gas
Delayed coking		DC		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.		

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Fluid coking		FC		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		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	CALCIN		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
Vertical-axis hearth		HRTH					
Horizontal-axis rotary kiln		KILN					
Fluid catalytic cracking	FCC		Fresh feed	5.50	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.
Fluid catalytic cracking		FCC					
Mild residuum catalytic cracking		MRCC					
Residual catalytic cracking		RCC					
Other catalytic cracking			Fresh feed	4.10	Early catalytic cracking processes on fixed catalyst beds.	Vacuum gasoils	
Houdry catalytic cracking		HCC					
Thermofor catalytic cracking		TCC					

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Distillate/gasoil hydrocracking	HYC		Fresh feed	2.85			
Mild hydrocracking Severe hydrocracking		HMD HSD			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. 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 boiling over 350°C that is upgraded to lighter products): ≥20% mass on feed	Vacuum gasoils and cracked heavy distillates, deasphalted oils, hydrogen	Full range of hydrocracked distillates from light gases to gasoil, hydrocracked bottoms
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	

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Desulfurization of C4–C6 feeds		C4C6			Desulfurisation 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			Desulfurisation 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 desulfurisation 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 desulfurisation process in which thiophenes and mercaptans are catalytically reacted with olefins to produce higher-boiling sulfur compounds removable by distillation. Does not involve hydrogen.	FCC gasoline cuts	
S-Zorb™ process		ZORB			Desulfurisation of naphtha/gasoline streams using a proprietary fluid-bed hydrogenation adsorption process in the presence of hydrogen	Various naphthas and gasolines	
Selective H/T of pygas/naphtha		PYGC			Selective or non-selective desulfurisation of pyrolysis gasoline (by-product of light olefins production) and	Pyrolysis gasoline, hydrogen	

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Pygas/naphtha Desulfurisation Selective H/T of pygas/naphtha		PYGD PYGS			other streams over a fixed catalyst bed, at moderate pressure and in the presence of hydrogen.		
Reactor for selective hydrotreating		*RXST*	-	-	*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			Fresh feed	0.90	A number of processes involving treating and upgrading of kerosene and gasoil streams.		
Kerosene hydrotreating	KHYT					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 desulfurisation step which should therefore not be accounted for separately.		
Conventional H/T		CONV/ KUS			Desulfurisation 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.		
Diesel hydrotreating	DHYT						Gasoil blending components, small quantities of naphtha and lighter products
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 desulfurisation step which should therefore not be accounted for separately.	Virgin and cracked gasoils, hydrogen	

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Conventional distillate H/T		CONV			Desulfurisation of virgin and cracked gasoils over a fixed catalyst bed in the presence of hydrogen. CONV, DHS and DUS correspond to different depths of desulfurisation.		
High severity distillate H/T		DHS					
Ultra-high severity distillate H/T		DUS					
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 desulfurisation step which should therefore not be accounted for separately.		
S-Zorb™ process		ZORB			Desulfurisation of gasoil using a proprietary 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	RHYT		Fresh feed	1.55	Desulfurisation 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	Desulfurised residue and relatively small quantities of lighter hydrocarbon liquids and fuel gas
Desulfurisation of atmospheric resid		DAR					
Desulfurisation of vacuum resid		DVR					
VGO Hydrotreating (or cracking feed hydrotreating)	VHYT		Fresh feed	0.90	Desulfurisation 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	Desulfurised vacuum gasoils and relatively small quantities of lighter hydrocarbon liquids and fuel gas
Hydrodesulfurisation/ denitrification		VHDN					
Hydrodesulfurisation		VHDS					

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Hydrogen production	HYG		Product	300.00			Hydrogen, CO2
Gas feeds					Hydrogen production from light hydrocarbons through either steam reforming or partial oxidation. Includes hydrogen purification.	C1 to C4 hydrocarbons	
Steam methane reforming		HSM					
Partial oxidation units of light feeds		POX					
Steam naphtha reforming		HSN			Hydrogen production by steam reforming of naphtha.	Naphtha	
Hydrogen Purification	*H2PURE*		-	-	*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.*		
Cryogenic unit		*CRYO*					
Membrane separation unit		*PRSM*					
Pressure swing absorption unit		*PSA*					
Catalytic reforming (inc. AROMAX)	REF		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 the process. CWT factor includes contribution for special fractionation linked with reforming (naphtha and reformate splitters, DIP etc.) on an average basis.	Desulfurised naphtha	Reformate for gasoline blending or aromatics production, hydrogen
Continuous Regeneration		RCR					
Cyclic		RCY					
Semi-regenerative		RSR					
AROMAX	U60				Special application of catalytic reforming for the specific purpose of producing light aromatics		
Alkylation/ polymerisation/dimersol	ALKY		Product	7.25	A range of processes transforming C3/C4 molecules into C7/C8 molecules over an acidic catalyst.		C6 to C8 high octane gasoline blending components
Alkylation with HF acid		AHF				C3 and C4	

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Alkylation with sulfuric acid		ASA			CWT factor includes contribution for special fractionation linked with such processes and acid regeneration where applicable on an average basis.	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		React or 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 basis.	n-butane, hydrogen	iso-butane
C5/C6 isomerisation	C5ISOM		React or 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 basis.	Light virgin naphtha, hydrogen	Isomerate for gasoline blending
Mol sieve separation	*U18*	*ISOSIV*	-	-	*Contribution included in C5ISOM*		
Oxygenate production			Product	5.60	Production of ethers by reacting an alcohol with olefins		Oxygenates for gasoline blending
MBTE distillation units	MTBE	DIST				Methanol, isobutene	
MTBE extractive units		EXT					

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
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 same unit with very similar associated emissions.	Isobutene	Isooctene
Propylene production Chemical grade Polymer grade	C35	 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
Sulfur recovery	SRU		Product	18.60	Partial oxidation of hydrogen sulphide into elemental sulfur. This CWT function represents the main process (Claus) and the tail gas units for enhanced recovery. It also includes hydrogen sulfide separation from refinery sour gas process streams using amines and amine regeneration.	Refinery sour gas process streams	Sulfur
AROMATICS							

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Aromatics solvent extraction ASE: extraction distillation ASE: liquid/liquid extraction ASE: liquid/liquid extraction, 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*	- - - -	- - - -	*The contribution of all columns and associated equipment 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 mixed xylenes
Paraxylene production Paraxylene adsorption Paraxylene crystallisation	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.*		

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
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	CDWAX		Fresh feed	1.60		Various luboil	Dewaxed

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
isomerisation					Catalytic breakdown of long paraffinic chains in intermediate streams in the manufacture of luboils.	intermediate streams	intermediate luboil streams
Catalytic wax isomerization and dewaxing		ISO					
Selective wax cracking		SWC					
Lube hydrocracker	LHYC	HCM	Fresh feed	2.50	Hydrocracking of heavy feedstocks for the manufacture of luboils	Vacuum g as oils	Full range of hydrocracked products from light gases to gasoil, luboil intermediate streams
Lube hydrocracker with multi-fraction distillation							
Lube hydrocracker with vacuum stripper	LHYFT	HCS					
Lube H/F with vacuum stripper		HFS					
Lube H/T with multi-fraction distillation		HTM					
Lube H/T with vacuum stripper		HTS					
Wax deoiling	WDOIL		Product	12.00	Solvent removal of lighter hydrocarbons from wax obtained from lube dewaxing (SDWAX)	Raw wax	Deoiled wax, light oil
Solvent is chlorocarbon		CHL					
Solvent is MEK/toluene		MEK					
Solvent is MEK/MIBK		MIB					
Solvent is Propane		PRP					
Lube / wax hydrotreating			Fresh feed	1.15	Hydrotreating of luboil fractions and wax for quality improvement	Luboil intermediate streams, wax, hydrogen	Hydrotreated luboil fractions, wax
Lube H/F with vacuum stripper	LHYFT	HFS					
Lube H/T with multi-fraction distillation		HTM					

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Lube H/T with vacuum stripper		HTS					
Wax H/F with vacuum stripper	WHYFT	HFS					
Wax H/T with multi-fraction distillation		HTM					
Wax H/T with vacuum stripper		HTS					
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.
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

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Air separation	U79		Oxygen (MNm^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 byproduct 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
Deethaniser	*DETH*		-	-	*The CWT factor refers to fresh NGL feed, therefore no separate contribution from individual columns*		
Depropaniser	*DPRO*		-	-			
Debutaniser	*DBUT*		-	-			
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.*		
Deethaniser							
Depropaniser							
Deisobutaniser	*DIB*						
Debutaniser							
Deisopentaniser	*DIP*						
Depentaniser							
Deisohexaniser							
Dehexaniser							
Deisoheptaniser							
Deheptaniser							
Naphtha splitter							
Conventional splitter	*CONV*						

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
Splitter with single heartcut	*HC1*						
Splitter with two heartcuts	*HC2*						
Standard column with heartcut draw	*HCD*						
Alkylate splitter							
Conventional splitter	*CONV*						
Splitter with single heartcut	*HC1*						
Splitter with two heartcuts	*HC2*						
Standard column with heartcut draw	*HCD*						
Reformate splitter							
Conventional splitter	*CONV*						
Splitter with single heartcut	*HC1*						
Splitter with two heartcuts	*HC2*						
Standard column with heartcut draw	*HCD*						
Flue gas treatment	U35/U89		(MNm^3/a)	0.10	Desulfurisation 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		Compress or power consump-tion. (kW)	0.15	Treatment and compression of refinery fuel gas for sale to third party.	Refinery fuel gas	Treated refinery fuel gas

Process Unit	Solomon Process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed	Typical product
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 gasworks plant*
CL exposed?	Yes
Associated Schedule 2 activity	Production of coke
Special provisions	PRODCOM 2019 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 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.

As PRODCOM 2019 does not include a respective code for coke-oven coke, PRODCOM 2004 codes are used.

PRODCOM	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)

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,*
- *H_2S/NH_3 incineration,*

- *coal preheating (defreezing),*
- *coke gas extractor,*
- *desulfurization 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 electricity consumed 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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When exporting to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for coke (expressed in UKAs / 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

3 Sintered ore

Benchmark name	Sintered ore
Benchmark number	3
Unit	Tonne of sintered ore
CL exposed?	Yes
Associated Schedule 2 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.*"

Agglomerated iron ore returned to the production process is not to be considered as part of the product.

The reference product is merchant sinter sent to the reduction furnace after leaving the sinter plant. When a significant screening operation is carried out at the – reduction furnace, this amount must be corrected to account for the screening ratio after the bunkers.

The table below shows relevant products according to definitions in PRODCOM 2019 statistics.

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.

PRODCOM	Description
07.10.10.20	Iron ores and concentrates agglomerated (excluding roasted iron pyrites)

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 electricity are excluded from the system boundaries.

Exported 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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In the case of export to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for sintered ore (expressed in UKAs / 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	Hotel metal
Benchmark number	4
Unit	Tonne of hot metal *Liquid iron at the exit point of the blast furnace (for the calculation of HAL)*
CL exposed?	Yes
Associated Schedule 2 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	N/A

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

The table below shows relevant products according to definitions in PRODCOM 2019 statistics.

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.

PRODCOM	Description
24.10.11.00	Pig iron and spiegeleisen in pigs, blocks or other primary forms

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 producing electricity are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In the case of export to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for hot metal (expressed in UKAs / 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
CL exposed?	Yes
Associated Schedule 2 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 the following section on EAF high alloy steel.

Where none of the criteria for the content of the metal alloying elements and the quality for high alloy steel are met, then 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.

The PRODCOM products listed in the table below refer to final products, not to the product after casting, which is further transformed in the downstream process steps. This benchmark therefore 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 (see section 4 Hot metal) and secondary steel (EAF carbon and EAF high alloy steel)

and do not allow differentiating between carbon and high alloy steel.

PRODCOM	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)

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines the system boundaries of the EAF carbon steel product benchmark when referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity':

> "*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.*
>
> *To determine indirect emissions, the total electricity consumption within the system boundaries must be considered.*"

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

To determine indirect emissions from electricity consumption, the total electricity consumption within the system boundaries must be included. These emissions are not eligible for free allocation but are used to calculate free allocation (see below).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a

consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). In the case of export to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)

Em_{direct} direct emissions within the system boundaries of EAF carbon steel production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 EAF carbon steel production 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 relevant system boundaries of EAF carbon steel production over the baseline period, expressed in MWh.

BM_p	benchmark for EAF carbon steel (expressed in UKAs / 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 per year) for product p.
$CLEF_{p,k}$	Carbon leakage exposure factor for product p in year k.

6 EAF high alloy steel

Benchmark name	EAF high alloy steel
Benchmark number	6
Unit	Tonne of crude secondary steel ex-caster
CL exposed?	Yes
Associated Schedule 2 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 alloy steel'. High alloy steel production requires ferro-alloys (ferro-chrome, ferro-nickel and others) as input to introduce the alloy elements to the product. They are introduced to improve the steel characteristics for 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 stringent requirements of'high surface quality' (to guarantee the absence of defects) and 'processability' (for downstream processes) are covered by this product benchmark. EAF steel should be regarded as high-quality steel if at least one of the following criteria is met:

- hydrogen content - max 0.0003%
- sulfur content - max 0.003%
- phosphorus content - max 0.01%
- micro cleanliness:
    - K3 (Oxide) < 40; K4 < 50 according to BS EN 10247:2017 (or an 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 / dm².

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 on an annual basis for all years of the relevant baseline period. If the application of these 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 the average annual values could be considered for each grade separately).

Alternatively, steel could be regarded as high surface quality and processability if, for more than 10% of the production output, one of the following technological non-destructive testing is used:

- 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
    - eddy currents. ASTM E309
    - flux leakage. ASTM E570

When 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) must 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 2019 statistics.

PRODCOM	Description
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)
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)

The PRODCOM products listed in the table above refer to final products, but 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.

Furthermore, the PRODCOM codes for the steel sector do not distinguish between primary steel (see hot metal benchmark section) and secondary steel (EAF carbon and EAF high alloy steel) and does not allow a differentiation between carbon and high alloy steel.

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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 reheating for hot rolling.*
>
> *To determine indirect emissions, the total electricity consumption within the system boundaries must be considered.*"

For crude steel produced via the EAF route, direct CO2 emissions result from fuel, carbon from electrodes, and scrap that is oxidised in the electric arc furnace. In the production of high alloy steels, CO2 emissions stem from ferro-alloys rather than from scrap (scrap grades usually fed into the EAF for this type of production have low carbon content.)

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)

Em_{direct} direct emissions within the system boundaries of EAF high alloy steel production over the baseline period. The direct emissions include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat import from other UK ETS installations and non-UK 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 EAF high alloy steel production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows:

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

With

$Elec\ use$ total electricity consumption within the relevant system boundaries of EAF high alloy steel production over the baseline period, expressed in MWh.

BM_p benchmark for EAF high alloy steel (expressed in UKAs / unit of product).

HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year) for product p.
$CLEF_{p,k}$	Carbon leakage exposure factor for product p in year k.

7 Iron casting

Benchmark name	Iron casting
Benchmark number	7
Unit	Tonne of liquid iron
CL exposed?	Yes
Associated Schedule 2 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, foundries, coating and pickling
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 2019 codes listed in the table below might help to identify processes using the benchmarked intermediate product.

PRODCOM	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

Point 2 of Annex I to the FAR defines the system boundaries of the iron casting product benchmark when referring to the 'definition of product benchmarks and system boundaries with consideration of exchangeability of fuel and electricity': 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.

To determine indirect emissions, only the electricity consumption of melting processes within the system boundaries must 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).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)
Em_{direct}	direct emissions within the system boundaries of casting iron production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK ETS installation, which is consumed within the system boundaries of the iron casting production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other UK ETS installations or non-UK ETS entities.
$Em_{NetHeatImport}$	emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 electricity consumption within the system boundaries of casting iron production 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.
BM_p	benchmark for casting iron (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year) for product p.
$CLEF_{p,k}$	Carbon leakage exposure factor for product p in year k.

8 Pre-bake anode

Benchmark name	Pre-bake anode
Benchmark number	8
Unit	Tonnes of pre-bake anode
CL exposed?	Yes
Associated Schedule 2 activity	Production of primary aluminium
Special provisions	N/A

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.

This product benchmark refers to an intermediate product rather than its end products. There is no PRODCOM code for pre-baked anodes nor any other industry standard or classification number.

Definition and explanation of processes and emissions covered

The FAR define the system boundaries as follows:

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

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

Preliminary allocation

The preliminary free allocation for a product benchmark sub-installation producing pre-baked anodes 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-bake anodes in year k (expressed in UKAs)

BM_p benchmark for pre-bake anode (expressed in UKAs / 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	Tonnes of unwrought non-alloy liquid aluminium Reference point to measure the amount of 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
CL exposed?	Yes
Associated Schedule 2 activity	Production of primary aluminium
Special provisions	N/A

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 2019 statistics. 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.

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

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:

- CO2 emissions resulting from the reaction between the carbon anode oxygen from the alumina

- CO2 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 CO2
- two PFCs, CF_4 and C_2F_6 emissions formed during brief upset conditions known as the "Anode Effect", when aluminia levels drop to a low level 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.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for aluminium (expressed in UKAs / 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	Tonnes of grey cement clinker
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 statistics. 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.

Note that this PRODCOM code also applies to white cement clinker (see the next section).

PRODCOM	Description
23.51.11.00	Cement clinker

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 grey cement clinker production include 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. When this limestone is used, it leads to emissions that have been account as part of

the hot metal benchmark.

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for grey cement clinker (expressed in UKAs / 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	Tonnes of white cement clinker (as 100% clinker)
CL exposed?	Yes
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	N/A

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).*"

The cement clinker must fulfil all of the following quantitative criteria regarding the content of certain substances:

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

The three criteria must 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 on 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 as met if the clinker has a reflection (Ry) 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 it's use as a main

binding component for certain products. As the list of applications above is comprehensive but not exhaustive, and no quantitative thresholds are given, compliance with this criterion should be confirmed by the operator in the monitoring methodology plan associated with the data collection template.

When 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 2019 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.

Note that this PRODCOM code also applies to grey cement clinker (see previous section).

PRODCOM	Description
23.51.11.00	Cement clinker

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. Using this limestone leads to emissions that have been accounted for as part of the hot metal benchmark.

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 in year k (expressed in UKAs)

BM_p benchmark for white cement clinker (expressed in UKAs / 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	Tonnes 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).*
CL exposed?	Yes
Associated Schedule 2 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 purposes other 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 2019 statistics. 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.

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

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

Figure 1 below gives a graphical representation of the system boundaries.

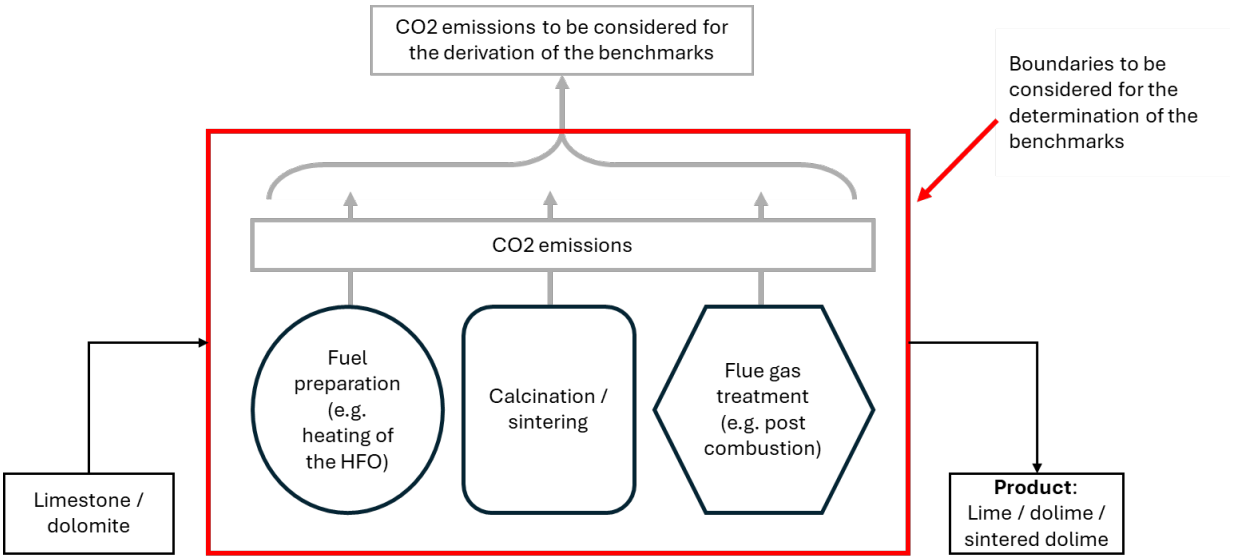

Figure 1 System boundaries (sector rule book for the development of CO2 benchmarks for the lime sector, 2010)

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 UKAs)

BM_p benchmark for lime (expressed in UKAs / 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, therefore, must be corrected for the calcium oxide and magnesium oxide content of the produced lime:

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

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 II(4) to the MRR
2. Conservative estimate not lower than 85% based on other data than composition data determined in accordance with Annex II(4) to the MRR
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 II(4) to the MRRG
2. Conservative estimate not lower than 0.5% based on other data than composition data determined in accordance with Annex II(4) to the MRR

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 British standards such as BS EN 459-2, BS EN 12485 and BS EN ISO12677.

Conservative estimates may be determined by calculating 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:

$$m_{CaO,k} = (A \div (100 - ((A - B \times 56.08 \div 40.31) \times 44.01 \div 56.08 + B \times 88.02 \div 40.31 - F))) \times 100$$

$$m_{MgO,k} = (B \div (100 - ((A - B \times 56.08 \div 40.31) \times 44.01 \div 56.08 + B \times 88.02 \div 40.31 - F))) \times 100$$

With

A: total CaO content in stone (%)

B: total MgO content in stone (%)

F: residual CO2 in burnt lime (%)

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).
CL exposed?	Yes
Associated Schedule 2 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 to 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*
> - *bulk density of the commercial product below 3.05 g/cm³.*
>
> *Dolime must 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 2019 PRODCOM code. The definition covers the benchmarked product dolime, but also the products Ultra low carbon dolime and Sintered dolime (see section 16 Sintered dolime) which have different characteristics and are not covered by this product benchmark.

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

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

Figure 1 in the section on Lime provides a graphical representation of the system boundaries.

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 UKAs)
BM_p	benchmark for dolime (expressed in UKAs / 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 of calcium oxide and magnesium oxide. The historical activity level, therefore, must be corrected for the calcium oxide and magnesium oxide content of the produced dolime:

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

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 dolime produced 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 II(4) to the MRR
2. Conservative estimate not lower than 52% based on other data than composition data determined in accordance with Annex II(4) to the MRR
3. 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 II(4) to the MRR
2. Conservative estimate not lower than 33% based on other data than composition data determined in accordance with Annex II(4) to the MRR
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 Britishstandards such as BS EN 459-2, BS EN 12485 and BS EN ISO12677.

Conservative estimates may be determined by calculating 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 dolime produced in year k of the baseline period expressed in mass-% could be calculated as follows:

$$m_{CaO,k} = (A \div (100 - ((A - B \times 56.08 \div 40.31) \times 44.01 \div 56.08 + B \times 88.02 \div 40.31 - F))) \times 100$$

$$m_{MgO,k} = (B \div (100 - ((A - B \times 56.08 \div 40.31) \times 44.01 \div 56.08 + B \times 88.02 \div 40.31 - F))) \times 100$$

With

A: total CaO content in stone (%)

B: total MgO content in stone (%)

F: residual CO2 in burnt dolime (%)

14 Sintered dolime

Benchmark name	Sintered dolime
Benchmark number	14
Unit	Tonnes of sintered dolime (as saleable product)
CL exposed?	Yes
Associated Schedule 2 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	N/A

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. There is no need for a correction for the CaO and MgO contents of sintered dolime.

The table below shows the relevant PRODCOM 2019 code. 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 definition covers the benchmarked product sintered dolime, but also the products ultra-low carbon dolime and ordinary dolime (see previous section) which have different characteristics and are not covered by this product benchmark.

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

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

Figure 1 in the section on Lime provides a graphical representation of the system boundaries.

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 UKAs)

BM_p benchmark for sintered dolime (expressed in UKAs / 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 (e.g. silica, lime, soda, cullet) into the furnace after subtraction of the volatile gaseous emissions, i.e.CO2, SO2, H20, NO, etc.
CL exposed?	Yes
Associated Schedule 2 activity	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions	N/A

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 2019 statistics. 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 PRODCOM products listed in the table above list refer to final products. However, this benchmark covers all the melted glass exiting the lehr, and not the final products defined by the PRODCOM codes, that are processed from the molten glass in the downstream process steps.

The quantities of molten glass can be calculated either based on the quantity of raw material (e.g. silica, lime, soda, cullet) used in the furnace, after subtraction of the volatile gaseous emissions (e.g., CO2, SO2, H2O, NO), or determined by measuring the glass exiting the lehr.

PRODCOM	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 ≤ 3.5mm
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 ≤ 3.5mm

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.

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 which includes process emissions and associated pollution control equipment (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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for float glass (expressed in UKAs / 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	Tonnes of packed product
CL exposed?	Yes
Associated Schedule 2 activity	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions	N/A

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 without the deliberate addition of colour into the furnace, either by using 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 2019 statistics as shown in the table below. 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.

PRODCOM	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)

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for bottles and jars of colourless glass (expressed in UKAs / 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	Tonnes of packed product
CL exposed?	Yes
Associated Schedule 2 activity	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions	N/A

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 2019 statistics as shown in the table below. 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.

PRODCOM	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)

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for bottles and jars of coloured glass (expressed in UKAs / 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	Tonnes of melted glass exiting the forehearth 'Melted glass exiting the forehearth' should 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. CO2, SO2, H20, NO, etc.
CL exposed?	Yes
Associated Schedule 2 activity	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
Special provisions	N/A

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 2019 statistics.

PRODCOM products 26.14.12.10 and 26.14.12.30 are also covered by the benchmark for mineral wool. Therefore, operators must carefully analyse which product benchmark applies, by considering the different applications of both benchmarked products (the mineral wool benchmarks apply only to products for thermal, acoustic and fire applications, see section 25 Mineral wool).

The PRODCOM products listed in the table below 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.

PRODCOM	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

.

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 withprocess CO_2 emissions resulting from the decarbonatisation of the glass mineral raw materials during the melting process.*
>
> *Downstream processes to convert the fibres into saleable 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 2 provides 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.

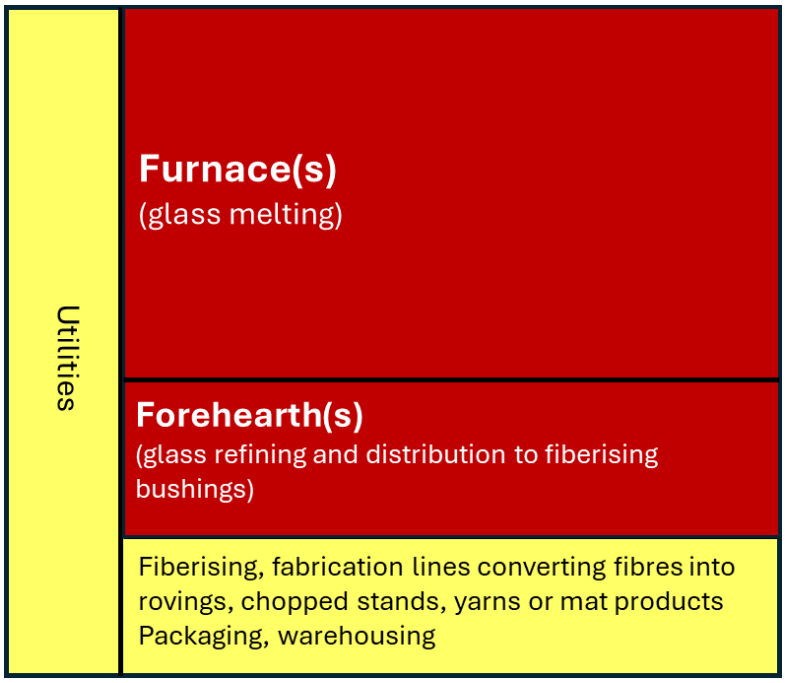

Figure 2 System boundaries - processes within the system boundaries are depicted red

This product benchmark includes the following emissions in particular:

- direct CO2 emissions associated with fossil fuel combustion in the process steps:
  - glass melting in the furnaces
  - glass refining and distribution through the forehearths to the fiberising bushings
- process CO2 emissions resulting from the decarbonation of the glass mineral raw materials used during the melting process.

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 in year k (expressed in UKAs)

BM_p benchmark for continuous filament glass fibre products (expressed in UKAs / 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	Tonnes of facing bricks
CL exposed?	Yes
Associated Schedule 2 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	N/A

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.*"

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

The table below shows relevant products according to definitions in PRODCOM 2019 statistics. 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.

Note that this PRODCOM code also includes products such as clay blocks that are not covered by the definition of the benchmarked product.

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

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 electricity production 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.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for facing bricks (expressed in UKAs / 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	Tonnes of pavers as (net) saleable product
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 statistics. 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 PRODCOM product also covers roof tiles which are covered by as separate benchmark (see next section).

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

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for pavers (expressed in UKAs / 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	Tonnes of roof tiles (saleable production)
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 statistics. As a general guideline, the identification of the products should never solely rely on PRODCOM codes reported in statistics.

Accessories defined by PRODCOM 2019 code 23.32.12.70 should be excluded.

PRODCOM	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)

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for roof tiles (expressed in UKAs / 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	Tonnes of powder produced
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 code is 23.31.10.00) 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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for spray dried powder (expressed in UKAs / 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	Tonnes of mineral wool (saleable product)
CL exposed?	Yes
Associated Schedule 2 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 and, in the case of 23.99.19.10, the 2019 statistics. 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.

PRODCOM 2010 products 23.14.12.10 and 23.14.12.30 could also be covered by the benchmark for continuous filament glass fibre products (see section 20). Therefore, operators must carefully analyse which product benchmark applies, by considering the different applications of both benchmarked products (the mineral wool benchmarks apply only to products for thermal, acoustic and fire applications).

PRODCOM	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

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines the system boundaries of the mineral wool product benchmark as follows::

"*All processes directly or indirectly linked to the production steps*

- *melting*
- *fiberising 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 must be considered."

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)
Em_{direct}	direct emissions within the system boundaries of mineral wool production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 mineral wool production over the baseline period. Irrespective of where and how the electricity is produced, these emissions, expressed in tonne CO2, are calculated as follows:

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

With

$Elec\ use$ total electricity consumed within the system boundaries of mineral wool production over the baseline period, expressed in MWh

BM_p benchmark for mineral wool (expressed in UKAs / 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 per year).

$CLEF_{p,k}$ carbon leakage exposure factor for product p in year k.

24 Plaster

Benchmark name	Plaster
Benchmark number	24
Unit	Tonnes of stucco (saleable production) Stucco, also known as 'Plaster of Paris', is hemi-hydrate plaster ($CaSO_4.1/2H_2O$) produced by heating ('calcining') raw gypsum at 150°C to 165°C thereby removing three-quarters of the chemically combined water.
CL exposed?	Yes
Associated Schedule 2 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 20MW are operated
Special provisions	N/A

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 section).

The table below shows relevant products according to definitions in PRODCOM 2019 statistics. 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 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	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

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 section), except board drying. The production of the intermediate product dried secondary gypsum (see section dried secondary gypsum) is not covered by the plaster benchmark.

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for plaster (expressed in UKAs / 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	Tonnes of dry secondary gypsum product
CL exposed?	Yes
Associated Schedule 2 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 20MW are operated
Special provisions	N/A

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.*"

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

- secondary gypsum: a by-product of flue gas desulfurisation 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 the relevant product according to the definition in PRODCOM 2019 statistics. 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.

This definition also covers plaster (see previous section).

PRODCOM	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)

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 dried secondary gypsum in year k (expressed in UKAs)

BM_p benchmark for dried secondary gypsum (expressed in UKAs / 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	Tonnes of stucco (saleable production) Stucco also known as 'Plaster of Paris' is hemi-hydrate plaster ($CaSO_4.1$ / $2H_2O$) produced by heating ('calcining') raw gypsum at 150°C to 165°C thereby removing three-quarters of the chemically combined water.
CL exposed?	No
Associated Schedule 2 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 products based on plaster. The benchmark covers both faced and non-faced products, as well as 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 2019 statistics. 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.

PRODCOM	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 agglomerated 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 agglomerated with plaster, ornamented

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

Point 2 of Annex I to the FAR defines 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 must 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 also covers board drying as an additional production step.

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)
Em_{direct}	direct emissions within the system boundaries of plasterboard production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK ETS installation, which 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat import from other UK ETS installations and non-UK 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 CO2 are calculated as follows:

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

With

$Elec\ use$ total electricity consumed by heat pumps applied in the drying stage over the baseline period, expressed in MWh

BM_p benchmark for plasterboard (expressed in UKAs / unit of product).

HAL_p historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).

$CLEF_{p,k}$ carbon leakage exposure factor for product p in year k.

27 Short fibre kraft pulp

Benchmark name	Short fibre kraft pulp
Benchmark number	27
Unit	Net saleable production in air dried metric tonnes (ADMt) The production is defined as the net saleable production of ADMt measured at the end of the production process. When pulp is produced, production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. ADMt of pulp meaning dry solids content of 90%.
CL exposed?	Yes
Associated Schedule 2 activity	Production of pulp from timber or other fibrous materials.
Special provisions	Special provision on allocation to integrated pulp & paper plants: activity levels only account for 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 production process. Air dry metric tonne of pulp meaning dry solids content of 90%.*"

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

Using air-dried metric tonnes accounts for the fact that moisture content differs between installations, and to ensure a common comparable reference is used. An installation will typically have a dry solid content measure and can calculate a 90% value in the following way: if for example the dry solid content is 92.8% and 1000t of pulp is produced, the atro (i.e., completely dry) production will be 928t. This can then be divided by 90% to obtain the amount of 90% dry mass, which will in this case be 1031t.

The table below shows relevant products according to definitions in PRODCOM 2019 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 statistic.

The listed PRODCOM code also covers the long fibre kraft pulp benchmark (see following section).

PRODCOM	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 (Article 16(6) of the FAR). This also applies to heat recovered from any pulp benchmark other than recovered paper pulp.

Example: if a pulp mill produces 100 tonnes of pulp and only 1 ADMt is sold on the market, then only 1 ADMt is eligible for free allocation under this benchmark. Note that this rule does not have any impact on the eligibility of the heat recovered and used or paper produced downstream.

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for short fibre kraft pulp (expressed in UKAs / 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 air dried metric tonnes (ADMt). The production is defined as the net saleable production of ADMt measured at the end of the production process. When pulp is produced, production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. ADMt of pulp meaning dry solids content of 90%
CL exposed?	Yes
Associated Schedule 2 activity	Production of pulp from timber or other fibrous materials
Special provisions	Special provision on allocation to integrated pulp & paper plant: activity levels only take 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 previous section). For more information on how to calculate air dried metric tonnes, see previous section.

The tables below shows relevant products according to definitions in PRODCOM 2019 statistics. This code also covers short fibre kraft pulp (see previous section).

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	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 (Article16(6) of the FAR). 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 ADMtair dried metric tonne is sold on the market, only 1 ADMt is eligible for free allocation under this benchmark. Note that this rule does not have any impact on the eligibility of the heat recovered and used or paper produced downstream.

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 electricity production 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 to ensure no double allocation occurs. Operators must check the products they produce, accounting for the characteristics of the product, the composition of product mixes and/ or the fields of application against the definition of the product benchmark.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for long fibre kraft pulp (expressed in UKAs / 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 air dried metric tonnes (ADMt). The production is defined as the net saleable production in air dried metric tonnes (ADMt) measured at the end of the production process. When pulp is produced, the production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. ADMt of pulp meaning dry solids content of 90%
CL exposed?	Yes
Associated Schedule 2 activity	Production of pulp from timber or other fibrous materials
Special provisions	Special provision on allocation to integrated pulp and paper plants: activity levels only account for pulp 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 – chemithermomechanical pulp and dissolving pulp.*"

For more information on how to calculate air dried metric tonnes, see short fibre kraft pulp section.

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 and will receive allocation based on fall-back approaches:

- semichemical pulp
- chemithermomechanical pulp (CTMP)
- dissolving pulp.

The table below shows relevant products according to definitions in PRODCOM 2019 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	Description
17.11.13.00	Chemical wood pulp, sulphite, other than dissolving grades
PRODCOM code partially covered by PB 29 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 next section).

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 (Article 16(6) of the FAR). 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 ADMtair dried metric tonne is sold on the market, then only 1 ADt is eligible for free allocation under this benchmark. Note that this rule does not have any impact on the eligibility of the heat recovered and used or paper produced downstream.

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for sulphite pulp, thermo-mechanical and mechanical pulp (expressed in UKAs / 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 air dried metric tonnes (ADMt). The production is defined as the net saleable production in ADMt measured at the end of the production process. ADMt of pulp meaning dry solids content of 90% When pulp is produced, the production is defined as the total pulp produced including both pulp for internal delivery to a paper mill and market pulp. The recovered paper pulp produced will predominantly be transported from the pulper to the paper machine in the form of a slurry. It must be calculated back to ADMt. The production amount can be defined by either: • measuring the amount of pulp from the pulper (if meters in place) • by calculation from the recovered paper input minus impurities removed, or • from a full mass balance
CL exposed?	Yes
Associated Schedule 2 activity	Production of pulp from timber or other fibrous materials
Special provisions	N/A

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."*

For more information on how to calculate air dried metric tonnes, see see short fibre kraft pulp section.

The table below shows relevant products according to definitions in PRODCOM 2019 statistics.

PRODCOM 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.

PRODCOM code partially covered by PB 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 previous section).

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to

'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for recovered paper pulp (expressed in UKAs / 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 air dried metric tonnes (ADMt). The production is defined as the net saleable production of air dried metric tonnes (ADMt) measured at the end of the production process. ADMt of paper is defined as paper with 6% moisture content.
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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."*

For more information on how to calculate air dried tonnes, see short fibre kraft pulp section.

The paper is used for printing newspapers and is produced from groundwood and/or mechanical pulp or recycled fibres or any percentage of combinations of the 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 2019 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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.

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 UKAs)

BM_p benchmark for newsprint (expressed in UKAs / 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

32 Uncoated fine paper

Benchmark name	Uncoated fine paper
Benchmark number	32
Unit	Net saleable production in air dried metric tonnes (ADMt). ADMtof paper is defined as paper with 6% moisture content.
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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.*"

For more information on how to calculate air dried tonnes, see short fibre kraft pulp section.

The tables below show relevant products according to definitions in PRODCOM 2019 and PRODCOM 2010 (for 17.12.12.00) 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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

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 UKAs)

BM_p benchmark for uncoated fine paper (expressed in UKAs / 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

33 Coated fine paper

Benchmark name	Coated fine paper
Benchmark number	33
Unit	Net saleable production in air dried metric tonnes (ADMt) ADMt of paper is defined as paper with 6% moisture content
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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.*"

For more information on how to calculate ADMt, see short fibre kraft pulp section.

More specifically coated fine paper covers:

- 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.
- 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 2019 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	Description
17.12.73.36	Coated bases for paper and paperboard of a kind used for: photo-, heat- and electro-sensitive paper and having 10 % or less of mechanical and chemi-mechanical fibres, and paper and paperboard of a kind used for writing, printing or other graphic purposes, which weighs less than or equal to 150g/m2
17.12.73.37	Coated paper, for writing, printing, graphic purposes (excluding coated base, weight <= 150g/m²)
17.12.73.60	Lightweight 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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for coated fine paper (expressed in UKAs / 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

34 Tissue

Benchmark name	Tissue
Benchmark number	34
Unit	Net saleable production of parent reel in air dried metric tonnes (ADMt) ADMt of paper is defined as paper with 6% moisture content
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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.*"

For more information on how to calculate ADMt, see short fibre kraft pulp section.

Not all production process steps in the manufacturing of each product are included within the benchmark (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 2019 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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.

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 UKAs)

BM_p benchmark for tissue (expressed in UKAs / 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

35 Testliner and fluting

Benchmark name	Testliner and fluting
Benchmark number	35
Unit	Net saleable production in air dried metric tonne (ADMt) Air dried metric tonne of paper is defined as paper with 6% moisture content.
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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 fibres obtained from recycled fibres.

Kraftliner is included in product benchmark Uncoated carton board (section 36).

For more information on how to calculate air dried tonnes, see short fibre kraft pulp section.

The tables below show relevant products according to definitions in PRODCOM 2019 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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.

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 UKAs)

BM_p benchmark for testliner and fluting (expressed in UKAs / 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

36 Uncoated carton board

Benchmark name	Uncoated carton board
Benchmark number	36
Unit	Net saleable production in air dried metric tonnes (ADMt). Air dry metric tonne of paper is defined as paper with 6% moisture content.
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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.*"

For more information on how to calculate air dried tonnes, see short fibre kraft pulp section.

The tables below show relevant products according to definitions in PRODCOM 2019 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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.

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 UKAs)

BM_p benchmark for uncoated carton board (expressed in UKAs / 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

37 Coated carton board

Benchmark name	Coated carton board
Benchmark number	37
Unit	Air dried metric tonnes (ADMt) The production 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
CL exposed?	Yes
Associated Schedule 2 activity	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
Special provisions	N/A

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.*"

For more information on how to calculate air dried tonnes, see short fibre kraft pulp section.

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 2019 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	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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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.

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 UKAs)

BM_p benchmark for coated carton board (expressed in UKAs / 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

38 Carbon black

Benchmark name	Carbon black
Benchmark number	38
Unit	Tonnes of furnace carbon black (saleable unit, purity >96%)
CL exposed?	Yes
Associated Schedule 2 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 3 below show key characteristics of carbon blacks and primary particle diameters, respectively. These characteristics should be used to determine if the carbon black product benchmark applies.

The table below shows relevant products according to definitions in PRODCOM 2019 statistics. 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 PRODCOM 2019 product does not only cover the benchmarked product but also gas- and lamp black.

PRODCOM	Description
20.13.21.30	Carbon (carbon blacks and other forms of carbon, n.e.c.)

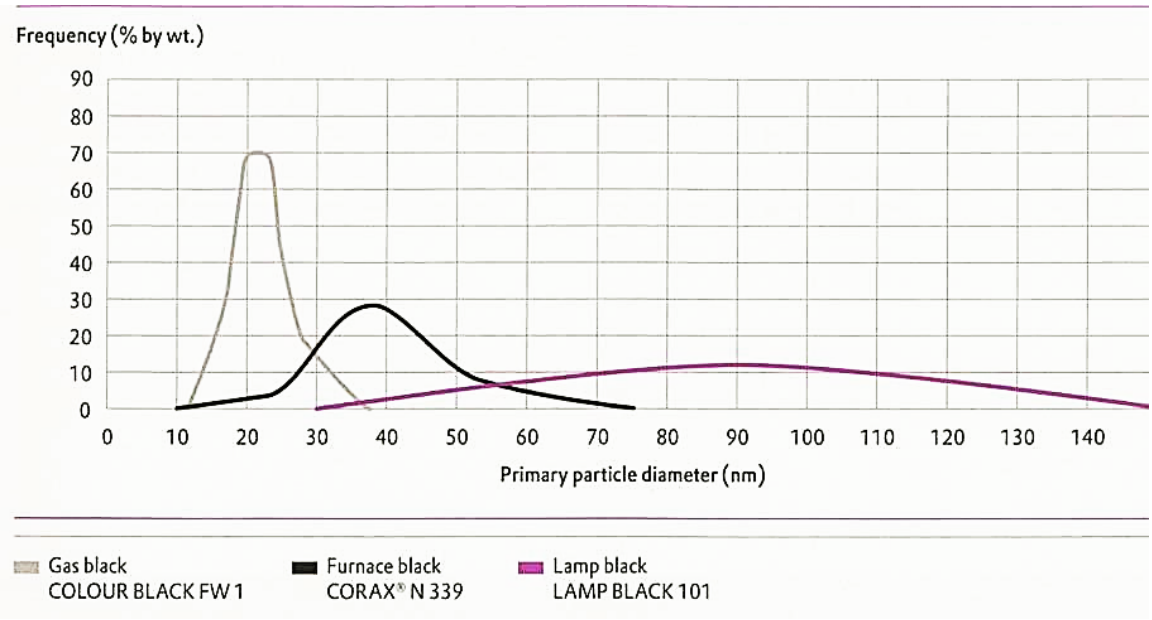

Figure 3

Primary particle diameters of carbon blacks[2]

		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

Table 3 Characteristics of carbon blacks (**Carbon black for the purpose of the product benchmark corresponds to furnace black**)

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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.*

[2] Figure referenced from Guidance Document no.9 on the harmonised free allocation methodology for the EU ETS post 2020

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

Exchangeability factor should be calculated considering electricity driven devices like pumps and compressors with a rated power of 2 MW or more."

The following emissions are included:

- CO2 emissions due to the combustion of the tail gas. An oxidation factor of 100% is assumed for tail gas combustion. Emissions due to flaring of tail gas from the furnace black production are also included in the system boundaries
- CO2 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 return.

To determine indirect emissions from electricity consumption, the total electricity consumption within the system boundaries refers to the total electricity consumption which is exchangeable with heat, particularly electricity-driven devices like large pumps, compressors, etc. that could be replaced by steam-driven units. These emissions are not eligible for free allocation but are used to calculate free allocation (see below).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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

- emissions from the combusted flared gas
- emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    - the fuels necessary to keep a pilot flame running
    - 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. 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 UKAs / year)

Em_{direct} direct emissions within the system boundaries of carbon black production over the baseline period. The direct emissions include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat import from other UK ETS installations and non-UK 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 consumed 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 CO2, 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 carbon black production over the baseline period, expressed in MWh

BM_p benchmark for carbon black (expressed in UKAs / unit of product).

HAL_p historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).

$CLEF_{p,k}$ applicable carbon leakage exposure factor for product p in year k.

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 to determine the historical activity level
CL exposed?	Yes
Associated Schedule 2 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 2019 statistics. 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 PRODCOM product only matches with the definition of the benchmarked product insofar as it covers nitric acid.

PRODCOM	Description
20.15.10.50	Nitric acid; sulphonitric acids

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.*"

Ammonia production, as well as electricity production, are excluded from the system boundaries. No additional allocation must be granted for exporting or using heat stemming from 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 UKAs)

BM_p benchmark for nitric acid (expressed in UKAs / 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 arises when a sub-installation receives measurable heat from sub-installations producing nitric acid.[3] In such cases, the preliminary allocation for the heat receiving sub-installation needs to be reduced by:

$$Reduction\ in\ preliminary\ allocation = BM_h \times HAL_{H,HeatFromNitricAcid}$$

With:

BM_h heat benchmark (expressed in UKAs / TJ)

$HAL_{H,HeatFromNitricAcid}$ annual historical import from a sub-installation producing nitric acid during the baseline period.

[3] Article16(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 must 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	Tonnes of dry purified adipic acid stored in silos or packed in (big) bags
CL exposed?	Yes
Associated Schedule 2 activity	Production of adipic acid
Special provisions	N/A

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 suitable for all typical applications, such as monomer for nylon production, raw material for the production of polyester polyols, food industry, lubricants, or plasticisers.

The table below shows the relevant product according to the definition in PRODCOM 2019 statistics. 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.

Note that the PRODCOM code includes the salts and esters of adipic acid which are not covered by the product benchmark.

PRODCOM	Description
20.14.33.85	Adipic acid; its salts and esters

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.*"

This means that the following emissions are covered:

- CO2 & N2O emissions direct from assets:
    - adipic acid manufacturing unit
    - N2O abatement unit.
- CO2 emissions from direct energy fuels used for N2O abatement unit
- CO2 emissions from indirect CO2:
    - net steam production (steam consumption minus steam recovery) for adipic acid manufacturing and N2O abatement unit.
- CO2 emissions from processing and handling of the side products glutaric acid and succinic acid.

Emissions related to electricity production 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.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to ‘UKETS15 FAR - Cross-boundary heat flows’.

Based on the defined scope above, Figure 4 illustrates which emissions (highlighted in yellow) are covered by the adipic acid benchmark. Descriptions of the emissions are provided in the text below the figure.

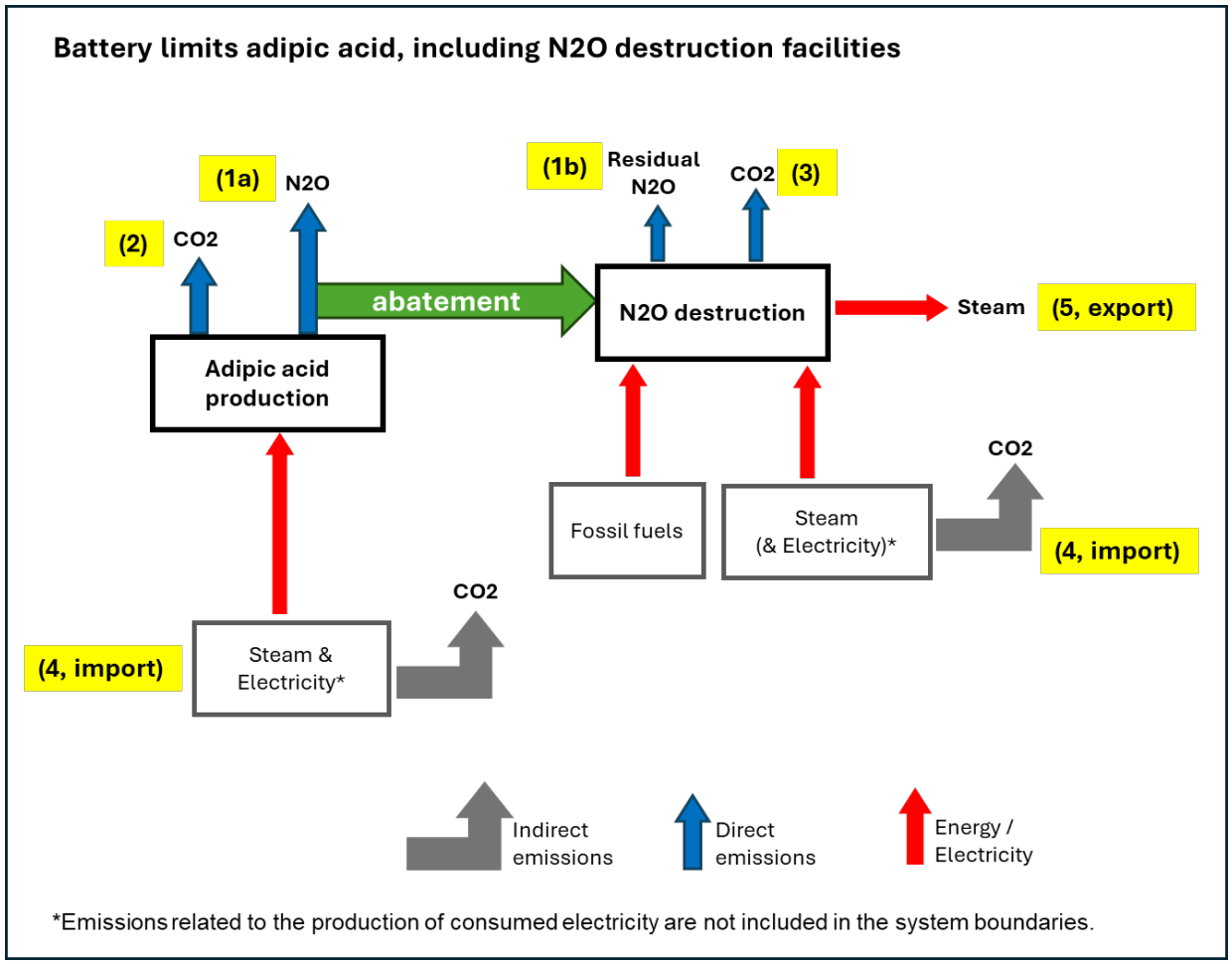

Figure 4 Emissions covered by the product benchmark for adipic acid

with:

(1a) direct N2O emissions when adipic acid waste gas stream is not connected to the N2O abatement unit (classically calculated from chemical N2Oemission factor x Adipic acid produced during this time, with 1 N2O = 310 CO2eq)

(1b) direct N2O emissions after abatement (classically N2O residual concentration is measured, with 1 N2O = 310 CO2eq)

(2) direct CO2 emissions from adipic acid synthesis. In this box all unit operations of the adipic acid plant are:

- oxidation reaction and offgas treatment
- crude grade adipic acid crystallisation and separation
- adipic acid re-crystallisation(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 CO2 emissions from fuels used in the N2O abatement unit (specific emission factor x quantity of fuel)

(4) indirect CO2 emissions 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 UKAs)

BM_p benchmark for adipic acid (expressed in UKAs / 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	Tonnes of ammonia produced as saleable (net) production and 100% purity.
CL exposed?	Yes
Associated Schedule 2 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 2019 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	Description
20.15.10.75	Anhydrous ammonia

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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 must be considered."*

The system boundary of an ammonia installation is defined as all activities falling 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 within the system boundaries and are not eligible for free allocation but are used to calculate free allocation (see below). To determine the indirect emissions, the total electricity consumption within the system boundaries must be considered.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to ‘UKETS15 FAR - Cross-boundary heat flows’.

Figure 5 below shows the energy inputs and emissions associated with ammonia production. The production process leads to direct CO2 emissions and to CO2 that is used as feedstock in chemical production processes. Both emissions are included in the system boundaries. CO2 emissions due to steam production are included in the system boundaries. The emissions related to electricity production and consumption are not eligible for free allocation

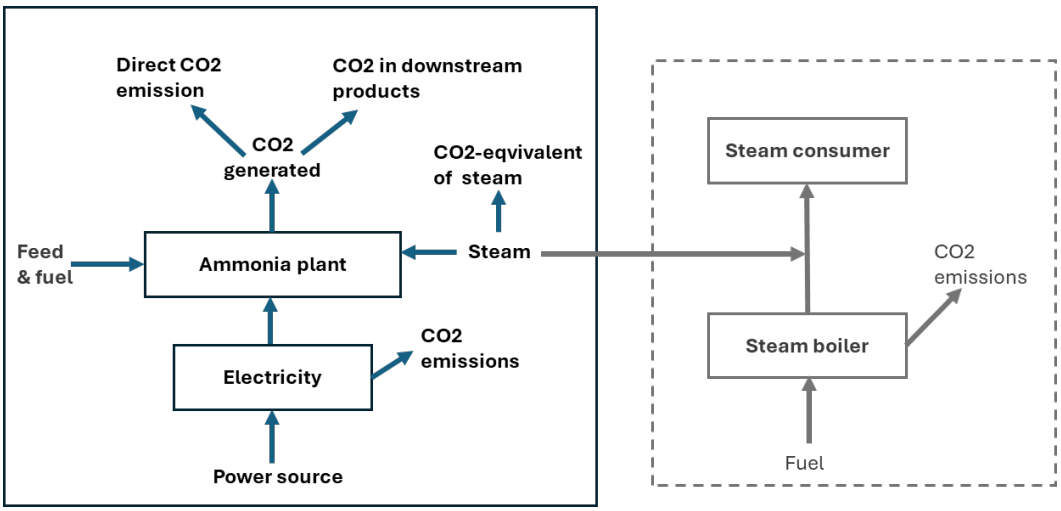

Figure 5 Energy inputs and emissions related to ammonia production.
The emissions related to electricity production and consumption are not eligible for free allocation

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. 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 UKAs / year)
Em_{direct}	direct emissions within the system boundaries of ammonia production over the baseline period. The direct emissions further include emissions due to heat production within the same UK ETS installation, that is consumed within the system boundaries of the amonia production process. Direct emissions should (by definition) exclude any emissions from electricity generation or net heat export/import from other UK ETS installations or non-UK ETS entities.
$Em_{NetHeatImport}$	emissions from any net measurable heat import from other UK ETS installations and non-UK 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 ammonia production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows: $$Em_{indirect} = Elec\ use \times 0.376$$ With $Elec\ use$ total electricity consumption within the system boundaries of ammonia production over the baseline period, expressed in MWh
BM_p	benchmark for ammonia (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

42 Steam cracking (high value chemicals)

Benchmark name	Steam cracking
Benchmark number	42
Unit	Tonnes of acetylene, ethylene, propylene, butadiene, benzene and hydrogen
CL exposed?	Yes
Associated Schedule 2 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."*

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 CH4).

A product mix of these chemicals only matches the definition of this product benchmark if both of the following conditions are fulfilled:

- the ethylene content is at least 30 mass - percent of the total product mix,[4] and

[4] This refers to the total HVC.

- the product mix has a content of HVC, fuel gas, butenes, and liquid hydrocarbons which together make at least 50 mass - percent of the total product mix.

The benchmark excludes HVC from supplemental feed (hydrogen, ethylene, other HVC) that receive allocation based on specific emission factors (see calculation of the preliminary allocation below).

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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 must 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 the equipment necessary to produce the HVC as a purified product or intermediate product with concentrated content of the respective HVC in its 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

Furthermore, any utility which carries out processes directly or indirectly linked to HVC production must be considered as included within the system boundaries of the product

benchmark. This includes demineralised water, cooling water, instrument air, caustic regeneration, as well as pre-treatment of gaseous feedstocks. Similarly, all associated emissions must be attributed to the product benchmark sub-installation

The following processes are excluded:

- C4 extraction (butadiene plant)
- C4-hydrogenation
- hydrotreating of pyrolysis gasoline & aromatics extraction
- logistics/storage for daily operation.

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

Figure 6 provides a graphical representation of the processes covered.

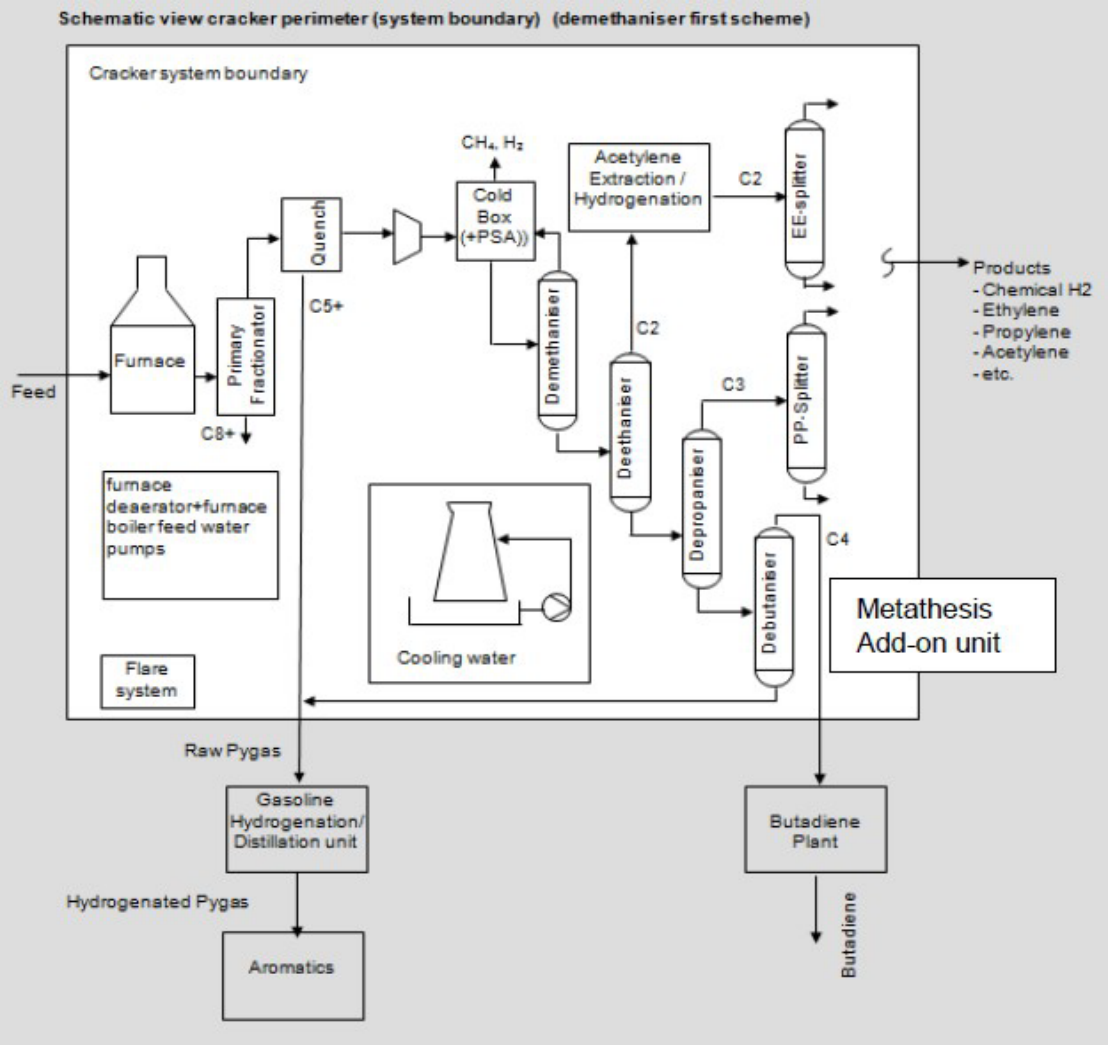

Figure 6 System boundaries of steam cracking benchmark[5]

[5] Figure sourced from Guidance Document no.9 on the harmonised free allocation methodology for the EU ETS post 2020

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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

- emissions from the combusted flared gas
- emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    - the fuels necessary to keep a pilot flame running
    - 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. 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.

The preliminary allocation for steam cracking should be determined by using the following specific formula:

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

$$\times arithmetic\ mean\left(HAL_{HVC,total,k} - HSF_{H,k} - HSF_{E,k} - HSF_{O,k}\right)$$

$$+ 1.78 \times arithmetic\ mean\left(HSF_{H,k}\right) + 0.24 \times arithmetic\ mean\left(HSF_{E,k}\right)$$

$$+ 0.16 \times arithmetic\ mean\left(HSF_{O,k}\right) \times CLEF_{p,k}$$

With:

$F_{p,k}$ annual preliminary allocation for a product benchmark sub-installation performing the process of steam cracking in year k (expressed in UKAs).

Em_{direct} direct emissions within the system boundaries of steam cracking over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 CO2 are calculated as follows:

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

with

$Elec\ use$ total electricity consumed within the system boundaries of steam cracking over the baseline period, expressed in MWh.

BM_p benchmark for steam cracking (expressed in UKAs / unit of product).

$HAL_{HVC,total,k}$ 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.

$CLEF_{p,k}$ applicable carbon leakage exposure factor for product p in year k.

43 Aromatics

Benchmark name	Aromatics
Benchmark number	43
Unit	CO2 weighted tonne (CWT)
CL exposed?	Yes
Associated Schedule 2 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 to the FAR

Definition and explanation of products covered

According to the FAR this product benchmark covers:

"Mix of aromatics expressed as CO2 weighted tonne (CWT)"

The table below shows relevant products according to definitions in PRODCOM 2019 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.

Note that further PRODCOM coded products might be covered by this benchmark.

PRODCOM	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	Other cyclic hydrocarbons
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)

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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 must be considered."

Indirect emissions from electricity consumption are not eligible for free allocation but are used in the calculation of free allocation (see below).

Measurable heat exported (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 a UK ETS consumer, or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

Processes defined by the CWT methodology only receive allocation according to this approach if they are part of the aromatics benchmark sub-installation. When such processes occur outside those boundaries, the majority should receive allocation based on fall-back approaches, although some can be covered by other product benchmarks e.g. refinery or hydrogen.

Emissions related to safety flaring and other flaring of gases associated with the production of aromatics are included:

- emissions from the combusted flared gas
- emissions from tcombusted fuels necessary to operate a flare, which are of two types:
  - the fuels necessary to keep a pilot flame running
  - 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. 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 UKAs / year)

Em_{direct} direct emissions within the system boundaries of aromatics production over the baseline period. The direct emissions further include emissions due to heat production within the same UK ETS installation, that 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 aromatics production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows:

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

With

$Elec\ use$	total electricity consumption within the system boundaries of aromatics production over the baseline period, expressed in MWh
BM_p	benchmark for aromatics (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

Determination of historical activity level

The concept of CO2 weighted tonne (CWT) is used to determine 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 the Refinery products section). To ensure a level playing field when aromatics are produced 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:

$$HAL_{CWT} = arithmetic\ mean\ (\sum_{i=1}^{n}(TP_{i,k} - CWT_i))$$

With:

$TP_{i,k}$	HAL of process unit i in year k as defined in the CWT approach
CWT_i	CWT factor for process unit i as defined in the CWT approach (see Table 4 below).

Table 4 below provides the calculation process of the HAL for a certain year, with the yellow cells requiring data input. 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 HAL will therefore be zero.

The appropriate measures of activity for a CWT function are shown in Table 4 and Table 5. Measures include the annual mass (expressed in kt/year) of net fresh feed (F), or product feed (P). Fresh feed is defined 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 began operating during the year, or a unit was idle during part of the year). Figures must be generated from actual flow measurements and/or material balance records.

Accuracy

To meet the desired accuracy for CWT, throughputs must be entered in kt/a with the required number of decimals for data reporting 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 is required for parameters used to calculate direct and indirect emissions of the (sub)installation:

- steam flows: ±5%
- electricity production: ±5%
- steam conditions: for steam enthalpies an accuracy of ± 0.1 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 activity level			CWT factor		CWT (kt in year k)
	Basis*	(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	
Desulfurisation of C4–C6 Feeds		C4C6			Desulfurisation 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			Desulfurisation 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 desulfurisation 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 desulfurisation process in which thiophenes and mercaptans are catalytically reacted with olefins to produce higher-boiling sulfur compounds removable by distillation. Does not involve hydrogen.	FCC gasoline cuts	

Process Unit	Solomon process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
S-Zorb™ Process		ZORB			Desulfurisation 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 desulfurisation Selective H/T of pygas / naphtha		PYGC PYGD PYGS			Selective or non-selective desulfurisation 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*		
Aromatics solvent extraction (ASE) ASE: Extraction distillation ASE: Liquid/Liquid extraction ASE: Liquid/Liquid with extraction 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 equipment required to purify individual aromatics is included in ASE.*		

Process Unit	Solomon process ID	Solomon Process Type	Activity basis	CWT factor	Description	Typical feed(s)	Typical product(s)
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 to convert 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	PXYL		Product	6.40	Physical separation of para-xylene from mixed xylenes.	Paraxylene-rich mixed xylenes	Paraxylene, other mixed xylenes
Paraxylene adsorption		ADS					
Paraxylene crystallisation		CRY					
Xylene splitter		*XYLS*			*The contribution of these columns and associated equipment is included in PXYL.*		
Orthoxylene rerun column		*OXYLRC*					
Cumene production	CUM		Product	5.00	Alkylation of benzene with propylene	Benzene, propylene	Cumene

44 Styrene

Benchmark name	Styrene
Benchmark number	44
Unit	Tonnes of styrene (saleable product)
CL exposed?	Yes
Associated Schedule 2 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 2019 statistics. 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.

PRODCOM	Description
20.14.12.50	Styrene

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines 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 must be considered."

Installation boundaries include ethylbenzene and styrene production, and all the related equipment needed to produce these materials, such as raw material purification, product purification, wastewater 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 accounted for, 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, operators must split emissions 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 ethylbenzene (EB) recycle stream is included), 100% of the energy consumption related to the SM sections (including EB recovery, methylbenzyl alcohol (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 should be attributed to the styrene benchmark as appropriate. For instance, if a wastewater facility treats 30% wastewater from styrene production and 70% wastewater from other facilities on the same site, then 30% of the direct emissions for the wastewater facility are covered by styrene production.

To determine indirect emissions, total electricity consumption within the system boundaries is exchangeable with heat, for example, heat pumps used in the distillation section. These emissions are not eligible for free allocation but are used to calculate free allocation (see below).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to

'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)

Em_{direct} direct emissions within the system boundaries of styrene production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 styrene production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonnes CO2 are calculated as follows:

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

With

$Elec\ use$ total electricity consumed within the system boundaries of the styrene production over the baseline period, expressed in MWh

BM_p benchmark for styrene (expressed in UKAs / unit of product).

HAL_p historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).

$CLEF_{p,k}$ applicable carbon leakage exposure factor for product p in year k.

45 Phenol/acetone

Benchmark name	Phenol/acetone
Benchmark number	45
Unit	Tonnes of phenol, acetone and the byproduct alphamethyl styrene (saleable product, 100% purity)
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 PRODCOM code listed in the table below. The production of phenol salts is not covered by this benchmark. 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.

PRODCOM	Description
20.14.24.10	Monophenols
20.14.62.11	Acetone

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 [alpha-methylstyrene] recovery for export*
- *AMS hydrogenation for ISB [inside system boundaries] recycle*
- *Initial wastewater purification (1st wastewater stripper)*
- *Cooling water generation (e.g., cooling towers)*
- *Cooling water utilisation (circulation pumps)*
- *Flare & incinerators (even if physically located OSB [outside system boundaries]) as well as*
- *Any support fuel consumption."*

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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

- emissions from the combusted flared gas
- emissions from the combustion of fuels necessary to operate a flare, which are of two types:
  - the fuels necessary to keep a pilot flame running
  - 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 UKAs)

BM_p benchmark for phenol/acetone (expressed in UKAs / 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	Tonnes of Ethylene oxide-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.
CL exposed?	Yes
Associated Schedule 2 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 to 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 + fibre 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, it is possible to find product ratios ranging from "EO-only" to "EG-only".

The table below shows relevant products according to definitions in PRODCOM 2019 statistics. 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.

Other polyether alcohols covered by PRODCOM 20.16.40.15 are not covered by this benchmark.

PRODCOM	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

Definition and explanation of processes and emissions covered

Point 2 of Annex I to the FAR defines the system boundaries of the ethylene oxide EO/ 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.*"

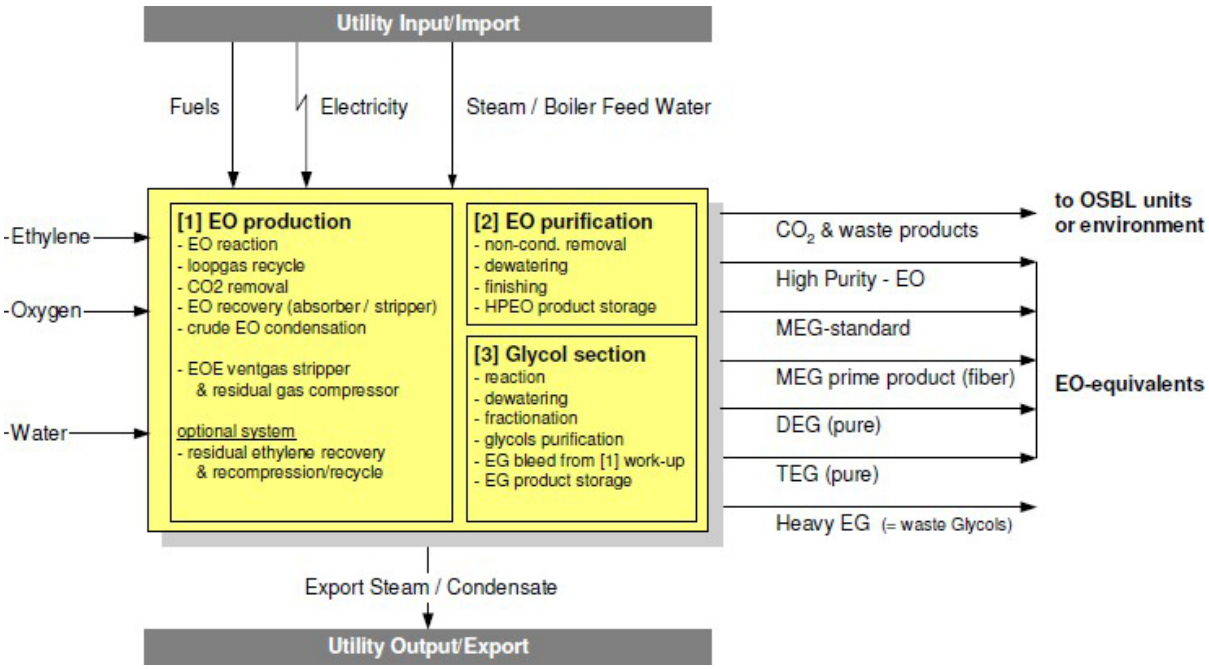

Figure 7 Inputs and outputs of EO and EG units that are covered by the benchmark[6]

The following process systems are included in the perimeter for the EO-EG benchmark[7]:

Unit-1: EO production

[6] Figure referenced from Guidance Document n°9 on the harmonised free allocation methodology for the EU ETS post 2020

[7] If process systems are shared with other systems (outside the EO-EG system boundary), e.g., shared cooling water systems, only the CO2 emissions allocated to EO-EG production are accounted for.

- EO reaction
- loop gas recycle
- CO2 removal
- EO recovery (absorber/stripper)
- crude EO condensation.

also included:

- the energy use of cooling water generation allocated to UNIT-1 (if the cooling water generation system is inside the EO-EG system boundary)
- electricity consumption of air coolers
- energy use during start-up periods (e.g., start-up boilers) allocated to UNIT-1
- EOE vent gas scrubber & residual gas recycle compressor
- residual ethylene recovery & recompression/recycle (if such a system is present).

Unit-2: EO purification

- non-condensables removal
- dewatering
- finishing
- HPEO product cooling (bringing & keeping HPEO to storage conditions).

also included:

- energy use during start-up periods allocated to UNIT-2
- electricity consumption of air coolers
- the energy use of cooling water generation allocated to UNIT-2 (if the cooling water generation system is inside the EO-EG system boundary)
- electricity consumption of a refrigeration system that produces a cold-utility to bring and to keep HPEO product at storage temperature.

Unit-3: Glycol section

- reaction
- dewatering
- fractionation
- glycols purification
- work-up/handling of the EG bleed originating from UNIT-1 work-up.

also included:

- energy use during start-up periods allocated to UNIT-3

- electricity consumption of air coolers
- the energy use of cooling water generation allocated to UNIT-3 (if the cooling water generation system is inside the EO-EG system boundary).

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 must be considered. These emissions are not eligible for free allocation but are used in the calculation of free allocation (see below).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to ‘UKETS15 FAR - Cross-boundary heat flows’.

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

- emissions from the combusted flared gas
- emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    - the fuels necessary to keep a pilot flame running
    - 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. 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 glycol products in year *k* (expressed in UKAs / year)

Em_{direct} direct emissions within the system boundaries of ethylene oxide/ethylene glycol products production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.

$Em_{NetHeatImport}$ emissions from any net measurable heat imported from other UK ETS installations and non-UK ETS entities over the baseline period by a sub-installation producing ethylene oxide/ethylene glycol products, irrespective of where and how the heat is produced

$Em_{indirect}$ indirect emissions from electricity consumption within the system boundaries of ethylene oxide/ethylene glycol products production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows:

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

With

$Elec\ use$ total electricity consumption within the system boundaries of ethylene oxide/ethylene glycol products production over the baseline period, expressed in MWh

BM_p benchmark for ethylene oxide/ethylene glycol products (expressed in UKAs / unit of product).

HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

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 below. The following formula should be used to determine the historical activity level in terms of EO-equivalents:

$$HAL_{EO/EG} = ArithmeticMean(\sum_{i=1}^{n}(HAL_{i,k} \times CF_{EOE,i}))$$

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 ethylene oxide or glycol production i in year k of the baseline period, expressed in tonnes.
$CF_{EOE,i}$	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	Tonnes of vinyl chloride (saleable product, 100% purity)
CL exposed?	Yes
Associated Schedule 2 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 2019 statistics. 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.

PRODCOM	Description
20.14.13.71	Vinyl chloride (chloroethylene)

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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

- emissions from the combusted flared gas
- emissions from the combustion of fuels necessary to operate a flare, which are of two types:
  - the fuels necessary to keep a pilot flame running
  - the fuels required to successfully combust the flared gas.

Preliminary allocation

In the production of VCM, hydrogen can be used as a fuel, substituting conventional fuels such as natural gas, thus reducing the direct emissions from the combustion process. Considering the very high greenhouse gas intensity of hydrogen production, the VCM benchmark value accounts for using hydrogen as if it was natural gas. The free allocation for each installation is therefore corrected to account for the emissions from hydrogen production covered by the benchmark (direct emissions and virtual emissions for hydrogen production):[8]

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

With:

[8] Article 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") must 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.*"

$F_{p,k}$	annual preliminary allocation for a product benchmark sub-installation producing VCM in year *k* (expressed in UKAs / year)
Em_{direct}	direct emissions within the system boundaries of VCM production over the baseline period.
$Em_{NetHeatImport}$	emissions from any net measurable heat imported from other UK ETS installations and non-UK ETS entities over the baseline period by a sub-installation producing ammonia, irrespective of where and how the heat is produced
$Em_{Hydrogen}$	Hydrogen-related emissions of VCM production over the baseline period (historical hydrogen consumption for VCM production (expressed in t CO2(e)) calculated from the historical heat consumption stemming from hydrogen combustion (expressed in TJ) multiplied by the value of the heat benchmark for the relevant allocation period.
BM_p	benchmark for VCM (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

48 S-PVC

Benchmark name	S-PVC
Benchmark number	48
Unit	Tonnes of S-PVC (saleable product, 100% purity)
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 statistics. 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.

Note that PRODCOM code 20.16.30.10 also covers E-PVC (see next section).

PRODCOM	Description
20.16.30.10	Polyvinyl chloride, not mixed with any other substances, in primary forms

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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS

consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for S-PVC (expressed in UKAs / 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	Tonnes of E-PVC (saleable product, 100% purity)
CL exposed?	Yes
Associated Schedule 2 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	N/A

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 2019 statistics.

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.

Note that PRODCOM code 20.16.30.10 also covers the S-PVC benchmark (see previous section).

PRODCOM	Description
20.16.30.10	Polyvinyl chloride, not mixed with any other substances, in primary forms

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 from the E-PVC production process usually arise from using steam, cooling, and fuels (light fuel oil, natural gas).

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

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for E-PVC (expressed in UKAs / 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	Tonnes of hydrogen (100% purity as net saleable production)
CL exposed?	Yes
Associated Schedule 2 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 to 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 in the hydrogen share of the total synthesis gas. The total amount of hydrogen and carbon monoxide is the sum of all the hydrogen and carbon monoxide contained in 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 the following section).The table below shows the relevant product according to definition in PRODCOM 2019 statistics. 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.

PRODCOM	Description
20.11.11.50	Hydrogen

There is no single PRODCOM code 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

Point 2 of Annex I to the FAR defines 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 must be considered."*

The system boundaries are set out in Figure 80 and the following production steps are included 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 carbon monoxide recycle duty), adsorption, absorption, and/or membrane
- related cooling and process water pumping duty.

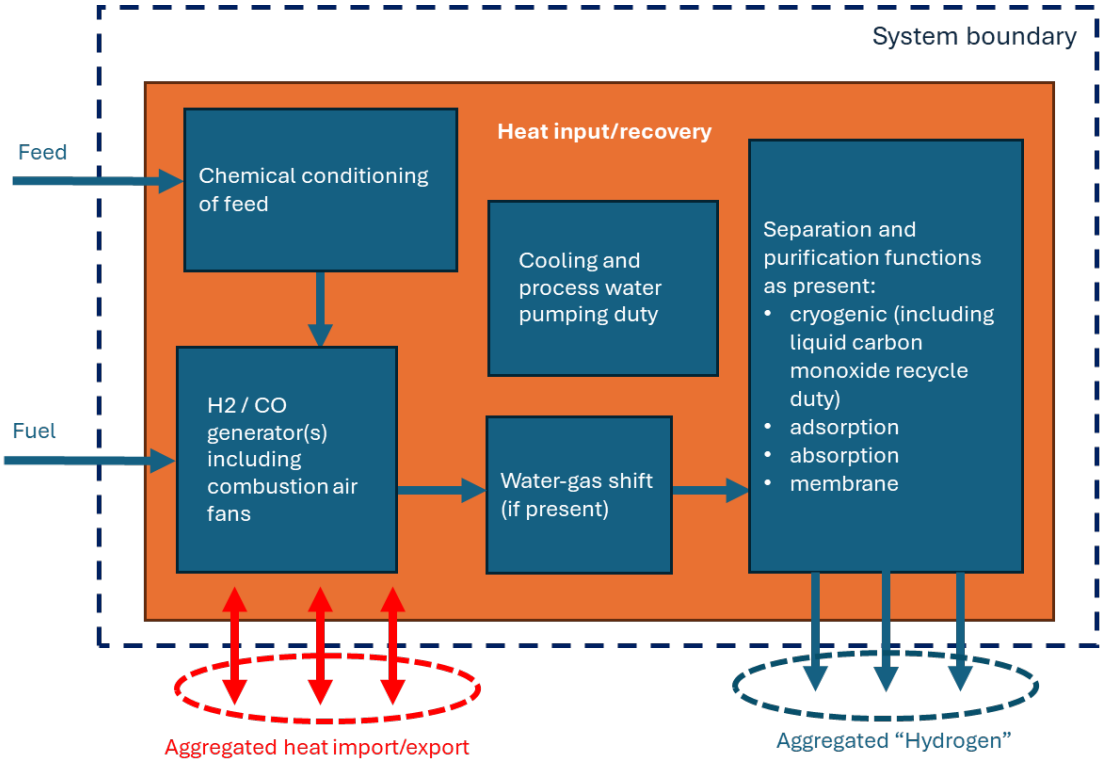

Figure 8 System boundaries of the hydrogen product benchmark

Hydrogen production covered by another product benchmark (e.g. the refinery products or syngas benchmark) cannot be included in the hydrogen benchmark. This is particularly the case for hydrogen extracted from a waste gas that is produced in a process covered by a 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 to calculate free allocation (see below).

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 in year *k* (expressed in UKAs / year)
Em_{direct}	direct emissions within the system boundaries of hydrogen production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.
$Em_{NetHeatImport}$	emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 hydrogen production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows: $$Em_{indirect} = Elec\ use \times 0.376$$ With $Elec\ use$ total electricity consumption within the system boundaries of hydrogen production over the baseline period, expressed in MWh
BM_p	benchmark for hydrogen (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year) (see below).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

Determination of historical activity level

To ensure a level playing field for hydrogen production in both refineries and chemical plants, the free allocation of emission allowances has been brought in line with the CWT approach for refineries by referring to a defined volumetric concentration of hydrogen. The historical activity level must be determined as follows:

$$HAL_{H_2} = arithmetic\ mean(HAL_{H_2+CO,k} \times (1 - \frac{1 - VF_{H_2k}}{0.4027}) \times 0.00008987)$$

With:

HAL_{H_2}	historical activity level for hydrogen production related to 100% hydrogen.
$HAL_{H_2+CO,k}$	historical activity level for hydrogen production related to historical hydrogen content (normal cubic meters per year at 0°C and 101.325 kPa) in year k of the baseline period.
VF_{H_2k}	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	Tonnes of synthesis gas referred to 47% hydrogen as net saleable production.
CL exposed?	Yes
Associated Schedule 2 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 to 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.

To calculate 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 code for 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

Point 2 of Annex I to the FAR defines 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 must be considered."

The system boundaries are set out in Figure 9 and the following production steps are be included 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.

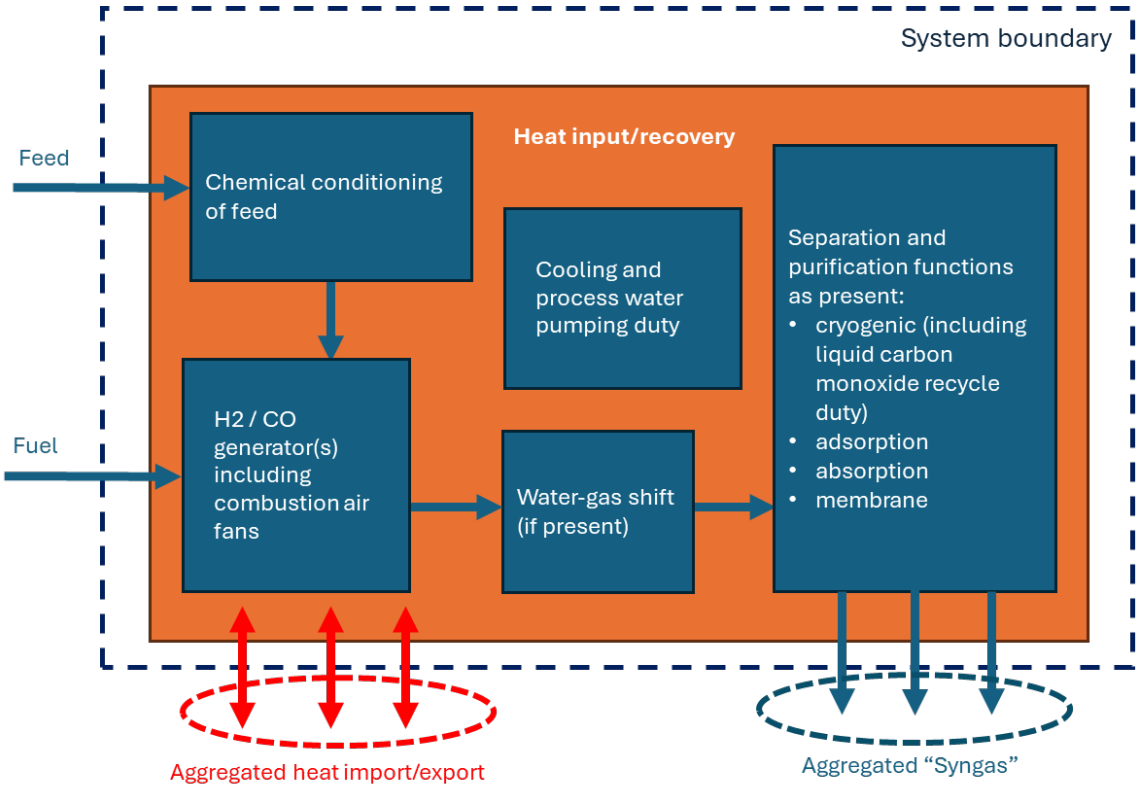

Figure 9 System boundaries of the synthesis gas product benchmark

Indirect emissions from electricity consumption are not eligible for free allocation but are used to calculate free allocation (see below).

Measurable heat exported (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 a UK ETS

consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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. 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 UKAs / year)
Em_{direct}	direct emissions within the system boundaries of synthesis gas production over the baseline period. The direct emissions further include the emissions due to heat production within the same UK 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 UK ETS installations or non-UK ETS entities.
$Em_{NetHeatImport}$	emissions from any net measurable heat imported from other UK ETS installations and non-UK 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 synthesis gas production over the baseline period. Irrespective of where and how the electricity is produced, these emissions expressed in tonne CO2 are calculated as follows: $Em_{indirect} = Elec\ use \times 0.376$ With

$Elec\ use$	total electricity consumption within the system boundaries of synthesis gas production over the baseline period, expressed in MWh
BM_p	benchmark for synthesis gas (expressed in UKAs / unit of product).
HAL_p	historical activity level, i.e. the arithmetic mean annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product per year) (see below).
$CLEF_{p,k}$	applicable carbon leakage exposure factor for product p in year k.

Determination of historical activity level

To ensure a level playing field for synthesis gas production in both refineries and chemical plants, the free allocation of emission allowances has been brought in line with the CWT approach for refineries by referring to a defined volumetric concentration of hydrogen. The historical activity level must be determined as follows:

$$HAL_{Syngas} = arithmetic\ mean(HAL_{H_2+CO,k} \times (1 - \frac{0.47 - VF_{H_2k}}{0.0863}) \times 0.0007047)$$

With:

HAL_{Syngas}	historical activity level for synthesis gas production relating to 47% hydrogen.
$HAL_{H_2+CO,k}$	historical activity level for synthesis gas production related to historical hydrogen content (normal cubic meters per year at 0°C and 101.325 kPa) in year k of the baseline period.
VF_{H_2k}	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	Tonnes of soda ash (as total gross production)
CL exposed?	Yes
Associated Schedule 2 activity	Production of soda ash (Na2CO3) and sodium bicarbonate (NaHCO3)
Special provisions	N/A

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 2019 statistics. 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.

PRODCOM	Description
20.13.43.10	Disodium carbonate

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,*
> - *carbon dioxide reactors,*
> - *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 electricity production are excluded from the system boundaries.

Measurable heat exported (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 a UK ETS consumer or a consumer not covered by the UK ETS. However, when heat is exported to a consumer covered by the UK ETS, the consumer will get free allocation only when a heat benchmark is applied (allocation for heat is already covered by the product benchmark). When heat is exported to non-UK ETS consumers, the heat exporter receives free allocation, and one or two heat benchmark sub-installations should be anticipated. For further guidance refer to 'UKETS15 FAR - Cross-boundary heat flows'.

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 UKAs)

BM_p benchmark for soda ash (expressed in UKAs / 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

This publication is available from: www.gov.uk/government/publications/uk-ets-2025-baseline-data-collection-and-hseuse-scheme-status-how-to-meet-the-data-submission-requirements

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