UKETS17 FAR - Waste gases and process emissions sub-installations

May 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

1. Overview

This document provides guidance to operators of installations under the UK Emissions Trading Scheme (UK ETS) and is intended to provide guidance on the free allocation of allowances to installations engaged in the production and consumption of waste gases and the associated allocation methods, with a focus on process emissions sub-installations.

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

2. Definitions

2.1 Articles relating to waste gases in the FAR

Definitions and allocation rules in this guidance document are based on the FAR. The relevant Articles are:

- The definitions in:
  - Article 2(10) on process emissions sub-installation (as well as all other articles relevant for process emissions)
  - Article 2(11) on waste gas
  - Article 2(13) on safety flaring
- Article 10(5) on the correct division of an installation into sub-installations
- Article 16(5) on aspects relating to the flaring of waste gases.

The Annexes to the FAR also include content relating to waste gases, in particular:

- Annex IV relating to the parameters for baseline data collection
- Annex VI relating to the minimum content of the monitoring methodology plan
- Annex VII relating to the applicable monitoring methods.

2.2 Definition of waste gases

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

> "*'waste gas' means a gas containing incompletely oxidised carbon in a gaseous state under standard conditions which is a result of any of the processes listed in point (10), where 'standard conditions' means temperature of 273,15 K and pressure conditions of 101 325 Pa defining normal cubic meters (Nm^3) according to Article 3(52) of the Monitoring and Reporting Regulation 2018.*"

To qualify as a waste gas, a gas must satisfy all three of the following conditions:

1. contain incompletely oxidised carbon
2. be in a gaseous state under standard conditions, and
3. occur as a result of one of the processes listed in the definition of process emissions.

Condition 1: Contain incompletely oxidised carbon

Carbon reacts with oxygen according to the following chemical equations:

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

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

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

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

Waste gases are usually a mix of different gases including CO_2 which are transferred from the originating process to other processes. Within these mixes, the CO_2 content is treated as part of the waste gas stream. The higher the proportion of non- and incompletely oxidised carbon in fuels, the higher the calorific value. The calorific value of completely oxidised carbon (CO_2) is zero.

Incompletely oxidised carbon will be in the form of CO or $C_mH_nO_o$. The amount of incompletely oxidised carbon should be higher than 1 weight percent in the gas on average. Therefore, pure hydrocarbon gas, with less than 1 weight percent oxygen bonded compounds (e.g. 99% ethylene), would not be considered a waste gas. Furthermore, a pure CO_2 stream of 99% purity (i.e. completely oxidised) cannot be considered waste gas.

Condition 2: Be in a gaseous state under standard conditions

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

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

To assess whether condition 3 is met, the following information should help to distinguish between process emissions and allocation for waste gases as part of the process emissions sub-installation.

The **process emissions sub-installation** is defined in Article 2(10) of the FAR:

> "*'Process emissions sub-installation' means emissions of greenhouse gases set out in column 2 of table C in Schedule 2 to the UK ETS Order other than carbon dioxide, which occur outside the system boundaries of a product benchmark listed in Annex I to this Regulation, or carbon dioxide emissions, which occur outside the system boundaries of a product benchmark listed in Annex I to this Regulation, as a direct and immediate result of any of the following processes and emissions stemming from the combustion of waste gases for the purpose of the production of measurable heat, non-measurable heat or electricity, provided that emissions that would have occurred from the combustion of an amount of natural gas, equivalent to the technically usable energy content of the combusted incompletely oxidised carbon, are subtracted:*

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

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

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

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

(e) *the use of carbon containing additives or raw materials for a primary purpose other than the generation of heat;*

(f) *the chemical or electrolytic reduction of metalloid oxides or non-metal oxides such as silicon oxides and phosphates for a primary purpose other than the generation of heat.*"

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

- **Type a process emissions**: non-CO_2 greenhouse gas emissions (i.e. N_2O for specific sectors; see Table C in Schedule 2 to the Order for the regulated activities for which N_2O emissions are specified

- **Type b process emissions**: CO_2 emissions from any of the activities [(a) to (f)] in the Article 2 of the FAR definition above

- **Type c process emissions**: emissions from the combustion of incompletely oxidised carbon such as CO emitted by any of activities [(a) to (f)], if it is combusted to produce heat or electricity. Only the emissions that are additional to the emissions that would occur if natural gas was used are taken into account. When calculating the additional emissions, the "technically usable energy content" should be used. Compared to other fuels, most waste gases have a higher emission intensity and are therefore less efficient than other fuels. Therefore, operators must apply a correction to account for the difference in efficiencies between using waste gas and using natural gas as a reference fuel.

Figure 1 illustrates the different types of process emissions, further described below.

- **Type a process emissions**

Allocation for these emissions will be accounted for under the process emission sub-installation. For further guidance, see 'UKETS11 FAR - Determining allocation at the installation level'.

- **Type b process emissions**

Allocation for these emissions will be accounted for under the process emission sub-installation. For these process emissions, only activities [(a) to (f)] carried out within the scope of the UK ETS can be considered.

As specified in Article 10(5)(h) of the FAR, type b process emissions only cover the CO_2 that is a direct and immediate result of the production process or chemical reaction, and as directly released to the atmosphere (as illustrated by the top-right box on Figure 1). CO_2 from the oxidation of CO or other incompletely oxidised carbon is not covered by type b process emissions, regardless of whether this oxidation takes place in the same technical unit or a separate one (but it would be covered under type c process emissions in case of energy recovery).

For further guidance, see 'UKETS11 FAR - Determining allocation at the installation level'

- **Type c process emissions**

Process emissions of type c refer to waste gases, and only the activities [(a) to (f)] carried out within the scope of the UK ETS can be considered. Any CO_2 which is part of a gas mix including incompletely oxidised carbon that is not directly released to the atmosphere should be treated as part of the waste gas (and not as type b process emissions).

Only gas mixes containing **more than a negligible amount, i.e. more than 1 weight percent, of incompletely oxidised carbon** and containing enough energy on their own to contribute to heat or electricity production, can be regarded as waste gases in the context of the definition of the type c process emissions sub-installation. These criteria should be met if:

1. the calorific value of the gas mix is high enough for the gas mix to burn without auxiliary fuel input

   OR

2. the calorific value of the gas mix is high enough to contribute significantly to the total energy input when mixed with fuels of higher calorific value.

Allocation for waste gas emissions will only take place if the waste gases are used efficiently to produce measurable heat, non-measurable heat, or electricity. Waste gas combusted in an open furnace (i.e. the part of incompletely oxidised carbon converted to CO_2 outside the furnace upon air exposure) is regarded as equal to non-safety flaring (if the energy from the combustion is not recovered, and so not be eligible for free allocation as per Article 10(5)(h) of the FAR).

A specific rule applies when waste gases occurring outside the boundaries of product benchmarks are not used, mainly in open furnaces, as further oxidation of incompletely oxidised carbon is difficult to control. Given the unknown composition of such waste gases (i.e. the uncertainty regarding its CO_2 content), 75% of the carbon content of the waste gas must be considered as converted to CO_2 and assigned to a process emissions sub-installation (Article 10 (5)(i) of the FAR).

Example: In an open furnace without energy recovery, a chemical reduction process leads to a mix of CO and CO_2 being produced. In the presence of air, the CO is further oxidised to CO_2 and as result, only CO_2 is released to the atmosphere. The CO_2 from the oxidation of CO occurring only upon air exposure cannot be regarded as process emission type b. This is because only the CO_2 which is the direct result of activities [(a) to (f)] in the definition above can be considered as a type b process emission. However, the gas mix produced in the open furnace fulfils the criteria for waste gases as it contains incompletely oxidised carbon, is in a gaseous state under standard conditions, and occurs as a result of one of the processes listed in the definition of process emissions. As this open furnace does not have equipment for energy recovery, the specific rule in Article 10(5)(i) of the FAR applies, which considers circumstances where the gas mix contains a share of CO_2 that has been directly and immediately created (i.e. not by the oxidation of CO). According to this rule, 75% of the quantity of the carbon content of the waste gas must be considered as converted to CO_2 and assigned to a process emissions sub-installation which is therefore eligible for free allocation.

Chapter 4 provides further details on calculating the free allocation for waste gases.

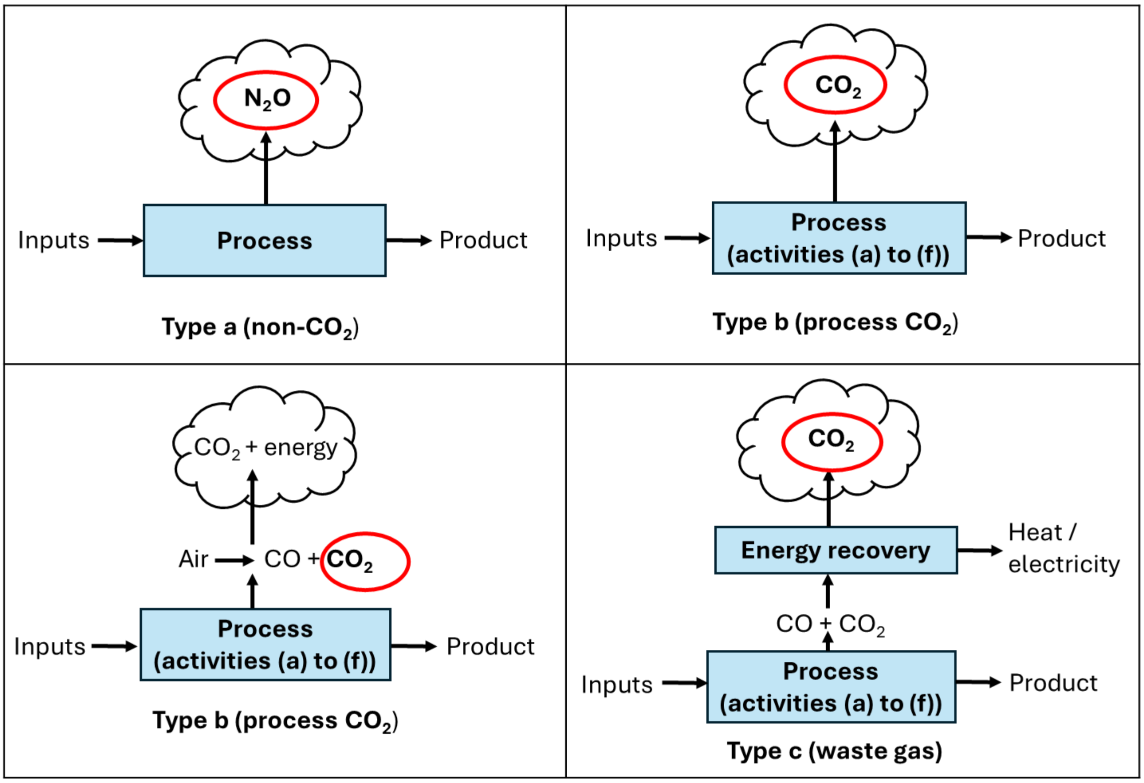

Figure 1: Overview of process emissions sub-installations
(the emissions covered by the sub-installations are marked by the red ellipses; the bottom left box illustrates the type b process emissions described in the example above)

Flaring and safety flaring

Flaring and safety flaring are relevant for calculating the free allocation of allowances to waste gases. According to Article 2(13) of the FAR:

"*'safety flaring' means the combustion of pilot fuels and highly fluctuating amounts of process or residual gases in a unit open to atmospheric disturbances which is explicitly required for safety reasons by relevant permits for the installation;*"

In other words, flaring can be considered as safety flaring if **all three** following conditions are met:

1. the flaring is required by a relevant permit for safety reasons
2. the combustion takes place in a unit open to atmospheric disturbances (the combustion in other units is not covered)
3. the amounts of process or residual gases are highly fluctuating.

The third requirement is considered to have been met if the flare does not operate continuously. Examples of flares that are not continuous are intermittent flares for planned or unplanned activities such as maintenance and tests, or unplanned events such as emergency situations or technical problems (including those in connected installations that usually use the waste gas). Continuously operating flares is considered to have met the third requirement if it can be demonstrated that the combusted amounts of residual gases are highly fluctuating on a daily basis, i.e. that the residual gases are not produced in standard quantities under normal operation, as is usually the case for batch processes. In this case, operators should use flaring over the entire baseline period for statistical analysis.

Please note that the requirements in a permit are not sufficient to qualify a flare as a safety flare, as the high fluctuation criterion needs to be met.

Safety flaring does not necessarily require that the residual gases flared are regarded as waste gases.

The emissions related to flaring include:

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

In instances of safety flaring gases that do not result from processes covered by product benchmarks, both combusted flared gas and fuels essential for operating the flare are eligible for free allocation, **based on the fuel benchmark allocation methodology**. For other types of flaring, emissions from both origins are **not eligible** for free allocation.

The flaring of waste gases resulting from processes covered by a product benchmark, other than safety flaring, that are not used for the purpose of producing measurable heat, non-measurable heat, or electricity, will lead to a reduction of allocation as of 2026, in line with Article 16(5) of the FAR. In this case, the preliminary annual allocation for the relevant product benchmark sub-installation will be reduced by the amount of annual historical emissions emitted from flaring these waste gases. Additional information related to the production of waste gas can be found in chapter 4.

3. Waste gases in specific industries

3.1 Iron, steel and other metal industries

In the iron and steel industry, waste gases arise in the coke oven, the blast furnace, and the basic oxygen furnace, and are often transferred to other installations (whether UK ETS or non-UK ETS) for energy recovery. CO_2 emissions from these waste gases occur in the installation importing and recovering the waste gases:

- coke making results in coke oven gas (COG), (emission factor: 44.4 tCO_2/TJ, calorific value: 38.7 TJ/Gg)[1] which has a lower emission intensity than natural gas (NG) (56.1 tCO_2/TJ, 48 TJ/Gg). In standalone coke oven plants, coke oven gas is used for the under-firing of coke oven batteries.
- however, in integrated steel plants with an onsite coke oven plant, blast furnace gas (BFG) is also used for the under-firing (260 tCO_2/TJ, 2.47 TJ/Gg). This low calorific gas – usually considered as a very low value fuel – is suitable for this purpose as it burns slowly and allows a more even distribution of heat across the walls of the coke oven chambers. In integrated steel works, blast furnace gas is used for many upstream processes (e.g. coke making) and downstream processes (e.g. rolling) as well as for electricity production, which may be outsourced. However, these processes are also used in standalone configurations where they must rely on other fuels such as natural gas.
- basic oxygen furnace gas (BOFG) is – as the name implies – produced in the basic oxygen furnace. The associated emission factor and calorific value lies between those for COG and BFG (182 tCO_2/TJ, 7.06 TJ/Gg). This gas can be used for both upstream and downstream processes.

In addition, waste gases can be formed in high temperature reduction processes to produce metal alloys.

3.2 Chemical industry

In the chemical industry, waste gases are formed during chemical reactions such as partial oxidisation, ammonium oxidisation, and hydro-formylation used to produce carbon black, acetylene, olefins, and synthesis gas. Additionally, waste gases are formed in the reduction of pure sand to silicon carbide using a carbon source. For instance, the tail gas from the carbon black process consists of 30-50% water vapour, 30-50% nitrogen, 1-5% CO_2 and small amounts of CO and H_2. Once cooled at standard pressure and dried before transport, this low

[1] Emission factors and calorific values from Annex VI to the MRR.

calorific mixture enables energy recovery by producing steam, hot water, or electricity, and will hence meet the definition of a waste gas.

4. Calculation of activity levels and free allocation

The calculation of activity levels, and hence free allocation, related to waste gases is split into two parts, which can be relevant in different types of sub-installations:

- allocation related to waste gas production (Part P in Figure 2; for further illustration see section 4.1)
- allocation related to waste gas consumption (Part C in Figure 2; also see section 4.2)

Further discussions on free allocation for waste gas production and consumption can be found in the following chapter.

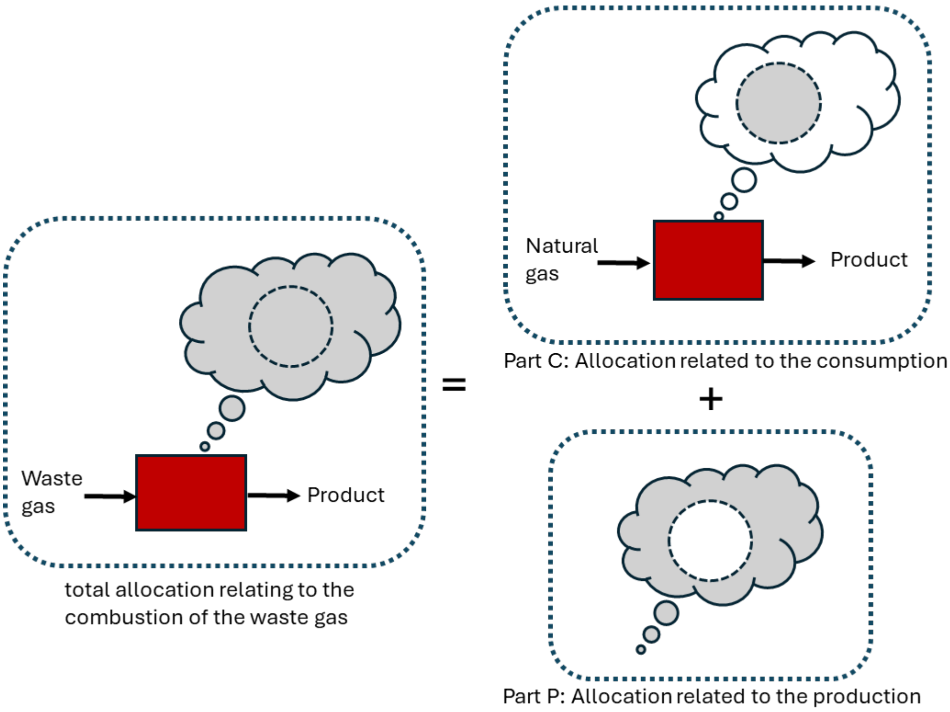

Figure 2: Splitting allocation relating to waste gases between consumer and producer

The **allocation for waste gas production** will be assigned:

- to the **producer** of the waste gas when the waste gas is produced within the boundaries of a product benchmark. This is because the emissions relating to waste gas production are already included in the product benchmark. When the consumer of the waste gas is a different entity to the producer of the waste gas, then this part of the allocation will go to an installation which does not emit the emissions relating to the combustion of the waste gas)

- to the **consumer** of the waste gas when the waste gas is produced outside the boundaries of a product benchmark. In this case, the allocation will go to the entity that emits the emissions from combustion of the waste gas.

Allocation related to the consumption of the waste gas will always be allocated to the **consumer** of the waste gas.

However, in many cases the waste gases will be consumed on the site where they have been produced, and the consumer and the producer will therefore be the same installation.

To further clarify this approach, section 4.3 describes the total allocation for waste gases produced inside and outside the boundaries of a product benchmark. To provide an easy reference, section 4.4 summarises allocation methods for waste gas production and consumption.

4.1 Allocation relating to waste gas production

When calculating the allocation for waste gas production, only emissions additional to those from the combustion of a reference fuel – natural gas – are included. The remaining emissions can, depending on the use of the waste gas, be allocated based on an allocation methodology relevant for waste gas consumption (see section 4.2). This guidance document focuses on determining activity levels for allocation calculation. For specific guidance on attributing emissions, see ‘UKETS13 FAR - Monitoring and reporting in relation to the free allocation rules’.

Example 1: Waste gases produced within the boundaries of a product benchmark

If the waste gas is produced within the boundaries of a benchmarked product, the allocation relating to waste gas production and safety flaring (see Figure 3) are already included in the product benchmark. Therefore, allocation for waste gas production (part P in Figure 2) is assigned to the producer of the waste gas and is included in the product benchmark sub-installation.

The consumer of the waste gas receives no additional allocation for waste gas production (part P, Figure 5). However, the consumer of the waste gas can receive allocation for consuming the waste gas (part C in Figure 2; see the section on consumption of the waste gas).

If waste gas is ultimately flared for reasons other than safety flaring, then, as of 2026, the preliminary allocation for the product benchmark sub-installation that the waste gas producer will receive will be reduced by the number of emissions from flaring this waste gas. In this case, the preliminary allocation of the sub-installation will be determined as follows for 2026 - 2030:[2]

[2] To be adjusted by special product benchmark factors or for exchangeability of fuel and electricity if relevant. See ‘UKETS11 FAR - Determining allocation at the installation level’ for more information.

$$F_{p,k} = (BM_p \times HAL_p - Arithmetic\ mean_{Baseline}(V_{WGfl} \times NCV_{WG} \times EF_{WG})) \times CLEF_{p,k}$$

Where:

$F_{p,k}$ annual preliminary allocation for product *p* in year k (expressed in UK allowances/year)

BM_p product benchmark value for product *p* (expressed in allowances/unit of product);

HAL_p historical activity level of product *p*, i.e. the arithmetic mean of the annual production in the baseline period as determined and verified in the baseline data collection (expressed in unit of product). See 'UKETS18 FAR - Sector specific guidance' for the unit of production to be used for different products

V_{WGfl} volume of waste gas flared for reasons other than safety flaring (expressed in Nm^3 or tonnes)

NCV_{WG} net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t);

EF_{WG} emission factor of the waste gas (expressed in tCO_2/TJ).

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

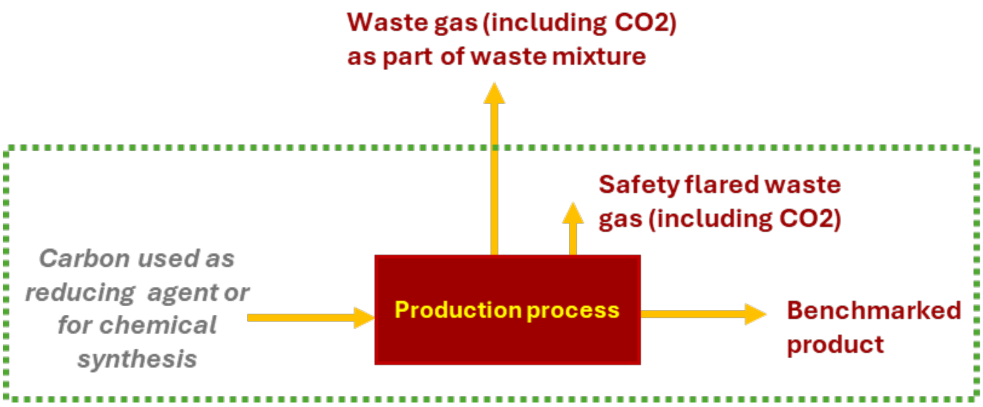

Figure 3: Emission of waste gases within the boundaries of a product benchmark[3]

Example 2: Waste gases produced outside the boundaries of a product benchmark

If the waste gas is produced outside the boundaries of a product benchmark and the waste gas is recovered (i.e. it is not ultimately flared for reasons other than safety flaring), a fall-back approach is applied (see Figure 4). The emissions relating to waste gas production (part P in Figure 2) that is recovered for producing measurable heat, non-measurable heat or electricity, will be regarded as a process emissions sub-installation. Emissions from waste

[3] The emissions related to the consumption of the waste gas (part C in Figure 2) are not represented here. Furthermore, emissions from the flaring of waste gases for reasons other than for safety reasons are included in the boundaries until 2025 and will be deducted as from 2026.

gases that are flared are not considered as process emissions and will not be eligible for free allocation, except in the case of safety flaring, when allocation will be calculated based on the fuel benchmark (see the definition of safety flaring to enhance understandings of the concept).

In Figure 4 below, the green dashed line shows the boundaries of the process emissions sub-installation.[4]

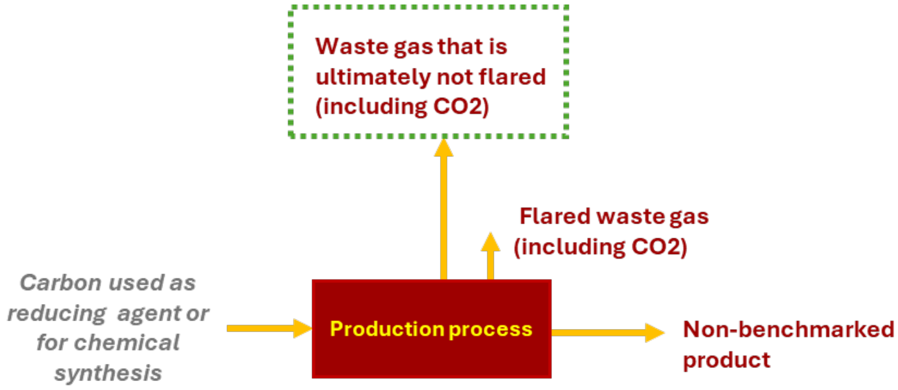

Figure 4: Emission of waste gases outside the boundaries of a product benchmark.

As the emissions related to the waste gas occur when the waste gas is combusted, the preliminary allocation will be given to the consumer of the waste gas. The preliminary free allocation is calculated by multiplying the HAL ($HAL_{WasteGas}$) with a factor of 0.97 and the CLEF:

$$F_{pe,k} = HAL_{WasteGas} \times 0.97 \times CLEF_{pe,k}$$

The HAL of this sub-installation is determined as follows:

$$HAL_{WasteGas} = Arithmetic\ mean_{BaselinePeriod}[V_{WG} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Corr_{\eta})]$$

Where:

$F_{pe,k}$	annual preliminary allocation for the process emissions sub-installation in year k (expressed in allowances/yr)
$HAL_{WasteGas}$	historical activity level of the sub-installation related to the production of waste gases not covered by a product benchmark (expressed in tCO_2e)
$CLEF_{pe,k}$	applicable carbon leakage exposure factor for the process emissions sub-installation in year k
V_{WG}	volume of waste gas that is not flared (expressed in Nm^3 or tonnes)

[4] The emissions related to the consumption of the waste gas (part C in Figure 2) are not represented here

NCV_{WG} net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)

EF_{WG} emission factor of the waste gas (expressed in tCO_2/TJ)

EF_{NG} emission factor of natural gas (56.1 tCO_2/TJ)

$Corr_{\eta}$ factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel natural gas, the default value of this factor is equal to 0.667

In circumstances when the emission factor of the waste gas is lower than the corrected emission factor of natural gas, $HAL_{WasteGas}$ should be considered equal to zero. In other words, $HAL_{WasteGas}$ cannot be negative.

The content of CO_2 in the waste gas is treated as part of the waste gas stream. Therefore, the values for the volume, the net calorific value and the emission factor of the waste gas are referring to the total waste gas stream including CO_2.[5]

A default correction factor ($Corr_{\eta}$) of 0.667 should be used unless the operator can provide acceptable evidence proving that a different factor should be used. Different factors should only be used if the uses of waste gas and efficiencies related to these uses are known.

4.2 Allocation relating to the consumption of the waste gas

Regardless of the composition of the waste gas and of its origin, the *use* of a waste gas (part C in Figure 2) is treated as for any other fuel:

- when the waste gas is used to produce electricity or when it is flared, there will be no allocation for this activity (except in the case of safety flaring of waste gases produced outside the boundaries of a product benchmark. In that case allocation will fall under the fuel benchmark)
- when the waste gas is used to produce a benchmarked product, the allocation is already taken into account in the benchmark for this product
- when the waste gas is used to produce measurable heat, the operator will receive allocation for the heat as part of a heat benchmark (if heat consumption is not already covered by a product benchmark)
- when the waste gas is used as a combustion fuel to produce non-measurable heat and not used for electricity production, the sub-installation consuming this fuel will receive an allocation based on the fuel benchmark.

[5] The same approach has been applied to waste gases covered by product benchmarks.

Note that in Figure 5 below, safety flaring only receives allocation based on a fuel benchmark when the flared waste gas is produced outside the boundaries of a product benchmark

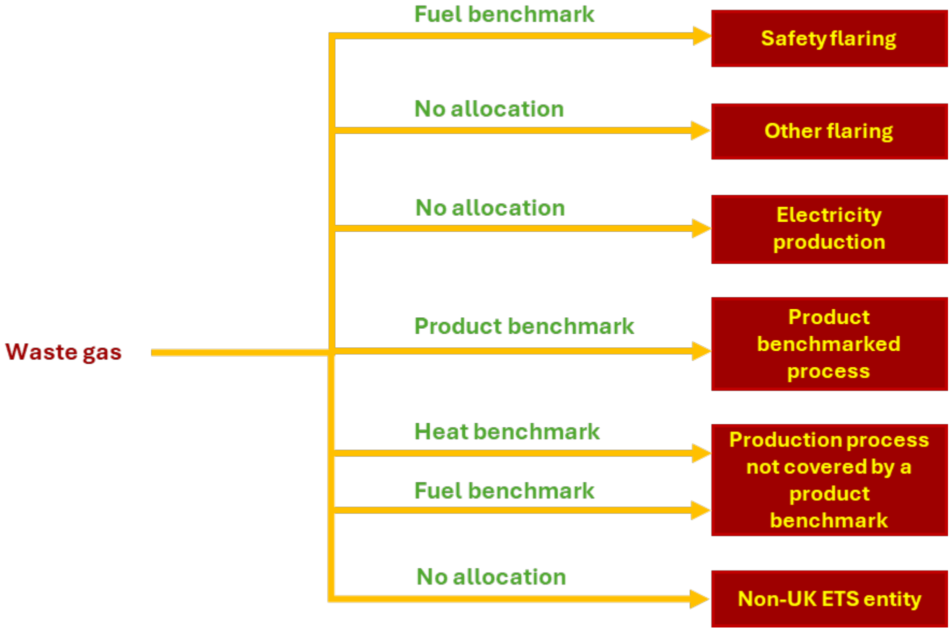

Figure 5: Allocation for the consumption of waste gases (part C in Figure 2)

4.3 Total allocation for production and consumption of waste gases

Example 1: Waste gases produced within the boundaries of a product benchmark

Figure 6 gives an overview of allocation methodologies to be used in the case of production of waste gases inside the boundaries of a product benchmark:

- **the allocation for waste gas production** (part P in Figure 2) is accounted for under the product benchmark. This allocation goes to the producer of the waste gas. If the waste gas is ultimately flared, the corresponding emissions will be subtracted from the free allocation as of 2026.

- **the allocation for waste gas use** (part C in Figure 2, if applicable) goes to the user of the waste gas. Figure 6 shows which allocation methodology should be used for different types of consumers.

In many cases, the waste gases will be consumed onsite, and therefore the consumer and the producer will be the same installation.

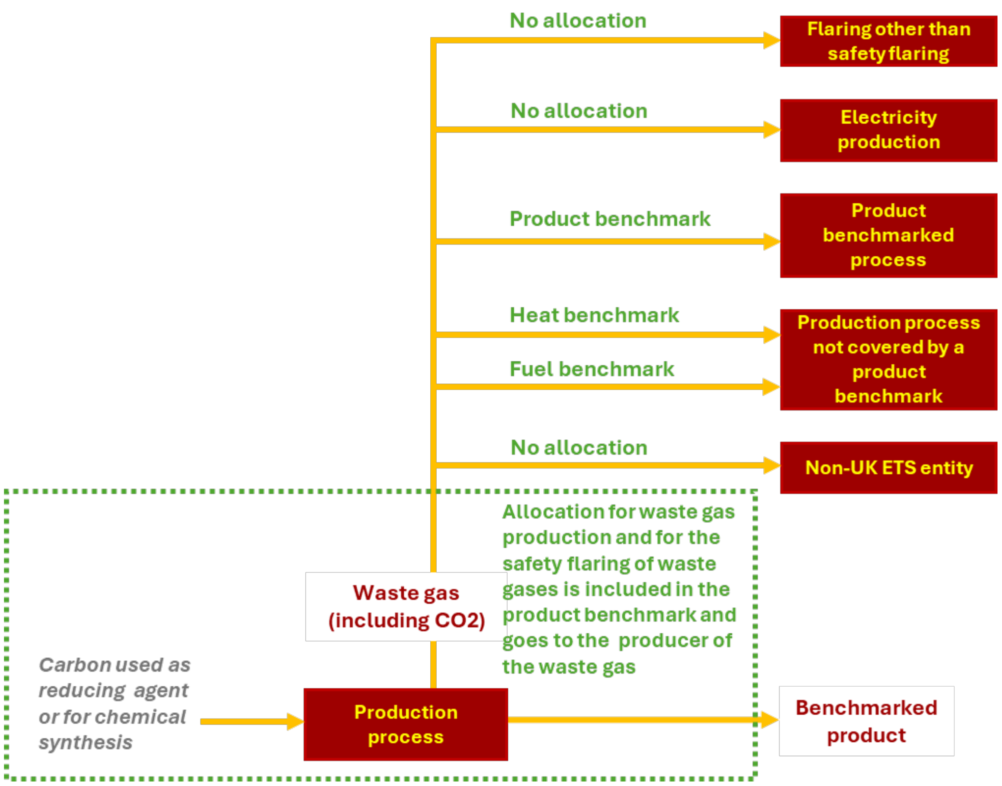

Figure 6: Overview of allocation when waste gases are produced within the boundaries of a product benchmark

Example 2: Waste gases produced outside the boundaries of a product benchmark

Figure 7 gives an overview of allocation methodologies when waste gases are produced outside the boundaries of a product benchmark:

- **the allocation for the production of waste gases that are ultimately not flared** (part P in Figure 2, and allocation indicated with dotted lines in Figure 7) is based on the approach for the process emission sub-installation (see the section on allocation relating to the production of the waste gas, case 2). This allocation goes to the user of the waste gas. If the waste gas is used by more than one UK ETS installation, the allocation is distributed between these installations based on the amounts of waste gases used by each of the different UK ETS installations.

- **the allocation for waste gas use** (Part C in Figure 2, if applicable) goes to the user of the waste gas. Figure 7 shows which allocation methodology should be used for different types of consumers.

In many cases, the waste gases will be consumed onsite, and therefore the consumer and the producer will be the same installation.

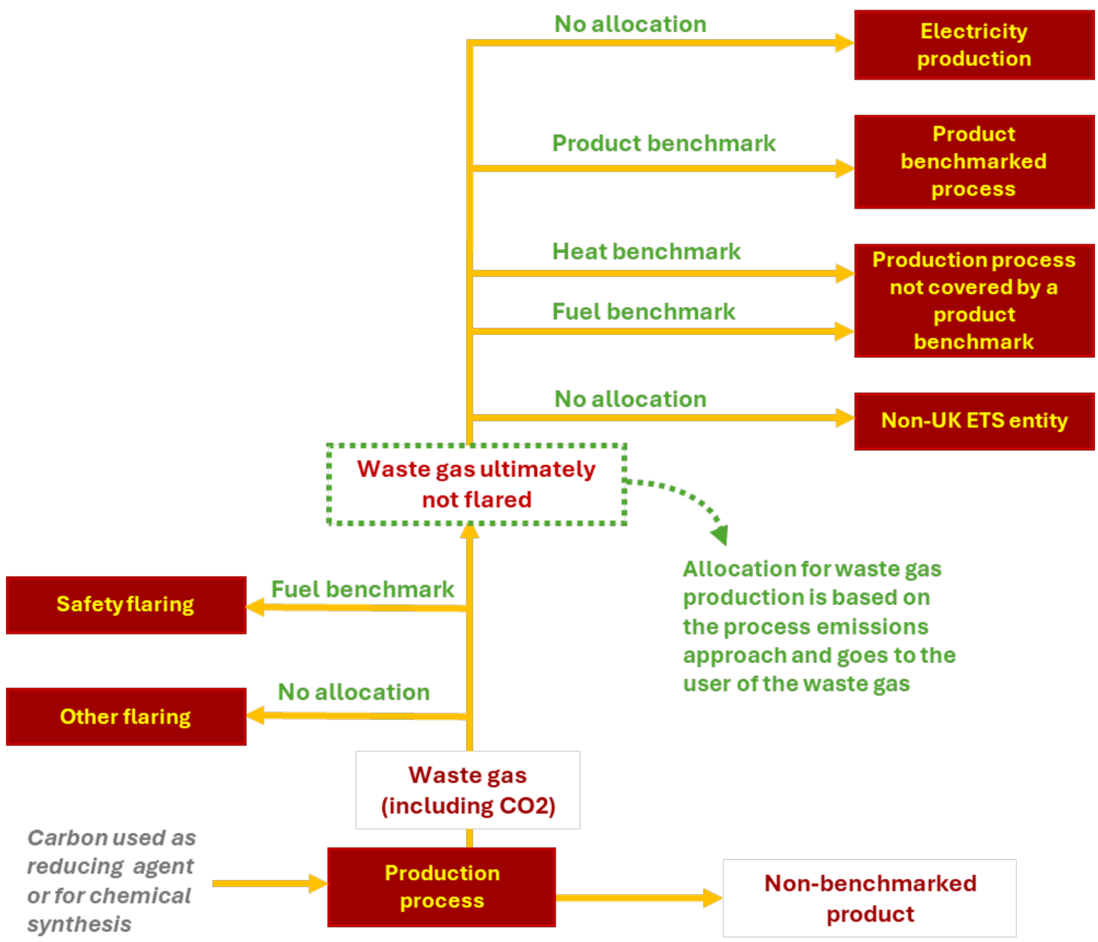

Figure 7: Overview of allocation when waste gases are produced outside the boundaries of a product benchmark.

Operators must ensure that an allocation is not applied twice for the same carbon content: once for the waste gas via **the process emission sub-installation**, and once via **a fuel benchmark sub-installation**:

- fuel used as a reducing agent or for chemical syntheses should not be considered as fuel input into a fuel benchmark sub-installation
- any fuel, the emissions from which ultimately end up as part of the waste gases, should not be allocated via a fuel benchmark sub-installation.

To avoid double counting, the HAL of the fuel benchmark sub-installation covering the fuel input to the production process causing the waste gases (see below left in Figure 7) should be determined as follows:

$$HAL_{fuel} = Arithmetic\ mean_{BaselinePeriod}[Fuel_{process} - V_{WG} \times NCV_{WG} \times \alpha]$$

Where:

HAL_{fuel}	historical activity level of the fuel benchmark sub-installation
$Arithmetic\ mean_{BaselinePeriod}$	arithmetic mean value over the baseline period
$Fuel_{process}$	total amount of fuel consumed in the production process excluding fuel used as a reducing agent or for chemical syntheses (expressed in TJ)
V_{WG}	total volume of waste gas exiting the production process (expressed in Nm^3 or tonnes)
NCV_{WG}	net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)
α	share of waste gases originating from the fuel

The historical activity level of the fuel benchmark sub-installation covering safety flaring (see top box on the left in Figure 7) should be determined as follows:

$$HAL_{fuel} = Arithmetic\ mean_{BaselinePeriod}[Fuel_{SafetyFlaring} + V_{WG} \times NCV_{WG} \times \beta]$$

Where:

HAL_{fuel}	historical activity level of the fuel benchmark sub-installation
$Fuel_{SafetyFlaring}$	total amount of fuel necessary for safety flaring i.e. the fuels necessary to keep a pilot flame running and fuels required to successfully combust the flared gas (expressed in TJ)
V_{WG}	total volume of waste gas exiting the production process (expressed in Nm^3 or tonnes)
NCV_{WG}	net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)
β	share of total waste gases that is flared for safety reasons

Note that safety flaring and the fuel input to the production process could be covered by the same fuel benchmark sub-installation. In that case, the historical activity level would be:

$$HAL_{fuel} = Arithmetic\ mean_{BaselinePeriod}[Fuel_{process} - V_{WG} \times NCV_{WG} \times \alpha + Fuel_{SafetyFlaring} + V_{WG} \times NCV_{WG} \times \beta]$$

4.4 Summary of allocation methodologies in the case of waste gases

Table 1 summarises the allocation for waste gases production within or outside the system boundaries of a product benchmark and the various types of waste gas consumption.

Table 1: Summary of allocation approaches for waste gases produced and consumed within or outside the boundaries of a product benchmark

Production	**Consumption**	**Type of consumption**	**Allocation for production to *producer***	**Allocation for consumption to *consumer***
Inside system boundary of Product BM	Inside system boundary of Product BM	Product BM	Product BM	Product BM
		Safety flare	Product BM	N/A*
		Flare	Product BM, deduction of emissions from flared WG as of 2026	N/A*
	Outside system boundary of Product BM	Measurable heat	Product BM	Heat BM
		Non-measurable heat	Product BM	Fuel BM
		Safety flare	Product BM	N/A*
		Flare	Product BM, deduction of emissions from flared WG as of 2026	N/A*
		Electricity	Product BM	None
Outside system boundary of Product BM	Inside system boundary of Product BM	Product BM	Formula in Example 2*	Product BM
	Outside system boundary of Product BM	Measurable heat	Formula in Example 2*	Heat BM
		Non-measurable heat	Formula in Example 2*	Fuel BM
		Safety flare	None	Fuel BM
		Flare	None	None
		Electricity	Formula in Example 2*	None

*Flares and safety flares from waste gases produced within the system boundaries of a product benchmark, are already accounted for in the product benchmark. As of 2026, the emissions from flaring of waste gases for reasons other than safety flaring will be deducted from the allocation based of product benchmarks (see section on allocation relating to the production of the waste gas).

5. Case Studies

In this section, three case studies are presented:

- Example 1 is the extensive example detailed in 'UKETS11 FAR - Determining allocation at the installation level' and is presented here with a focus on the treatment of waste gases i.e. how to define the relevant sub-installations and the key data for operators to consider.
- Example 2 shows how to calculate the allocation when waste gases are produced within the boundaries of a benchmarked product. The example relates to an iron and steel plant that sells its waste gases to a third party that then uses the waste gases to produce both electricity and heat.
- Example 3 shows how to calculate the allocation when waste gases are produced outside the boundaries of a benchmarked product. The example relates to a chemical plant which uses part of the waste gases to produce electricity on site, sells part of the waste gases to a third party to produce heat, and flares the remainder.

5.1 Example 1 – Defining sub-installations linked to waste gases

In this example, a plant produces 3 products:

- P2, which is a benchmarked product
- P1 and P3 which are non-benchmarked products.

Each of these products consumes fuel and heat and produce waste gases (see Figure 8). The remainder of this section discusses:

- issue 1: waste gases produced in the production process of product P2
- issue 2: waste gases produced in the production processes of products P1 and P3
- issue 3: waste gases consumed within the installation to produce steam
- issue 4: waste gases flared
- issue 5: impact on the fuel benchmark sub-installation.

For further information on other aspects of this example, see section 7.3 of 'UKETS11 FAR - Determining allocation at the installation level'.

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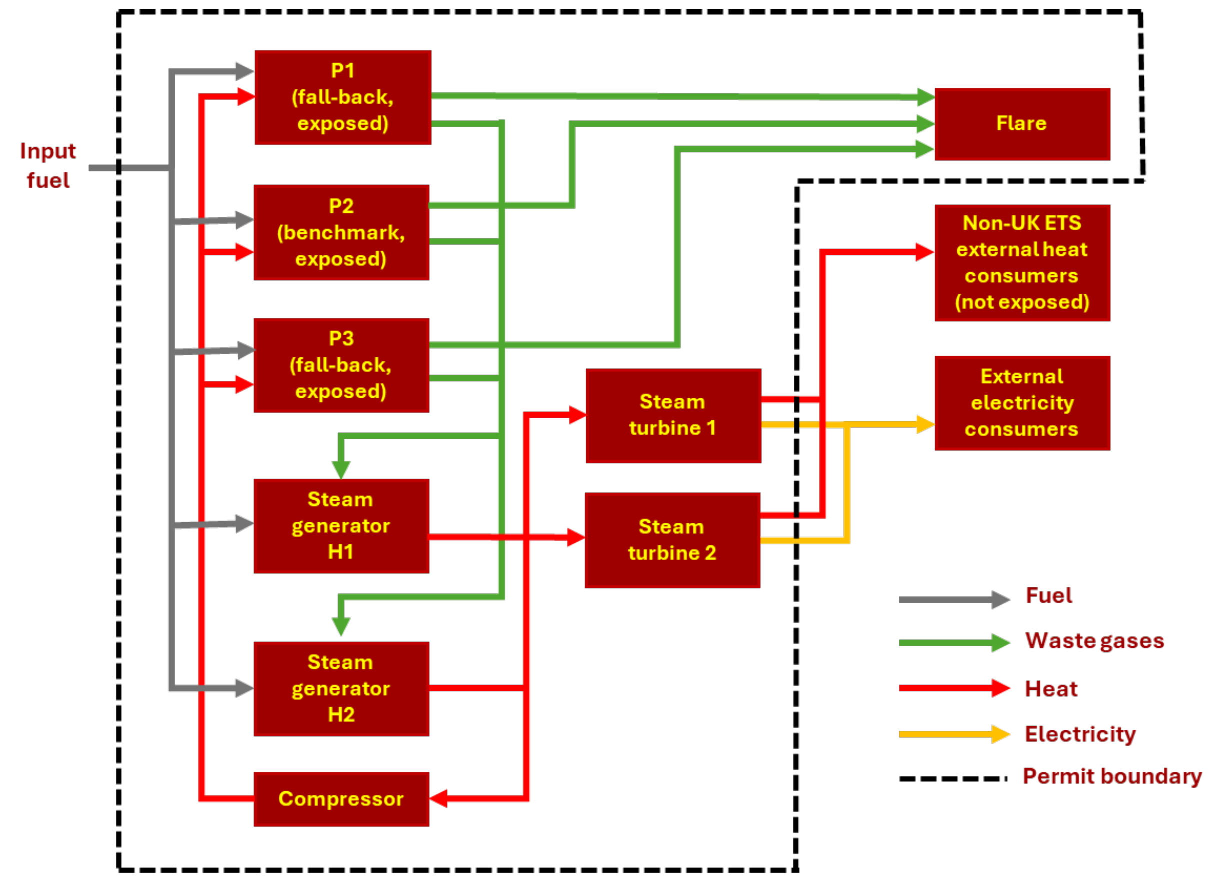

Figure 8: Example 1 - installation boundaries; raw material flows are not shown (e.g. carbon used as a reducing agent or for chemical synthesis)

Issue 1: waste gases produced in process P2

Product P2 is a benchmarked product. Therefore, allocation to the producer of waste gases is included within the P2 product benchmark (see Figure 9). Data relating to the waste gas will only be needed if the waste gas is ultimately flared for reasons other than safety flaring, as otherwise the allocation will only be based on P2 production data.

The preliminary allocation for this sub-installation from 2021 to 2025 is:

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

And from 2026, it will be:

$$F_{p,k} = (BM_p \times HAL_p - \ Em_{WGfl}) \times CLEF_{p,k}$$

With:

$$Em_{WGfl} = Arithmetic\ mean_{BaselinePeriod}(V_{WGfl} \times NCV_{WG} \times EF_{WG})$$

Where:

$F_{p,k}$ annual preliminary allocation for product p in year k (expressed in UKAs/year)

BM_p relevant product benchmark value (expressed in allowances/unit of product)

HAL_p historical activity level of the product benchmark sub-installation (expressed in unit of product)

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

Em_{WGfl} annual amount of emissions from flared waste gases during the relevant baseline period (expressed in tCO_2/yr)

V_{WGfl} volume of waste gas flared for reasons other than safety flaring (expressed in Nm^3 or tonnes)

NCV_{WG} net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)

EF_{WG} emission factor of the waste gas (expressed in TJ/Nm^3 or TJ/t)

Allocation to the consumer of waste gases produced by process P2 are discussed in issues 3 and 4.

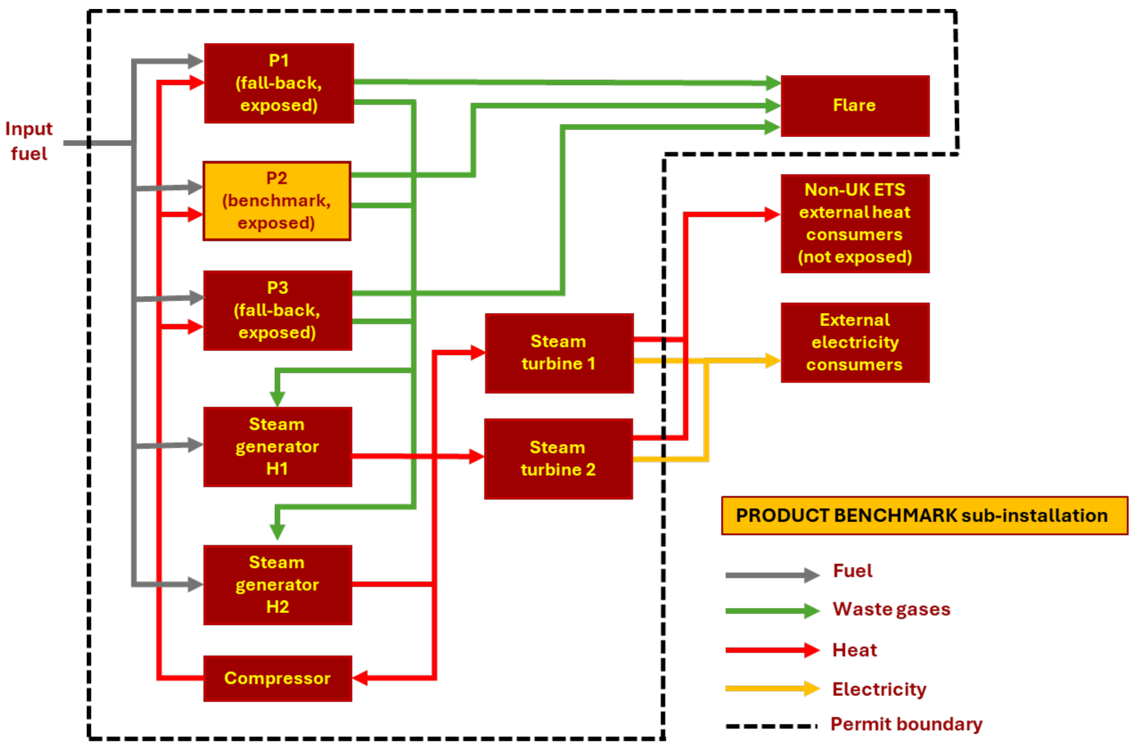

Figure 9: Example 1 - waste gases produced by P2 (highlighted process) are included in the product benchmark P2; raw material flows are not shown (e.g. carbon used as a reducing agent or for chemical synthesis)

Issue 2: waste gases produced in processes P1 and P3

P1 and P3 are not benchmarked products. Allocation for these processes is determined by considering the production of these waste gases as process emissions. It is then allocated to the consumer of these waste gases (steam gen H1 and H2, where the emissions occur). In this example, as the consumer is also the producer of the waste gas, the sub-installation will be part of the installation; if the waste gas had been sold to an ETS-installation, the latter installation would have received the allocation.

Waste gases from both P1 and P3 will be part of the same process emission sub- installation (see Figure 10). If additional and physically separate process emissions of type a or type b were emitted from within the boundaries of the installation, these would have been included in the process emissions sub-installation also.

The preliminary allocation of the process emissions sub-installation will be:

$$F_{i,k} = Reduction\ factor \times HAL \times CLEF_{i,k}$$

With:

$$HAL\ = Arithmetic\ mean_{BaselinePeriod}[V_{WG} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Corr_{\eta})]$$

Where:

$F_{i,k}$	annual preliminary allocation for sub-installation i in year k (expressed in allowances/yr)
$Reduction\ factor$	0.97
$CLEF_{i,k}$	applicable carbon leakage exposure factor for sub-installation i in year k
V_{WG}	volume of waste gas that is not flared (expressed in Nm^3 or tonnes)
NCV_{WG}	net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)
EF_{WG}	emission factor of the waste gas (expressed in tCO_2/TJ)
EF_{NG}	emission factor of natural gas (56.1 tCO_2/TJ)
$Corr_{\eta}$	correction factor to account for the technically usable energy content; compared to natural gas (for the use of electricity production, a default value of 0.667 can be used)

Allocation to the consumer of waste gases produced by processes P1 and P3 are discussed in issues 3 and 4.

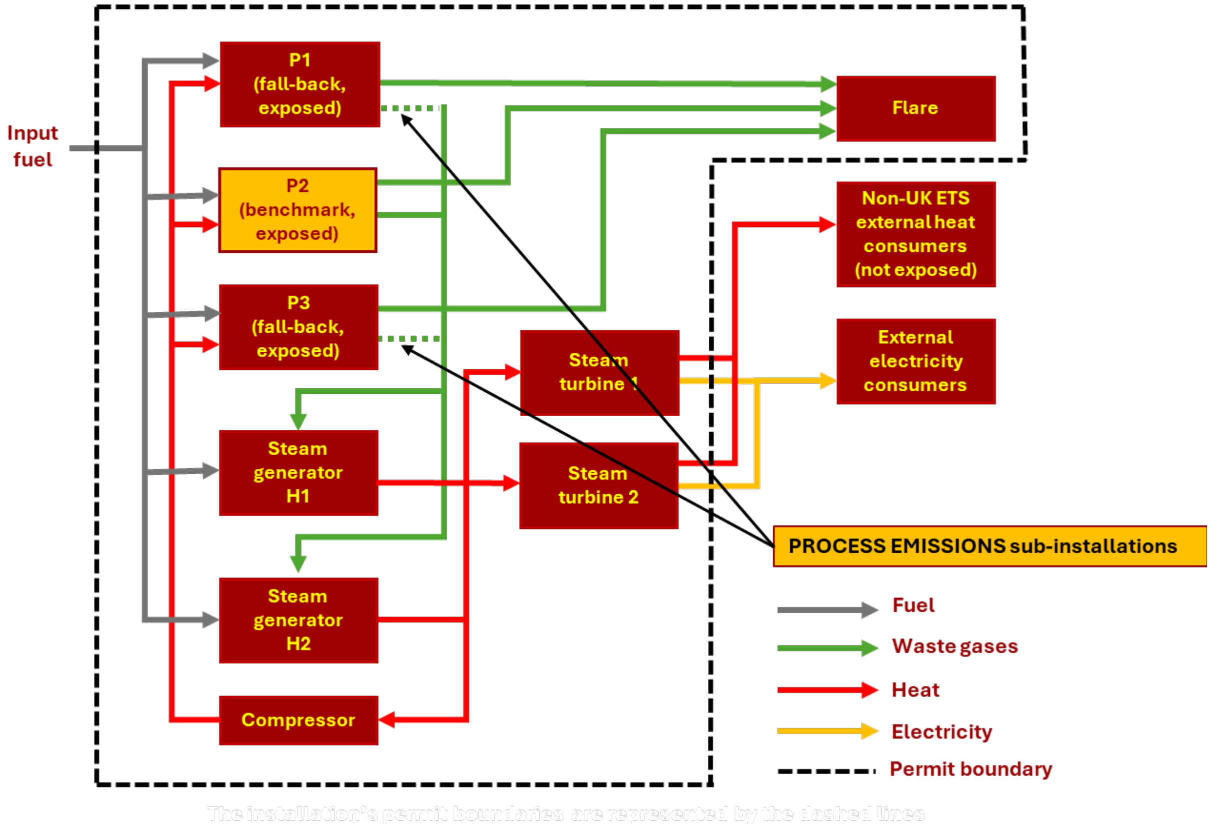

Figure 10: Example 1- waste gases from non-benchmarked products (P1 and P3) are included in a process emissions sub-installation.[6]

The allocation related to these process emissions goes to the waste gas consuming process (in this example: Steam gen H1 and H2 which are part of the same installation); Raw material flows are not shown (e.g. carbon used as a reducing agent or for chemical synthesis)

Issue 3: waste gases consumed within the installation to produce steam

The emissions linked to waste gases used to generate steam are covered under heat sub-installations under which allowances are allocated to the heat consumers. The data used to calculate the allocation is the arithmetic mean of the heat consumed over the baseline period by the relevant heat consumers (heat consumed to produce P1 and P3 in the case of the sub-installation in Figure 11, and heat exported to external heat consumers in the case of Figure 12). Heat is split between 2 heat BM sub-installations to take into account the different carbon leakage status of each sub-installation (see 'UKETS11 FAR - Determining allocation at the installation level' for further guidance).

[6] This refers to the 'production part' of the waste gases, see Figure 2 for more information.

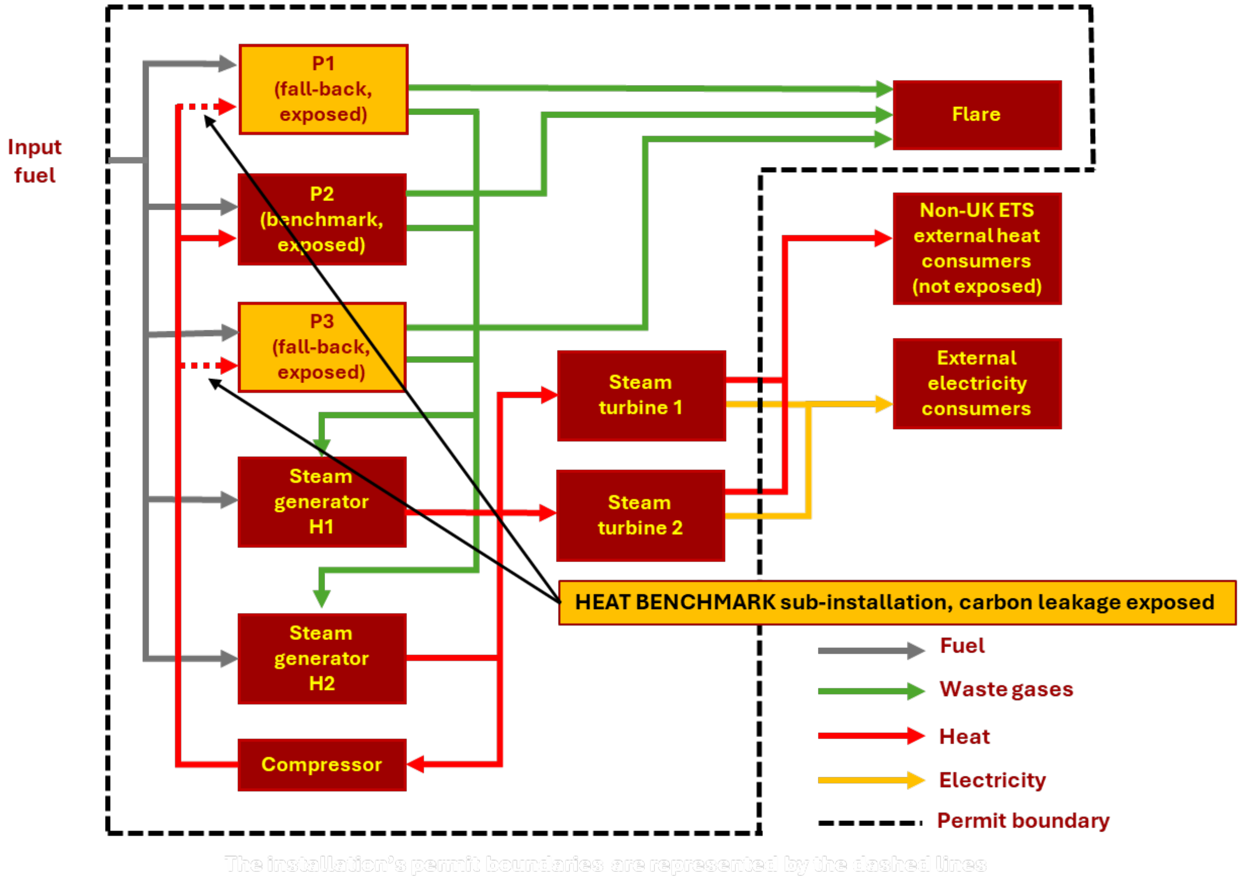

Figure 11: Example 1 - P1 and P3 receive allocation for consumed heat that was partially produced using waste gases; raw material flows are not shown (e.g. carbon used as a reducing agent or for chemical synthesis)

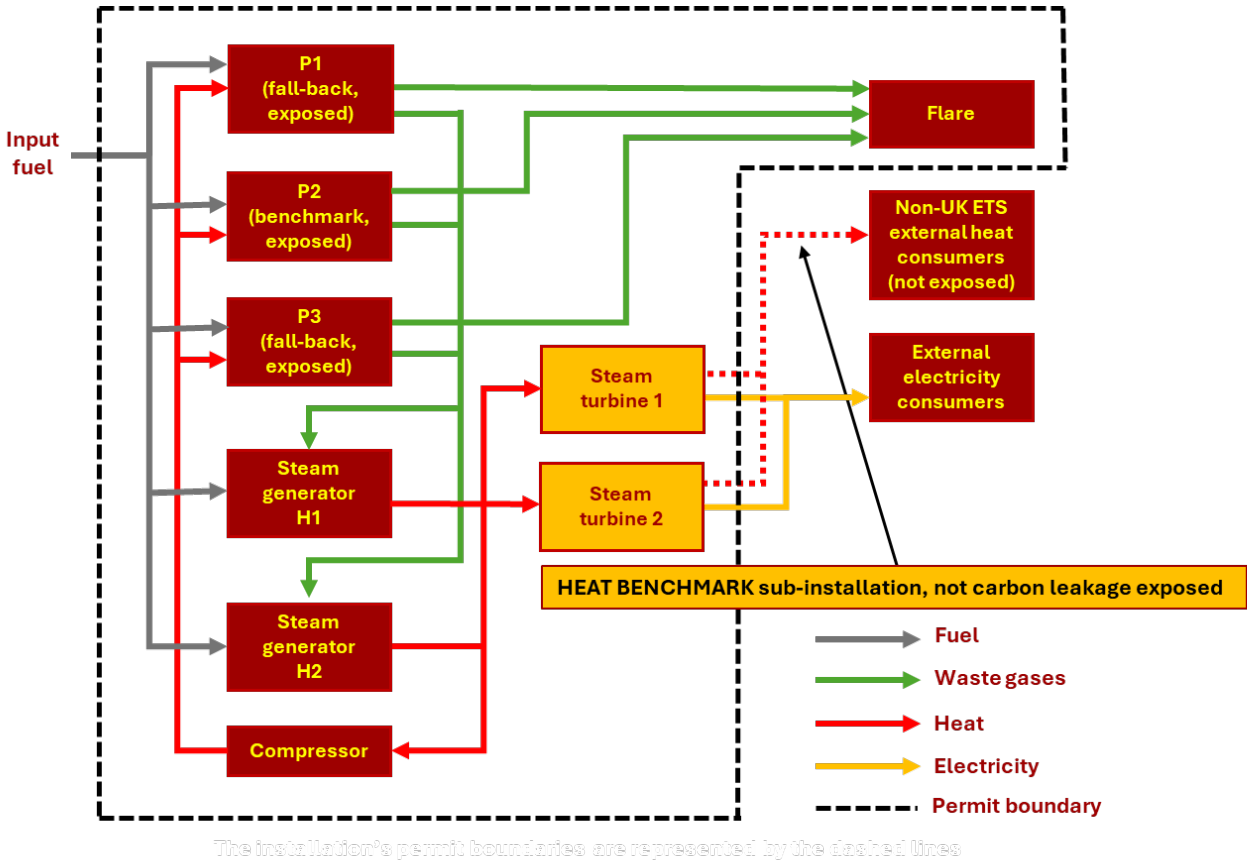

Figure 12: Example 1 - steam turbines 1 and 2 receive allocation for the heat exported to external non-ETS heat consumers; the exported heat was partially produced using waste gases; raw material flows are not shown (e.g. carbon used as a reducing agent or for chemical syntheses)

Issue 4: waste gases flared

Emissions from waste gases flared are not eligible for free allocation, unless the flaring meets the criteria for safety flaring (see section 2.2), in which case there will be an allocation.

Safety flaring of waste gases produced by processes P1 and P3 will be included in the fuel sub-installation of the plant (see issue 5). Safety flaring (and all flaring more generally) of waste gases produced by P2 is already accounted for in the product benchmark for P2 and is not eligible for free allocation under a fuel benchmark.

If waste gas flaring does not meet the criteria for safety flaring, then the amount of emissions corresponding to the share of flared waste gas produced by P2 needs to be deducted from the P2 product benchmark sub-installation as of 2026 (see issue 1).

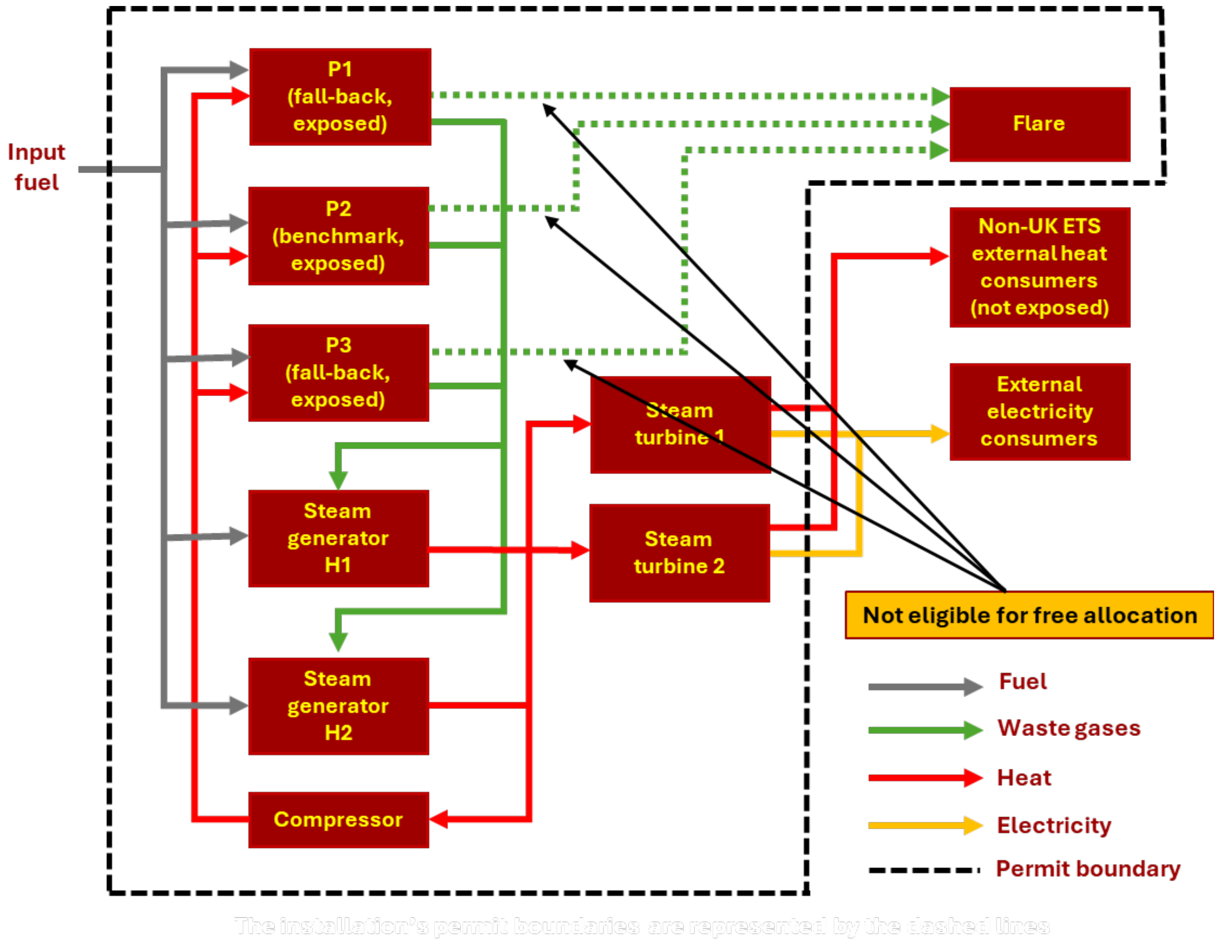

Figure 13: Example 1 – flaring (except for safety flaring) is not eligible for free allocation

Issue 5: impact on the fuel benchmark sub-installation

If any fuels used to produce P1 and P3 are converted into waste gases, they cannot be allocated to the fuel benchmark sub-installation (see Figure 14). Therefore, the preliminary allocation for the fuel sub-installation should be:

$$F_{fuel,k} = BM_{fuel} \times HAL_{fuel} \times CLEF_{fuel,k}$$

With:

$$HAL_{fuel} = Arithmetic\ mean_{BaselinePeriod}[Fuel_{process} - V_{WG} \times NCV_{WG} \times \alpha + Fuel_{SafetyFlaring} + V_{WG} \times NCV_{NG} \times \beta]$$

Where:

$F_{fuel,k}$	annual preliminary allocation for the fuel sub-installation in year k (expressed in allowances/yr)
BM_{fuel}	42.6 allowances/TJ
HAL_{fuel}	historical activity level of the fuel sub-installation
$CLEF_{fuel,k}$	applicable carbon leakage exposure factor for the fuel sub-installation in year k
$Fuel_{process}$	total amount of fuel consumed in production processes 1 and 3 excluding fuel used as a reducing agent or for chemical syntheses (expressed in TJ)
V_{WG}	total volume of waste gas exiting the production process (expressed in Nm^3 or tonnes)
NCV_{WG}	net calorific value of the waste gas (expressed in TJ/Nm^3 or TJ/t)
$Fuel_{SafetyFlaring}$	total amount of fuel necessary for safety flaring, i.e. the fuels necessary to keep a pilot flame running and fuels required to successfully combust the flared gas (expressed in TJ)
α	share of waste gases originating from the fuel
β	share of total waste gases flared in accordance with the definition of safety flaring.

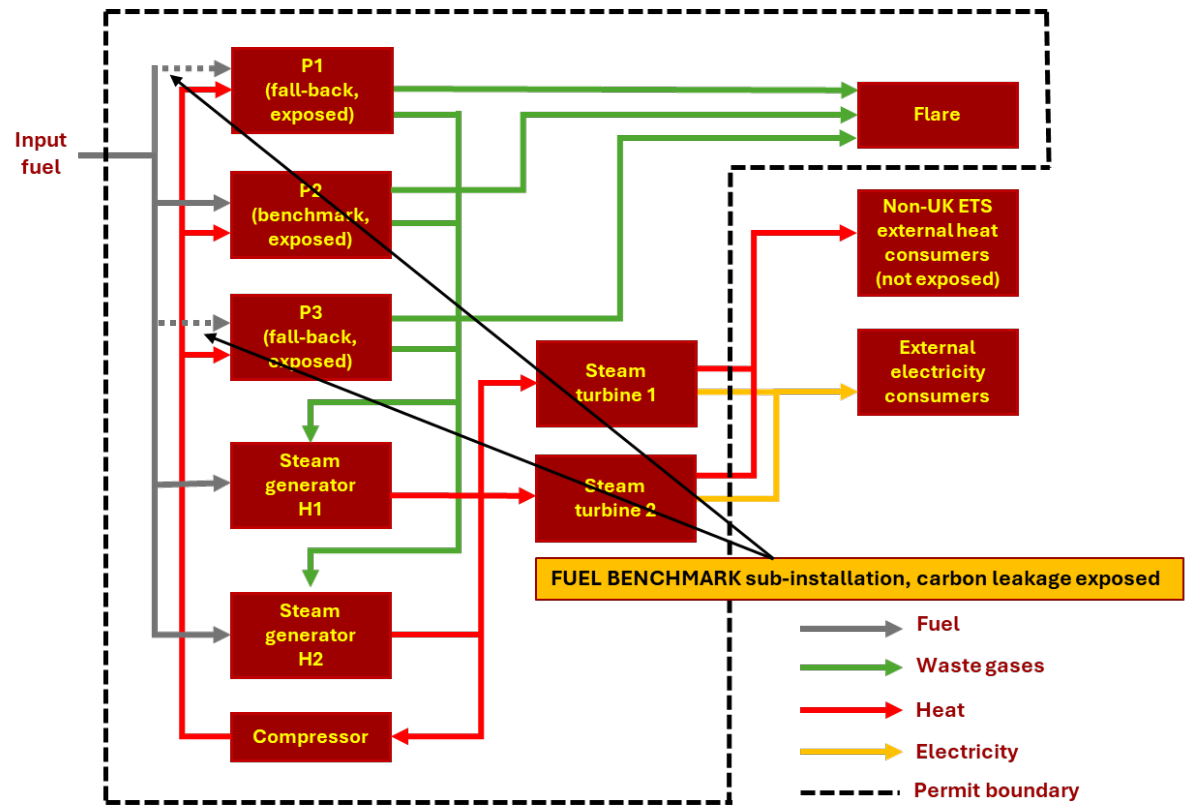

Figure 14: Example 1 – Fuel combusted in P1 and P2 is eligible for free allocation. This fuel benchmark sub-installation also includes any safety flaring of waste gases produced by P1 and P2, but excludes fuels that are converted into waste gases

5.2 Example 2 – Allocation in the case of a benchmarked product

In this example, an integrated steel plant:

- Uses part of its blast furnace gas (BFG) for under-firing the stoves
- Sells the remaining BFG to:
  - a power plant (covered by the UK ETS)
  - another installation covered by the UK ETS (plant A) using the BFG for heat production.
- Uses its coke oven gas (COG) for under-firing and flares the remaining amount (see Figure 15).

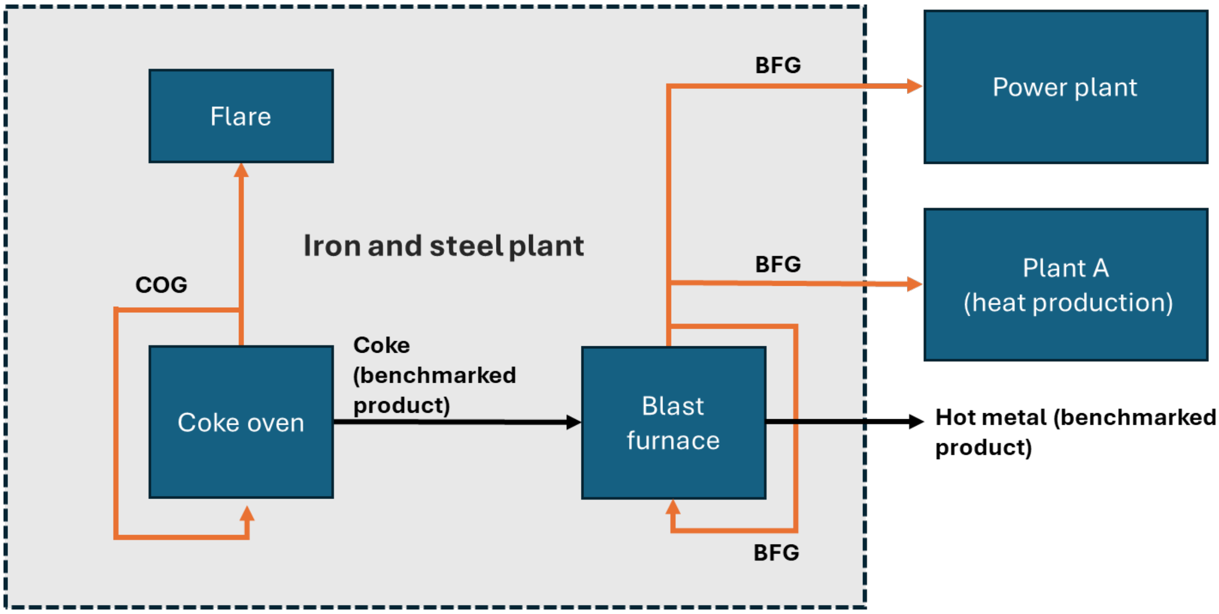

Figure 15: Example 2 – waste gases produced within a product benchmark

The preliminary allocation to the steel plant will be the following, regardless of whether the waste gas is used for direct or indirect heating, or for electricity production:

$$F_{inst,k} = BM_{hot\ metal} \times HAL_{hot\ metal} \times CLEF_{hot\ metal,k} + (BM_{coke} \times HAL_{coke} - Em_{COGfl}) \times CLEF_{coke,k}$$

With:

Until 2025: $Em_{COGfl} = 0$

From 2026: $Em_{COGfl} = Arithmetic\ mean_{BaselinePeriod}(V_{COGfl} \times NCV_{COG} \times EF_{COG})$

Where:

$F_{inst,k}$	annual preliminary allocation for the installation in year k (expressed in allowances/year)
$BM_{hot\ metal}$	1.288 allowances/t hot metal
$HAL_{hot\ metal}$	historic activity level i.e. the arithmetic mean production of hot metal over the baseline period
$CLEF_{hot\ metal,k}$	applicable carbon leakage exposure factor for the hot metal sub-installation in year k
BM_{coke}	0.217 allowances/t coke
HAL_{coke}	historic activity level i.e. the arithmetic mean production of coke over the baseline period
$CLEF_{coke,k}$	applicable carbon leakage exposure factor for the coke sub-installation in year k
Em_{COGfl}	annual amount of emissions from flared COG during the second baseline period (expressed in tCO_2/yr)
V_{COGfl}	volume of COG flared for reasons other than safety flaring (expressed in Nm^3 or tonnes)
NCV_{COG}	net calorific value of the COG (expressed in TJ/Nm^3 or TJ/t)
EF_{COG}	emission factor of the COG (expressed in tCO_2/TJ)

The preliminary allocation to Plant A relating to its heat consumption (including heat produced from the waste gases) will be the following, assuming that Plant A produces heat used to produce non-benchmarked products or for export to non-UK ETS consumers:

$$F_{A,k} = BM_{heat} \times HAL_{heat} \times CLEF_{A,k}$$

Where:

$F_{A,k}$	annual preliminary allocation for Plant A in year k (expressed in allowances/year
BM_{heat}	47.3 allowances/TJ
HAL_{heat}	historic activity level i.e. the arithmetic mean heat consumption of Plant A over the baseline period expressed in TJ
$CLEF_{A,k}$	applicable carbon leakage exposure factor for the product produced in Plant A using the imported heat, in year k.

There will be no free allocation for the power plant.

5.3 Example 3 – Allocation in the case of a non-benchmarked product

In this example, a chemical plant not covered by a product benchmark:

- Uses part of its waste gases to produce electricity onsite
- Sells part of its waste gases to another UK ETS installation (Plant B) for heat production
- Flares the remaining waste gases.

The above situation is illustrated in Figure 16 below.

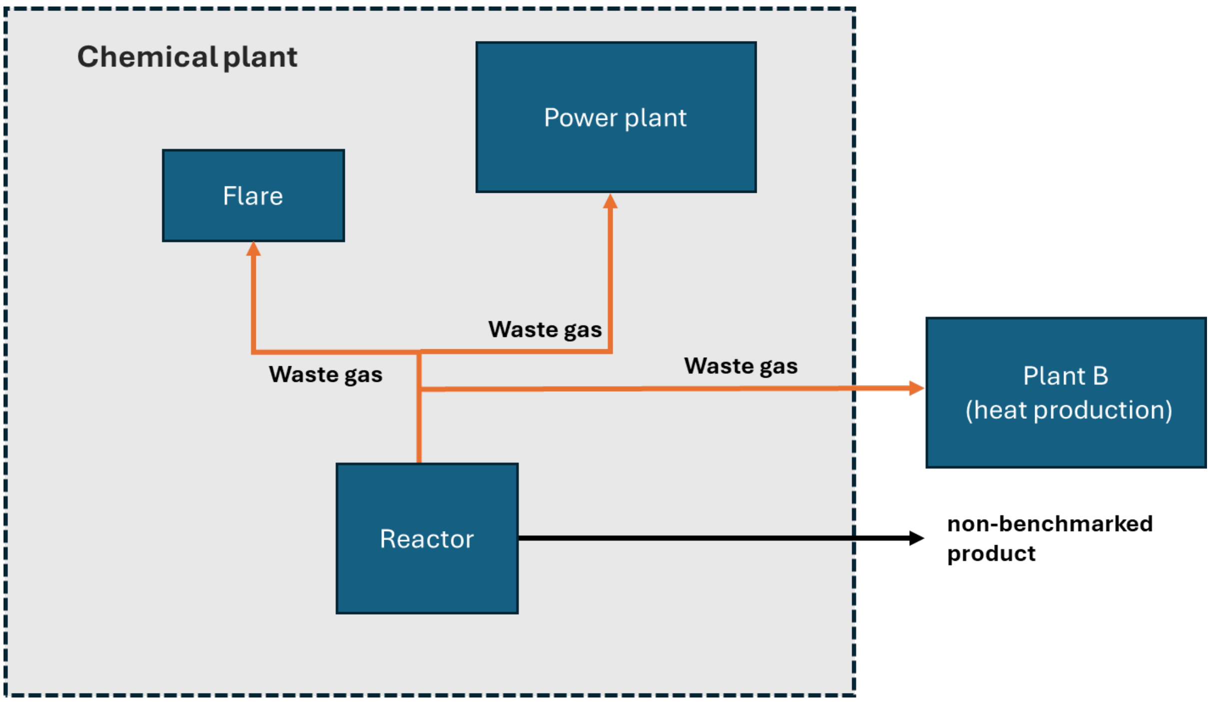

Figure 16: Example 3 – waste gases produced outside the boundaries of a product benchmark

In this case, operators must ensure that the allocation for waste gas produced is split between the chemical plant (that uses its own waste gas) and the external user of the waste gas (plant B).

The preliminary allocation for the chemical plant relating to waste gas produced will be the following, taking into account all non-flared waste gas, regardless of whether it is used for direct or indirect heating, or for electricity production:

$$F_{i,k} = 0.97 \times Arithmetic\ mean_{BaselinePeriod}[V_{WG,Chemical\ Plant} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Corr_{\eta})] \times CLEF_{i,k}$$

Where:

$F_{i,k}$	annual preliminary allocation for sub-installation i in year k (expressed in allowances/year)
$V_{WG,Chemical\ Plant}$	non-flared volume of waste gas in Nm^3 or tonnes used internally in the chemical plant
NCV_{WG}	net calorific value of the waste gas in TJ/Nm^3 or TJ/t
EF_{WG}	emission factor of the waste gas in tCO_2/TJ
EF_{NG}	emission factor of natural gas (= 56.1 tCO_2/TJ)
$Corr_{\eta}$	factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel (natural gas)
$CLEF_{i,k}$	applicable carbon leakage exposure factor for sub-installation i in year k

The chemical plant will get no free allocation for using waste gases to produce electricity, nor any allocation for waste gases flared, except if they are flared for safety reasons. When safety flaring occurs, an additional allocation will be given to the chemical plant and included in its fuel benchmark sub-installation *(not presented here)*.

The preliminary allocation to Plant B[7] (external waste gas consumer) relating to waste gas produced will be the following, taking into account all non-flared waste gas, regardless of whether it is used for direct or indirect heating, or for electricity production:

$$F_{B,WG,k} = 0.97 \times Arithmetic\ mean_{BaselinePeriod}[V_{WG,Plant\ B} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Corr_{\eta})] \times CLEF_{B,k}$$

[7] In this example, Plant B is covered by the UK ETS. If that were not the case, then there would be no free allocation for this part of the waste gas production.

Where:

$F_{B,WG,k}$ annual preliminary allocation for Plant B for the producer part of the waste gases in year k (expressed in allowances/year)

$V_{WG,Plant\ B}$ non-flared volume of waste gas in Nm^3 or tonnes used in Plant B

NCV_{WG} net calorific value of the waste gas in TJ/Nm^3 or TJ/t

EF_{WG} emission factor of the waste gas in tCO_2/TJ

EF_{NG} emission factor of natural gas (= 56.1 tCO_2/TJ)

$Corr_\eta$ factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel (natural gas)

$CLEF_{B,k}$ applicable carbon leakage exposure factor for the product produced by Plant B in year k

In addition to the allocation for the production of the waste gas, Plant B will also get allocation for the heat produced based on the combustion of the waste gases (and possibly other fuels, not presented in Figure 16). The preliminary allocation to Plant B relating to its heat consumption (including heat produced from the waste gases) will be the following:

$$F_{B,H,k} = BM_{heat} \times HAL_{B,H} \times CLEF_{B,k}$$

$$F_{B,H,k} = BM_{heat} \times HAL_{B,H} \times CLEF_{B,k}$$

Where:

$F_{B,H,k}$ annual preliminary allocation for Plant B for the consumer part of the waste gases (based on the heat benchmark) in year k (expressed in allowances/year

BM_{heat} 47.3 allowances/TJ

$HAL_{B,H}$ historic activity level i.e. the arithmetic mean heat consumption of Plant B for the measurable heat produced from the waste gases over the baseline period and consumed on-site or exported (expressed in TJ)

$CLEF_{B,k}$ the applicable carbon leakage exposure factor for the product produced in Plant B with the imported heat, in year k.

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