Carbon Border Adjustment Mechanism (CBAM) Monitoring, Reporting and Verification Technical Guidance: for installations, verifiers and accreditation bodies.

Send us your feedback on this technical guidance

This technical guidance provides supplementary information on the monitoring, reporting and verification requirements for the UK Carbon Border Adjustment Mechanism (CBAM). We're still working to improve this content and will be updating the guidance as necessary to reflect further technical analysis and stakeholder feedback.

You can send technical feedback on this guidance to cbampolicyteam@hmrc.gov.uk, with 'MRV technical guidance feedback' in the subject line until November 13th 2026.

We will consider all feedback received and may make further updates before 1st January 2027.

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A1.0 Summary

The Carbon Border Adjustment Mechanism (CBAM) will ensure highly traded, carbon intensive products imported from jurisdictions outside the United Kingdom (UK) face a comparable carbon price to that paid by UK manufacturers.

This is intended to ensure decarbonisation efforts in the UK lead to a true reduction in global emissions rather than simply shifting emissions overseas (known as carbon leakage).

From 1 January 2027, CBAM applies to specified goods in the following sectors:

- Aluminium;
- Cement;
- Fertiliser;
- Hydrogen;
- Iron and steel.

CBAM liability is based on the embodied emissions of imported CBAM goods, measured in tonnes of carbon dioxide equivalent (tCO_2e). The importer can either:

- report actual emissions data (emissions intensity) to HM Revenue and Customs (HMRC); or
- rely on default emissions values (DVs).

For actual emissions data to be used, the installation that produces the CBAM goods must monitor emissions and arrange for them to be independently verified in line with the CBAM requirements. The installation must then provide the importer with a verification report.

The CBAM Monitoring, Reporting and Verification (MRV) framework is closely aligned with the MRV requirements used in the UK Emissions Trading Scheme (UK ETS).

This guidance is part of a collection of CBAM guidance documents. It is intended for those operators manufacturing and importing CBAM goods into the UK, but it may also be of interest to other operators and verifiers involved in the MRV of emissions from stationary installations.

This guidance explains how to determine and verify emissions associated with the manufacture of CBAM goods. While it does not create any additional legal obligations beyond those set out in the legislation, it is intended to support consistent interpretation and application of CBAM requirements.

B2.0 Introduction

B2.1 About this document

This guidance explains the CBAM MRV requirements for:

- installation operators;
- verifiers;
- accreditation bodies.

Those who import CBAM goods into the UK should refer to the guidance for importers which can be found at the following link: https://www.gov.uk/government/collections/carbon-border-adjustment-mechanism

B2.2 How to use this guidance

This guidance is divided into sections, depending on your role.

B2.2.1 For operators

Section C3.0: Quick guide for operators

This section provides an overview of the CBAM requirements for operators manufacturing CBAM goods that are to be imported into the UK. It also includes links to other sections of the guidance which contain more detailed information.

Operators are encouraged to read this section to gain an understanding of the key monitoring and reporting obligations.

Section D4.0: How to monitor and report emissions

This section provides the monitoring and reporting requirements that apply to operators. It also covers:

- monitoring plans;
- monitoring methodologies;
- acceptable reasons for deviating from a monitoring methodology, including unreasonable cost or technical feasibility.

Section E5.0: Sector specific monitoring

This section provides detailed guidance for each CBAM sector. Each section includes:

- sector-specific monitoring requirements;
- reporting requirements;

- worked examples.

B2.2.2 For verifiers and accreditation bodies

Section F6.0: Accreditation and verification

This section explains:

- accreditation requirements for verification bodies;
- the verification process;
- the responsibility of verifiers;
- the reports and documentation that verifiers must complete.

B2.2.3 Annexes

The annexes contain:

- emissions reporting templates;
- verification reporting templates;
- unreasonable cost templates;
- definitions;
- abbreviations;
- commodity codes for each CBAM sector.

B2.3 Reference Documentation

This guidance only explains the MRV requirements for CBAM. It should be read alongside the following documents:

- Finance Act 2026 - this is the primary legislation for CBAM. The CBAM is covered in Part 5 and in Schedule 16, Schedule 17, Schedule 18 and Schedule 19 of the Act;
- The Carbon Border Adjustment Mechanism (Administrative Provisions) Regulations 2026 – this secondary legislation sets out administrative provisions for CBAM;
- The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 – this secondary legislation sets out the process for the determination of emissions and the verification process for CBAM goods;
- Carbon Border Adjustment Mechanism: System boundaries document (referenced throughout this guidance as 'system boundaries document') – this secondary legislation is a reference document which details the system boundaries for CBAM goods;
- The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB) (referenced throughout this guidance as 'force of law notice')– this tertiary legislation sets out further details of the MRV requirements for CBAM goods.

This guidance does not replace the legislation or the notices listed above. It

explains the MRV requirements that apply to those CBAM goods that are to be imported into the UK and is intended to help operators, verifiers and accreditation bodies understand the requirements to be met for actual emissions values to be used for CBAM goods.

Unless otherwise stated, references in this guidance are to other sections of this document. References to legislation, notices or other guidance documents are clearly identified.

B2.4 Roles and responsibilities

B2.4.1 Importers (liable persons)

The importer of the CBAM goods into the UK is usually the liable person for CBAM.

The liable person is responsible for:

- registering for CBAM;
- submitting CBAM returns to HMRC: this includes reporting the emissions data in the form of emissions intensity;
- paying any CBAM liability due;
- keeping the records required under CBAM legislation.

The first CBAM accounting period runs from 1 January 2027 to 31 December 2027. Further information on accounting periods and returns can be found in section C3.7.1 and section C3.7.2.

B2.4.2 Operators

Operators are those organisations that produce goods which are to be imported into the UK.

The operator is responsible for:

- monitoring emissions associated with the goods they produce;
- determining the embodied emissions of those goods;
- maintaining a monitoring plan and supporting records;
- obtaining information on relevant precursor goods where required;
- appointing a verifier;
- obtaining verification reports;
- providing emissions information to customers and importers (the liable person) who require it for their CBAM obligations.

The operator will have direct access to the information needed to emissions from its own production processes. Where relevant precursor goods are used, additional information may need to be obtained from the producer of those goods.

The term operator is used throughout section C3.0, section D4.0 and section E5.0 of this guidance.

B2.4.3 Verifiers

Independent verifiers are responsible for:

- assessing whether emissions information has been determined in line with CBAM requirements;
- verifying emissions information;
- producing verification reports.

Verification reports will be required by importers to support their CBAM obligations.

The term verifier used throughout section F6.0 of this guidance.

C3.0 Quick guide for operators

This section provides an overview of the CBAM requirements for operators that produce CBAM goods that are to be imported into the UK.

Reading this section first will help operators understand the key monitoring and reporting obligations.

C3.1 What is CBAM?

CBAM is designed to ensure importers of certain goods face a carbon price that is comparable to the carbon price paid by UK producers of the same goods under the UK ETS. This supports the UK's transition to net zero and helps reduce the risk of carbon leakage, where production moves overseas to jurisdictions with lower carbon costs.

CBAM applies to specified goods in the following sectors:

- Aluminium;
- Cement;
- Fertiliser;
- Hydrogen;
- Iron and steel.

This includes certain precursor goods and finished goods, with those goods in scope referred to as CBAM goods.

A full list of CBAM goods can be found in:

- Schedule 16 of the Finance Act 2026;
- Annex VII of this guidance.

CBAM applies to goods imported into the UK from 1 January 2027.

C3.2 Does the operator produce CBAM goods?

If an operator manufactures goods in the sectors listed above, they will need to determine whether any of the goods they manufacture falls within the scope of CBAM.

To check whether the goods they manufacture are in the scope of CBAM, they will need to compare them against the commodity codes found in the following:

- Schedule 16 of the Finance Act 2026;
- Annex VII of this guidance.

The operator who manufactures CBAM goods should:

- compile a list of all goods and precursor goods in the sectors listed above produced at their installation;
- compile a list of any precursor goods obtained from outside the installation and used in the production processes;
- identify the relevant commodity codes for each good and precursor good;
- compare the commodity codes against Schedule 16 of the Finance Act 2026 or Annex VII of this guidance.

By undertaking the above, it allows the operator to identify the goods that fall under the requirements of CBAM. If the goods produced by an operator do not fall within the CBAM commodity codes, CBAM does not apply to those goods.

Note: In some cases, the same CBAM commodity code can apply both to a finished good produced by the installation and to a precursor good used in its production. This could arise, for example, in the iron and steel, aluminium, and fertiliser sectors.

C3.3 Are your goods imported into the UK?

CBAM will apply to specified goods that are imported into the UK on or after 1 January 2027, where the importer meets or exceeds the £50,000 minimum registration threshold over a 12-month period.

If CBAM goods are used by another manufacturer to produce other CBAM goods, they will be treated as precursor goods. If those CBAM goods are imported into the UK, the emissions from these precursor goods will need to be included in the emissions of the final CBAM good.

If CBAM goods are imported into the UK, either directly or as precursor goods, importers of the CBAM goods may ask for information about the actual emissions associated of the goods intended to be imported.

C3.4 How do I use commodity codes for CBAM purposes?

The CBAM commodity codes define which goods are within scope of CBAM.

Commodity codes comprise of two parts:

- a numerical 4, 6 or 8-digit numbering system – this reflects different levels of product disaggregation;
- a short text description of each product category giving its essential characteristics.

The first 6 digits are identical to the Harmonised System used in

international trade. Further detail on the Harmonised System can be found via the following link: https://www.gov.uk/trade-tariff. The remaining 2 digits are UK specific additions. Full details of the CBAM commodity codes can be found in:

- Schedule 16 of the Finance Act 2026;
- Annex VII of this guidance.

C3.5 What are embodied emissions?

CBAM liability is based on the embodied emissions of imported CBAM goods into the UK which is measured in tonnes of carbon dioxide equivalent (tCO_2e). The embodied emissions of imported CBAM goods are the emissions intensity multiplied by the weight of the imported CBAM goods.

Embodied emissions include:

- direct emissions from the production processes producing the CBAM goods; and
- emissions embodied in relevant precursor goods used to produce the CBAM goods.

CBAM only covers direct emissions, with the relevant gases in scope being carbon dioxide (CO_2), nitrous oxide (N_2O), tetrafluoromethane (CF_4), and hexafluoroethane (C_2F_6). These gaseous emissions are subsequently converted to tCO_2e for reporting purposes. CBAM does not include indirect emissions that are associated with the use of electricity.

More information on calculating embodied emissions can be found in section D4.2.4.

C3.6 What is the emissions intensity?

Emissions intensity represents an amount of CO_2, or CO_2e, embodied within a quantity of a CBAM good, expressed per tonne or functional unit. Where the liable person chooses to use actual emissions data, the operator will need to provide information on the emissions intensity of goods produced that are either imported directly into the UK or used as a precursor good in the production of other CBAM goods.

C3.7 How are emissions reported to the UK government?

The operator producing CBAM goods will not be required to report emissions directly to HMRC. Only the liable person is required to report information to HMRC, and this will be in the form of submitting a CBAM tax return. The importer can either use actual embodied emissions or rely on

default values. The following information (through to C3.8.7.2) sets out requirements for using actual embodied emissions.

The operator provides the importer with the relevant data by providing them with a verification report or summary verification report.

Where the liable person chooses to use the actual emissions data, they must report the emissions intensity of the imported CBAM goods in their tax return so that HMRC can calculate the embodied emissions (tCO_2e).

There is a choice of which monitoring period (as set out in the following section) that the verified emissions intensity reported to HMRC can be sourced from, but these must be one calendar year.

C3.7.1 Obligations impacting the importer (liable person)

Where the CBAM good is imported into the UK before 1 January 2028, the liable person (importer) can use a verified emissions intensity from either:

- the calendar year in which the good was imported or the preceding calendar year; or
- the calendar year monitoring period that the CBAM good was produced.

The importer will need to submit their return for the CBAM goods imported in 2027 by 31 May 2028.

Where CBAM goods are imported into the UK from 1 January 2028, the liable person can use an emissions intensity from the monitoring period from either:

- the most recent calendar year for which there are verified emissions from the two calendar years preceding the calendar year in which the good was imported; or
- the calendar year monitoring period that the CBAM good was produced.

For CBAM goods imported from 1 January 2028, the liable person will be required to submit quarterly tax returns.

C3.7.2 How the liable person's obligations impact the operator

If the liable person (importer) chooses to use actual emissions data for the goods produced, they must report the emissions intensity of the imported CBAM good in their tax return so that HMRC can calculate the embodied emissions (tCO_2e).

For CBAM goods imported before 1 January 2028, the operator will need to either:

- provide the liable person with a verification report from the monitoring period of either 2026 or 2027; or
- provide the liable person with a verification report from the monitoring period in the goods were produced.

For CBAM goods imported from 1 January 2028, the operator will need to either:

- provide the liable person with the most recent verification report to the date of import – it cannot be over two calendar years old prior to year of import. For example:
  - if the CBAM good is imported in 2029, and there is a verification report from 2028, this needs to be provided to the liable person;
  - if the CBAM good is imported in 2029 and there is no verification report for 2028, a verification report for 2027 can be provided; or
- provide the liable person with a verification report from the monitoring period in which the CBAM good was produced.

The operator will need to provide the liable person with their first verification report for the CBAM goods imported in 2027 before 31 May 2028.

C3.8 The monitoring of emissions

It is recommended that the operator undertake the following steps when developing the monitoring plan.

C3.8.1 Step 1: Define the production processes

The “production process” means the chemical or physical processes carried out in parts of an installation where goods are produced under a CBAM aggregated goods category. The system boundaries refer to the inputs, outputs, and corresponding emissions during the manufacture of these specific CBAM goods.

Guidance on system boundaries can be found in section D4.4 and for each CBAM sector within section E5.0.

C3.8.2 Step 2: Understand the monitoring period

The monitoring period for the emissions from the manufacture of CBAM goods is one calendar year.

C3.8.3 Step 3: Identify the parameters to be monitored:

C3.8.3.1 Measuring direct emissions

When measuring direct emissions from the manufacture of CBAM goods, there are two methodologies that can be applied:

1. **Calculation-based** approach – where emissions are determined on the quantities of all fuels and relevant materials consumed, together with the corresponding "calculation factors" (or "emission factors") based on the carbon content of the fuel or material.

2. **Measurement-based** approach – where emissions are determined on the measure of the concentration of the greenhouse gases in addition to the flow of the flue gas for each emission stack (known as an "emission source").

The rules for monitoring the direct emissions can be found in section D4.6.

C3.8.3.2 Direct emissions relating to heat flow

Heat consumption (both the heat produced within the installation or the heat received from an external source) will need to be attributed to each production process.

The rules on the determination of the emission factor for heat can be found in section D4.8 (particularly section D4.8.1 to section D4.8.4).

C3.8.3.3 Precursors

A precursor good is a CBAM good used in the production of another CBAM good which is identified in the system boundaries document.

The rules for monitoring precursor related data can be found in section D4.9.2.

If an operator uses precursor goods which are produced in the UK, the emissions associated with these precursor goods are exempt from CBAM. Therefore, when calculating the embodied emissions, the emissions for these UK produced precursors do not need to be included in the calculation. Further information on UK produced precursor goods can be found in Section 147(3) of the Finance Act 2026.

C3.8.3.4 Additional qualifying parameters

There will be additional qualifying parameters that the liable person (the

importer) will require to assist them in reporting the required information to HMRC as part of their CBAM tax return. This additional information will be dependent on the CBAM goods produced.

For example:

- for the import of cement, the total clinker content will need to be reported;
- for mixed fertilisers, the content of the different forms of nitrogen will need to be reported.

Further details on the required data for the above CBAM goods can be found in section E5.1 and section E5.3.

C3.8.4 Step 4: choosing monitoring methodologies

The operator will need to select the appropriate method to determine the emission from the manufacture of CBAM goods. This includes:

- calculation-based approaches;
- measurement-based approaches;
- use of default values, where permitted.

C3.8.4.1 Quantities of fuels and materials

For the quantities of fuels and materials (including precursors) that are used during the manufacture of CBAM goods, the operator will need to:

- have measurement instrumentation to provide details on how much has been consumed during the reporting period (for example: weighing belts, flow meters, heat meters);
- determine the amount of material used via purchase records and stock measurements that are taken at the end of each reporting period.

Where precursor goods are used, the operator will also need to determine the quantity of those goods consumed in the production process.

C3.8.4.2 Calculation Factors

For calculation factors, the options that are available to the operator can be found in section D4.6.1.5.

C3.8.4.3 Continuous emissions measurements

For continuous emission measurements (CEMS), the instrumentation to be used will need to be defined. This also includes the applicable calibration and maintenance process for this equipment. This information will need to be documented and should be included in the monitoring plan.

C3.8.4.4 Data gaps

Where there are data gaps, it will be necessary to define an estimation methodology, or a method based on known correlations of the measurement parameters.

If no other methods are available for the monitoring of the embodied emissions, and in cases where the producer of precursor goods does not provide the data, in these cases default values for the embodied emissions of the CBAM goods can be used. Default values can be found in Prepare for the Carbon Border Adjustment Mechanism (CBAM) - GOV.UK and further guidance on their use can be found in section D4.10.

C3.8.4.5 Choosing between methodologies

There will be occasions where there will be a choice of different monitoring methodologies that can be used. In these cases, the force of law notice (ODT, 344KB) contains provisions in Section A4 on how to select the most accurate data source.

Further details on this can also be found in section D4.5.

C3.8.5 Step 5: Create a monitoring plan

The monitoring methodology to be used for all the materials or emission sources that need to be followed to comply with the rules of CBAM must be documented within a monitoring plan. This document allows the same methodology to be applied consistently over the coming years.

The monitoring plan must explain:

- what is monitored;
- how data is collected;
- which monitoring methodologies are used;
- how data quality is checked;
- how emissions are calculated and reported.

The monitoring plan should be clear and transparent and contain sufficient details to serve as instructions to the responsible persons who perform the necessary CBAM tasks. It will also aid the understanding of CBAM within the installation and for verifiers who will be verifying the emissions from the manufacture of CBAM goods. Due to this difference in audience, it may be useful to include diagrams within the monitoring plan.

Further information on monitoring plans can be found in section A.6 of the force of law notice (ODT, 344KB) and in section D4.5.

The monitoring plan must include control measures covering the data flow from the primary data to the final embodied emissions. These control measures are to ensure errors within the data are minimised.

More information on this can be found in section D4.5.7.

C3.8.6 Step 6: Monitor emissions and maintain records

Installation operators must:

- monitor emissions and activity data throughout the reporting period;
- maintain relevant records;
- regularly review the monitoring plan to ensure it remains accurate and up to date.

At the end of the reporting period, operators must:

- calculate the emissions intensity associated with the CBAM goods produced;
- provide the required information to customers (for example liable persons or those manufacturers using the operator's goods in the production of their CBAM goods) who need to use the information to meet their CBAM obligations.

Further guidance can be found in sections D4.0 and in section E5.0.

C3.8.6.1 Stocktake and sampling

The steps above are to prepare the installation who manufacturer CBAM goods and the responsible person within the installation for the monitoring requirements of the CBAM. There will be tasks that will need to be performed throughout the year (for example on a daily, weekly, monthly or annual basis or as required) to determine the:

- quality of fuels and materials consumed;
- sampling of fuels or materials for analysis;
- completion of maintenance activities;
- control and calibration of measuring instruments etc.

C3.8.6.2 Data collection

The operator must:

- collect all the relevant data;
- calculate the emissions of the goods produced;
- perform all relevant quality control and assurance measures as stated in the monitoring plan.

C3.8.6.3 Review

At least once per monitoring period, a review must be completed across the whole monitoring plan. The aim of this review is to establish if the monitoring plan is still accurate to reflect the activities carried out at the installation and for the goods produced.

Further guidance can be found in section D4.5.7.

C3.8.6.4 Data management

Where there are changes at the installation, or improvements made to the monitoring plan, document controls procedures must be in place to ensure the latest version of the monitoring plan is used.

Where applicable, independent verification, such as under ISO 14001 or an emissions trading scheme (for example EU ETS) will help to identify areas for improvement. To reduce the risk of data transfer errors, the operator can consider using a standard template when sharing CBAM information with customers.

This can improve consistency, particularly where information is requested by multiple organisations or by customers operating in different languages.

C3.8.7 Step 7: Understand the liable person's reporting requirements

An operator is not required to report emissions directly to HMRC as part of a CBAM tax return.

C3.8.7.1 Reporting by the liable person

For CBAM only the importer of the CBAM goods (the liable person) will be required to report CBAM data to HMRC through a CBAM tax return.

C3.8.7.2 Verified emissions data

The verified emissions intensity that is reported to HMRC as part of the CBAM tax return can be taken from different monitoring periods in line with Regulation 9 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulation 2026.

D4.0 How to monitor and report emissions

D4.1 Definitions

When completing the relevant calculations in this section, the operator should ensure they understand the terms used. Full definitions and abbreviations are provided in Annexes IV and V; however, the key definitions used are set out below.

- **aggregated goods category**: the classifications used to group similar products together for CBAM emissions calculation and reporting;
- **complex goods**: goods produced using one or more precursor goods;
- **direct emissions**: emissions related to the production processes of CBAM goods. This includes (however is not limited to) emissions from the production of heating and cooling consumed during the production processes, irrespective of whether the heating or cooling was produced on or off site;
- **embodied emissions**: the emissions attributable to the production of a CBAM good;
- **functional unit**: the amount of goods produced in tonnes (t) classified under the same commodity code. Exceptions to this are as follows:
  a) for fertilisers, the kilograms of nitrogen contained in the goods produced under the respective commodity codes constitute the functional unit;
  b) for commodity codes 2523 10 00, 2523 21 00, 2523 29 00, and 2523 90 00, the tonnes of clinker contained in the goods produced under the respective commodity codes shall constitute the functional unit;

  Further details on the cement and fertiliser functional units can be found in section E5.1 and section E5.3;
- **installation**: a stationary industrial unit where CBAM goods, either solely or alongside other goods, are manufactured or processed;
- **operator**: of an installation means a person who has control over its operation;
- **precursor goods**: a CBAM good which is used in the production of another CBAM good and is identified as relevant to determining the emissions embodied in that CBAM good in the system boundaries document;
- **production process:** the chemical or physical processes carried out to produce CBAM goods, together with the specified system boundaries relating to the inputs, outputs and corresponding emissions associated with those goods. This includes multifunctional production processes and joint production processes where these are used for the purposes of monitoring and calculating embodied emissions;
- **production route**: a specific technology used in a production process

to produce goods;

- **simple goods**: goods produced in a production process requiring exclusively input materials and fuels having zero embodied emissions;
- **tonne of CO_2e**: one metric tonne of carbon dioxide ('tCO_2'), or an amount of any other GHG adjusted to the equivalent global warming potential of CO_2.

D4.2 Summary of what needs to be monitored by operators

To determine the embodied emissions of CBAM goods, operators may need to monitor the following, depending on their operations:

- direct emissions from the installation;
- heat flows associated with production processes;
- precursor goods used in production;
- sector-specific parameters required for particular goods.

Where an installation produces more than one product, they will need to ensure the emissions are appropriately attributed to the individual CBAM goods. However, if they produce CBAM goods with the same functional unit, this will be classed as a single production process.

Due to the rules for attributing emissions to goods, operators will need to determine certain flows of heat (for example steam and hot water etc.) to and from the installation and between relevant production processes. The same will apply to any "waste gases" (for example blast furnace gas in the steel industry) as both heat and waste gases are associated with the direct emissions at the installation.

Installation operators will need to monitor the quantities of specific input materials into the manufacturing process, which themselves may have embodied emissions and may be classed in their own right as a CBAM good. For these input materials (precursor goods), they will need to determine the embodied emissions of these goods. Where precursor goods are purchased to produce other CBAM goods, the manufacturer of the final CBAM good will need to obtain the information on the embodied emissions from the supplier or manufacturer of these precursor goods.

D4.2.1 Monitoring period

The monitoring period is 1 calendar year (1 January until 31 December). This allows sufficient time for the operator to collect the required data. A period of 12 months is considered representative, as this reflects any seasonal variations in the operations of the installation. It also allows for any periods of disruption such as planned annual shutdowns and start-ups. A full year of data helps to mitigate any data gaps, for example by taking

meter reads on either side of any missing periodic data points.

Operators are encouraged to prepare their monitoring methodology and the monitoring plan as early as possible.

D4.2.2 Installation, production process and production routes

The key terms defined in section D4.1 and in Annex V that are relevant to this section are:

- installation;
- production process;
- multifunctional production process;
- joint production process;
- aggregated goods category;
- production route.

Under the definitions listed above, an installation manufacturing CBAM goods may be comprised of one or more production processes. Each production process must relate to a single CN code for the CBAM goods that are produced at the installation.

However, in some cases an operator may have multiple production routes used to produce CBAM goods within the same aggregated goods category. Where this situation occurs, the routes are to be treated as a single production process, and these may be monitored together using one set of system boundaries.

In summary, an installation may contain multiple production processes, and a production process may contain multiple production routes. Attributed emissions are always calculated at the production process level. Additional rules for defining production processes and establishing their system boundaries are set out in section D4.4.

D4.2.3 Activity level: quantity of goods produced

For a given reporting period, the 'activity level' is the total quantity of goods (expressed in tonnes) produced within a production process that meets a particular CBAM commodity code (CN). For the determination of the activity level of a production process, the quantity of all goods under all commodity codes which represent an 'aggregated goods category' must be added together to give the total amount.

The activity level for an installation or production process producing CBAM goods will need to consider the saleable product. The operator will need to include any product used directly as precursor goods within another production process ('relevant precursor material').

To avoid double counting, there needs to be the consideration of the final products that leave the system boundaries of the production process. Where products are returned to the same process, as well as any waste or scrap, they will need to be excluded these from the total of the CBAM goods.

In reporting the activity level for goods, it should also consider any special provisions that will apply to goods for specific production processes or production routes. For each sector, these are referred to in section E5.0.

D4.2.4 Direct embodied emissions

If an operator produces CBAM goods, they will need to account for their emissions when reporting the embodied emissions of the goods they produce. In this context this means:

- **direct emissions**: the combustion and process emissions for the installation. It also includes any emissions produced during the production of heat that is consumed by the installation during the manufacture of CBAM goods. Where the installation receives heat from a third party this will also need to be included;
- **direct attributed emissions**: any emissions that are relevant to the production process producing CBAM goods. It is based on the direct emissions from the installation, including those relevant heat flows, material flows, waste gases etc.;
- **direct embodied emissions**: the emissions associated with the goods produced and are calculated from the direct attributed emissions of the production process by adding the embodied emissions of any relevant precursor materials that will be used within the production process;
- **specific direct embodied emissions**: the direct embodied emissions of the goods produced, divided by the activity level of the production process. The result must be expressed as tCO_2e per tonne of product;
- **specific total embodied emissions**: the total sum of the specific direct embodied emissions.

The approach used to monitor direct emissions must reflect the range of 'emission sources' and 'source streams' at the installation manufacturing the CBAM goods. This includes any precursor goods used in the production route where the embodied emissions must be considered when calculating the embodied emissions of the final CBAM good.

The approach to be used to calculate emissions data for the CBAM goods produced must be included in the monitoring plan. This ensures consistency in reporting year on year. The monitoring plan will also help the verifier during the verification process, as they will have a document to verify against. Further details on the information that must be included in a monitoring plan can be found in section D4.5.1.

D4.2.4.1 Embodied emissions in precursor goods

When calculating the total embodied emissions for CBAM goods over a reporting period, this information will need to include the embodied emissions in any precursor goods that will have been used to produce the final CBAM good (known as the 'complex good'). The embodied emissions of the relevant precursor goods that are used must be added to the attributed emissions of the complex good.

The inclusion of the embodied emissions of precursor goods is needed to ensure the carbon costs associated with UK ETS can be compared with the carbon costs for the CBAM.

The relevant emissions will need to reflect those captured under the UK ETS, specifically:

- carbon dioxide (CO_2) for all sectors;
- nitrous oxide (N_2O) for the fertiliser sector;
- perfluorocarbon (PFCs) for the aluminium sector.

D4.2.4.2 Embodied emissions outside the operator's control

When calculating the embodied emissions of CBAM goods, the operator will need to take account of emissions associated with heat or precursor goods that are supplied by another organisation. Where heat or precursor goods are supplied by a third party, they should use the most recent emissions information available from that supplier. This may include:

- emissions associated with heat imported from another installation;
- embodied emissions of precursor goods supplied by another installation.

The operator will need to use this information when determining the embodied emissions of the CBAM goods they produce.

D4.2.5 Units for reporting embodied emissions

When reporting the embodied emissions, this must be in tonne of CO_2e (tCO_2e). This means that for one metric tonne of carbon dioxide, or any other greenhouse gas listed in section D4.2.4.1, with an equivalent ('e') global warming potential; i.e. where relevant, N_2O and PFCs emissions must be converted into their equivalent 'tCO_2e' value before they are reported.

For reporting purposes, emissions data should be rounded to the nearest whole tonne of CO_2e. Rounding must only be carried out after all calculations have been completed.

When calculating embodied emissions, significant values should be recorded using up to 5 decimal places. Where fewer decimal places are available, trailing zeros should be used where required.

The level of rounding will depend on the accuracy and precision of the measurement equipment that has been used to obtain the values for the CBAM calculations.

D4.3 How to determine embodied emissions

D4.3.1 The concept

For the purpose of the CBAM, the concept of embodied emissions is based on the principles and the requirements for the carbon footprinting of products. Under the requirements to carbon footprint a product, it is usually understood that Greenhouse Gas (GHG) emissions are expressed in $kgCO_2e$ or tCO_2e per declared unit (for example a tonne of goods). This is based on a life-cycle perspective of the goods covering:

- all significant emissions from the upstream and downstream processes (called life-cycle stages);
- from mining and production to transport;
- to use and to its end-of-life.

The difference between the CBAM and product carbon footprinting is that the CBAM only covers the emissions that would be subject to carbon pricing under the UK ETS if the goods were produced in the UK. As a result, the system boundaries used for the CBAM is narrower than those typically used for product carbon footprint assessments.

Under the UK ETS and the CBAM, downstream emissions are outside the scope of the schemes. This includes emissions associated with the use of a product and its end-of-life treatment. Emissions from the transport of materials and other upstream activities are also outside the scope of the CBAM, unless they relate to relevant precursor goods which must be included in the calculation of the total embodied emissions.

Table 5-1 below compares the scope of the CBAM emissions with the UK ETS and other common GHG carbon footprinting schemes.

Parameter	**ISO 14064-1 (Annex B)**	**GHG protocol**	**UK ETS**	**CBAM**

"Direct emissions"	Category 1	Scope 1	Subject to system boundaries of each ETS installation	Defined as 'direct emissions' means emissions related to the production processes of CBAM goods. This includes (but is not limited to) emissions from the production of heating and cooling consumed during the production processes, irrespective of whether the heating or cooling was produced on or off site
"Direct emissions" (mobile, e.g. forklift, cars)			Outside the scope	Outside the scope
"Indirect emissions" (upstream)				
of heating/cooling imported	Category 2	Scope 2	Covered if produced in a UK ETS installation	Included under "direct emissions"
of electricity imported			Covered if produced in a UK ETS installation	Outside the scope
of fuels imported	Category 3	Scope 3	Outside the scope	Outside the scope
Transport			Outside the scope	Outside the scope
of (precursor) materials imported	Category 4		Covered if produced in a UK ETS installation	To the extent precursors are defined as relevant in the implementing act
"Indirect emissions"	Category 5		Outside the scope	Outside the scope

(downstream and other, e.g. use of product, end-of-life emissions)				

Table 5-1: Compares the scope for the CBAM emissions against the scope of UK ETS and other common GHG carbon footprinting schemes.

For the purpose of determining the embodied emissions in specific CBAM goods, the starting point is the emissions at an installation level as explained below:

1. emissions at an installation need to be split ('attributed') to emissions of its production processes;
2. relevant embodied emissions of precursor materials will need to be added;
3. results will need to be divided by the activity level of each production process. This will result in a 'specific embodied emissions' of the goods resulting from the production process;
4. considerations are reflected in the definitions of direct emissions, in which requirements need to be taken into account for precursor materials.

Further details of the approach to determine the emissions for each sector can be found in section E5.0.

D4.3.2 From installation emission to the calculations of total emissions

The following outlines the steps an operator will need to complete to allow the determination of the calculation of the embodied emissions of an imported CBAM good. The first step explains the concept, while the second looks at the attribution of emissions and the final step looks at the calculation of the embodied emissions.

If operators are already experienced with a similar emissions monitoring scheme such as an emissions trading scheme (ETS), they will already be aware of some of the information in this section of the guidance.

D4.3.2.1 Top-down approach

For the CBAM, the approach to be taken is a top-down approach which is as follows:

- the determination of the emissions at the installation as detailed in section D4.6;
- the split of the installation into 'production processes' that produce CBAM goods (or group of) for which there will need to be the determination of the embodied emissions;

- the total installation's emissions will need to be 'attributed' to the production process using the concepts described in section D4.7. The rules that will need to be followed for defining the boundaries of the production process can be found in section D4.4;
- the attribution of emissions to a production processes can be a complex task. This is due to the rules having to be designed to ensure different installations are treated as equally as possible; These different situations include:
    - Different ways of heat supply: heat can be produced directly within the process from fuels or the generation of electricity (for example Combined Heat and Power (CHP) plants). It can also be received from other parts of the installation such as:
        - from a central boiler;
        - a CHP unit;
        - a steam grid;
        - from an exothermal chemical reaction;
        - from outside the installation;

      As a result of this a certain number of emissions would be attributed to any such heat. Further details can be found in section D4.8.5;
    - Waste gases: need to be taken into consideration, as some gases have a heating value due to the incomplete oxidisation of fuel which may occur as result of the production process, for example in a blast furnace of a steel plant. Further details can be found in section D4.8.1;
- the addition of the emissions of the relevant precursor materials that may be used during the production process of the CBAM good. The 'attributed emissions' of the production process only gives the emissions of the CBAM good as if it were a 'simple good'. However, if precursor goods are used during the manufacture of CBAM goods, the product becomes a 'complex good', and the emissions of the precursor goods will need to be added to the emissions from the manufacture of the final complex CBAM good. More details on the rules for monitoring precursor goods can be found in section D4.9.2.

D4.3.2.2 Concept of installation-level monitoring

The force of law notice (ODT, 344KB) contains several different monitoring methodologies. This provides the operator of the installation that manufactures CBAM goods with a choice of monitoring methodology. This ensures the data provided is the most accurate and obtaining the data is cost effective.

It is often beneficial to choose a monitoring methodology which is already in place and in use at the installation manufacturing the CBAM goods. For example, process control, for other emissions trading schemes, or used for confirming the quantities of materials and fuels that have been sold or

received.

Figure 4-1 below introduces some of the main concepts and terms which are used when discussing the monitoring concepts for the CBAM.

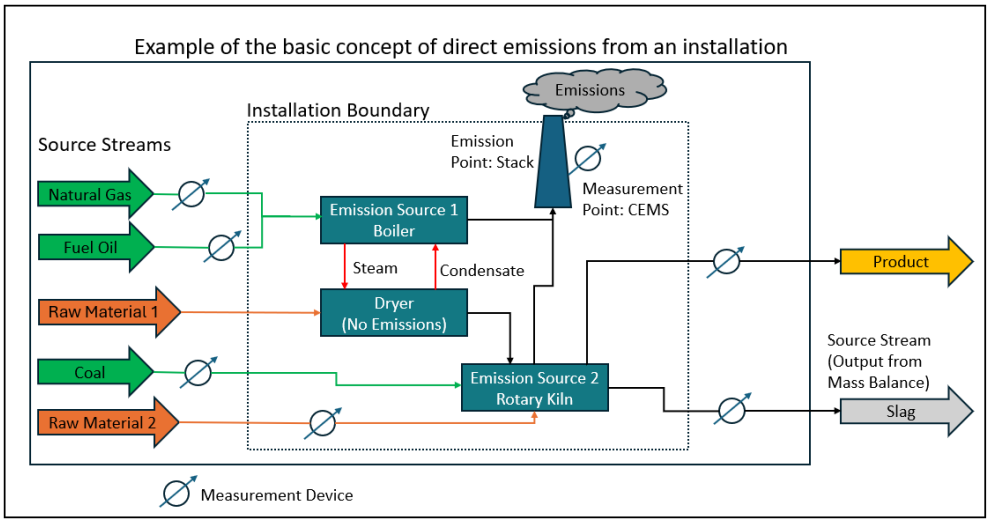


Figure 4-1: shows a simple installation example for explaining basic monitoring concepts.

In the above example, the installation consists of:

- a dryer, where raw material 1 is dried using steam from a boiler. This material is considered not to contribute to the emissions;
- raw material 2 (for example limestone) is calcined in a rotary kiln, where CO_2 is set free from a carbonate.

The dry material does not contribute directly to the installation's emissions. The calcined material is then combined to produce a single final product. As the installation produces only one final product, it is treated as a single production process for the purposes of the CBAM.

The following elements can be shown when considering Figure 4-1.

- **Source stream:**
  The fuels or materials containing carbon that are released by combustion, or other chemical processes are captured by the term 'source stream'. In the case of outputs such as products, by-products or wastes containing a significant amount of carbon, these would also qualify as a 'source stream'. Using a 'mass balance' approach would take these into consideration by subtracting their carbon amounts from the overall emissions. In Figure 4-1, the input source streams are the fuels; natural gas, fuel oil and coal. Additionally, this could also include the material "raw material 2", and potentially the products and the slag, if they contain relevant amounts of carbon.

- **Emission source:**

A single process unit, such as the boiler and the kiln have the term 'emission sources' which is consistent with the terminology used in UK ETS. The stack could be considered an emission source; however, the more consistent term for this is an 'emission point', which mirrors UK ETS. Under both the CBAM and the UK ETS, the Emission Point is the location where a Continuous Emission Monitoring System (CEMS) would be installed at a 'measurement point' (which is the location of the CEMS unit).

D4.3.2.3 Monitoring approaches

The force of law notice (ODT, 344KB) allows the following monitoring approaches to be applied at an installation level.

D4.3.2.4 Calculation-based approach

This covers two methods and more details can be found in section D4.6.1. The two methods are:

- Standard method - as per section D4.6.1.1;
- Mass balance - as per section D4.6.1.3.

D4.3.2.5 Standard method

The standard method determines the emissions based on the quantity of all the fuels or input materials. This includes the 'emission factor' for the fuels or materials.

Where carbon is not emitted (for example if some carbon remains in the ash of the fuel), this will be accounted for by the 'oxidation factor' of the fuels or materials. In other cases, any incomplete combustion processes will need to be taken into consideration by the application of a 'conversion factor'. In Figure 4-1 the measurement instruments indicate where the quantities of the source streams are determined for this purpose.

D4.3.2.6 Mass balance method

The mass balance method determines emissions by monitoring the movement of the carbon that is contained in fuels and materials into and out of a production process. Under this approach, operators must determine:

- the quantities of fuels and input materials;
- the quantities of output materials;
- the carbon content of those fuels and materials.

Carbon emissions are calculated using the difference between the fuel/material entering and leaving the production process. Further guidance on the mass balance method is provided in section D4.6.1.3.

D4.3.2.7 Measurement-based approach

Figure 4-1 references a measurement point on the stack where the emissions are released into the atmosphere. This measuring point is used where a measurement-based approach has been chosen. In a measurement-based approach, emissions are determined through direct measurement at the emission point as opposed to calculating them from the use of fuels and materials (source streams).

In Figure 4-1, instead of monitoring individual fuels and materials separately across the installation, it may be feasible for the emissions for the whole installation to be measured from a common emission point, i.e. the stack (emission point) using Continuous Emissions Monitoring System (CEMS).

Further guidance on a measurement-based approach is provided in section D4.6.2.

D4.3.2.8 Biomass source streams

Figure 4-1 does not show how biomass is treated in the determination of the emissions from an installation manufacturing CBAM goods. Where a source stream contains biomass, some or all the associated CO_2 emissions can be zero-rated, subject to the applicable sustainability criteria.

This is achieved by applying a biomass fraction to the preliminary emission factor. For a source stream consisting entirely of eligible biomass, the resulting emission factor can be zero.

Further guidance on biomass sustainability requirements is in section D4.6.3.

D4.3.2.9 Choosing a monitoring methodology

To avoid double counting, the operator must decide how emissions from the manufacture of CBAM goods will be monitored. There may be situations where both a calculation-based and measurement-based approach will need to be used to determine the emissions from the manufacture of CBAM goods. However, where they are used, they should either:

- apply to different parts of the installation; or
- be used to corroborate the same emissions data.

When selecting the monitoring methodology, the chosen approach(s) should:

- cover all the relevant emissions;
- ensure there are no gaps in monitoring approach;
- ensure emissions are not counted more than once.

Once the appropriate monitoring methodology has been selected, it must be documented in the monitoring plan.

When selecting a monitoring approach, it is important to identify who has control of the measurement devices that are to be used, i.e. are they in the control of the operator or a third party. In Figure 4-1, the measurement device for natural gas is located outside the boundary of the installation, which in most cases is an indication that the measurement device is under the control of the fuel supplier.

However, depending on the layout of the installation, this may not always be the case. Therefore, it is important that the person who controls the measurement device is identified. Further guidance regarding the information that can be used for those devices that are under the control of a third party (for example invoices) can be found in section D4.6.

D4.3.2.10 Measurement instruments and analysis:

Figure 4-1 indicates potential measurement devices that can be used for the monitoring of emissions. These measurement devices are to be used to determine the quantity of the fuels and materials that are used during the manufacture of CBAM goods. Measurement devices can be used in 2 ways:

- **Continual metering** – this records the consumption of fuel whereby the readings are taken for example on a daily, monthly or annual basis;
- **Batch metering** – this records the quantity of fuels or materials by batch, for example where the weight of every truck or train delivery is recorded before being used. In this case, stock levels will need to be accounted for at the beginning and end of the reporting period.

In Figure 4-1, it can be assumed that natural gas is metered continually, while for fuel oil, coal and the raw materials a batch-wise approach is adopted.

D4.3.2.11 Qualitative elements

For the qualitative element of the source streams, for example the ‘calculation factors’, further details are given in section D4.6.1.5. However, in principle the following options exist:

- **Fixed values** – these are commonly used for emission factors. These

values can be internationally accepted standard values or more suitable national values, literature values etc.;

- **Values determined by laboratory analysis** – this approach is more appropriate for larger quantities of fuel or materials, or in such cases where the quality of the fuel or material is variable.

In cases where sampling is used, there must be the assurance that the sampling process is carried out in such a way to ensure the sample is representative both in terms of its sample location and the size of the sample. There must also be assurance that the analysis of the sample (including its transport to the analysis location) is carried out in accordance with the accepted standards for laboratories that are competent for the task, ideally one that can demonstrate accreditation to ISO/IEC 17025.

There are also other elements that need to be considered which are associated with:

- The special methods for the determination of non-CO_2 GHGs: PFCs in the production of aluminium (see section D4.6.4), and N_2O in the production of nitric acid and fertilisers, see section E5.3;
- Rules on the 'transferred CO_2' relating to Carbon Capture and Use (CCU) and Carbon Capture and Storage (CCS). Further information on this can be found in section D4.6.5.

Figure 4-2 below shows the basic inputs and outputs into a normal production process, and this needs to be considered when establishing the process to determine the emissions for the CBAM goods that are to be imported into the UK.

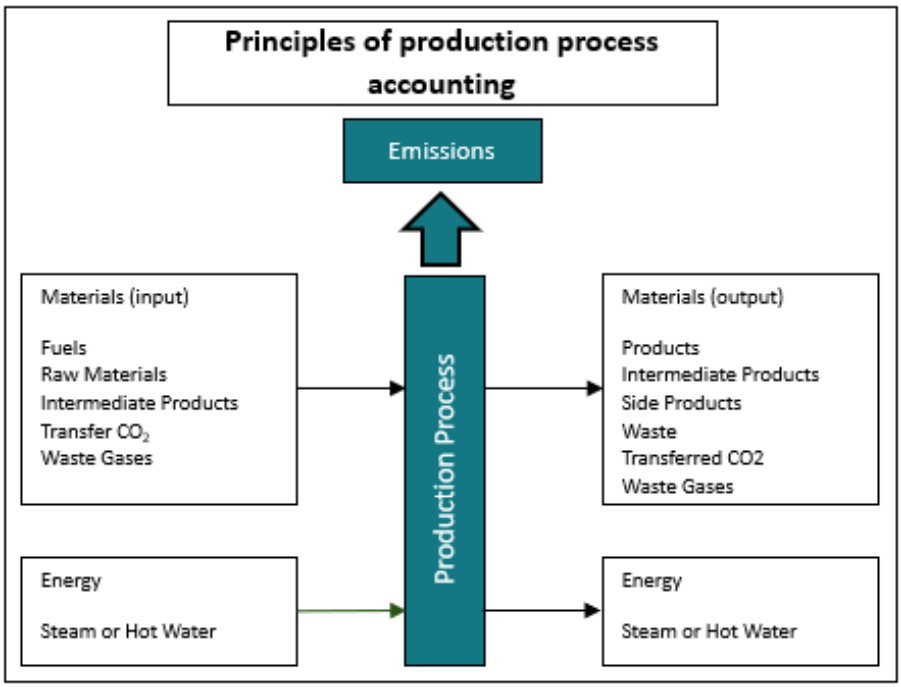


Figure 4-2: shows a schematic description of the system boundaries that

would need to be considered for the attribution of emissions to a production process.

D4.3.2.12 Attribution of emissions to production processes

As illustrated above, the attribution of emissions can be a complex task. This could be partly due to the boundary of the production process. The operator should consider the use of an energy and mass balance to enable the attribution of emissions, as illustrated in Figure 4-2 above.

D4.3.2.13 Attributed emissions

To calculate the attributed direct emissions for a production process over the whole monitoring period, the relevant formula to be used is equation 45 of the force of law notice also shown below:

$$AttrEm_{Dir} = DirEM^{*} + Em_{H,imp} - Em_{H,exp} + WG_{corr,imp} - WG_{corr,exp} - Em_{el,prod}$$

In cases where $AttrEm_{Dir}$ is calculated to have a negative value, this should be set to zero.

The following formula (equation 46) of the force of law notice provides guidelines on which parameters need to be monitored where an installation consists of more than one production process, or where heat supply is split or in cases where waste gases are found at the installation.

$$EI_{g,Dir} = \frac{AttrEm_{g,Dir}}{Al_{g}}$$

Where:
$AttrEm_{Dir}$ is the attributed emissions of the production process over the whole monitoring period. This is to be expressed in tCO_2e.

$DirEM^{*}$ is the attributable emissions from the production process, determined for the whole monitoring period, using the approaches contained within the force of law notice and illustrated in this guidance. The rules that must be followed are:

a) Measurable heat: In situations where fuel is consumed to produce measurable heat, which is then consumed outside the production process, or is used in more than one different production process, these will not need to include these fuels in the calculation of the attributable emissions from the production process. However, these will need to be included in the parameter $Em_{H,imp}$ as this will avoid any double counting;
b) Waste gases: In situations where emissions are produced by waste gases, and these gases are produced and fully consumed within the same production process, these will need to be included in the

parameter $DirEM^*$. Where goods are exported from the production process, the emissions from waste gases, will need to be included in the parameter $DirEM^*$ irrespective of where they are consumed. However, in situations where waste gases are exported, there will need to be the calculation of the parameter $WG_{corr,exp}$;

c) Where emissions are generated from the combustion of waste gases imported from other production processes, these emissions must not be included in the parameter $DirEM^*$. Instead, these must be included in the parameter $WG_{corr,imp}$.

$Em_{H,imp}$ are the emissions equivalent to the quantity of measurable heat imported into the production process. To determine these emissions, the following rules apply:

a) Emissions that relate to measurable heat – these include heat imported into the production process (including imports from other installations including non-CBAM entities), other production processes within the same installation, in addition to any heat received from a central powerhouse, or from a more complex steam network which supplies heat to more than one production process;

b) Emissions from measurable heat will need to be determined using equation 47 from the force of law notice. This equation is shown below:

$$Em_{H,imp} = Q_{imp} \times EF_{heat}$$

Where:
EF_{heat} is the emission factor for the production of measurable heat and expressed in tCO_2/TJ;
Q_{imp} is the net heat imported to and consumed in the production process is expressed in TJ.

$Em_{H,exp}$ are the emissions equivalent to the quantity of measurable heat exported from the production process. These will need to be determined in accordance with the rules provided in section G.2 of the force of law notice. For the exported heat from the installation, either the emissions of the known fuel mix shall be used, or if the actual fuel mix is unknown, the standard emission factor of fuel most commonly used in the country and industrial sector can be used, assuming a boiler efficiency is of 90%.

If heat is recovered from electricity-driven processes and from nitric acid production, this is not to be accounted for in the calculations.

$WG_{corr,imp}$ is the attributed emissions of the production process which consumes any waste gases that may imported from another production process, that are corrected for the monitoring period.

$WG_{corr,exp}$ is the emissions equivalent to the quantity of waste gases that

may be exported from the production process, determined for the monitoring period.

$EI_{g,Dir}$ is the emissions intensities of the goods $_g$ which are expressed in tCO_2e per functional unit and valid for the monitoring period.

AL_g this is the activity level of the goods $_g$. This could be the quantity of the goods produced during the monitoring period, which are determined in accordance with section F of the force of law notice (ODT, 344KB). This value will need to be expressed in functional units.

D4.3.3 Calculation of embodied emissions of a good

D4.3.3.1 Adding the precursors' embodied emissions of the precursor goods

The final step in determining embodied emissions of a CBAM good is to account for any relevant precursor goods as identified in the system boundary and used in the production process. This ensures all emissions for the CBAM goods that are produced are captured.

If precursor goods are produced at the same installation, a 'bubble approach' can be used. Section D4.4.2.1 below provides further information. As this 'bubble approach' will already include the emissions that have occurred at the installation, the only additional emissions that will need to be included and calculated are the emissions for the precursor goods that have been purchased.

To assist in the determination of the embodied emissions of the purchased precursor goods, the following equation can used:

$$EF_{Pro,dir} = AttrEm_{proc,dir} + \sum_{i=1}^{n} M_i \times EI_{i,dir}$$

Where:
$EF_{Pro,dir}$ is the embodied emissions at the production process over the reporting period;
$AttrEm_{proc,dir}$ is the attributed direct emissions of the production process as determined in line with this section for the reporting period;
M_i is the mass of precursor $_i$ consumed in the production process during the reporting period;
$EI_{i,dir}$ is the specific direct embodied emissions of precursor goods $_i$.

In cases where precursor goods are produced at the same installation, the EI values should be determined using the approach stated within the force

of law notice.

In situations where precursor goods are received from other installations, the relevant information will need to be requested from the operator of the installation where the precursor goods were produced. There is no set template for this request, so the information requested must be appropriate and sufficient to calculate the overall emissions for the CBAM goods produced.

In cases where precursor goods are received from different operators, the EI values may be different for each operator that provided the precursor goods. If this occurs, the M_i and EI_i values will need to be used in the calculation separately as if they were different precursor goods.

D4.3.3.2 Specific embodied emissions (normalising to 1 tonne of product)

Once the above has been completed to determine the embodied emissions at a process level, this will need to be divided by the 'activity level' to determine the specific embodied emissions of the CBAM goods. To do this the following equation can be used:

$$EI_{g,dir} = \frac{EF_{Proc,dir}}{AL_g}$$

Where:
$EI_{g,dir}$ is the specific embodied emissions of the goods under the aggregated goods category $_g$;
$EF_{Pro,dir}$ is the embodied emissions at the production process over the reporting period;
AL_g is the activity level of the production process producing CBAM goods of the aggregated goods category $_g$. For example, this would be the total mass of all goods of that category produced during the reporting period.

The above formulas assume that it will be simpler to determine the process-level emission data before dividing by the activity level for the relevant production process. However, the emissions can be calculated from the precursor goods in a single step with the normalisation to one tonne. For complex goods this can be completed by the following equation:

$$EI_g = \frac{AttrEm_g + EE_{ImpMat}}{AL_g}$$

$$EE_{InpMat} = \sum_{i=1}^{n} M_i \times EI_i$$

Where:
m_i is the specific mass consumption of precursor $_i$ used in the production process yielding one functional unit of CBAM goods ($_g$), expressed in functional unit of precursor $_i$ per functional unit of CBAM goods ($_g$) (i.e. dimensionless);
EI_i are the emissions intensity of precursor $_i$ expressed in tCO_2e per functional unit of precursor $_i$.

In case of a simple non-complex goods, the EE_{InpMat} value can simply equal to zero.

When determining the emissions, the first task that will need to be completed is to normalise the attributed emissions before calculating the EI element of the equations. To complete this task, the installation operator can use equations 52, 53 and 54 from the force of law notice as shown below, whereby the specific mass consumption m_i for each precursor $_i$:

$$m_i = \frac{M_i}{AL_g}$$

As a result of the above, the specific embodied emissions of the complex goods $_g$ can be expressed as:

$$EI_g = ae_g + \sum_{i=1}^{n} (m_i \times EI_i)$$

Where:
ae_g is the specific attributed direct or indirect emissions of the production process yielding goods $_g$, expressed in tCO_2e per tonne of $_g$ being equivalent to the specific embodied emissions without the precursor embodied emissions:

$$ae_g = \frac{AttrEm_g}{AL_g}$$

The approach used is determined by the operator. However, they must be able to demonstrate that the calculation chosen, provides the same results as EI.

Where data is provided on the embodied emissions of a precursor good that is used during the manufacture of the complex good, it must be assumed that this data has been calculated correctly.

For the element EI_i, it should be assumed the value resulting from the installation where the input material was produced is correct. This is on the

assumption that the installation providing the data can adequately measure and communicates all the required data.

D4.4 Defining the system boundaries of the production process and production routes

To determine the embodied emissions of the aggregated goods categories, the system boundary of the production process for the CBAM goods will need to be defined for the goods being produced.

When defining a system boundary, the following will need to be identified:

- all relevant production processes or equipment used during production of the CBAM goods;
- all fuel, energy (heat or waste gases) and material flows, into and out of the relevant production processes;
- the sources of greenhouse gas emissions emitted from the relevant production processes, and where relevant, during the production of the precursor materials that may be consumed.

The steps that can be taken to identify the production routes are:

D4.4.1 Step 1: Identify all goods, physical units, inputs, outputs and emissions for the installation

For this step, identify:

- all physical units and production processes involved in manufacturing the CBAM goods;
- all inputs used in the production process, including raw materials, precursor goods, fuels and heat;
- all outputs from the production process, including CBAM goods, by-products, waste materials, heat and waste gases;
- all greenhouse gas emission sources associated with the production process.

This information will help to define the system boundaries of the production process and determine which emissions must be included in the calculation of embodied emissions.

To meet the CBAM requirements and the definition of direct emissions, any imported heat must also be considered. Where heat is supplied by another installation, the emissions associated with that heat must be included when determining the total direct emissions relevant to the production process.

D4.4.2 Step 2: Identify relevant production processes and production routes

Once step 1 has been completed, the next step is for the operator to identify all the goods they produce which are captured by a CBAM commodity code as per Schedule 16 of the Finance Act 2026 with a further detailed list captured in Annex VII.

Using these sources, the operator can identify:

- which goods produced are within the scope of the CBAM;
- the aggregated goods category to which those goods belong.

Once the aggregated goods category for a CBAM good has been identified, the next process is to define the relevant production process. This process is explained below.

For each CBAM good, the following should be identified:

- the production route used to manufacture the good;
- the relevant physical units and equipment;
- the inputs and outputs of the production process;
- the association emission sources.

D4.4.2.1 Identify System Boundaries

To identify the system boundaries of the production process, the operator should:

- prepare a schematic diagram of the installation, which maps out the production processes and identifies the relevant system boundaries;
- identify any shared equipment, such as boilers, CHP plants and steam grids that supply multiple production processes. Emissions from this equipment will need to be monitored separately and allocated to each production process according to the amount of heat consumed.

Identifying this equipment will help to determine where emissions arise and how those emissions should be attributed to different production processes. In many cases, the emissions from this equipment could already be monitored separately under other regulations. However, for the purposes of the CBAM, the emissions from this equipment must be attributed to the production process according to the amount of heat consumed by the different production processes within the installation.

When identifying the system boundaries of the production processes, there are several different configurations possible. The implications of these are as follows:

- if a single category of CBAM good is manufactured, the installation

boundary, the production process system boundary and the monitoring and reporting boundary for the embodied emissions will be the same;

- if several different unrelated categories of CBAM goods are manufactured, the production process system boundary for each category of CBAM goods produced will need to be defined within the single installation;
- if the same category of CBAM good is manufactured by employing different production routes, this can be defined either by a single production process system boundary, or a separate production process system boundary for each different production routes. If a separate process is assigned, the embodied emissions of the CBAM goods will need to be calculated separately for each production route;
- if a category of a complex CBAM good is manufactured and precursor are used in its manufacture, the operator can choose to use a joint (single) production process system boundary. This is known as a 'bubble approach';
- if in addition to producing a CBAM good, the operator also manufactures non-CBAM goods, the only production process system boundaries that will need to be identified is for the production process that relates to the CBAM good. In this situation it is recommended there is a defined additional production process system boundary for the non-CBAM goods. This will help to confirm that all relevant emissions have been captured.

D4.4.2.2 Simplifications

There are several simplifications that can be applied for certain sectors. These are listed within the force of law notice (ODT, 344KB) and include:

- **Iron and steel installations** – for the manufacture of these categories of CBAM goods and where two or more goods from a specific product group are produced, the operator can monitor and report the embodied emissions by defining one joint production process. This is on the provision that none of the produced precursor materials are sold separately (i.e. the 'bubble approach' as mentioned above);
- **Aluminium installations** – if the operator is involved in the manufacture of two or more goods from the unwrought aluminium or aluminium product groups, they can monitor and report the embodied emissions by defining one joint production process. This is on the provision that none of the produced precursor materials are sold separately (i.e. the 'bubble approach' as mentioned above);
- **Mixed fertiliser installations** – for the manufacture of these products, the monitoring of the respective production process can be simplified by determining one uniform value of embodied emissions

per tonne of nitrogen which is contained within the mixed fertilisers. This is irrespective of the chemical form of nitrogen (ammonium, nitrate or urea forms).

D4.4.2.3 Defining system boundaries

In defining the system boundaries of the production process, the key criteria that will need to be followed by the operator are:

- the system boundaries that are identified should enclose all the physical units performing the sequential process steps to produce the CBAM goods;
- the system boundary includes any dedicated supporting units that are necessary for the production process to operate and maintain full production capacity. For example:
  - combined heat and power (CHP) plants may support input activities by providing heat or electricity;
  - flue gas treatment or scrubbing equipment may support output activities by managing emissions from the production process;
- where a physical unit supports more than one production process, its emissions must be identified and attributed separately. For example, where a boiler supplies steam to several combustion processes, the associated emissions must be monitored separately and attributed in accordance with the approach and formulae provided in section D4.9.

When establishing the system boundaries of the production process, there only needs to be the inclusion of those units that are stationary at the point of use. Emissions from equipment such as forklifts, trucks, and bulldozers do not need to be included in the system boundary of the production process.

The relevant emissions from the installation should cover 100% of the CBAM goods and any non-CBAM goods that are manufactured, in particular:

- where the installation has a single production process, then all the relevant emissions from the installation should be attributed to the production process associated with the CBAM goods;
- where the installation has several relevant production processes, where necessary the emissions will need to be attributed to the shared equipment, source streams and emission sources between the different CBAM production processes that have been identified.

As the result of the above, all inputs, outputs and corresponding emissions will be attributed to a production process, except where the emissions relate to a non-CBAM good.

When the operator is establishing the system boundaries of the CBAM production process, they will need to ensure that the production processes

do not overlap. This is to ensure that inputs, outputs and any corresponding emissions are not covered by more than one production process.

As part of the CBAM verification process, the verifier will need to check the system boundaries to ensure it accurately reflects the production process for the CBAM goods.

D4.4.3 Step 3: Determine the monitoring needs at an installation level

When all the relevant CBAM production processes and the related emission sources and source streams have been identified as per the above steps, the next step is for the operator to decide which monitoring approach to apply:

- Calculation-based approach;
- Measurement-based approach.

More details on these approaches can be found in section D4.6.

At this stage, the focus should be on identifying the monitoring arrangements that are needed to determine the total emissions from the installation.

In some cases, additional material or energy flows may need to be monitored for the purpose of attributing emissions to individual production processes, even though they are not required for determining total installation-level emissions.

For example, waste gas generated during the production of pig iron may be used in a downstream iron or steel production process. In this situation, the waste gas does not need to be monitored separately when determining the total emissions from the installation. However, it could need to be monitored when attributing emissions between production processes.

The attribution of emissions to production processes, and subsequently to individual CBAM goods is explained in the next step.

D4.4.4 Step 4: Assign emissions to production processes

Once the methodology for determining the total emissions at the installation manufacturing the CBAM goods has been established, the operator must ensure all the data needed to attribute emissions to the defined production processes and the goods produced is available.

At this stage, the determination of the emissions associated with each production process should be established before taking account of any precursor goods. In other words, each CBAM good should initially be

treated as a “simple good”, meaning that only the direct emissions attributed to the production process are considered.

The aim is for the attribution of all emissions from the production process to the goods produced, without any data gaps and any double counting. In this context, any “heat” produced for use outside of the production process is also classed as a good, as this has an economic value and can be traded. Additionally, where there are any goods which are not covered by the CBAM, these will need to be considered to enable the attribution of all emissions.

D4.5 Planning monitoring

This section outlines the monitoring approaches that can be used to determine the emissions for the CBAM goods produced. The operator must always use the best available data source that is available, taking account of technical feasibility and unreasonable costs.

D4.5.1 Documentation needed to plan for monitoring

The operator producing CBAM goods must develop and maintain a monitoring plan that sets out the monitoring methodologies that will be used to determine the CBAM emissions and production data.

The monitoring plan helps ensure monitoring is carried out consistently over time and provides the verifier with the information needed to assess compliance with the CBAM requirements.

The monitoring plan must:

- define the system boundaries of the installation;
- document the production process used;
- capture any specific requirements for each industrial sector;
- identify which source streams are use as part of a calculation-based approach or mass balance approach;
- identify which emission sources are captured by a measurement-based approach.

The monitoring plan also needs to contain all other relevant monitoring approaches, such as for the qualities and quantities of CBAM goods produced, heat and waste gas flows etc. (as applicable).

The monitoring plan can also contain diagrams that accompany any process description of the installation These can help to:

- visualise the production process, its system boundaries and source streams used;
- confirm that there has been no double counting, or that any data

gaps exist in the CBAM emissions reporting process.

To support compliance and verification, operators should establish a documentation management process for the monitoring plan. This will help ensure that:

- the monitoring plan remains accurate and up to date;
- changes are properly controlled and documented;
- the verifier has access to the latest version of the supporting documentation.

The monitoring plan should be maintained as a single document. This is similar to the monitoring plans used under an emissions trading scheme or other monitoring, reporting and verification (MRV) frameworks.

D4.5.2 Monitoring methodology principles and procedures

The monitoring plan is the primary document that explains how the operator complies with the monitoring requirements for the CBAM. Emissions and production data must be monitored by the operator consistently from one reporting period to the next. This document can be used by the staff responsible for monitoring, reporting and verification activities and can also support the training of new staff involved in CBAM compliance.

D4.5.2.1 Key principles

The key principles for planning CBAM monitoring are:

- the monitoring approach is the most accurate and uses the best available data whilst keeping the approach as simple as possible;
- makes use of existing systems and procedures that are already in place at the installation;
- the monitoring approach is based on the most reliable data sources available, supported by robust measurement instruments, short data flows and effective control procedures;
- there is full transparency and traceability of how the CBAM data is collected, processed and reported. The monitoring plan must state any calculations or assumptions that are to be made and what controls are in place to ensure the accuracy of the data;
- any supplementary procedures that support the monitoring process are referenced within the monitoring plan;
- roles and responsibilities are clearly defined, including the location of relevant documents, records and data sources used for CBAM compliance.

The monitoring plan must be maintained as a live document. As installations evolve over time, monitoring methodologies, data sources and production processes could change. Therefore, the monitoring plan must

be reviewed regularly and updated where necessary.

Where existing document control systems are already in place, such as those used for ISO 14001, an emissions trading scheme or other management systems, it is recommended that the monitoring plan is incorporated within those arrangements.

D4.5.2.2 Information to be included in the monitoring plan

The contents of the monitoring plan will depend on the activities carried out at the installation manufacturing the CBAM goods. The information that must be contained in the monitoring plan is stated in Section A6 of the force of law notice (ODT, 344KB). In addition to this information, the operator may also find it useful to include the following in the monitoring plan:

- The data collection process, including:
  - metering data;
  - invoices;
  - production protocols;
  - stock determination; etc.
- Sampling of materials and fuels, including:
  - frequency;
  - methodology;
  - sample storage;
  - transportation method;
  - mixing of samples over a period of time; etc.
- Laboratory analyses of fuels and materials, including:
  - analysis criteria;
  - certification evidence;
  - transportation method;
  - frequency;
  - results; etc.
- Maintenance and calibration of meters, including:
  - calibration records;
  - certificates;
  - details of responsible parties; etc.
- Description of the calculations and formulae used to determine the CBAM emissions and activity level;
- Documentation of any standard values that are to be used, including their sources;
- Control activities which can include:
  - process for checking results, for example the four-eyes principle;
- Data archiving to ensure:
  - data is stored securely;
  - protected against manipulation;
  - protected against loss;

- retrievable following changes in software; etc.
- A regular annual review to identify any improvements in the applied monitoring process.

D4.5.3 Written procedures

In addition to the monitoring plan, the operator should establish detailed supporting procedures such as work instructions or operational procedures.

D4.5.3.1 Contents

Written procedure documents can help to ensure monitoring and reporting activities are carried out consistently across the organisation and that all staff involved in CBAM compliance understand their responsibilities.

These documents could cover:

- Responsibilities and competency of personnel – this will provide a description of the roles and key personnel responsible for compliance with the CBAM regulations;
- Data flow and control – this will provide an indication of how the data received is going to be controlled to ensure its free from loss;
- Quality assurance measures – this will provide an indication to the checks that are going to be made on the data to ensure its complete and is free from errors;
- Estimation method(s) – this will provide an indication of the process to be used when substitute data will need to be used in cases where there are data gaps;
- Review of monitoring methodology – this will provide an indication on when and how the current applied monitoring methodology will be reviewed to ensure it is still appropriate for the activities undertaken and the CBAM goods produced;
- A sampling and analysis plan – this will provide details on the frequency for the completion of monitoring, the approach to be taken to complete monitoring and the process used to analyse the sample material;
- Procedure for demonstrating compliance with EN ISO/IEC 17025 where accredited laboratories are used (where relevant) – this will provide the process that will need to be undertaken to ensure the laboratories used for analysis are certified to the required standard;
- Procedure for the use of a measurement-based methodology (including for corroborating calculations and for subtracting biomass emissions, if relevant) – this will provide details of the approach to be taken if a measurement-based approach is applied for the monitoring of emissions under the CBAM;
- Procedure for the regular review of documentation – this will provide

an indication on the frequency of the review of the above procedures. It will also provide an indication as to who and when this review will be completed. In addition, this will also include the review and update of the list of products and precursors produced and/or imported by the installation manufacturing CBAM goods.

The operator is responsible for ensuring all staff involved in CBAM monitoring and reporting activities are aware of, and follow, the relevant monitoring procedures. The documentation should be:

- clearly identified;
- appropriately controlled;
- kept up to date.

It is vital that staff only use and have access to the current versions of any documentation that has been established for CBAM compliance.

D4.5.4 Choosing best available data sources

In section A4 of the force of law notice (ODT, 344KB), reference is made to the principle of "best available data sources" which considers technical feasibility without incurring unreasonable costs. When looking at the approach to be used to determine the embodied emissions of CBAM goods, the following should be considered:

- "**Best**" – this means the most accurate option that is available to determine the required data needed for CBAM compliance. Where there is more than one measurement instrument or methodology available for the same parameter, the option that provides the most accurate and reliable results should normally be used
  Where measurement instruments fall under "legal metrological control" (i.e. instruments officially verified under some legislation, for example gas meters and fuel delivery meters owned by the fuel supplier), these are preferred over other meters due to their defined characteristics.

  The "best" element also includes the elements needed to process the collected data. For example, automated data collection systems generally reduce the risk of transcription errors and loss of data when compared to a manual recording process. Where a manual collection process is used, appropriate control procedures should be implemented, as per section D4.5.3;

- "**Available**" – In many cases, the operator will already hold much of the information required for CBAM monitoring because it is also used for process control, financial accounting or environmental compliance purposes. Where the required data is not already available, the following options should be considered:

- purchase an additional measurement system;
- establishment of a system for the sampling and analysis of materials and performing laboratory analysis;
- consider the use of other methods;
- use of literature sources that provide reasonable and credible standard values for the parameter required to be monitored (for example standard emission factors for fuels).

The CBAM requirements provide flexibility in how the monitoring requirements are met but the most reliable data sources must always be used where available. The regulations recognise that the administrative burdens and cost should also be considered when selecting the appropriate monitoring methodology. Therefore, a deviation to a monitoring methodology can be based on the following provided it can be justified, documented and provides a reasonable level of accuracy:

- "technical feasibility";
- "unreasonable costs".

This approach mirrors the approaches that are included in emissions trading schemes for technical feasibility or unreasonable costs. Further details on the above can be found in section D4.5.5 and section D4.5.6.

Similar to emissions trading schemes, the CBAM allows the use of measurement systems that are not under the control of the operator. This means that if a fuel supplier already determines values such as the net calorific value (NCV) and the emission factor (EF) for the fuels used, or if the supplier owns the meter or weighbridge that is used to determine the quantity of fuel or materials, this data can be used for the purpose of the CBAM. In these cases, the operator will not be required to purchase their own measuring equipment, but it is good practice to obtain and retain details of the calibration of the measuring equipment that is in use. However, the "best" method would always be to use measuring equipment that is under the control of the operator.

D4.5.4.1 Data sources

A data source is any information used to determine the emissions associated with a production process and the resulting embodied emissions of the goods produced.

This includes the:

- determination of the fuel and material quantities;
- fuel, material and energy flows;
- carbon content of materials;
- temperature, pressure of fuels and steam etc.

Further details on the parameters that will need to be monitored by the operator for each category of CBAM goods are provided in section E5.0.

There are methods that can be used to determine data sources, these include:

- **Direct determination** – this is where there are direct readings of the measurement device that is in use. On these values, the operator would apply a direct standard value for an emission factor or undertake (internal or external) laboratory analysis to determine the carbon content of the material used. This is considered a 'direct determination' if all the parameters required are actually measured;
- **Indirect determination** – this is where an 'estimation method' has been applied. In this case several assumptions will need to be made which will need to be based on a scientific valid relationship. For example, if a boiler that produces steam is used, however there is no heat meters installed, considerations should be made to use the boiler efficiency data provided by the manufacturer of the boiler. This can then be used to calculate the quantity of heat produced which is based on the fuel consumption of the boiler.
  Similarly, for the determination of process emissions from cement clinker using Method B is an indirect method. The quantities of calcium oxide (CaO) and magnesium oxide (MgO) contained in the clinker are used to calculate the quantity of carbonates that were present in the raw materials. This approach is based on established stoichiometric relationships.

Direct determination methods are generally preferred. However, indirect methods can be acceptable where they provide sufficient reliable results while avoiding disproportionate administrative costs.

D4.5.4.2 Correlations

Correlations can be regarded as an enhanced form of an indirect determination. This approach uses a known relationship between two parameters, where one parameter is easier to measure than the other parameter. Examples include:

- the determination of the emission factors for coal using correlations between the ash content and calorific value;
- the determination of the composition of certain process gases using density or thermal conductivity measurements.

Where correlations are used, they should be periodically confirmed through laboratory analysis. Annual verification is generally regarded as good practice. This will help to demonstrate that the correlation remains more representative than the use of standard values, while recognising that representative laboratory analysis remains the preferred approach.

D4.5.4.3 Primary and corroborating data sources

As the operator there could be more than one data source available for the same parameter. Where this occurs, the identification of the most reliable source will need to be made and recorded within the monitoring plan as the "primary data source". The other available sources should be retained as "corroborating data sources" and used periodically to verify the consistency of the primary data source.

Using corroborating data in this way forms part of the control activities described in section D4.5.7 and can help identify data gaps, errors or unexpected trends.

D4.5.4.4 Reviewing data sources

There is no single monitoring approach that will be appropriate in every circumstance. The operator should select the approach for the data source and monitoring methodology that provides the most reliable and practical means of determining emissions at their installation.

Data sources and monitoring methodologies should be reviewed periodically, particularly when:

- new technologies become available;
- monitoring costs change significantly;
- production processes are modified;
- legislative requirements change.

It is recommended that the outcomes of these reviews are documented and retained as evidence for the CBAM verification process.

D4.5.5 Monitoring-related costs

Section A4 of the force of law notice (ODT, 344KB) recognises that the preferred monitoring methodology may not always be technically feasible or proportionate to the costs involved.

The operator may use existing systems, equipment and data sources already available at their installation, or apply an alternative monitoring methodology where the following can be demonstrated:

- the preferred approach is technically not feasible;
- the preferred approach would result in unreasonable costs.

This flexibility enables the operator to adopt a monitoring approach that is proportionate to the activities carried out at the installation while still ensuring that emissions are determined with sufficient accuracy.

Further guidance on the concepts of technical feasibility and unreasonable costs is provided in this section.

Where an operator relies on technical feasibility or unreasonable cost as justification for a particular monitoring approach, the justification must be documented and supported by appropriate evidence. As part of the CBAM verification process, the verifier will assess whether the justification is reasonable and whether the chosen approach complies with the requirements of the force of law notice.

D4.5.5.1 Determining unreasonable costs

Point 7(a) of section A.4 of the force of law notice (ODT, 344KB) looks at the methodology for applying an unreasonable justification for the chosen monitoring approach.

It is the responsibility of the operator to undertake a cost-benefit assessment of the proposed monitoring improvement and determine whether the costs are reasonable. Where it is concluded that the costs are unreasonable, the justification must be documented and the supporting evidence retained in the monitoring plan. The verifier will assess whether the justification is reasonable as part of the CBAM verification process.

D4.5.5.2 Calculating the justification

To determine whether the costs are unreasonable, the operator must compare the cost of the monitoring improvement against the benefit gained from the improvement. The justification of unreasonable cost is assessed by using the following formula:

Justification = improvement factor × CO_2e reference price.

- Improvement factor – for this element of the calculation the following will need to be considered:
  - the improvement in the estimated uncertainty of a measurement which is expressed in a percent, that is multiplied by the estimated emissions over the monitoring period;
  - 1% of the related emissions means no improvement of the measuring uncertainty is required;
  - related emissions mean the combined total of the following:
    - direct emissions that result from the use of a source stream (for example a material or fuel) or an emission source (for example a production process);
    - emissions attributed to a quantity of measurable heat;
    - embodied emissions of a material produced or a precursor.

- CO_2e Reference Price – this element of the calculation is the costs for the determination of specific data. The costs shall therefore be deemed unreasonable where the cost estimation exceeds the benefit of the determination methodology.

As the operator, there will be the need to calculate the benefit by multiplying an improvement factor against a reference price of £20.00 per tonne of CO_2.

As part of the cost calculation, there will need to be the inclusion of a depreciation period which will need to be based on the economic lifetime of the equipment to be used, where applicable. The types of costs that should be considered include:

- Investment costs – this is for new equipment. In consideration of this cost, this should be the cost per annum depreciated over the economic lifetime of the investment, for example depreciated on a straight-line basis;
- Operating and maintenance costs – this includes aspects such as the annual calibration of the equipment;
- Costs due to disrupted operations – this would include the shutdown of the production process or manufacturing site to enable the new monitoring equipment to be installed. However, this cost may be mitigated as the installation could take place at the same time as any annual shutdown periods;
- Any other reasonable resulting costs.

D4.5.5.3 Determining whether the costs are unreasonable

If the annual cost of the proposed investment exceeds the calculated benefit, the costs would be considered unreasonable, and a less costly monitoring approach could be used. However, where the cost of the improvement is less than £2,000.00 per year, the improvement will always be considered reasonable, and an unreasonable-cost justification cannot be accepted.

A template for an unreasonable-cost assessment is provided in Annex VIII; however, the use of the template is optional, and the operator can use their own template providing the same factors are considered.

D4.5.5.4 Unreasonable cost justification: accepted

Parameters:

- emissions in 2026 = 12,000 tCO_2;
- emissions in 2027 = 14,000 tCO_2;
- investment cost = £50,000.00;
- depreciation = 5 years;

- annual operating and maintenance costs = £5,000.00.

From the above the following can be determined:
- average emissions = 13,000 tCO_2;
- 1% improvement factor (average emissions multiplied by 1%) = 130;
- improvement factor multiplied by £20.00 = £2,600.00;
- costs per year for improvement (investment cost divided by the number of years depreciation plus the annual operating and maintenance costs) = £15,000.00.

Justification is accepted for making no improvement.

This is due to the cost estimation exceeding the benefit of applying the approved determination methodology. In this case the benefit was calculated by multiplying the improvement factor of 1% by the reference price of £20.00 per tonne of CO_2e, which came out at £2,600.00.

An improvement in a monitoring methodology which is more than £2,000.00 will always be deemed to be an unreasonable cost.

D4.5.5.5 Unreasonable cost justification: rejected

Parameters:
- emissions in 2026 = 3,000 tCO_2;
- emissions in 2027 = 5,000 tCO_2;
- investment cost = £8,500.00;
- depreciation = 8 years;
- annual operating and maintenance costs = £300.00.

From the above the following can be determined:
- average emissions = 4,000 tCO_2;
- 1% improvement factor (average emissions multiplied by 1%) = 40;
- improvement factor multiplied by £20.00 = £800.00;
- costs per year for improvement (investment cost divided by the number of years depreciation plus the annual operating and maintenance costs) = £1,363.00.

Justification for making no improvement is rejected.

This is due to the cost estimation not exceeding the benefit of applying the approved determination methodology. In this case the benefit was calculated by multiplying the improvement factor of 1% by the reference price of £20.00 per tonne of CO_2e, which came out at £800.00. As the operator's cost estimation was under this amount, the justification for making no improvement was not acceptable.

An improvement in a monitoring methodology which is less than £2,000.00 will always be deemed not to incur an unreasonable cost.

D4.5.6 Determining technical feasibility

Point 6 of section A.4 of the force of law notice (ODT, 344KB) looks at the methodology for applying a technical feasibility justification for the chosen monitoring approach.

A monitoring approach may be considered technically infeasible where the necessary equipment, infrastructure, safety conditions or technical capability are not available to support its implementation. Examples of this can be:

- where the operator does not have sufficient space to install equipment;
- if there are safety concerns within the installation;
- if the technology needed for the monitoring approach is not available in the country where the CBAM goods are manufactured.

Technical infeasibility is usually closely linked with unreasonable costs.

Where the operator has applied justification for the chosen monitoring approach based on technical feasibility, this must be documented within the monitoring plan.

To assist in the justification of technical feasibility, a template can be found in Annex IX. The completion of this template is optional, but operators can choose to create their own, providing the same parameters are captured.

An example of technical feasibility is shown below:

Situation
A manufacturer is required to analyse a source stream on a weekly basis. Samples are taken manually and transported to an external laboratory for analysis. Due to the composition of the source stream, there are safety risks that need to be considered when taking and transporting the samples

Proposal
The manufacturer wants to reduce the frequency of analysis from weekly to monthly for safety reasons. Evidence has been provided which shows there is very little fluctuation in the composition of the source stream being analysed. It is proposed that the manufacturers internal laboratory is used as opposed to the external laboratory. The internal laboratory is not certified for the analysis but is certified to the same quality standards as the external laboratory. The manufacturer has provided a comparison of the results from analysis from both laboratories which shows little to no differences

Conclusion
This justification is acceptable on safety grounds. The manufacture has provided evidence to support the reduction in analysis and has provided evidence to support the use of their internal laboratory.

D4.5.7 Control measures and quality management

To comply with the CBAM requirements, the operator should ensure the data used to determine embodied emissions is complete, accurate and free from errors. It is recommended that the operator establishes appropriate control systems covering the:

- collection;
- processing;
- calculation;
- reporting of the CBAM data.

The force of law notice (ODT, 344KB) contains the requirements on the control activities and systems that must be contained within the monitoring plan. Establishing effective control systems can help improve data quality, reduce the risk of errors and support the verification process.

The operator could already have control systems in place for other monitoring and reporting requirements, such as emission trading schemes, greenhouse gas monitoring programmes or environmental management systems such as ISO 14001. Where appropriate, these existing arrangements could be adapted or expanded to cover the requirements of the CBAM.

The following sections provide examples of control activities and how they can be applied to support the Monitoring Reporting and Verification process for the CBAM.

D4.5.7.1 Step 1: Perform a risk assessment

The first-step is to map the complete data flow used for CBAM monitoring and reporting. This should include the journey of the data from its original source, such as fuel invoices, laboratory results or meter readings, through to the final embodied emissions calculations and reported values.

During this process the following should be identified:

- where the data is collected;
- how the data is recorded and stored;
- how the data is transferred between systems;
- how the calculations are performed;
- how the final emissions data is generated and reported.

Once the data flow has been mapped, this will need to be assessed to identify where errors are most likely to occur and which have the greatest impact on the reported emissions.

Particular attention should be given to situations where:

- the likelihood of an error occurring is high;
- the impact of an error on reported emissions is high;
- both the likelihood and impact of an error are moderate.

These areas should be prioritised when designing control activities and quality assurance procedures.

This risk assessment will help ensure that monitoring resources are focused on the areas where errors are most likely to affect the accuracy of the embodied emissions data.

D4.5.7.2 Step 2: Establish effective controls

Once the highest-risk areas have been identified, control measures should be established to reduce the likelihood and impact of errors. For example, where there is a risk that:

- a measurement instrument may fail;
- data may be entered incorrectly;
- information may be transferred incorrectly between systems;
- calculations may be applied incorrectly.

Control measures should be implemented as appropriate to manage and reduce those risks.

D4.5.7.3 Step 3: Review the effectiveness of control measures

Once control measures have been implemented, they should be reviewed periodically to ensure that they remain effective.

One simple approach is the four-eye principle, where a task or control activity is independently reviewed by another person. For example, a data transfer, calculation or emissions report are checked by someone other than the individual who performed the original task. Regular reviews can help identify weaknesses in the control systems and opportunities for improvement.

Typical areas where control measures may be required include:

- calibration and maintenance of the relevant measurement equipment used;
- quality assurance of the information technology systems;
- segregation of duties in the data flow and control activities;

- management of staff competence;
- internal reviews and validation of data (for example comparing collected data with different data sources such as energy efficiency data and comparing internal measurement devices with those under external control etc.);
- corrections and corrective action in the event of data gaps due to instrument failure;
- control of out-sourced processes that are not under the control of the installation operator;
- documentation and record retention, including the management of document versions.

D4.6 Determine the installation emissions

The CBAM uses a top-down approach to determine the embodied emissions of CBAM goods. This means the operator will need to determine the total emissions of the installation. These emissions will need to be attributed to the relevant production processes before being allocated to the CBAM goods produced by the production processes. This section of the guidance provides information relating to how these calculations can be carried out.

The emissions from the manufacturer of CBAM goods can be monitored in different ways. The methods shown below can either be used separately or they can be combined to ensure that there are no data gaps or double counting.

The first task will be the selection of a monitoring approach on the basis that it will give the most accurate and reliable results as referred to in section D4.5.4. The exception is where a particular approach is required for a specific sector or reasons. The monitoring approaches that can be followed are:

- **Calculation-based approach**
  This approach requires the operator to determine emissions from the source streams based on activity data such as fuel usage data. The operator will need to use this fuel usage data, together with additional parameters that either come from standard values or from laboratory analysis to calculate the emission for the goods produced This approach can be known as either the ‘standard methodology’ (which distinguishes combustion and process emissions) or the ‘mass-balance methodology’.
- **Measurement-based approach**
  In this approach the operator will be using a CEMS to directly measure the emissions from emissions sources, i.e. the exhaust stack.

As mentioned above, a combination of approaches can be used to determine the emissions from a production process. This is on the provision there is no double-counting or data gaps within the emissions data that is to be reported. This allows the use of different monitoring approaches for different parts of the installation.

Figure 4-3 below illustrates how the calculation can be completed for all the emissions as required for the CBAM.

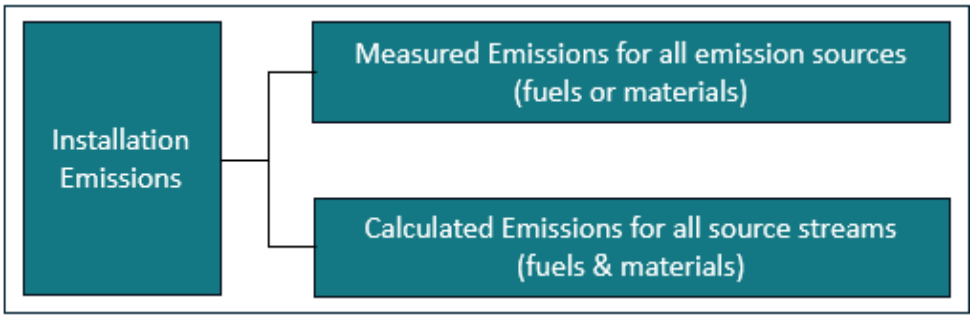


Figure 4-3: shows an overview of installation emissions.

The above is also illustrated in equation 1 of the force of law notice as shown below:

$$Em_{Inst} = \sum_{i=1}^{n} Em_{calc,i} + \sum_{j=1}^{m} Em_{meas,j}$$

Where:
Em_{Inst} is the direct emissions of the installation expressed in tCO_2e;
$Em_{calc,i}$ is the emissions from source stream $_i$ determined using a calculation-based approach expressed in tCO_2e;
$Em_{meas,j}$ is the emissions from emission source $_j$ determined using a measurement-based approach expressed in tCO_2e.

For the definition of the terms ‘source stream’ and ‘emission source’ reference should be made to Annex V.

D4.6.1 Calculation-based approach

D4.6.1.1 Standard methodology

The standard approach methodology is straightforward and can be applied where a fuel or material can directly be linked to the emissions associated with the production of a CBAM good.

The process requires the calculation of the emissions by means of the activity data, which is the amount of fuel or process input material

consumed. This is then multiplied by an emission factor. There are two other factors that may need to be applied to the calculation. These are to correct the emission values in situations where there is incomplete chemical reaction. These other factors are the oxidation factor for combustion emissions, and the conversion factor for process emissions.

When applying the standard methodology, the concept of applying the best available measurement methodology must be applied. In addition, the force of law notice sets out recommended improvements which go over and above the minimum requirements, and which operators are encouraged but not obliged to apply.

The monitoring requirements of the standard methodology are based on the following:

- Combustion emissions:
  - minimum requirements:
    - fuel quantity (t or m^3);
    - emission factor (tCO_2/t or tCO_2/m^3);
  - recommended improvement:
    - fuel quantity (t or m^3);
    - net calorific value (TJ/t or TJ/m^3);
    - emission factor (tCO_2/TJ);
    - oxidation factor;
    - biomass fraction.
- Process emissions:
  - minimum requirements:
    - activity data (t or m^3);
    - emission factor (tCO_2/t or tCO_2/m^3);
  - recommended improvement:
    - activity data (t or m^3);
    - emission factor ($t\ CO_2/t$ or $t\ CO_2/m^3$);
    - conversion factor.

The standard formulas that can be used for combustion and process emissions and parameters are shown in the force of law notice (ODT, 344KB).force of law notice (ODT, 344KB). Further details of these formulas are given below:

D4.6.1.2 Combustion emissions

Installation operators can calculate the combustion emissions by applying equation 2 from the force of law notice as shown below:

$$Em_i = AD_i \times EF_i \times OF_i$$

Where:
Em_i is the emissions in tCO_2 caused by fuel i;

AD_i is the activity data (TJ), of fuel $_i$;
EF_i is the emission factor in tCO_2/TJ of fuel $_i$;
OF_i is the oxidation factor of the fuel $_i$.

The AD_i element of the above equation can be calculated by applying the following equation:

$$AD_i = FQ_i \times NCV_i$$

Where:
FQ_i is the fuel quantity consumed in t or m^3 of fuel $_i$;
NCV_i is the net calorific value TJ/t or TJ/m^3 of fuel $_i$;

The OF_i element is able to be calculated by applying the following equation:

$$OF = 1 - \frac{C_{ash}}{C_{total}}$$

Where:
C_{ash} is the carbon contained in the ash and flue gas cleaning dust;
C_{total} is the total carbon contained in the fuel combusted.

When looking at the value for the activity data (AD_i), the units are usually in tonnes, and this would be the case for solids and liquids. The unit of Nm^3 is usually used for gaseous fuels. For the latter value, to achieve numbers of similar magnitude, the values are usually given in 1,000 Nm^3 in practice.

The oxidation factor (OF_i) element for the combustion emissions is normally determined by laboratory analysis. The two C variables stated above (C_{ash} and C_{total}) are expressed as (tonnes C) which is the quantity of material or fuel multiplied by the concentration of carbon contained within the fuel. As the result of this, it is not only the carbon content of the ash that must be determined, but the quantity of ash for the period in which the oxidation factor applies must also be determined.

To help to reduce administrative burdens, a conservative assumption can be used so that OF_i =1.

With regards to the combustion emissions, the emission factor (EF_i) is usually expressed in relation to the energy content and net calorific value of the fuel rather than its mass or volume:

- in the case where the emission factor is required to be calculated for a fuel from the analysis of the carbon content and net calorific value, equation 5 from the force of law notice as shown below can be used:

$$EF_i = CC_i \times \frac{f}{NCV_i}$$

- in the case the emission factor of a material or fuel expressed as tCO_2/t is to be calculated from the analysis of the carbon content, equation 6 from the force of law notice as shown below can be used:

$$EF_i = CC_i \times f$$

In the above equation, f is the ratio of molar mass of CO_2 to C where:

$$f = 3.664\ tCO_2/t\ C.$$

The above approach can be modified, only on the basis where there is evidence that a higher accuracy can be achieved, as follows:

- where activity data (AD_i) is expressed as the fuel quantity (i.e. in t or m^3), rather than using the above equation;
- where the emission factor (EF_i) is expressed as tCO_2/t fuel or tCO_2/m^3 fuel, as applicable;
- where the net calorific value (NCV_i) can be omitted from the calculation if the EF_i element is expressed as tCO_2/t fuel. However, it is recommended that the NCV_i element is still reported to allow for consistency checking and for the monitoring of the energy efficiency across the whole production process for the CBAM goods that is produced.

D4.6.1.2.1 Biomass

If an operator uses biomass as a fuel for combustion and it complies with the definition in Article 3 of the ETS Monitoring and Reporting Regulation and the definitions in the 'Renewable Energy Directive' (RED II), this fuel can be zero-rated in terms of the emissions (CO_2) from this fuel. This approach applies for accounting purposes only. Physically CO_2 is still emitted from the installation manufacturing CBAM goods, however these emissions will not need to be reported.

Further details on the use of biomass can be found in the following guidance document UKETS03 MRR - Reporting biomass in installations.

D4.6.1.2.2 Mixed Fuels

If the operator uses mixed fuels, which are fuels containing both fossil and biomass elements, they will need to determine the preliminary emission factor and the biomass fraction for the fuel that is used.

To help with this calculation, equation 7 from the force of law notice can be used as shown below:

$$EF_i = EF_{pre,i} \times (1 - BF_i)$$

Where:
EF_i is the emission factor EF in tCO_2/TJ of fuel $_i$;
$EF_{pre,i}$ is the preliminary emission factor of fuel $_i$ (i.e. the emission factor assuming the total fuel is fossil);
BF_i is the biomass fraction (dimensionless) of fuel $_i$.

Where a fossil fuel is used, but the biomass fraction is unknown, the BF_ivalue shall the set to a conservative value of zero.

D4.6.1.2.3 Process emissions

If process emissions are used as part of the manufacture of CBAM goods, equation 8 from the force of law notice as shown below can be used:

$$Em_j = AD_j \times EF_j \times CF_j$$

Where:
AD_j is the activity data (t of material) of material $_j$;
EF_j is the emission factor in tCO_2/t of material $_j$;
CF_j is the conversion factor (dimensionless) of material $_j$.

In the above equation, the operator can assume the CF_j element equals 1. This value can always be used where it reduces the monitoring efforts.

If there are mixed process input materials that contain inorganic as well as organic forms of carbon, the following must be applied:

- determination of the preliminary emission factor for the mixed material by the analysis of the total carbon content (CC_j) and using a conversion factor, and where appropriate a biomass fraction and net calorific value which relates to the total carbon content;
- determine the organic and inorganic contents separately and treat them as two separate source streams.

The AD_i element in the above equation refers to either:

- an input material;
- the resulting output from the process.

For this purpose, the operator can apply two methods for calculating process emissions. These methods are:

- **Method A** – based on the inputs to the process;
- **Method B** – based on the outputs from the process.

The above methods are considered equivalent. However, in the case of

Method B (output based), this can only be used where the CO_2 process emissions are from carbonates. For other process emissions except for carbonates, only Method A (input based) can be used.

An important element for carbonate process emissions occurs during flue gas desulphurisation. Operators will need to include these in the calculation of any emissions that relate to heat and from the use of CHP units (see sections D4.8.2 to D4.8.4).

D4.6.1.2.4 Carbonate process emissions

To calculate process emissions from the thermal decomposition of carbonate-based (inorganic) materials, as referenced above, the operator will need to use either of the following methods:

- **Method A (input based)**
  The emission factor, conversion factor and activity data relate to the amount of material input (carbonates) to the production process. In this case, the standard emission factors for carbonates that can be found in Table 3 of Annex VI can be used, whilst considering the composition of the material.
- **Method B (output based)**
  The emission factor, conversion factor and activity data relate to the amount of material output (metal oxides) from the production process. In this case the standard emission factors for metal oxides that can be found in Table 4 of Annex VI can be used, whilst considering the composition of the material.

When choosing between these methods the operator should select the approach that provides the most accurate and reliable results for each source stream. In doing so, there will need to be the consideration of the measurement systems available for the determination of the activity data and the avoidance of unreasonable costs.

D4.6.1.2.5 Mixed materials process emissions

Where a manufacturing process uses input materials that contain inorganic and organic forms of carbon, the following approaches can be used:

- determine the total preliminary emission factor for the mixed material. For this there will need to be the analysis of the total carbon content, the application of a conversion factor and if applicable, a biomass fraction and net calorific value that relate to the total carbon content;
- determine the organic and inorganic contents separately and treat each of these as a separate source stream.

In both cases, Method A must be applied.

Where a mixed material contains a biomass fraction, the emission factor for the biomass element can be set to zero. This is on the provision that the primary purpose of the material is not energy generation. In these circumstances, the operator must be able to demonstrate that the use of the material meets the definition of process emissions.

Where the main purpose is for the generation of heat, the criteria in the ETS Monitoring and Reporting Regulation and in the 'Renewable Energy Directive' (RED II) will need to be met. Further details on the use of biomass and the zero rating of biomass can be found in the guidance document UKETS03 MRR - Reporting biomass in installations and within section D4.6.3.

D4.6.1.3 Mass balance approach

The mass balance approach is a calculation-based approach that can be used for determining the emissions at the installation manufacturing the CBAM goods. This approach can be used in cases where the installation is complex, for example at an integrated steelworks. In these installations, it could be difficult to directly link emissions to individual input materials because a significant proportion of the carbon introduced into the process can remain within products, by-products or waste streams.

Using a mass balance approach for these complex installations will allow for a complete balance of the carbon entering and leaving the installation or a defined part of the installation. The CO_2 quantities relevant for each source stream that is used is based on the carbon content within each material, without distinguishing fuels and process materials. Non-emitted carbon leaving the installation that is in the product produced is considered by the output source streams, which will have a negative activity data.

The key requirements for using a mass balance approach are:

- minimum requirement:
  - material quantity (t);
  - carbon content (tC/t material);
- recommended improvement:
  - material quantity (t);
  - carbon content (tC/t material);
  - net calorific value (TJ/t); and;
  - biomass fraction.

When considering setting up a monitoring approach for a mass balance methodology, the operator will need to consider:

- emissions of carbon monoxide (CO) to the atmosphere will not need to be counted as an outgoing source stream. However, they are considered as the molar equivalent amount of CO_2 emissions. This

can be accomplished by not listing the CO as an outgoing material;

- comply with the principle of completeness of the monitoring data. Consideration will need to be taken of all the materials and fuels that are used if they are not monitored by an approach outside the mass balance.

The emissions for a mass balance approach can be calculated by calculating the emissions that correspond to each source stream. This can be completed by applying equation 9 from the force of law notice as shown below:

$$Em_k = f \times AD_k \times CC_k$$

Where:
f is the ratio of the molar mass of CO_2 and C: f = 3.664 tCO_2/t C;
AD_k is the Activity Data (t) of material $_k$; (for outputs, AD_k is negative);
CC_k is the Carbon Content of material $_k$ (dimensionless and positive).

In the case where the carbon content of fuel $_k$ is calculated from an emission factor expressed in tCO_2/TJ, the operator can use equation 10 from the force of law notice as shown below:

$$CC_k = EF_k \times \frac{NCV_k}{f}$$

If the carbon content of a material or fuel $_k$ is calculated from an emission factor expressed in tCO_2/t, then equation 11 from the force of law notice as shown below can be used:

$$CC_k = \frac{EF_k}{f}$$

D4.6.1.3.1 Treatment of Biomass in mass balances

Emissions which originate from biomass, can be zero-rated if the biomass complies with the criteria in the ETS Monitoring and Reporting Regulation and in the 'Renewable Energy Directive' (RED II). As these criteria apply only to the energetic use of biomass, it must be established if the biomass source streams are used for primary energy production. For example, the use of charcoal as a reducing agent in a blast furnace will qualify as primary non-energetic use.

In the case of mixed fuels or materials containing biomass being included as an input material or fuel into a mass balance, the preliminary carbon content will need to be adjusted to reflect the fossil fraction of the material or fuel. In cases where the biomass fraction is not known, the operator will need to take this as if there was no biomass in the material

or fuel used. If this does occur, equation 12 from the as shown below should be used:

$$CC_k = CC_{pre,k} \times (1 - BF_k)$$

Where:
CC_k is the Carbon Content of material k (dimensionless and positive);
$CC_{pre,k}$ is the preliminary Carbon Content of fuel k (i.e. emission factor assuming the total fuel is fossil);
BF_k is the Biomass Fraction of fuel k (dimensionless).

Where the operator has used biomass as the input material or fuel, and the output material contains carbon, the biomass fraction will need to be treated conservatively within the mass balance calculation. This means the fraction of biomass in the total output carbon, shall not exceed the total fraction of biomass contained in the input materials and fuels. The only exception is where the operator can provide evidence of a higher biomass fraction in the output materials by a "trace the atom" (stoichiometric) method or by Carbon 14 analysis.

D4.6.1.4 Rules for activity data

Section B4 of the force of law notice (ODT, 344KB) provides the requirements that the operator will need to follow to determine the activity data over the monitoring period.

D4.6.1.4.1 Approaches

The two approaches that will need to be followed are:

- Continual metering: this is at the process where the material is either consumed or produced;
- Batch-wise determination: this is where separate quantities (batches) are delivered or produced which will subsequently need to be added up over the reporting year. As part of this process, the operator will need to take into consideration any stock changes. For this approach, the following formulas can be used:
  - $Cons = I - E + S_{start} - S_{end}$
  - $Prod = E - I - S_{start} + S_{end}$

  Where:
  $Cons$ is the amount of fuel or material consumed during the reporting period;
  I is the amount of the fuel or material 'imported' to the installation during the reporting period;
  E is the amount of the fuel or material 'exported' from the

installation during the reporting period;
S_{start} is the stock at the start of the reporting period;
S_{end} is the stock at the end of the reporting period.

In situations where the determination of stock quantities by direct measurement would incur unreasonable costs as per section D4.5.5, an estimate of the quantities can be based on:

- data from previous years which has been correlated with an appropriate activity level (i.e. same products being produced, same input materials being used, same production patterns etc) for the reporting period;
- data based on documented procedures and respective data in the audited financial statements for the reporting period.

Furthermore, if the operator is using the date at the end of the reporting period, however this leads to an unreasonable cost, they can choose the next most appropriate date to separate reporting periods. The deviations involved for each of the CBAM products produced, materials or fuels used will need to be clearly recorded to form the basis of a value that is representative for the reporting period. This deviation will need to be considered for the next reporting period.

D4.6.1.4.2 Preferred Approach

The preferred approach is to use measurements and measurement devices that are under the control of the operator. However, if the installation does not have relevant measurement instruments available, the installation is able to limit the monitoring costs so that other measurements and measurement instruments can be used. This would be the case where the operator has measurement instruments that belong to the supplier of the fuels or materials where a commercial transaction takes place. The commercial transaction will involve a quality of measurement instruments that enables mutual trust. These measurement instruments are often referred to as measurement instruments that are under 'legal metrological control'.

Measurement instruments that are outside of the control of the operator can be used in the following situations:

- their use will lead to more accurate results than using a measurement instrument that is under the control of the operator;
- using such an instrument will result in a lower risk of errors within the data set, than using the measurement instruments that is under the control of the operator.

If the operator uses a measurement system outside of their control, the readings can be taken directly from the measurement device or system (where possible), or they can be taken from the invoices issued by the fuel

or material supplier.

D4.6.1.4.3 Requirements for measurement systems

An important element for the operator is to establish the quality of the measurement device that is to be used. This can be done by the establishment of an 'uncertainty' of the measurement device that is used and where the readings are taken from.

The operator will need to understand the measurement devices that are in use at their installation. This is needed to ensure the operator can make a choice on the "best" data source that is to be used for CBAM compliance. Further information on this can be found in section D4.5.4.

For the most significant emission at the installation that is manufacturing CBAM goods where the CO_2 emissions are more than 500,000 tCO_2 per year, the uncertainty of the measurement devices used over the full reporting period must be 1.5% or less.

In the case of the minor source streams where the CO_2 emissions are below 10,000 tCO_2 per year, the uncertainty used over the full reporting period must be less than 7.5%. These values will apply unless their application leads to an unreasonable cost. If this is the case, the operator will need to complete an unreasonable cost justification as explained in section D4.5.5.

If a situation occurs where the operator needs to replace a measuring instrument, for example in the case of a malfunction or its calibration shows that the desired uncertainty can no longer be met, they must look to replace the failed measurement device with a device that has the same or better uncertainty level. The operator must always take the approach to improve the measurement devices that are in use at their installation, whilst ensuring they continue to meet the existing standard.

D4.6.1.5 Rules for calculation factors

As part of the determination of the CBAM emissions, the operator will need to use an element known as calculation factors in the calculation-based approach. The exception to this will be during the determination of the activity data element. This section of the guidance covers rules for the following, as referenced in section D4.6.1.4 and section D4.6.1.5:

- emission factor (EF);
- net calorific value (NCV);
- oxidation factor (OF);
- conversion factor (CF);
- carbon content (CC);

- biomass fraction (BF).

Calculation factors are the qualitative information (i.e. the characteristics of the material) of the source streams (fuel and material), which can be determined by laboratory analysis. The determination of these calculation factors involves significant effort and require specialised competence. It is often the case that these calculation factors are set as fixed values in the monitoring methodology. The justification for these being used is that they have been obtained from external analysis outside the requirements of the operator, for example obtained from the latest national inventory submission to the Secretariat of the United Nations Framework Convention on Climate Change. Therefore, these fixed values provide sufficiently representative data.

The determination of the calculation factors needs to be consistent with the state they are used for the related activity data. For example, if the installation's activity data relates to coal that is weighed as it is taken from a coal pile, this material may contain:

- coal dust;
- moisture from rain or from dust prevention.

In the above both the NCV and CC values will need to be determined with the same moisture level. If laboratory analysis is carried out on dry material (i.e. no moisture in the material), then the operator will need to adjust the activity data accordingly to reflect the moisture content or vice versa.

D4.6.1.5.1 Methods for setting calculation factors

For the CBAM, the following methods can be used for the setting of the calculation factors. These methods are listed with increasing data quality:

- fixed values ("type I standard values");
- fixed values ("type II standard values");
- correlations for determining proxy data;
- laboratory analysis: carried out outside of the control of the operator, for example by the supplier of the fuel or material, where the value is contained in purchase documents. This is without further information being provided on the method that has been applied;
- laboratory analysis: carried out in a non-accredited laboratory, or carried out in an accredited laboratory, with the application of a simplified sampling method;
- laboratory analysis in an accredited laboratory: where the best practice has been applied regarding the sampling of the material or fuel.

D4.6.1.5.2 Fixed values

As the manufacturer of CBAM goods, the operator will have a wide range of options to enable them in the choice of the value for each of the calculation factors required to monitor each source stream. With this in mind, the operator must choose the most appropriate and accurate values that are available. To ensure consistency over time and to prevent arbitrary changes in the data, the approach to be used must be stipulated in the monitoring plan. This will ensure the same approach can be used year on year.

For some of the values that the operator may need to use, these can be taken from national GHG inventories of the country where they are situated and these values may change year on year. In these cases, there should be the documentation and implementation of procedures to ensure:

- the values which are subject to change are regularly updated;
- the source of the data;
- the person responsible for completing the above tasks.

'Type I standard values' are:

- standard factors provided in Annex VI;
- standard factors contained in the latest Intergovernmental Panel on Climate Change (IPCC) guidelines for GHG inventories;
- values based on laboratory analysis carried out in the past, not older than 5 years and considered representative for the fuel or material being used.

'Type II standard values' are more accurate than the 'Type I' standard values and are:

- standard factors used by the country where the installation is located for its latest national inventory submission to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC);
- values published by national research institutions, public authorities, standardisation bodies, statistical offices etc. for the purpose of more disaggregated emission reporting than under the previous point;
- values specified and guaranteed by the supplier of a fuel or material where there is evidence that the carbon content exhibits a 95% confidence interval of not more than 1%;
- stoichiometric values for the carbon content and related literature values for the NCV of a pure substance;
- values based on laboratory analysis carried out in the past, not older than 2 years and considered representative for the fuel or material being used.

D4.6.1.5.3 Correlations for determining proxy data

The operator can determine a proxy for the carbon content or emission factor from the following parameters:

- density measurement of specific oils or gases, including those common to the refinery or steel industry;
- net calorific value for specific coal types for example:
    - anthracite coal (hard coal);
    - bituminous coal (house/steam coal);
    - sub-bituminous coal;
    - lignite coal (light brown coal)).

The pre-condition for using such correlation is that the operator establishes an empirical correlation at least once per year using laboratory analysis which meets the requirements below. The difference from using direct analysis lies in the fact that the operator will need to carry out the analysis only once a year for establishing the correlations. The operator will not need to carry out this analysis for each batch of material used, which will help to reduce the overall costs of monitoring.

D4.6.1.5.4 Requirements for laboratory analysis

This section applies to all types of laboratory analysis required for the determination of the properties of materials and for determining the correlations of materials as referenced above. This is not limited to the source streams and to the calculation-based approaches but can also relate to the goods produced and to all measurements used for a measurement-based approach.

For each batch of material or fuel that is subject to analysis, a representative sample will be required. The results from this analysis shall only be used in the calculation for the batch from which the sample was taken.

Any analysis, sampling, calibrations and validations for the determination of the calculation factors shall be carried out by the operator, or on behalf of the operator, by applying methods based on corresponding ISO standards. Where such ISO standards do not exist, the chosen method shall be based on suitable (European) EN or national standards. Where no applicable published standards exist, suitable draft standards, industry best practice or other scientifically proven methodologies can be used, whilst limiting sampling and measurement bias.

D4.6.1.5.5 Analysis frequency

The amount of analysis that the operator will need to complete throughout the year will have an impact on the overall monitoring costs. It is therefore desirable not to carry out analysis where it is not required. However, where materials or fuels are very heterogeneous, more frequent analysis will be

required. The section below focuses on the required frequency of analysis as opposed to the frequency for taking samples, which is covered further on in this section of the guidance.

Section B.5.4.2 of the force of law notice (ODT, 344KB) contains Table 1 which is also shown in Table 4-1 below, which illustrates the minimum frequency of analysis for different materials. This table builds on the experience of the sampling frequencies of UK ETS.

Fuel/material	**Minimum frequency of analyses**
Natural gas	At least weekly
Other gases, in particular synthesis gas and process gases such as refinery mixed gas, coke oven gas, blast-furnace gas, convertor gas, oilfield, and gas field gas	At least daily — using appropriate procedures at different parts of the day
Fuel oils (for example light, medium, heavy fuel oil, bitumen)	Every 20,000 tonnes of fuel and at least six times a year
Coal, coking coal, coke, petroleum coke, peat	Every 20,000 tonnes of fuel/material and at least six times a year
Other fuels	Every 10,000 tonnes of fuel and at least four times a year
Untreated solid waste (pure fossil or mixed biomass/fossil)	Every 5,000 tonnes of waste and at least four times a year
Liquid waste, pre-treated solid waste	Every 10,000 tonnes of waste and at least four times a year
Carbonate minerals (including limestone and dolomite)	Every 50,000 tonnes of material and at least four times a year
Clays and shales	Amounts of material corresponding to emissions of 50,000 tonnes of CO_2 and at least four times a year
Other materials (primary, intermediate, and final product)	Depending on the type of material and the variation, amounts of material corresponding to emissions of 50,000 tonnes of CO_2 and at least four times a year

Table 4-1: shows the minimum analyses frequencies in accordance with the Implementing Regulation.

Regarding the “number of times a year” element within the above table, the operator could have situations where they only operate for part of the year, or where fuels or materials are delivered in batches that are consumed over multiple reporting periods. In these cases, the installation operator will need to choose the most appropriate schedule for analysis whilst ensuring it is representative of the period of operation. This is on the provision that it results in a comparable uncertainty as referenced in the last point of the following paragraph.

In certain circumstances the operator may be able to deviate from the frequency listed in Table 4-1 above, as shown below:

- the table does not contain the frequency of analysis for the fuel or material that is used in the production of a CBAM good. In this case the best option is to use the 1/3 rule where the analysis frequently leads to 1/3 of the uncertainty over the whole reporting period;
- where undertaking the minimum frequency listed in the above table would incur unreasonable cost;
- if the fuel or material is uniform and the composition of all the elements are consistent based on historic analysis including the analytical values for the fuels or materials in the monitoring period (calendar year) immediately preceding the current monitoring period. This is on the provision that any variation in the analytical values for the fuel or material does not exceed 1/3 of the uncertainty that apply in the determination of the activity data of the fuel or material.

Where a different frequency of analysis than listed above has been applied, this must be documented in the monitoring plan.

D4.6.1.5.6 Sampling

When taking samples, the operator must ensure the samples are representative of the total batch of the delivered material or fuel. To ensure the samples are representative, the operator will need to take into consideration the quality and the state of the material or fuel received when compared to similar deliveries in the past. In addition, the operator must consider other aspects such as the available sampling equipment, segregation of deliveries, distribution of the particle size of the fuel/material, the stability of samples, etc. These will have an impact on the results of the analysis. The sampling method that is to be followed must be documented within the monitoring plan.

The operator must develop and document within the monitoring plan and a dedicated sampling plan for each material or fuel received where a sample is required to be taken. This sampling plan must contain at least the following:

- the applicable standards that need to be followed;
- information on the sampling methodology that need to be followed;
- information on the:
    - responsibilities;
    - locations;
    - frequencies;
    - quantities;
- the methodology for the storage of the samples;
- the approach for the transportation of the samples at the installation and to the laboratory that will be undertaking the analysis.

D4.6.1.5.7 Frequency of Sampling versus Frequency of Analysis

It is important that there is no confusion between the term “Frequency of Analysis” with the “Frequency of Sampling”. The latter is the frequency of taking samples from a batch or from a delivery of a fuel or material. In general, the operator will need to take a lot more samples than the four that they will be required to take over the year to obtain representative results.

An example of this is as follows:

An installation using coal burns 500,000 tonnes of coal a year. In accordance with Table 4-1 above, the operator is required as a minimum to analyse every 20,000 tonnes of coal. This will result in at least 25 different laboratory samples each year.

The objective of a documented sampling plan is to prepare (at least) 25 laboratory samples that are representative for each of the 20,000 tonnes of coal. To ensure the samples that are to be sent to the laboratory are representative, more than just one sample will need to be taken from each batch of 20,000 tonnes of coal.

D4.6.1.5.8 Requirements for laboratories

The laboratories that an operator uses to undertake the analysis of samples to determine the calculation factor element, must be accredited in accordance with ISO/IEC 17025, for the relevant analytical methods to be used.

An operator can use a laboratory that is not accredited; however, this is only where there is evidence that access to an accredited laboratory is technically not feasible or would incur unreasonable costs. For this the operator will need to apply the approach in section D4.5.5 and ensure this is documented within their monitoring plan.

Where an operator uses a non-accredited laboratory, this laboratory must be sufficiently competent, and the operator must be able to demonstrate this with the appropriate evidence documented in the monitoring plan. A laboratory shall be deemed competent when they can comply with all the following:

- it is economically independent of the operator, or at least organisationally shielded from influence by the management of the operator;
- it applies the applicable standards for the analysis requested;
- it employs personnel who are competent for the specific tasks that have been assigned;

- it appropriately manages the sampling and sample preparation, including the control of the sample integrity;
- they undertake regular quality assurance processes on:
  - the calibration of equipment;
  - the sampling and analytical methods. This includes regular participation in proficiency testing schemes;
  - apply analytical methods to certified reference materials;
  - inter-comparison with an accredited laboratory.
- they manage their equipment appropriately, which includes:
  - maintenance;
  - implementing procedures for calibration;
  - adjustment;
  - maintenance;
  - repair of equipment;
  - record keeping.

D4.6.1.5.9 Determining the biomass fraction

In the case that the operator will be required to determine the biomass fraction of the materials or fuels they use, there are specific rules that must be considered. These rules are:

- The biomass fraction will only need to be determined for mixed materials or fuels which contain biomass and fossil fractions. For pure fossil fuels, the biomass fraction is zero. Pure biomass is a material or fuel that is 100% biomass;
- If the biomass fraction is hard to analyse, or if the operator does not want to make use of zero-rating of the fuel (for example because the biomass fraction of the materials or fuel is very small), a conservative approach can be applied which assumes the whole material or fuel is a fossil material or fuel;
- Only biomass which complies with the 'Renewable Energy Directive' (RED II) as described in section D4.6.3 can be counted as a "biomass fraction". Any remaining other biomass must be counted as part of the fossil element of the material or fuel.

The operator may want to consider the following when determining the biomass fraction of the material or fuel that they use:

- If the operator wants to determine the biomass fraction by laboratory analyses, the appropriate standards that need to be followed are:
  - ISO 21644:2021 (Solid recovered fuels – Methods for the determination of biomass content);
  - EN 15440 (Solid recovered fuels – Methods for the determination of biomass content).

  These standards offer three methods of analysis namely:
  - selective dissolution method;
  - manual sorting method;

- Carbon 14 method.

All three of the above methods have their advantages and disadvantages.

The choice of the method that will need to be used must be carefully selected for the specific purpose of the source stream. The operator will need to consider the limitations of each method as described in the standards.

If the operator uses waste from a defined production process or from an external source, the composition of the waste could already be well-known. If this is the case, an acceptable approach to determine the biomass fraction could be based on a mass balance approach. For example, if waste is received from a wood particle board manufacturer and this is combusted at the installation manufacturing the CBAM goods, it may be possible to determine the biomass fraction (i.e. the wood element) and fossil fraction (i.e. the resin element) from the manufacturing specification of the particle board.

D4.6.2 Measurement-based methodology

In contrast to the calculation-based approach, greenhouse gases that are contained in the emissions from stacks can be used to determine the carbon dioxide emissions. This can be difficult in those installations that have multiple emission points (stacks) or indeed it can be impossible where fugitive emissions (emissions not released through stacks), need to be taken into consideration. However, the strength of applying a measurement-based methodology is the independence of the fuels and materials that may be used, for example where different wastes are combusted.

The measurements from stacks can be undertaken by the installation of a continuous emission monitoring system (CEMS). This is a permanent emission monitoring system that is set up on the stack and measures the real time emissions from the stack. CEMS systems always require two elements:

- measurement of the GHG concentration;
- measurement of the volumetric flow of the gas stream where the measurement takes place.

For certain emissions, such as the monitoring of N_2O emissions, the use of a measurement-based methodology, is mandatory. For example, in nitric acid and fertiliser production. Further information can be found in section E5.3.

For the monitoring of CO_2 emissions, a measurement-based methodology can only be used where there is evidence that using this approach will lead to more accurate data than using a calculation-based methodology. In certain circumstances operators could be able to justify the use of a CEMS based system when compared to the risk of complying with a calculation-based methodology. An example of this could be due to the composition of the material being used, whereby there are no compatible measurement devices, or on safety grounds, for example where there are acid-based gases which makes laboratory analysis not possible. In these cases, the installation of a CEMS system and the application of a measurement-based methodology is the only viable solution.

If the operator has several emission sources and these cannot be measured as one whole single emission source, the operator will need to measure these emissions separately and add the results together to obtain the total emissions over the duration of the monitoring period.

Section B6 of the force of law notice (ODT, 344KB) provides further details on the requirement for applying a monitoring-based methodology. The essential requirements are summarised below.

D4.6.2.1 Calculating the emissions of a reporting period

For the calculation of emissions over the reporting period, the operator must sum up all the hourly averages over the monitoring period for the measured greenhouse gas concentration and multiplied these by the hourly values of the flue gas flow. The hourly values must also be averaged over all individual measurement results of the respective operating hours. For this calculation, the operator must use equation 13 from the force of law notice as shown below:

$$GHG\ EM_{total}[t] = \sum_{i=1}^{HoursOp} \left(GHG\ conc_{hourly,i} \times V_{hourly,i}\right) \times 10^{-6} \left[\frac{t}{g}\right]$$

Where:
$GHG\ EM_{total}$ is the total annual GHG emissions in tonnes;
$HoursOp$ is the total number of hours for which the measurement-based methodology has been applied. This includes the hours for which data has been substituted in accordance with the data gap methodology as shown in the data gaps section below;
$GHG\ conc_{hourly,i}$ is the hourly concentrations of GHG emissions in g/Nm^3 in the flue gas flow measured during operation for hour or shorter reference period $_i$;
$V_{hourly,i}$ is the flue gas volume in Nm^3 for one hour $_i$, determined by integrating the flow rate over the hour.

In the above calculation, the index $_i$ refers to the individual operating hour.

For the above, the operator could use the hourly averages for each parameter before any further calculation are completed. For shorter reference periods, the operator can use half hours instead of full hours without additional costs, if this fits better to the configuration of the measurement instrument for the purpose to determine the annual emissions.

D4.6.2.2 CO_2 emissions from biomass

If the operator uses biomass as a fuel and it complies with the sustainability criteria set out in the 'Renewable Energy Directive' (RED II), they can rate this fuel as zero-rated in terms of the CO_2 emissions from this fuel.

D4.6.2.3 Determination of flue gas flow

To measure the flue gas flow, the operator will need to select the measuring point(s) to ensure that the measurement is representative for the whole cross-sectional area of the stack, and away from any bends which could affect the flow of the gas (see the "Quality requirements" section below). An alternative method is to calculate the flue gas flow by using a suitable mass balance approach. By undertaking this approach, the operator would have to consider, the CO_2 emissions for the following:

- all significant parameters on the input side, including at least input material loads, input airflow and process efficiency;
- on the output side at least the product output and the concentration of oxygen (O_2), sulphur dioxide (SO_2) and nitrogen oxides (NO_X).

D4.6.2.4 Determination of the greenhouse gas concentration in the flue gas

The operator will need to determine the concentration of greenhouse gases in the flue gas by means of the continuous measurement of the gases at a representative sample point. For this the operator will need to apply one of the following methods:

- direct measurement of the concentration of the greenhouse gases;
- indirect measurement of the concentration of greenhouse gases.

However, the operator will need to account for the measured concentration values of all other components that is in the gas stream. This can be completed by using equation 14 from the force of law notice as shown below:

$$GHG\ conc\ [\%] = 100\% - \Sigma_i Conc_i[\%]$$

Where:
$Conc_i$ is the concentration of gas component $_i$.

D4.6.2.5 Treatment of measurement gaps

During the application of a CEMS, there will be situations where the CEMS equipment will be:

- out of control;
- out of range;
- out of operation for part of the hour or for the reference period.

As the result of the above, the operator will have a period where there is a gap in the data being analysed by the CEMS unit, i.e. a data gap.

To resolve this data gap, the operator will need to substitute the missing data with the related hourly average. To calculate this hourly average for a specific hour or a shorter reference period, the operator will need to pro-rata the existing data for the missing reference period.

During this data gap calculation, the operator must ensure at least 80% of the maximum number of data points for the missing parameter is available for the pro-rata of the missing data. For example, if over a period of 100 days there are 20 days of missing data, then 80 days of consecutive data across the period of the data gap must be used (i.e. 40 days either side of the data gap).

In situations where there are fewer than 80% of the maximum number of data points are available, the operator must use equation 16 from the force of law notice as shown below:

$$C^*_{subst} = \bar{C} + 2\sigma_c$$

Where:
$\bar{C}$ is the arithmetic mean of the concentration of the specific parameter over the whole monitoring period or, where specific circumstances applied when data loss occurred, an appropriate period reflecting the specific circumstances;
σ_c is the best estimate of the standard deviation of the concentration of the specific parameter over the whole reporting period, or where specific circumstances applied when data loss occurred, an appropriate period reflecting the specific circumstances.

Where the monitoring period referred to above is not applicable to enable the determination of the substitute values due to significant technical changes at the installation manufacturing the CBAM goods, the operator can choose another sufficiently representative timeframe to determine

the average substitute value and apply a standard deviation to ensure the replacement value is conservative. Ideally this should be within the last 6 months. For example, if the operator has made a similar product on a different production line or in a different part of their organisation, then they could propose to use this data as the basis for the substitute data.

Where the operator has a missing parameter other than the concentration, they will need to determine the substitute values via a suitable mass balance or energy balance approach. This will need to be validated by using the remaining measured parameters of the measurement-based methodology and the data during regular working conditions, whilst considering a time period of the same duration as the data gap.

The operator must ensure that the approach to be taken in the event of a data gap is documented within their monitoring plan.

D4.6.2.6 Quality requirements

The operator will need to carry out all measurements by applying the methods which are based on international standards:

- ISO 20181:2023 Stationary source emissions — Quality assurance of automated measuring systems;
- ISO 14164:1999 Stationary source emissions — Determination of the volume flowrate of gas streams in ducts — Automated method;
- other relevant ISO standards, in particular ISO 16911-2 (Stationary source emissions — Manual and automatic determination of velocity and volume flow rate in ducts).

In situations where no applicable published standards exist, suitable draft standards, industry best practice guidelines or other scientifically proven methodologies can be used. This is on the basis they limit sampling and measurement bias.

The operator also needs to consider all relevant aspects of the CEMS. This includes but is not limited to:

- the location of the equipment;
- the process for the calibration of equipment – both on a continual basis and annual basis;
- details on the measurement approach;
- quality assurance considerations;
- quality control procedures.

The approach for using CEMS equipment must be documented within the monitoring plan and will need to include the above points.

D4.6.2.7 Further requirements

When the operator has determined CO_2 emissions by a measurement-based methodology, they will need to confirm this amount by calculating the annual emissions of each greenhouse gas in question for the same emission sources and source streams. As the result of this, the requirements of a calculation-based approaches can be simplified as appropriate.

When the operator measures CO_2, any amounts of carbon monoxide (CO) that is emitted, will need to be considered as the molar equivalent of CO_2.

D4.6.3 Treatment of biomass emissions

Under the rules for GHG inventories that were established by the United Nations International Panel on Climate Change (IPCC) and used under the Paris agreement, CO_2 emissions from biomass are accounted for at the point where the biomass is harvested (for example for wood, this will be the point where the tree is felled). To avoid double counting, emissions from the use of biomass shall be zero rated. This is to account for the CO_2 emissions being zero at the point where the biomass is consumed as fuel or process material. This is despite the fact that the CO_2 is still physically emitted to the atmosphere at the point of use.

D4.6.3.1 Criteria for zero-rating of biomass emissions

If the operator uses biomass in solid, liquid or gaseous forms, they must consider the following when zero rating the emissions:

1. Solid or gaseous biomass, and bioliquids – if forms of biomass are used for non-energy purposes, providing they meet the criteria in the ETS Monitoring and Reporting Regulation, then the emission factor of zero can be applied to the fraction of the fuel or material that is biomass;
2. Bioliquids – if a bioliquid is used as a fuel for combustion purposes, subject to point 3 below, the emission factor shall be zero. This will only be the case if the sustainability criteria that is set out in Article 17(2) to (5) of the 'Renewable Energy Directive' (RED II) has been fulfilled. In the case the bioliquids that are used within the combustion process which does not comply with these criteria, there may be the need to treat the carbon content of the bioliquid as fossil carbon;
3. Where category 1 tallow or category 2 tallow is used as a fuel, the emission factor for this material may be treated as zero. This will only apply where the tallow is used to produce heat at the installation manufacturing the CBAM goods.
   Tallow is complicated, not just by the physical state that it can exist in but by its potential classification under the Animal By-Product

Regulation (EC) No 1069/2009 (ABPR) and the associated Animal By-Product Regulation implementing regulation No 142/2011 that are enforced through the Animal By-Products (Enforcement) Regulations;

In relation to categories of tallow, this means:

a. "Category 1 tallow" means tallow that is category 1 material under Article 8 of the Animal By-Product Regulation (EC) No 1069/2009 (ABPR) laying down health rules as regards animal by-products and derived products not intended for human consumption;
b. "Category 2 tallow" means tallow that is category 2 material under Article 9 of the Animal By-Product Regulation (EC) No 1069/2009 (ABPR) laying down health rules as regards animal by-products and derived products not intended for human consumption.

4. If peat, xylite and fossil fractions of mixed fuels or materials are used, then these materials are not considered to be biomass, and these fuels will not be zero rated in terms of their CO_2 emissions.

D4.6.3.2 Relevant biomass parameters

In line with the equations that are included for biomass in section D4.6.1, the operator must determine the following for each source stream that is used:

- standard methodology – combustion, minimum requirement:
  - activity data (t or m^3);
  - emission factor (tCO_2/t or tCO_2/m^3);

  recommended improvement:
  - activity data (t or m^3);
  - net calorific value (TJ/t or TJ/m^3);
  - emission factor (tCO_2/TJ);
  - oxidation factor;
  - biomass fraction, evidence for meeting the criteria of section as mentioned above (section D4.6.3);
- standard method – process emissions, minimum requirement:
  - activity data (t or m^3);
  - emission factor (tCO_2/t or tCO_2/m^3);

  recommended improvement:
  - activity data (t or m^3);
  - emission factor (tCO_2/t or tCO_2/m^3);
  - conversion factor;
- mass balance, minimum requirement:
  - activity data (t);
  - carbon content (tC/t material);

  recommended improvement:
  - activity data (t);

- carbon content (tC/t material);
- net calorific value (TJ/t);
- biomass fraction, evidence for meeting the criteria mentioned in section D4.6.3.

Where an installation uses biomass, the operator must document in the monitoring plan all the evidence that the biomass used meets the relevant sustainability criteria. This will be needed by the verifier during the verification process.

D4.6.4 Determine perfluorocarbon (PFC) emissions

As per the system boundaries document, perfluorocarbon (PFC) emissions are only captured under the CBAM for Aluminium goods. For PFC emissions, the gases that the operator will need to monitor are CF_4 and C_2F_6. This will also include any emissions from anode effects as well as fugitive emissions. The method that will need to be followed for the CBAM is based on the guidance "Aluminium sector greenhouse gas protocol" which is published by the International Aluminium Institute (IAI). This method uses a calculation-based approach which significantly deviates from the calculation-based approach that is outlined in section D4.6.1 above. For the measurement of PFCs, the methods which will need to be followed are:

- The "slope method";
- The "overvoltage method".

The method that will need to be applied depends on the process control equipment that has been installed at the installation manufacturing CBAM goods.

Details on the principal requirements and calculation formula and other details on the applicable methods for PFC emissions can be found in section E5.4.

In addition to PFC emissions, operators will need to consider any CO_2 emissions from anode consumption in primary aluminium production. This will need to include the embodied emissions of the CBAM good. Additionally, operators will need to include all fuel-related emissions from secondary aluminium production as well as from diverse forming steps downstream of aluminium melting. For this purpose, a calculation-based methodology can be applied.

More details are given in the section on special rules for the aluminium sector in section E5.4.

D4.6.5 Rules for transfers of CO_2 between installations

If as part of operational activities of an installation, there may be the transfer of CO_2 out of the installation. If this occurs, there are specific rules that the operator will need to apply, particularly on how the emissions are attributed when the CO_2 is transferred. The rules that apply will depend on the following:

- if pure or almost pure CO_2 is being transferred, for example, for use as a chemical feed stock for urea production;
- CO_2 that is already an inherent part of a waste gas or other gaseous source stream is transferred.

When CO_2 originates from:

- fossil carbon:
  - a combustion process or processes that result in process emissions;
  - where CO_2 is imported from other installations;
  - non-CBAM entities, including in the form of inherent CO_2.

The operator will need to account for these as not being emitted, on the following basis:

- CO_2 is used within the installation or transferred out of the installation for any of the following:
  - for the purpose of CO_2 capture, which monitors emissions for the purpose of this Regulation;
  - an installation, non-CBAM entity, or transport network with the purpose of long-term geological storage of CO_2 which monitors emissions for the purpose of this Regulation;
  - a storage site for the purpose of long-term geological storage which monitors emissions for the purpose of this Regulation;
- CO_2 is transferred out of the installation and used to produce precipitated calcium carbonate, in which the used CO_2 is chemically bound.

When CO_2 is transferred to another installation or a non-CBAM entity, the operator can account for the CO_2 as not being emitted, providing the following evidence covers the whole chain of custody to the:

- storage location;
- the installation, or non-CBAM entity, receiving the CO_2;
- the transport operators/method of transport;
- the fraction of CO_2 that is stored or used for the production of chemically stable products compared to the total amount of CO_2 transferred out of the installation.

Additionally, the operator must comply with the monitoring requirements set in section D4.6.5.3.

D4.6.5.1 Accounting for inherent CO_2

The term 'inherent CO_2' refers to CO_2, which is contained in a gas, such as:

- natural gas;
- a waste gas (including blast furnace or coke oven gas);
- process inputs (including synthesis gas) in the emission factor for that source stream, except where the inherent CO_2 originated in another installation producing CBAM goods.

If an operator transfers inherent CO_2 out of their installation, they will need to account for the CO_2 emissions as part of the overall emissions from the installation. This includes if the CO_2 is emitted downstream (for example vented or flared).

It is important that if the transfer of CO_2 out of the installation forms part of the activities of the installation, this must be documented in the monitoring plan.

To ensure consistent reporting and to avoid double counting, inherent CO_2 must be accounted for in the CBAM installation in which it originates.

The above rules apply to the direct emissions at installation level. For calculating attributed emissions of a production process, the formulae given in section D4.3.2.13 apply.

D4.6.5.2 Capture and transfers of CO_2 between installations for storage (CCS) and use (CCU)

Where pure or almost pure CO_2 emissions are captured by the activities of the operator and this is transferred to another installation including a non-CBAM installation, the transferred CO_2 can be subtracted from the original calculated emissions. This is on the provision that both of the following conditions are met:

- the purpose is for storage or transport for long-term geological storage;
- the CO_2 is used to produce products where the CO_2 is permanently chemically bound.

In all other cases, the CO_2 that is transferred out of the installation must be accounted for in the emissions report for the CBAM goods that are produced. The operator must ensure that details of the above are documented in the monitoring plan.

D4.6.5.3 Monitoring requirements

To ensure operator consistently assess their CO_2 emissions to avoid double counting, inherent CO_2 must either be accounted for in the CBAM installation in which it originates or by the CBAM installation to which it is transferred, whereby:

- the originating CBAM installation that transfers out a source stream containing inherent CO_2 to another CBAM installation;
- the originating CBAM installation subtracts the CO_2 from their emissions – the operator will normally have to do this by means of a mass balance process. As part of this calculation, inherent CO_2 will need to be treated in the same way as any other carbon in that outgoing source stream;
- the exception is where:
    - the inherent CO_2 is transferred then emitted (for example vented or flared);
    - is transferred to a non-CBAM installation;
    - where the receiving CBAM installation transfers the CO_2 and uses a source stream that contains inherent CO_2;
    - the emission factor (or in case of mass balances, the carbon content) takes into account inherent CO_2 (i.e. the CO_2 forms a part of the source stream, and the inherent CO_2 counts as emitted by the installation which emits the CO_2).

In relation to the metering of the transferred CO_2, the same approach would apply as would be applied for the transfer of waste gas.

To monitor the quantity of CO_2 transferred between installations, it is recommended that the operator applies a measurement-based methodology. The receiving and/or transferring installation should monitor the incoming CO_2 stream using a CEMS. The operator will need to share the results of their measuring process with either the person sending or receiving the CO_2. This is to ensure the quantities transferred are aligned to ensure the reporting is consistently between installations.

The operator can omit the results from the complete CO_2 stream, or a clearly identifiable part of the installation, where the CO_2 is transferred. In these cases, they will need to ensure the CO_2 quantity can be calculated from the input source streams of the installation manufacturing the CBAM goods.

In the case of CO_2 that is permanently chemically bound into products, it is recommended the operator uses a calculation-based methodology as opposed to using a mass balance approach.

The operator must document within the monitoring plan the chemical reactions that applied, and all relevant stoichiometric factors that have been used to determine the CO_2 which is permanently chemically bound

into the CBAM goods produced.

D4.6.5.4 Monitoring rules for CO_2 transfers

Where an operator transfers CO_2, there are certain rules that will need to be followed. These rules include:

- the operator must clearly state the details of the receiving installations or non-CBAM entities. This must be documented in the monitoring plan. The amount of CO_2 not emitted will need to be reported in the CBAM emissions report pursuant to Annex I;
- the operator must clearly state the details of the installations or non-CBAM entities from which CO_2 was received. This must be recorded in the monitoring plan. The amount of CO_2 not emitted will need to be reported in the CBAM emissions report pursuant to Annex I;
- the operator must determine the quantity of CO_2 transferred from one installation or a non-CBAM entity to another installation using a measurement-based methodology. For the determination of the amount of CO_2, which is permanently chemically bound, a calculation-based methodology is preferred over a mass balance approach. The operator must ensure all chemical reactions that have been applied and all relevant stoichiometric factors are documented in the monitoring plan;
- where CO_2 is used for the purposes of Carbon Capture and Storage (CCS) and Carbon Capture and Use (CCU), the monitoring methods set out in points 21 to 23 of Annex IV of the Commission Implementing Regulation (EU) 2018/2066 shall apply.

D4.7 Rules for attributing emissions to production processes

Section D4.3.12 covered the approach that operators need to follow to attributing emissions from installation level to production processes. Section D4.3.2.13 provides the formula that will need to be followed to calculate these emissions. From following these equations, it is apparent that the operator will also need to consider additional parameters beyond the installation to allow the determination of the CBAM emissions.

The following sections cover:

- generic rules – to help attribute parameters to production processes. This covers the splitting of the data for source stream or attributing heat flows to products etc.;
- monitoring rules for heat flows;
- heat produced by 'cogeneration' (CHP), i.e. in a single process;
- rules for waste gases.

D4.7.1 Generic rules for the metering of parameters to be attributed to production processes

The force of law notice (ODT, 344KB)force of law notice (ODT, 344KB) provides the generic rules operators must follow to attribute various data sets (source streams, heat and waste gases) to production processes.

When undertaking this task, the following will need to be considered:

- where data for a specific data set is not available (i.e. there is a data gap) for each production process, an appropriate method for determining the required data for each individual production process will need to be established. In this situation the operator will need to apply either of the following principles depending on which principle provides the most accurate results:
    - where different goods are produced one after the other on the same production line, the operator will need to attribute sequentially the inputs, outputs, and corresponding emissions to relevant goods or production processes based on the usage time per year for each product; and;
    - where products are produced in parallel at the same time or in the same production process, the operator will need to attribute the inputs, outputs, and corresponding emissions based on suitable correlating parameters such as:
        - the mass or volume of individual goods that have been produced;
        - estimates based on the ratio of free reaction enthalpies of the chemical reactions involved;
        - based on another suitable distribution key that is corroborated by a sound scientific methodology.

If hydrogen is produced using electrolysis, the operator will need to consider the requirements contained in section E5.5.6 of this guidance document.

Another issue that the operator will need to consider is how they will correlate the different measurements at the installation with the level of the production process (or specific physical units of the installation, such as individual boilers and furnaces etc.).

Table 4-2 below provided guidance on this process:

Background:
Fuel is used in several physical units at the installation. The consumption of the fuel (natural gas) is determined using continual metering. The installation has one central measurement device (a main gas

meter) which measures the total quantity of gas entering the installation. There are further sub-meters at the individual process units. The quality of these gas meters may differ.

The main gas meter is the meter of the highest importance for economic reasons, and both the operator and the gas supplier are interested in accurate measurement results. In many countries these meters are subject to National Legal Metrological Control. Where this is not the case, the owner of the gas meter (often the gas supplier or grid operator) will ensure the meter is regularly maintained and calibrated (including the instruments for temperature and pressure compensation).

For cost reasons the gas sub-meters may often be of lower accuracy and will have a higher uncertainty. Also, some operators may not have any separate meters, or the locations of the meters may not coincide with the boundaries of the sub-installations.

Figure 4-4 below provides an example where natural gas is used in three physical units serving two production processes. Units 1 and 2 belong to production process 1, and unit 3 belongs to production process 2. The figure shows different situations that can be found in typical installations:

Case 1: The total amount of gas is metered by the measuring instrument MI_{total}. The second measuring instrument (MI-1) relates directly to production process 1. The result from this meter should be used for CBAM purposes. The gas quantity for production process 2 is simply calculated as difference between the readings of MI_{total} and MI-1.

Case 2: There are two meters covering two production processes. As there is no single meter for the total gas entering the installation, it is to be assumed that the determination of the gas consumption will be the sum of the readings from the two gas meters.

Case 3: This has two meters; however, they are located in a way that they cannot be used for determining the production process-level gas consumption. In this situation there will need to be the establishment of a process similar to Case 1 above, i.e. the operator should install a gas sub-meter either at a position like MI-1 or like MI-2 in Case 2 and then continue as per the approach in Case 1.

Case 4: The gas consumption is "over-determined", i.e. there are more measuring instruments than required. In this situation it may be observed that the sum of the gas sub-meters' readings (MI-1a, MI-1b and MI-2) differs from the reading of the main gas meter MI_{total}. As mentioned above, it is usually assumed that the result of MI_{total} is the most reliable one. Therefore, the production processes' data must be adjusted as such that their sum is identical to the installation-level data. This can be achieved by applying a "reconciliation factor" (see equation below). The readings from the gas sub-meters will then need to be corrected by multiplying the reading with a reconciliation factor.

Note:

In Case 4 above, it is assumed that MI_{total} is the best instrument, and the others are of lower quality. However, this is not always the case. It might be that MI-2 is considerably higher quality than the other two gas sub-meters. In this case it would be justified to use the method described in case 1 instead. The instruments MI-1a and MI-1b would then be used only as corroborating data source.

Table 4-2: shows metering examples.

In Case 4 above, the operator will need to apply a "reconciliation factor". This can be determined by applying equation 32 from the force of law notice as shown below:

$$RecF = \frac{D_{Inst}}{\sum D_{pp}}$$

Where:
$RecF$ is the reconciliation factor;
D_{Inst} is the data value determined for the installation as a whole;
D_{pp} is the data values for the different production processes.

The data for each production process is then corrected using equation 33 from the force of law notice as shown below with $D_{PP,corr}$ being the corrected value of D_{pp}:

$$D_{PP,corr} = D_{pp} \times RecF$$

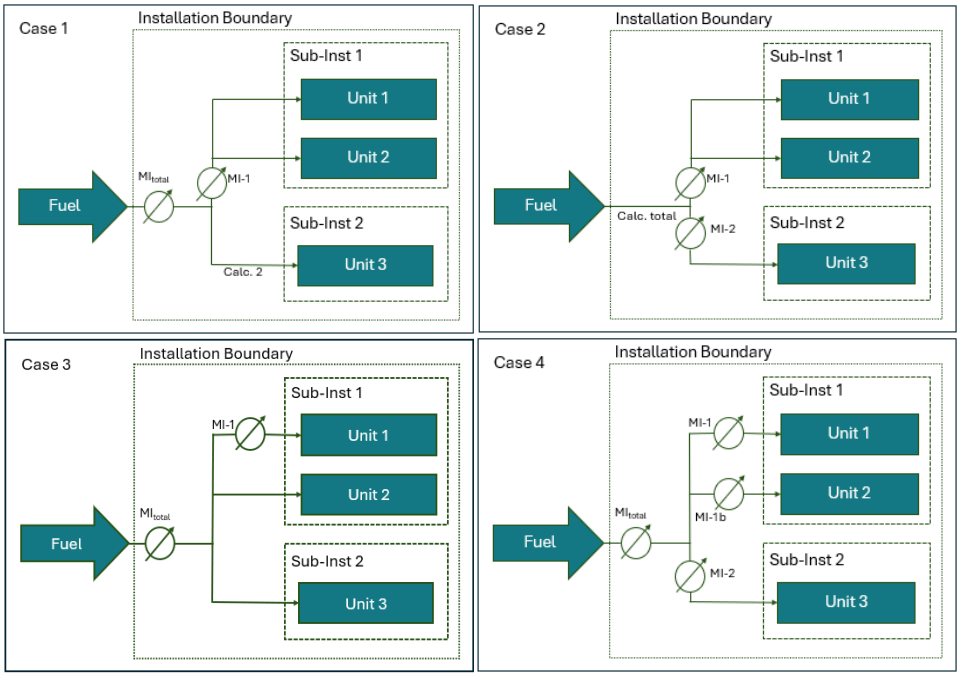


Figure 4-4: shows examples of different situations which explains the basic concepts for splitting data to production processes. In the above, the term "Sub-Inst." should be read as "production process".

The above illustrates how important it is that the monitoring plan documents the full process that is being used to determine the emissions and the equipment that are being using to obtain the raw data (for example fuel consumption values) to calculate the emissions.

D4.8 Rules for measurable heat and emissions

If as part of the manufacture of CBAM goods, the operator does not use any heat in the production process, the following section D4.8.1 and section D4.8.2 are not relevant for CBAM compliance.

Measurable heat is the net amount of measurable heat produced by the installation. When specifying amounts of measurable heat, the operator should always refer to the net amount of measurable heat determined as the heat content (enthalpy) of the heat flow transmitted to the heat-consuming process or an external user minus any heat content in the return flow.

As part of the CBAM obligations, the operator must consider those processes which are necessary for operating the heat production and distribution, for example deaerators, make-up water preparation, and regular blow offs, when determining the efficiency of the heat system. This must be accounted for in the embodied emissions of the CBAM goods produced.

In the case where several consecutive processes consume heat and this is at different temperatures; the operator must determine the amount of heat consumed by the different production processes. The only exemption is where the processes are part of the overall production process for the CBAM good. If there is the re-heating of steam between its transfer between production processes, this will need to be treated as additional heat production. If heat is used to provide cooling via an absorption cooling process, this cooling process must be considered as a heat-consuming process.

This section looks at the quantification of net measurable heat flows and the calculation of heat emissions factors. Heat is a relevant parameter for the attribution of emissions to a production process. This is regardless of if heat is received from:

- another installation;
- from another production process;
- from a central heat supply that serves more than one production processes;
- where heat is exported from the process to other production processes within the installation or to another installations.

The term ‘other installations’ will also include district heating networks.

The treatment of waste gases, CHP and biomass energy and their emissions are discussed separately in the following sections.

D4.8.1 Quantification of net heat flows

Where measurable heat is:

- produced in;
- consumed by;
- imported into;
- exported from the production process.

The operator will need to monitor and attribute the net quantity of measurable heat and the emissions associated with the production of the CBAM good.

Measurable heat has the following characteristics:

- measurable heat is to be understood as the ‘net measurable heat’, i.e. the amount of heat (enthalpy) consumed by a production process. The operator will be required to determine this by subtracting the heat content entering the process or external user (as forward flow) and the heat content returning from the process (as return flow);
- heat flows (forward and return) must be transported using a heat transfer medium, which is typically hot water or steam. However, this can also be heated oil and hot air, etc.;
- heat flows are transported through pipework or ducts (for hot air);
- heat flows are or could be measured by a heat meter.

In determining the net quantity of measurable heat consumed by the production process, the operator must consider the following:

- imports or exports of measurable heat – the amount of heat imported or exported should be quantified. The operator will need to establish (i.e. monitor) the emissions associated with the production of that heat;
- the number of production processes that consume the same heat transfer medium – the quantity of heat consumed by each of the heat consuming processes will need to be determined separately, unless they form part of the same overall production process for the same CBAM good;
- the quantity of heat consumed by the operation of the heat distribution network. This will also need to include any heat losses.

The precise monitoring of the net quantity of measurable heat will require the operator to measure the following parameters:

- flow rate of the heat transfer medium (volumetric or mass flow) to

production process;

- state of the heat transfer medium entering the heat consuming process. Where the “state” includes all parameters relevant for determining the specific enthalpy of the medium, the following will need to be considered:
  - temperature;
  - pressure (in case of steam or other gases);
  - type of the medium (hot water, steam, heated oil etc.);
- for steam information on saturation or degree of super-heating etc. will be required;
- state of the heat transfer medium leaving the heat consuming process;
- details where the flow rate of the returned heat transfer medium (condensate in case of steam) is different from the forward flow, or if unknown, suitable assumptions for its enthalpy are required.

Based on the measured values, the operator will need to determine the enthalpy and the specific volume of the heat transfer medium using suitable steam tables or engineering software. The above process must be documented in the monitoring plan.

The operator may find the determination of the above a difficult task. This can be due to the installation having a complex heat network which may include several heat sources and multiple consumers of the heat. Therefore, section C.1.2.1 of the force of law notice (ODT, 344KB) provides several different methods that can be used to determine the net quantity of measurable heat at the installation. These methods are also shown and explained below.

D4.8.2 Monitoring requirements

If heat is used, the operator should establish processes for the direct, and where necessary the indirect, measurement of heat flows at the installation. This will need to be completed using in-house measurement systems. The process that will need to be established must be documented, implemented, and maintained through written procedures and recorded in the monitoring plan. As per all CBAM procedures this will also need to include a process for the regular checking and review of the heat flows at the installation manufacturing the CBAM goods to confirm:

- any additions or removals of heat consuming units at the installation or production process;
- any changes in the types of heat flows at the installation i.e. heat imports, production, consumption or exports;
- any modifications that will be required to the monitoring methodology, if relevant.

D4.8.2.1 Methodologies for determining net measurable heat

Where the CBAM production process consumes measurable heat that is produced within the installation manufacturing CBAM goods, the operator can use one of the following methods to determine the net quantity of measurable heat produced and the corresponding emissions.

Methods 1 to 3 relate to decreasing data quality and monitoring effort. It is preferred that Method 1 is used over Method 2, which is preferred overusing Method 3 (see section D4.5.4 on selecting best available data sources).

D4.8.2.2 Method 1: Using measurements

In this method, for all the relevant parameters listed above, the operator will either measure these or they will be known. Where steam condensate is not returned or its flow is unknown, a reference temperature of 90°C can be used. The mass flow rate and heat flow rate of the medium can be calculated using equation 27 from the force of law notice as shown below:

$$m = \frac{V}{v}$$

Where:
m is the mass flow rate in kg/s;
V is the volumetric flow rate in m^3/s;
v is the specific volume in m^3/kg.

If it is considered that the mass flow rate is the same as the flow rate for the transmitted and returned medium, in this case the operator should use equation 28 from the force of law notice by using the difference in enthalpy between the transmitted flow and the return as shown below.

$$Q = \left(h_{flow} - h_{return}\right) \times m$$

Where:
Q is the heat flow rate in KJ/s;
h_{flow} is the specific enthalpy of the transmitted flow in KJ/Kg;
h_{return} is the specific enthalpy of the return flow in KJ/Kg;
m is the mass flow rate in Kg/s.

If the operator determines or knows that the mass flow rates are different, the following needs to be considered if it is confirmed that:

- some condensate remains in the product;
- the respective amount of condensate enthalpy is not deducted;
- some condensate is lost.

In relation to the last point above, an estimate of the loss of condensate will need to be made and deducted from the mass flow of the heat transfer medium.

The operator can determine the net annual heat flow from the above data, by either of the following methods:

- determine annual average values for the parameters determining the annual average enthalpy of the transmitted and returned heat medium, and multiply these with the total annual mass flow by using equation 28 below;
- determine the hourly values of the heat flow and sum up those values over the annual total operating time of the heat system. Subject to the data processing system, hourly values can be substituted by other time intervals as appropriate.

D4.8.2.3 Method 2: Calculation of a proxy based on measured efficiency

This method builds on the energy input of all fuels that can be used and determines the amount of net measurable heat based on the known efficiency of the boiler(s). For this calculation, the operator can use equations 29 and 30 respectively from the force of law notice as shown below:

$$Q = \eta_H \times E_{In}$$

$$E_{In} = \sum i\ AD_i \times NCV_i$$

Where:
Q is the net amount of heat in TJ produced over the reporting period
η_H is the measured efficiency of heat production;
E_{In} is the energy input in TJ from fuels determined using the second equation over the reporting period;
AD_i is the Annual Activity Data (i.e. quantities consumed) of fuels $_i$ in tonnes or Nm^3;
NCV_i is the Net Calorific Value in TJ/t or TJ/Nm^3 of fuels $_i$

The above method refers to the 'measured efficiency' of heat production because it is advisable to measure the efficiency 'over a reasonably long period' of time. This is to ensure the operator can take into account the different load states of the installation.

As an alternative, the operator can take the efficiency of heat production from the boiler manufacturer's documentation (which is the less preferred approach, considering the generic hierarchy of approaches). In this case, the operator will need to consider the specific part load curve by using an annual load factor which is shown in equation 31 from the force of law

notice as shown below:

$$L_F = \frac{E_{In}}{E_{Max}}$$

Where:
L_F is the load factor;
E_{In} is the energy input (TJ) from fuels determined over the reporting period;
E_{Max} is the maximum fuel input if the heat producing unit had been running at 100 % nominal load for the full calendar year.

If the installation has a steam raising boiler, the operator of the installation will need to base the efficiency of this boiler on a situation in which all condensate is returned. A temperature of 90°C should be assumed for the returned condensate, if no actual values are able to be provided.

D4.8.2.4 Method 3: Calculating a proxy based on the reference efficiency

This method is meant for situations where the boiler efficiency is not known. This follows the same approach as Method 2; however, it uses a reference efficiency of 70% as a conservative assumption. This means the η_H reference value, that will need to be used in equation 29 of Method 2 above, is to be set at 0.7.

D4.8.2.4.1 Specific requirements for cross-boundary heat flows

In the case of cross-boundary heat flows (i.e. imports and exports) of measurable heat, the operator should where possible be able to determine the quantity of these heat flows using their own measuring system, ensuring the monitoring approach covers the following:

- the quantity of heat imported where applicable, separately for each source, and record its origin;
- obtained data from the supplier of the imported heat for determining emissions, for the most recent available reporting period;
- the quantity of heat exported, if applicable.

D4.8.2.4.2 Heat energy balance

At the installation manufacturing CBAM goods, there may be a complex heat flow process, i.e. imports, exports or the transfer of measurable heat between different production processes at the same installation etc. In this situation the operator will need to split the heat between the different heat production and consumption processes. For this process a heat and energy balance should be used, which must:

- determine the split for the annual quantities across all flows of measurable heat into and out of the production process;
- attribute the corresponding fuel input emissions to the production processes, in proportion to the heat split. Where heat losses are not attributed to specific production processes, this will need to be attributed proportionally to the split of heat consumed;
- corroborate overall consumption and the corresponding emissions.

This heat balance must be documented in and form part of the monitoring plan.

D4.8.2.4.3 Methodologies for determining fuel emission factors for measurable heat

Where measurable heat is consumed within or exported from the installation manufacturing CBAM goods, the operator must determine the heat related emissions by applying one of the following approaches:

- **Approach 1** – the heat produced in the installation is used by ways other than a CHP (not cogeneration);
- **Approach 2** – the heat produced in the installation is used by a CHP (cogeneration);
- **Approach 3** – the heat was produced outside of the installation.

D4.8.2.4.4 Approach 1 – Emission factor of non-CHP measurable heat produced in the installation

Where measurable heat is produced by the combustion of fuels within the installation manufacturing CBAM goods, except in cases where the heat produced is by cogeneration, the operator must determine the emission factor of the relevant fuel mix and the emissions so that they can be attributed to the production process. For this the operator can undertake this task by using equation 35 from the force of law notice as shown below:

$$Em_{Heat} = EF_{mix} \times \frac{Q_{consumed}}{\eta}$$

Where:
Em_{Heat} is the heat-related emissions of the production process in tCO_2;
EF_{mix} is the Emission Factor of the respective fuel mix pressed as tCO_2/TJ including emissions from flue gas cleaning, where applicable;
$Q_{consumed}$ is the amount of measurable heat consumed in the production process in TJ;
η is the efficiency of the heat production process.

In the above equation, the operator can calculate the EF_{mix} value

separately by using equation 36 from the force of law notice as shown below:

$$EF_{mix} = \frac{(\Sigma\, AD_i \times NCV_i \times EF_i + EF_{FGC})}{(\Sigma\, AD_i \times NCV_i)}$$

Where:
AD_i is the Annual Activity Data (i.e. quantities consumed) of fuels $_i$ in tonnes or Nm^3 used for measurable heat production;
NCV_i is the Net Calorific Value in TJ/t or TJ/Nm^3 of fuels $_i$;
EF_i *is* the Emission Factor of fuels $_i$ expressed in tCO_2/TJ;
Em_{FGC} is the process emissions from flue gas cleaning expressed in tCO_2.

These parameters are readily available if the operator has used a calculation-based approach for the monitoring of direct emissions as shown in section D4.6.1.

Where a waste gas as defined in section D4.8.5 forms part of the fuel mix for the manufacture of the CBAM good, and where the emission factor for the waste gas is higher than the standard emission factor of natural gas, in these cases the operator must use the standard emission factor to calculate the EF_{mix} as opposed of using the emission factor of the waste gas.

D4.8.2.4.5 Approach 2 – Heat produced in the installation by via a CHP

The emissions of the total fuel input to a CHP unit will need to be split in accordance with the method described in section D4.8.4 to give the operator the emissions for the heat that has been generated from the CHP unit.

D4.8.2.4.6 Approach 3 – Emission factor of measurable heat imports produced outside of the installation

When the CBAM production process consumes imported measurable heat that is provided by a third-party located outside of the installation, the operator will need to request the details of the emissions that are associated with the production of this heat. The operator will also need to ensure that these emissions have been determined by the supplier by using either Approach 1 or Approach 2 and they have used the data from the latest available reporting period.

If the actual emissions data is not available from the supplier of the heat, the operator should use a standard value emission factor for the most used fuel in the relevant country and industrial sector. It should also be assumed that the boiler efficiency is 90%.

D4.8.2.4.7 Exceptions

In quantifying the net measurable heat, there has been no distinction made on its origin, provided the heat receive by the installation manufacturing CBAM goods is in scope of the CBAM. However, there are several exceptions to this rule which the operator will need to consider. These exemptions are stated below and are also referenced in section C.1.3 of the force of law notice (ODT, 344KB):

- heat produced from exothermic chemical processes (i.e. not combustion) – where the CBAM production process consumes measurable heat that is produced from an exothermic chemical process, for example nitric acid or ammonia production, the operator will need to:
  - determine the amount of measurable heat consumed separately from other measurable heat;
  - assign zero CO_2 emissions to that particular heat consumption;
- heat recovered from electricity-driven processes, the operator should:
  - determine the amount of measurable heat consumed which has been recovered from the electricity driven process, such as heat recovered from air compressors and used for supplying hot process water (separately from other measurable heat);
  - assign zero CO_2 emissions to that heat consumption;
- heat recovered from 'non-measurable heat', to avoid double counting where the production process producing CBAM goods consumes measurable heat that has been recovered from non-measurable heat generated from fuels, for example where heat is recovered from kiln exhaust gases, the operator should:
  - determine the amount of measurable heat consumed which has been recovered from the kiln exhaust gases (separately from other measurable heat);
  - divide this amount of heat by a reference efficiency of 90% to determine the equivalent energy input for the measurable heat recovered. The operator will then need to subtract this energy input from the fuel input into the kiln for the non-measurable heat.

D4.8.3 Rules for electrical energy and its emissions

Electricity is not captured by the CBAM in the UK; however, the treatment of CHP electrical energy and its related emissions are discussed separately in section D4.8.4 below.

D4.8.4 Rules for combined heat and power (CHP)

The term CHP is also referred to as 'cogeneration'. This is the simultaneous generation of heat and power within a single integrated process.

The heat produced from a CHP can be recovered and used to heat other elements such as hot water, steam or hot air, whilst the power output from the CHP is usually electricity. As a CHP is a single combined process, the split of emissions between heat and power must be calculated using certain assumptions and formulae to allocate emissions to each output.

Section G.2.2 of the force of law notice (ODT, 344KB) provides the approach for attributing emissions from a CHP to production processes. This attribution is based on the calculation of specific emission factors for the heat and power outputs from the CHP. The approach that the operator will need to follow is shown below:

D4.8.4.1 Information required to attribute CHP emissions to production processes

To calculate the split in emissions between heat and power outputs from a CHP, the operator will need to collect the following information:

a) The total amount of fuel input into the CHP unit within the reporting period: This can be done by applying equation 30 from the force of law notice as shown below:

$$E_{In} = \sum i \; AD_i \times NVC_i$$

Where:
E_{In} is the energy input from fuels;
AD_i is the Activity Data (i.e. quantities consumed) of fuels $_i$ in tonnes or Nm^3;
NCV_i is the Net Calorific Value in TJ/t or TJ/Nm^3 of fuels $_i$.

There may be parameters stated above that the operator will already have available if a calculation-based approach has been applied for monitoring of direct emissions as per section D4.6.1;

b) Heat produced by the CHP: The activity level in this case will be the net amount of measurable heat Q_{net} produced by the CHP measured in TJ during the reporting period. Rules for the determination of heat flows are shown in section D4.8;

c) Electricity produced by the CHP: The activity level is the net amount of electricity (or mechanical energy, where applicable) measured in TJ that is produced by the CHP during the reporting period. The net amount of electricity means the amount of electricity that has been exported (i.e. leaving the system boundaries) of the CHP unit;

d) Total emissions from the CHP: This comprises of the emissions from the fuel input to the CHP, as well as the amount of emissions that will

be used for flue gas cleaning. The operator will need to express this as the tonnes of CO_2 (tCO_2) per year. This can be calculated by using equation 37 from the force of law notice as shown below:

$$Em_{CHP} = \sum_i AD_i \times NCV_i \times EF_i + Em_{FGC}$$

Where:
Em_{CHP} is the emissions of the cogeneration unit during the monitoring period expressed in tCO_2;
AD_i is the Annual Activity Data (i.e. quantities consumed) of the fuels $_i$ used for the CHP unit expressed in tonnes or Nm^3;
NCV_i is the Net Calorific Values of the fuels $_i$ expressed in TJ/t or TJ/Nm^3;
EF_i are the Emission Factors of the fuels $_i$ expressed in tCO_2/TJ;
Em_{FGC} are the process emissions from flue gas cleaning expressed in tCO_2;

e) Average efficiencies for heat and electricity over the reporting period: These are dimensionless values and the operator will need to calculate these from points (a) to (c) as shown above. The equations that should be used for this calculation are equations 38 and 39 respectively as shown in the force of law notice as shown below. However, if the inputs to points (a) to (c) above are not available, the operator will need to use the efficiencies presented under point (f) below:

$$\eta_{heat} = \frac{Q_{net}}{E_{ln}}$$

$$\eta_{el} = \frac{E_{el}}{E_{ln}}$$

Where:
η_{heat} is the average efficiency of heat production during the monitoring period (dimensionless);
Q_{net} is the net amount of heat produced during the monitoring period by the cogeneration unit expressed in TJ as determined in accordance with point C.1.2 of the force of law notice (ODT, 344KB);
E_{ln} is the energy input of fuels expressed in TJ;
η_{el} is the average efficiency of electricity production during the monitoring period (dimensionless);
E_{el} is the net electricity production of the cogeneration unit during the monitoring period, expressed in TJ.

f) Design or standard efficiencies: Where it is not technically feasible or would incur unreasonable costs for the operator to determine the efficiencies of heat (η_{heat}) and electricity (η_{el}), these values could be determined via technical documentation, for example the design values of the installation;

In situations where there are no such values available, then conservative values of η_{heat} = 0.55 and η_{el} = 0.25 can be used;

g) Reference efficiencies: These are used in the calculation of the attribution factors for emissions. The reference efficiency values used for heat production in a stand-alone boiler, and for electricity production without cogeneration. The operator should select the appropriate fuel-specific reference efficiency value as shown in section F of the force of law notice (ODT, 344KB);

h) The attribution factors for heat from a CHP: This value can be calculated by using equation 40 from the force of law notice as shown below:

$$F_{CHP,heat} = \frac{\frac{\eta_{heat}}{\eta_{ref.heat}}}{\frac{\eta_{heat}}{\eta_{ref.heat}} + \frac{\eta_{el}}{\eta_{ref.el}}}$$

Where:
$F_{CHP,heat}$ is the attribution factor for heat (dimensionless);
η_{heat} is the average efficiency of heat production during the monitoring period (dimensionless);
$\eta_{ref.heat}$ is the reference efficiency for heat production in a stand-alone boiler (dimensionless);
η_{el} is the average efficiency of electricity production during the monitoring period (dimensionless);
$\eta_{ref.el}$ is the reference efficiency of electricity production without cogeneration (dimensionless);

i) Specific emission factors for CHP related measurable heat: In this situation the factors that the operator will need to use to attribute the related (direct and indirect) emissions to the CBAM production processes will need to be determined by the application of equation 41 from the force of law notice as shown below:

$$EF_{CHP,Heat} = Em_{CHP} \times \frac{F_{CHP,Heat}}{Q_{net}}$$

Where:
$EF_{CHP,Heat}$ is the Emission Factor for the production of measurable heat in the cogeneration unit expressed in tCO_2/TJ;
Em_{CHP} is the emissions of the cogeneration unit during the monitoring period expressed in tCO_2;
$F_{CHP,heat}$ is the attribution factor for heat (dimensionless);
Q_{net} is the net heat produced by the cogeneration unit expressed in TJ;

j) Specific emission factor for heat production from cogeneration: To establish the emission factor for the heat that is produced by

cogeneration, the operator will need to apply equation 42 from the force of law notice as shown below:

$$Em_{Heat} = EF_{CHP,heat} \times Q_{consumed}$$

Where:
Em_{Heat} is the heat-related emissions of the production process in tCO_2;
$EF_{CHP,Heat}$ is the Emission Factor for the production of measurable heat in the cogeneration unit expressed in tCO_2/TJ;
$Q_{consumed}$ is the amount of measurable heat consumed in the production process expressed in TJ;

k) If part of the cogeneration process, waste gas forms part of the fuel mix and where the emission factor of the waste gas is higher than the standard emission factor of natural gas, (see Table 4 in section F of the force of law notice (ODT, 344KB), the operator will need to use the standard emission factor to calculate the EF_{mix} instead of using the emission factor relevant to the waste gas that is used within the cogeneration process.

D4.8.5 Rules for waste gas and emissions

Waste gases can result from the incomplete combustion or chemical reaction during certain production processes. This is particularly the case in the iron and steel sector; for example, coke oven gas (COG), blast furnace gas (BFG) and basic oxygen furnace gas (BOFG) which is also known as 'converter gas'.

These waste gases are a mixture of CO_2 and incompletely oxidised carbon, which is usually carbon monoxide (CO). In some cases, this can also include hydrogen (H_2) and further gases. These "waste gases" have an energy content that is recoverable through their use as a fuel, in addition to them containing 'inherent' emissions arising from their production process.

The recovery and use of waste gases as a fuel to produce electricity or heat is preferable over the venting or flaring of these gases. This is energy efficient and avoids the release of emissions that would otherwise have been produced through the combustion of another fuel to produce the same energy.

The following sections of this guidance cover the quantification of energy and the attribution of emissions from waste gases to the production process.

The treatment of flares is also covered below; however, this is a special case.

D4.8.5.1 Determination of the activity data for waste gases

A waste gas must satisfy the following three conditions:

- the waste gas contains incompletely oxidised carbon which is usually in the form of CO;
- it must be in a gaseous state under standard conditions;
- the waste gas occurs as a result of one of the processes listed in the definition of process emissions, in particular:
  - the chemical, electrolytic or pyrometallurgical reduction of metal compounds in ores, concentrates and secondary materials;
  - the removal of impurities from metals and metal compounds;
  - chemical syntheses of products and intermediate products where the carbon bearing material participates in the reaction;
  - the use of carbon containing additives or raw materials;
  - the chemical or electrolytic reduction of metalloid oxides or non-metal oxides such as silicon oxides and phosphates.

Industrial processes may not solely rely on waste gases and must also operate in a stand-alone configuration. This means that any waste gas that an operator uses must be interchangeable with other fuels, for example natural gas.

To determine the volume of waste gas consumed by the production process, the supply of waste gas should be metered.

D4.8.5.2 Monitoring requirements for waste gases and flares

For the monitoring of waste gases, the operator will need to determine the calculation factors (i.e. NCV and EF or CC) and the volume of the respective waste gas (in Nm3). The relevant requirements are set out in section G.2.3 of the force of law notice (ODT, 344KB). When undertaking the monitoring of waste gases and flares, the operator will also need to take into consideration the requirements indicated in section D4.6.1, whilst also considering the requirements contained in section D4.5.4.

If the production process consumes waste gases, the operator will need to attribute the emissions based on equation 43 from the force of law notice as shown below:

$$WG_{corr,imp} = V_{WG} \times NCV_{WG} \times EF_{NG}$$

Where:
V_{WG} is the volume of the waste gas imported;
NCV_{WG} is the Net Calorific Value of the waste gas imported;
$EF_{NG}$is the standard EF of natural gas given in section F of the force of law notice.

If waste gases are consumed in different production processes, the operator will need to attribute the emissions in accordance with equation 44 of the force of law notice as shown below:

$$WG_{corr,exp} = V_{WG,exp} \times NCV_{WG} \times EF_{NG} \times Corr_{\eta}$$

Where:
$V_{WG,exp}$ is the volume of waste gas exported from the production process;
NCV_{WG} is the Net Calorific Value of the waste gas;
$EF_{NG}$is the standard Emission Factor of natural gas given in section F of the force of law notice;
$Corr_{\eta}$ is the factor that accounts for the difference in efficiencies between the use of the waste gas and the use of the reference fuel natural gas. The standard value is $Corr_{\eta}$ = 0.667.

In using the above, the operator will need to retain sufficient evidence for the verification process of the CBAM goods produced. It is important that the above process is documented in the monitoring plan.

D4.8.5.2.1 Flares

If the operator operates flares using waste gases, they will need to ensure the monitoring implemented covers both routine and operational flaring such as:

- trips;
- start-up and shutdown;
- emergency reliefs in production processes.

When calculating the emissions from flared gases, the operator should include:

- emissions from the combusted flared gas;
- emissions from the combustion of fuels required to operate the flare for example the pilot flame and fuels to combust the flared gas;
- inherent CO_2 in the flared gas source stream.

If the operator is unable to implement the accurate monitoring of a flare due to either technical feasibility or unreasonable costs, the reference emission factor of 0.00393 tCO_2/Nm^3 should be used.

The operator can improve the specific emission factors that are relevant to their installation by applying process modelling based on industry standard models. If this is possible, the operator will need to consider the relative proportions and the molecular weights of each of the contributing source streams. The operator will then be able to establish a weighted annual average figure that can be derived for the molecular weight of the flare

gas. For activity data, a higher measurement of uncertainty than for other fuels that are combusted would be acceptable.

In the above situation, it is important that this is documented in the monitoring plan.

D4.8.5.3 Attribution of direct emissions

In the CBAM production process, the operator may have waste gases that are fully used in a single production process or are transferred outside the system boundary of the production process so they can be used in another production process producing the CBAM goods. For situations where the waste gases are not used within the same production process, the operator must use the formula given in section D4.3.2.13, so they can calculate the attributed emissions of the production process.

D4.9 Calculation of embodied emissions of goods

Section D4.3.2.13 of this guidance describes the approach operators will need to undertake to attribute emissions to the production process. The same section provides the formula for the calculation of the embodied emissions of those goods from the attributed emissions. It is apparent that the operator will need to consider and determine further parameters and these are covered in the sections below.

D4.9.1 Rules for the goods produced

The operator will need to determine the activity level of each of the production processes. The activity level is the quantity of CBAM goods that are produced within the installation within a given reporting period. As explained in the definitions within section D4.1 the quantities of all CBAM goods of the same 'aggregated goods category' will need to be summed up to give the activity level value.

D4.9.1.1 The activity level

The activity level of the CBAM goods produced at the installation manufacturing the CBAM goods, is the total mass of the CBAM goods leaving the production process. This product will need to meet the product specification for a commodity code category as listed in Schedule 16 of the Finance Act 2026 and as referenced in Annex VII. This can include both the final products and any precursors that may be used to produce other CBAM goods.

D4.9.1.1.1 Avoidance of 'double counting'

To avoid any double counting of production values, it is important that the operator only counts the quantity of the final CBAM goods leaving the system boundaries of the production process. Only the CBAM goods that meet the required specifications, for example saleable CBAM goods or CBAM goods being used as a precursor good within the same installation, will need to be accounted for as part of this calculation.

The following are excluded from the reporting of the activity level:

- goods that do not meet the desired quality or specification and are returned to the same production process for re-processing and re-working;
- scrap, by-product or waste materials from the production process, including where this is sent to a different installation for re-processing, re-working or for disposal.

All attributed emissions from the production process will need to be accounted for on saleable CBAM goods. Any scrap or waste will have zero embodied emissions, thus avoiding any double counting. From an environmental viewpoint, this incentivises the operator to decrease material consumption and avoid the production of scrap and waste, as a process that produces very little scrap or waste will have lower embodied emissions.

D4.9.1.2 Activity level monitoring requirements

The operator should first identify all the CBAM goods produced in the installation, together with the applicable commodity codes. This must be documented within the monitoring plan. This will enable the tracking of the CBAM goods produced so that the quantity of goods produced by each of the production processes can accurately be determined. The key aspects of monitoring are discussed below.

D4.9.1.3 Tracking of CBAM goods

A comprehensive list of the CBAM goods (and precursor goods) produced in the installation should be established and regularly reviewed. This should include:

- the review of the product specifications of the listed goods to ensure they match the commodity codes contained in Schedule 16 of the Finance Act 2026, with a further detailed list shown in Annex VII;
- the correct attribution of the listed goods to the production processes;
- the update of any listed goods to include any new goods produced by the installation for the first time. This includes the identification of any commodity codes for the new products produced;
- in the case of situations where the new product belongs to an aggregated goods category previously not found at the installation,

the operator will need to define the additional production process to separately monitor the embodied emissions of that good. The exception is where a 'bubble approach' has been applied as referenced in section D4.4;

- the operator will need to relate any inputs, outputs and emissions for the new goods that have been produced to the relevant production processes.

The addition of new CBAM goods could change the existing attribution of inputs, outputs and emissions to any existing CBAM products that are produced. Therefore, the review process and its frequency must be documented within the monitoring plan. Where there has been the identification of new products, this review should be undertaken immediately.

D4.9.1.4 Methods to determine the activity level of goods

The principle of monitoring the activity level is the same as the methods that would need to be followed for the monitoring of the activity data for a source stream that can be used, and for the quantification of the CBAM goods that are produced. Details of these approaches can be found in section D4.2.3, while the rules for selecting best available data sources can be found in section D4.5.4.

The quantities of the CBAM goods produced and/or sold, often form part of the financial report of the operator. This information can help to reduce the effort to provide this information for the CBAM. The operator should ensure that there is consistency between the CBAM data and with the financially audited reports and the report used for the corroboration of the embodied emissions calculation.

D4.9.2 Rules for monitoring of precursor data

The operator must determine the quantity of each precursor good that is used within the production process. This is to enable the calculation of the total embodied emissions of the CBAM complex good. Where a default emissions value is used to determine the emissions of a precursor good, the operator will need to establish the weight of the precursor good which will need to be calculated in accordance with this section.

If the precursor goods are covered by the same production process, the operator must determine the quantity of any additional precursor goods that:

- may be used;
- have been obtained from other installations;
- have been obtained from other production processes.

The operator is required to determine the amount and the emission separately for each installation where precursor goods have been obtained. The method for determining this information must be stated in the monitoring plan as follows:

- where the precursor goods are produced at the same installation as the CBAM goods, but in a different production process when applying the rules contained within section A.4 of the force of law notice (ODT, 344KB), and in section D4.5.4, the data that the operator will need to establish must include:
    - the embodied direct emissions of the precursor goods as an average over the monitoring period, expressed in tonnes CO_2e per tonne of precursor good;
    - the quantity of precursor goods consumed during each production process relevant to each precursor good;
- where precursor goods are obtained from another installation, the data that the operator will need to establish (in English) must include:
    - the country of origin of the imported goods;
    - the installation where they were produced, which is identified by:
        - the unique installation identifier, if available;
        - the applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;
        - the address;
        - the coordinates of the installation;
    - the production routes used as defined in section A.3 of the force of law notice (ODT, 344KB);
    - the values of applicable specific parameters required for the determination of the embodied emissions;
    - the emissions intensity of the precursor goods and averaged over the most recent monitoring period, expressed in tonnes CO_2e per tonne of precursor;
    - the start and end date of the monitoring period used by the installation from which the precursor goods were obtained;
    - the amount of precursor goods used in each production process.

    For each quantity of precursor goods for which there is incomplete or inconclusive data, the operator can use the applicable default values made available in accordance with paragraph 11(1) of Schedule 17 to the Finance Act 2026.

    When a type of precursor good is produced in different production processes, the operator must calculate the emissions intensity of that precursor good as a weighted average of those different production processes.

If an operator uses precursor goods which are produced in the UK, the emissions associated with these precursor goods are exempt from CBAM. Therefore, when calculating the embodied emissions, the emissions for these UK produced precursors do not need to be included in the calculation. Further information on UK produced precursor goods can be found in Section 147(3) of the Finance Act 2026.

D4.10 Use of default factors and other methods

Whenever the in operator does not have all necessary data available for the calculation of the embodied emissions of the CBAM goods, this will result in a data gap. The operator will need to close this data gap by applying the best available data or by means of an estimation method. For minor data gaps in the data for the installation (for example missing an analysis of one batch of fuel), the monitoring plan should document a suitable estimation method that can be used as described in section D4.10.2.

For other situations, there are default values for the specific direct emissions of the CBAM goods and the CBAM precursor goods that can be used. There are certain conditions that apply for the use of default values which are discussed in section D4.10.1.

D4.10.1 Default emissions values

Default emission values have been calculated by HM Treasury for each commodity code. These can be found via the following link (Prepare for the Carbon Border Adjustment Mechanism (CBAM) - GOV.UK) and are set out on the following basis:

- there is one default value for each CBAM good at the 8-digit commodity code level;
- the values apply to each good, regardless of origin;
- default values are in tonnes of carbon dioxide equivalents (tCO2e) per tonne of product;
- in some cases, the same default value may apply to several commodity codes;
- default values will be updated as necessary to account for any future changes to the Combined Nomenclature (CN) system. For help with CN codes, visit the Trade Tariff tool to look up commodity codes, duty and VAT rates.

Whilst it is preferable for the liable person to use independently verified actual emissions data, default emissions values will also be available to determine the embodied emissions in CBAM goods. This means the liable

person can meet CBAM obligations when actual emissions data is unavailable. Default emissions values can also be used for precursor goods, even where actual emissions data is used for the final CBAM good. However, actual emissions data cannot be used for precursor goods if default emissions values are used for the final CBAM good. Default values can also be used to check the plausibility of the actual data.

D4.10.2 Minor data gaps in the monitoring data

A data gap can occur as part of the everyday activities when monitoring data at the installation producing CBAM goods. When a data gap occurs, the operator must select suitable substitute data for the period of the data gap. As part of this process, the operator needs to ensure the substituted data is conservative, i.e. the data ensures the emissions are not under-estimated, and that the activity levels are not over-estimated.

The following guidance should be considered by the operator when selecting suitable replacement data:

- Calculation factors in a calculation-based methodology: in the event of missing data, for example when a sample has not been taken in time or no laboratory analysis was undertaken, substitution by a standard value will be the simple approach (see section D4.6.1.5);
- Activity data (section D4.6.1.4): in the case that there is missing activity data, for example a truck delivering goods was not weighed, the operator should consider using the average mass of similar truck loads during the same reporting period. In this situation, there will need to be the addition of a supplement, for example one standard deviation to ensure the data estimate is conservative;
- Measurement instrument is not functioning properly: in this situation the instrument should be replaced or repaired as soon as possible. However, the instrument may exhibit a higher uncertainty. In this case the operator can still use this value as it will show a conservative value. If the readings are unable to be obtained due to a failed meter, or if there are no other instruments available, the operator will need to conservatively estimate the missing data.

  In the case of flow meters, the operator can use an average flow rate that is determined during the same reporting period with the addition of a supplement value, for example one standard deviation. This ensures that the estimate is conservative.

  In other cases, for example heat measurements, the operator can use an estimate based on the energy efficiency of the process. For the application of this, the operator will need to determine this over the reporting period, with the addition of a supplementary value.

The operator must ensure the monitoring plan contains the details of all

the approaches that will be used in the event of a data gap. Additionally, once the approaches have been established, the operator should undertake regular reviews to ensure the chosen approaches are the best available approaches to apply in the event of the occurrence of a data gap.

D4.11 Reporting template

As part of the requirements of the CBAM, the operator will be required to share emissions information with:

- the verifier;
- the relevant importer of CBAM goods into the UK;
- any other organisation who uses the operator's CBAM goods as precursor goods.

For CBAM, templates have been established that show the structure of the required information that the operator will need to provide to others. These are shown in the Annex of this guidance and covers the following:

- Emissions report – this should be used when establishing the CBAM emissions data for the reporting period. The operator will need to share the completed template with the verifier;
- Verification report – this is to be used by the verifier when assessing the CBAM Emissions Report;
- Verification summary – this is to be completed by the verifier following the assessment of the CBAM Emissions Report. The template will provide the verified opinion of the CBAM Emissions Report.

Even though templates have been developed, it is the responsibility of the operator to ensure the verifier and any organisations who are supplied with the CBAM goods to be provided with all the required information.

E5.0 Sector Specific Monitoring

Section D4.0 explains how to monitor and report CBAM emissions and the production routes that apply. This section explains the sector-specific monitoring, reporting and verification requirements for those goods. It also includes worked examples to show how the requirements may be applied in practice for each sector.

This guidance document is intended primarily for operators or installations producing goods within the scope of CBAM. However, verifiers, accreditation bodies and importers may also find it useful.

Note on examples:
The worked examples are intended primarily for readers from those specific sectors. However, readers are invited to also learn from the other examples, as each example also contains concepts which may be of interest to other sectors.

The following worked examples are included:

Cement sector examples:

- Section E5.1.12 – An example for splitting a cement installation into separate production processes;
- Section E5.1.13 – An example for how specific embodied emissions are derived for cement sector goods, the resulting embodied emissions of imports into the UK.

Iron and Steel sector examples:

- Section E5.2.13.1 – An example for integrated steel works and conversion to iron or steel products. Shows how emissions intensity values are derived for iron and steel sector goods, produced by the blast furnace/basic oxygen furnace (BOF) route and the resulting embodied emissions of imports into the UK;
- Section E5.2.13.2 – An example for EAF and conversion to iron or steel products. Shows how specific embodied emissions are derived for crude steel and iron or steel products, produced by the EAF route and the resulting embodied emissions of imports into the UK;
- Section E5.2.13.3 – An example for the production of screws and nuts from purchased steel rods. Where purchases precursors that contribute the majority of the embodied emissions, while the installations own process contributes little to the total embodied emissions.

Fertilisers sector examples:

- Section E5.3.10.1 – An example for deriving emissions intensity values expressed relative to the functional unit (kilograms of nitrogen

contained with the good) for a particular mixed fertiliser grade, NPK 15-15-15, produced by mixing and granulation.

- Section E5.3.10.2 – An example for deriving emissions intensity values expressed relative to the functional unit (kilograms of nitrogen contained with the good) for another mixed fertiliser grade, Potassium Nitrate (KNO3), produced from a joint production process with the precursor Nitric Acid.

Aluminium sector example:

- Section E5.4.8 – An example for shows how emissions intensity values are derived for aluminium sector goods. The installation produces products from two aggregated goods categories, unwrought aluminium and aluminium products, each of which is defined as a single production process, as the intermediate product is sold. Therefore, a joint production process is not possible.

Hydrogen sector example:

- Section E5.5.7 – An example for deriving the emissions intensity value for hydrogen produced by the steam reforming production route.

E5.1 Cement sector

E5.1.1 Unit of production and emissions intensity for the cement sector

The quantity of cement goods imported into the United Kingdom (UK) must be expressed in metric tonnes. The operator must record the quantity of CBAM good(s) produced by the installation or production process(s) for the purposes of monitoring and completing the operator's emissions report for submission to the verifier.

Table 5-1 below outlines important parameters for this CBAM goods sector.

Industrial sector	Cement
Unit of production	The quantity of goods produced in tonnes (metric) reported separately for each type of CBAM good (i.e. classified under the same CN code) produced, by the installation or production process. Tonnes (metric) for calcined clay, cement clinker and aluminous cement, and tonnes of clinker content for cement goods (i.e., CN codes 2523 10 00, 2523 21 00, 2523 29 00 and 2523 90 00), reported separately for each type of CBAM good produced, by the installation or

	production process, in line with sections 3.4 to 3.7 of the system boundaries document.
Associated activities	Producing cement clinkers and calcined clays, grinding and blending cement clinker to produce cement.
Relevant greenhouse gas emissions	Carbon dioxide (CO_2)
Direct Emissions	Tonnes (metric) of CO_2e
Unit for emissions intensity	Tonnes CO_2e emissions per tonne of good, reported separately for each type of CBAM good, by the installation or production process. Tonnes CO_2e emissions per tonne of calcined clay, cement clinker or aluminous cement, and tonnes CO_2e emissions per tonne of clinker content for cement (excl. aluminous cement), reported separately for each type of CBAM good, by the installation or production process.
Unit for embodied emissions	Tonnes CO_2e

Table 5-1: shows the key elements that are representative of the cement CBAM goods sector.

The operator must monitor the data required to calculate emissions intensity in metric tonnes of CO_2 equivalent (tCO_2e) emissions, per tonne of good output. Emissions intensity must be calculated for the specific installation or production process.

For cement (excluding aluminous cement) emissions intensity must be determined per tonne of clinker content, and where cement is produced and placed on the market with different clinker contents, emission intensity must be calculated and averaged in line with the composition based rules set out in section I.1.16 and equation 56 of the force of law notice (ODT, 344KB).

The following sections set out how to define the system boundaries for cement sector goods and identify the parts of the production process that must be included for monitoring purposes, and for the preparation of the operator's emissions report.

E5.1.2 Definition and explanation of goods covered

Table 5-2 below lists the relevant goods in scope of CBAM in the cement sector. The CN codes in the central column are the starting point for which a 'production process' is to be identified for the purpose of monitoring emissions, encompassing all production routes used within the installation in line with the system boundaries document.

Aggregated goods category	CN Code	Description
Calcined clay	2507 00 80	Other kaolinic clays
Cement clinker	2523 10 00	Cement clinkers
Cement	2523 21 00	White Portland cement, whether or not artificially coloured
	2523 29 00	Other Portland cement
	2523 9000	Other hydraulic cements
Aluminous cement	2523 30 00	Aluminous cement - also referred to as 'Calcium Aluminate Cement'

Table 5-2: shows CBAM goods in the cement sector.

The aggregated goods categories listed in Table 5-2 above include both finished cement goods and precursor goods (intermediate products) that are consumed in the production of cement.

Only input materials identified as relevant precursors in the system boundaries document must be considered. Table 5-3 below lists the precursors by aggregated goods category and production route.

Aggregated Goods Category Production route	Relevant precursors
Calcined clay	None
Cement clinker	None
Cement	Cement clinker; calcined clay (if used in the process)
Aluminous cement	None

Table 5-3: shows aggregated goods categories their production routes and relevant precursors.

Precursor goods relevant to the system boundary are 'cement clinker (CN code 2523 10 00), which includes both white clinker (used to make white cement) and grey clinker, and 'calcined clay' (CN code 2507 00 80), which is a clinker substitute and may be used to modify the properties of the cement produced.

These precursors are defined as simple goods, as they cannot be produced from other CBAM goods.

The finished cement goods listed in Table 5-2 above comprises both white Portland cement, grey Portland cement, other hydraulic cements and aluminous cement. These goods are defined as complex goods (with the exception of aluminous cement) as they are made using precursor goods.

Other constituents used in cement manufacture, in particular granulated blast furnace slag, fly ash and natural pozzolana that are used in the manufacture of other hydraulic cement goods (including blended or 'composite' cements) are not considered to have any embodied emissions and are not in scope for CBAM. Their use and the associated emissions are taken into account through the emissions of the cement production process, but no additional embodied emissions of these constituents are added as separate precursors under the CBAM rules.

E5.1.3 Definition and explanation of relevant production processes and routes

The system boundaries of precursors and cement goods are distinct and may, under certain conditions, be added together to include all processes directly or indirectly linked to the production processes for these goods, including input activities to the process and output activities from the process.

Where precursors and complex goods are produced in the same installation, and the precursors are not transferred for sale or use in another production processes, the operator may use a joint production process. For example, where all cement clinker produced at an installation is used on site to manufacture cement, the operator may monitor emissions and calculate emissions intensity jointly across the production processes for both clinker and cement.

E5.1.4 Calcined clay production process

Calcined clay may be used as a clinker substitute. Kaolinic clay that is calcined (metakaolin) can be added to cement in place of clinker in varying proportions in order to modify the properties of the cement mixture.

The system boundaries document sets out the functional unit and system boundaries for the calcined clay production route. For the purposes of this guidance, the system boundaries for emissions monitoring are as follows:

- all processes directly or indirectly linked to the production processes, such as raw material preparation, mixing, drying, and calcining, and flue gas cleaning;
- CO_2 emissions from the combustion of fuels as well as from raw materials, where relevant.

As per the system boundaries document, there are no relevant precursors for this production process.

Note that CN code 2507 00 80 includes both calcined and non-calcined kaolinic clays.

Cement sector goods are produced by several different process routes. These are outlined below.

E5.1.5 Cement clinker production process

Cement clinker is produced in clinker plants (kilns) by the thermal decomposition of calcium carbonate to form calcium oxide, followed by the clinkering process in which the calcium oxide reacts at high temperatures with silica, alumina and ferrous oxide to form clinker. Grey and white clinkers may be produced depending on the temperature of the process and purity of raw materials.

The system boundaries document defines the functional unit, and system boundaries for direct emissions monitoring from cement clinker production as follows:

"calcination of limestone and other carbonates in the raw materials, conventional fossil kiln fuels, alternative fossil-based kiln fuels and raw materials, biomass kiln fuels (such as waste-derived fuels), non-kiln fuels, non-carbonate carbon content in raw materials, or alternative raw materials such as fly ash used in the raw meal in the kiln and raw materials used for flue gas scrubbing"

As per the system boundaries document, there are no relevant precursors for this production process.

Typical raw materials include limestones and shales. Emissions from the cement clinker production process result from the combustion of both kiln and non-kiln fuels and from raw materials used in the process such as limestone. In line with the system boundaries document, emissions include both process emissions from the calcination of carbonates in the raw materials and combustion emissions from all relevant fuels used in the kiln system and for drying of raw materials and fuels.

In line with the above definition of system boundaries, the following production steps are included within the system boundaries of cement clinker installations:

- Raw material preparation – grinding, milling, homogenisation;
- Fuel storage and preparation – for conventional and waste derived fuels;
- Clinker production ('clinker burning') – all steps for the integrated kiln system including preheating, kiln processing and clinker cooling;
- Intermediate storage – storage of cement clinker under cover before export off site or cement grinding;
- Emissions control – for treating releases to air, water or ground.

The methods for calculating process emissions from carbonate materials

on either an input or output basis are given in section E5.1.10.2.

A variation on the clinker production process may be with permanent geological storage i.e. carbon capture and sequestration (CCS). Where CO_2 is captured and permanently stored or used in accordance with the CBAM rules, this should be reflected in the determination of embodied emissions in line with the force of law notice (ODT, 344KB); however, CCS/CCUS has not been taken into account when establishing default values.

Note that no distinction is made between white clinker and other clinker (including grey) used in the production of cement.

E5.1.6 Cement production process

Cement (apart from aluminous cement) is defined as a complex good as it is produced from relevant precursors, cement clinker, and calcined clay (if used in the production process).

Cement is produced in a grinding plant (cement mill), which may be located at the same installation that produced the cement clinker, or at a separate standalone plant. Cement clinker is ground and blended with certain other constituents to produce the finished cement product. Depending on the mix of different constituents this may be Portland cement, blended cement (containing a mix of Portland cement and other hydraulic constituents), or other hydraulic cements.

The system boundaries document defines the system boundaries for direct emissions monitoring of the cement production route, as encompassing all processes directly or indirectly linked to the production processes, where relevant for drying of materials.

Relevant precursors are cement clinker and calcined clay (if used in the process).

In line with the above definition of system boundaries, the following production steps are included within the system boundaries of cement installations:

- Material preparation – materials (cement clinker, calcined clay and mineral additives) handling and pre-treatment, for example preheating and drying mineral additives;
- Cement production – all steps, including crushing, grinding, further milling and separation by particle size;
- Cement storage, packaging and dispatch;
- Emissions control – for treating releases to air, water or ground.

Figure 5-1 below shows how the cement clinker and cement production processes relate to each other.

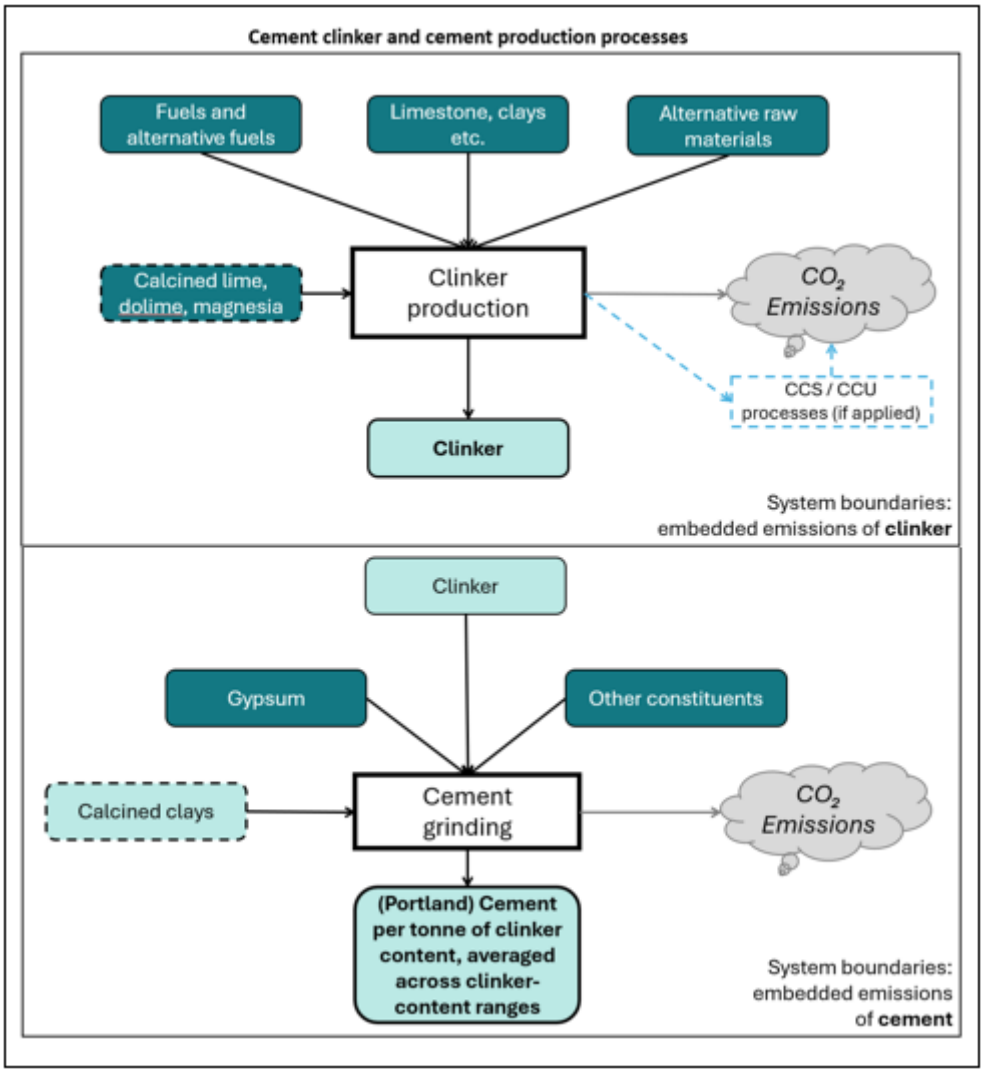


Figure 5-1: shows the system boundaries of the cement clinker and cement production processes. Note boxes with a dashed outline (e.g. calcined clays) represent optional precursors or process steps that are only included where they are actually used at the installation.

Direct emissions of the cement clinker production process result from the combustion of both kiln and non-kiln fuels and from raw materials used in the process such as limestone. Direct emissions may also result from fuels used for drying materials used to make the final cement product.

E5.1.7 Aluminous cement production process

Aluminous cement is regarded as a simple good as it is produced directly from aluminous clinker by a continuous production process and is ground without the addition of further additives in line with the definition of simple goods and the aggregated goods category “Aluminous cement” in the system boundaries document.

The system boundaries document defines the functional unit and the

system boundaries for the aluminous cement production route, as encompassing:

- All processes directly or indirectly linked to the production processes where fuel is combusted;
- Process emissions from carbonates in raw materials, if applicable, and flue gas cleaning.

There are no relevant precursors for this production process.

Figure 5-2 below shows the integrated production of aluminous cement which includes both clinkering and cement grinding production steps, from raw material preparation through to emissions control, in line with the above definition of systems boundaries.

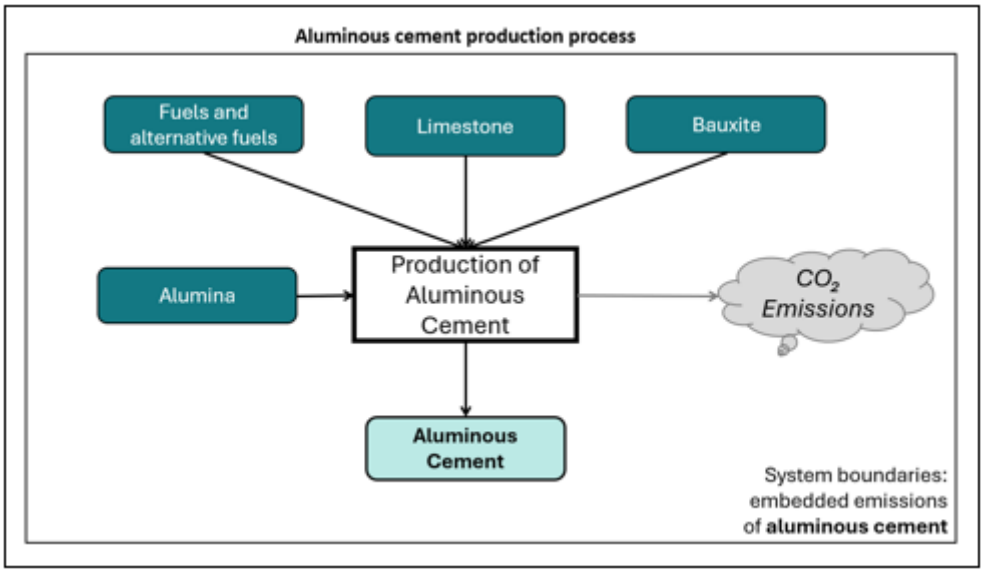


Figure 5-2: shows the system boundaries of the aluminous cement production process.

Note that alumina (produced from bauxite) is treated as a raw material for the purposes of the aluminous cement aggregated goods category and is not a relevant precursor, as per the system boundaries document. Its contribution to embodied emissions is taken into account through the emissions of the aluminous cement production process, and no separate embodied emissions of alumina are added as a precursor.

E5.1.8 Sector-specific requirements for monitoring

Direct emissions should be monitored in line with the methodology set out in the force of law notice (ODT, 344KB) and outlined above.

E5.1.9 Emissions covered

Relevant direct emissions that should be monitored for the cement sector

are:

- Carbon dioxide emissions (direct) from the fuel combustion process from stationary plants only (excludes emissions from any mobile plant such as vehicles);
- For both kiln and non-kiln fuels, cement kiln fuels include conventional fossil fuels such as natural gas and coal, alternative fossil-based fuels such as petroleum coke or waste chipped vehicle tyres, and biomass fuels (biomass wastes). Non-kiln fuels refers to fuels used outside of kilns: for example, to calcine clays in flash calciners, and where cement materials are dried;
- Carbon dioxide emissions (direct) other than from the fuel combustion process, resulting from:
    - Thermal decomposition of carbonate containing raw materials (such as limestone, dolomite etc.);
    - Non-carbonate carbon content in the raw materials (such as carbonaceous clay, limestone, shale);
    - Alternative raw material (such as fly ash used in the raw meal), or from any fossil/biomass additives used;
    - Discarded cement kiln dust (CKD) or bypass dust;
- Carbon dioxide emissions (direct) resulting from the production of measurable heating (for example steam) and cooling that is consumed within the system boundaries of the production process, regardless of the location of the production of the heat (i.e. from on-site generation or from imports from off-site);
- Carbon dioxide emissions (direct) resulting from emissions control (for example from carbonate raw materials such as soda ash used for acidic flue gas cleaning). This is included for any good where this is applicable.

Direct emissions from the different source streams above are not monitored separately but are added together to result in the total direct emissions for the installation or production process.

E5.1.10 Additional rules

E5.1.10.1 Determining process emissions

For determining direct emissions from cement clinker production, additional rules also apply for the monitoring of process emissions from raw meal components depending on whether the activity data refers to:

- Process input material (for example, limestone), shall be based on the carbonate content of the process input (calculation Method A) with adjustment for cement kiln dust (CKD) or bypass dust that leaves the kiln system;
- Process output material, for example the amount of clinker produced (calculation Method B).

Note that both methods are considered equivalent. The operator should choose the method which overall leads to more reliable data, which is more applicable for their equipment, and that avoids unreasonable costs. Calculation methods A and B are further described in section E5.1.10.2 and section E5.1.10.3 of this guidance document.

E5.1.10.2 Calculation of emissions related to discarded CKD or bypass dust

Add CO_2 process emissions, from bypass dust or cement kiln dust (CKD) leaving the kiln system, corrected for a partial calcination ratio of CKD.

- Minimum requirements: An emission factor of 0.525 tCO_2/t dust is applied.

Recommended improvement: the emission factor (EF) to be determined at least once annually in line with the provisions of section B.5.4 of the force of law notice (ODT, 344KB) which sets out the requirements for laboratory analyses and using the following formula:

$$EF_{CKD} = \left(\frac{EF_{Cli}}{1 + EF_{Cli}} \times d\right) \Big/ \left(1 - \frac{EF_{cli}}{1 + EF_{Cli}} \times d\right)$$

Where:
EF_{CKD} is the emission factor of partially calcined cement kiln dust (tCO_2/t CKD);
EF_{Cli} is the installation-specific emission factor of clinker (tCO_2/t clinker);
d is the degree of CKD calcination (released CO_2 as percentage of total carbonate CO_2 in the raw mix).

E5.1.10.3 Method B - clinker output based

For this method, a sector-specific rule is given in the force of law notice (ODT, 344KB).

Activity data *ADj* for clinker production [t] over the reporting period may be determined by either:

- Direct weighing of clinker (if technically feasible);
- Based on cement deliveries, by material balance using the following stock adjustment calculation (equation 24):

$$Cli_{prod} = (Cem_{deliv} - Cem_{SV}) \times CCR - Cli_s + Cli_d - Cli_{SV} \quad \text{(Equation 24)}$$

Where:
Cli_{prod} is the amount of clinker produced expressed in tonnes;
Cem_{deliv} is the amount of cement deliveries expressed in tonnes;

Cem_{SV} is the cement stock variations expressed in tonnes;
CCR is the clinker to cement ratio (tonnes clinker per tonne cement);
Cli_s is the amount of clinker supplied expressed in tonnes;
Cli_d is the amount of clinker dispatched;
Cli_{SV} is the amount of clinker stock variations expressed in tonnes.

Recommended Improvement: that the emission factor is determined in accordance with the provisions of section B.5.4 of the force of law notice (ODT, 344KB), using laboratory analyses.

For the conversion factor CF_j the conservative assumption that CF_j = 1 may be applied in order to reduce monitoring efforts.

E5.1.10.4 Clinker to cement ratio (CCR)

In calculating the embodied emissions in cement goods, the majority of emissions result from cement clinker. Therefore, the CCR, which is the mass ratio of tonnes cement clinker consumed per tonne of cement produced (also known as the 'clinker factor'), must be taken into account. For CN codes 2523 10 00, 2523 21 00, 2523 29 00 and 2523 90 00, the functional unit is the tonnes of clinker contained in the goods. For the other CN codes, the default functional unit is the tonnes of product.

The CCR should be derived either:

- Separately for each of the different cement products, based on laboratory analyses in line with the provisions of section B.5.4 of the force of law notice (ODT, 344KB);
- By calculation, as ratio from the difference of cement deliveries and; stock changes and all materials used as additives to the cement including by-pass dust and cement kiln dust.

The CCR is expressed as a percentage (%) value, which typically ranges from 80% up to 95 % for Portland cement. The CCR is particularly relevant for the calculation of relevant embodied emissions for blended or composite cements that are produced, where the clinker content can range widely for different types of composite cement with the balance being made up of other constituents such as mineral additives, with zero emissions.

For cement goods sold in different ranges of composition, the operator must calculate the emissions intensity of the goods according to the tonnes of clinker contained in the goods, using equation 56 from the force of law notice:

$$EI_{g(cki)} = EI_g \; x \; CK_i$$

Where:

$EI_{g(cki)}$ is the emissions intensity of the CBAM goods with clinker content CKi;
EI_g is the emissions intensity calculated in Equations 46 or 53 of the force of law notice;
CK_i is the average clinker content of the CBAM goods within a range of composition in tonnes of clinker per tonne of CBAM goods.

Note that for cement goods that are sold in custom-made compositions at the request of the client, the operator is required to issue a declaration of clinker content for each consignment of the good; and in substituting into equation 56, CKi will be the specific clinker content of the consignment.

E5.1.11 Additional reporting parameters

Table 5-4 below lists out the additional information that must be included in the operator's emissions report for submission to the verifier.

Aggregated goods category	**Reporting parameter**
Calcined clay	Whether or not the clay is calcined.
Cement clinker	None.
Cement	Clinker content of cement. This is the: • Mass ratio of tonnes cement clinker consumed per produced tonne of cement (**clinker to cement ratio or CCR);** • Is expressed as percentage.
Aluminous cement	None.

Table 5-4: shows additional cement sector parameters required in the operator's emissions report.

The operator needs to ensure that they collect all the parameters necessary for their CBAM goods and state them in the operator's emissions report, for submission to the verifier.

E5.1.12 Example for splitting a cement installation into separate production processes

The operator should refer to the system boundaries document in order to establish the system boundary for each production process, by deciding what physical production units belong to the production process(es) and what inputs, outputs, and emissions are relevant. The approach for doing this is discussed in this section of the guidance and in section E5.1.3 and an example of this is given as shown in the table 5-5 below for the cement sector.

For a notional cement plant that both produces and exports cement clinker (commodity code 2523 10 00) and cement (commodity code 2523 29 00), the operator would need to go through the following steps to split the cement plant into separate production processes under CBAM:

Step 1: List all goods, physical units, inputs, outputs and emissions to/from the installation:

In this first step, the operator uses the existing information available on their installation, such as lists of industrial equipment and plans, to identify the:

- Physical units carrying out the production processes at their installation, such as kilns, boilers, dryers, flue gas cleaning, ball mills, bagging plant;
- Process inputs required for making the goods, for example raw materials, fuel, electricity;
- Outputs from the process, for example goods produced, by-products, heat, waste gases;
- Emissions from the process.

These are listed in table 5-5 below.

Inputs	**Physical units**	**Outputs**	**Relevant CBAM Emissions**
Kiln - fossil fuels for example coal and Heavy Fuel Oil (HFO)	Kiln system and associated equipment for example for raw meal preparation Mill - grinding equipment (including dryer) and associated plant for example for bagging cement	Kiln - cement clinker Mill - cement goods, by type	Kiln - direct emissions from combustion of fuels
Kiln - alternative and waste fuels (to cement clinker kiln) for example, high calorific value fraction of municipal solid waste	Other industrial equipment unrelated to cement production (to be excluded from system boundaries). Heat exchanger for district	Kiln - other outputs: for example, cement kiln dust District heating, (or cooling or electricity)	Kiln - direct emissions from alternative and waste fuels Kiln - direct process emissions from carbonates

Kiln – electricity consumed by clinker kiln and associated equipment Mill – fossil fuels to cement dryer Mill – electricity consumed by cement grinding plant and associated equipment Kiln - raw materials: Limestone, clays Kiln - alternative raw materials: for example, fly ash Mill - cement clinker from kiln Mill - additives used in cement manufacture	heating Flue gas cleaning equipment (for treating gaseous and dust emissions)		

Table 5-5: shows a checklist for inputs, physical units, outputs and emissions for an example cement installation.

Notes on table 5 – 5:

- The kiln fossil fuel inputs are those combusted to generate heat for the use in the process under consideration or elsewhere. Both the fuel quantity (and in particular its carbon content/emission factor) as well its energy content are relevant for attributing it to different production processes;
- The kiln output 'cement clinker' can be a precursor or a product (where the production process also includes a 'finished' good). The precursor product may also be an output from the installation; for example, if the operator exported both cement clinker and cement from the installation;
- The mill output 'cement finished good' is the physical product output of the installation/production process;
- The kiln output 'other products' (by-products) and waste only need to be monitored if relevant in terms of carbon content for the

determination of the production process's emissions, and energy content for corroboration purposes;

- The other outputs may include measurable heat (or cooling or electricity, if fuels are used in their generation) exported from a CBAM installation or production process should be treated like a second product, i.e. a certain amount of emissions must be subtracted from the emissions of that production process.

Step 2: Identify relevant production processes and production routes:

In this step, the operator identifies that the installation produces cement clinker and cement, each of which is listed in Tables 1a to 1e of the system boundaries document under separate commodity codes.

The production of goods with the same functional unit is defined as a single production process. In this case the functional unit is the tonnes of clinker contained in the goods produced under the same CN code. The operator uses the Table 5-5 above as a checklist for assigning the relevant inputs, outputs and emissions to each production processes. This is relatively simple in most cases, for example:

- Cement clinker production process:
  - Physical units: Cement kiln, including preheaters, pre-calciner, clinker cooler, and associated auxiliary equipment such as flue gas cleaning;
  - Inputs / sources streams: Fuels, raw materials and alternative raw materials for the process;
  - Outputs (goods): Cement clinker, kiln dust (re-introduced into the clinker production process);
  - Other outputs: measurable heat exported to district heating network;
  - Emission sources: direct emissions (combustion and process) related to the kiln system.
- Cement production process:
  - Physical units: Grinding plant, direct fired dryer and associated auxiliary equipment for example cement bagging plant;
  - Inputs/source streams: Cement clinker, fuels for the dryer, additive materials used in making cement such as gypsum;
  - Outputs (goods): Cement;
  - Emission sources: direct emissions (from cement dryer, if applicable).

Figure 5-3 below shows a schematic which helps to visualise the respective system boundaries of each production process and production route, and how to assign inputs, outputs and emissions accordingly.

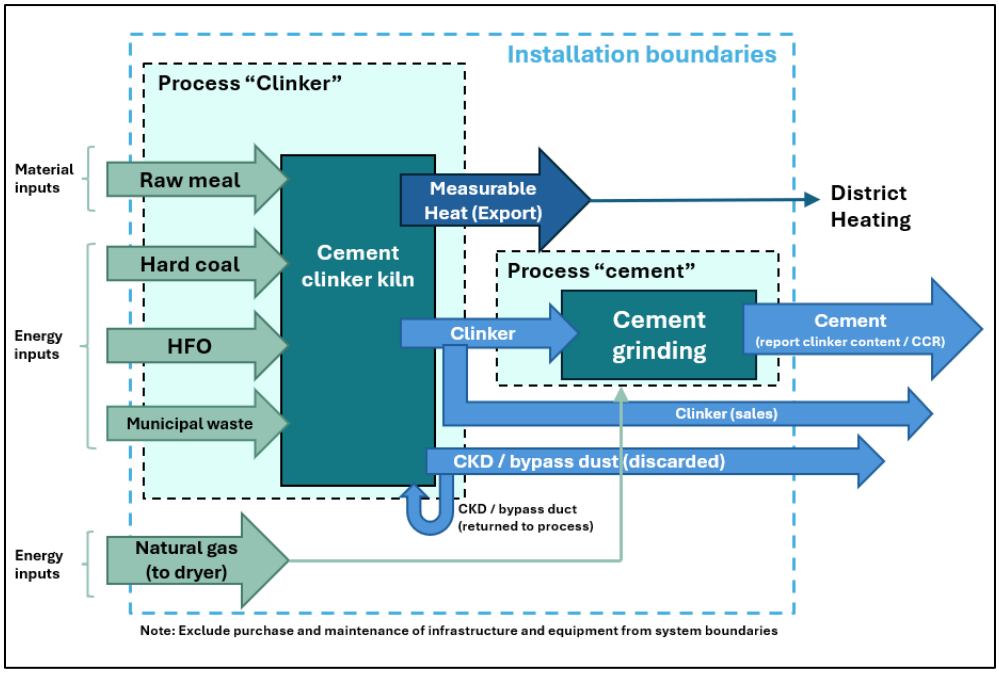


Figure 5-3: shows a schematic used to define the system boundaries of an example cement clinker and cement processes installation.

In the case of the above cement installation, both the kiln system and cement grinding plant are relatively self-contained parts of the installation, without shared equipment, and there is no doubt about the system boundaries of each production process. The only element that is not widely found in this industry is the heat recovery from the clinker kiln for the purpose of district heating. In practice, it would not be a separate production process, but in calculating the attributed emissions of the clinker production process, the heat would be taken into account.

The following worked example for the cement sector shows how, for the production processes defined, relevant emissions are calculated and assigned to production processes, and specific embodied emissions are calculated. For simplification, the district heating is omitted in that example, as are the additional direct emissions from the dryer before the cement grinding.

E5.1.13 Worked example for the cement sector

The following worked example shows how specific embodied emissions are derived for cement sector goods. The resulting embodied emissions of imports into the UK are then calculated at the end of the example for reporting.

In this example the installation produces two products: cement clinker and cement, each of which is defined as a single production process, as each is covered by a different functional unit.

Figure 5-4 below gives an outline view of the installation and shows the system boundaries as a hatched line for each production process. The physical units carrying out each production process have been grouped under 'Clinker production' and 'Cement mill' and the different inputs and outputs and sources of emissions have been identified for each production process.

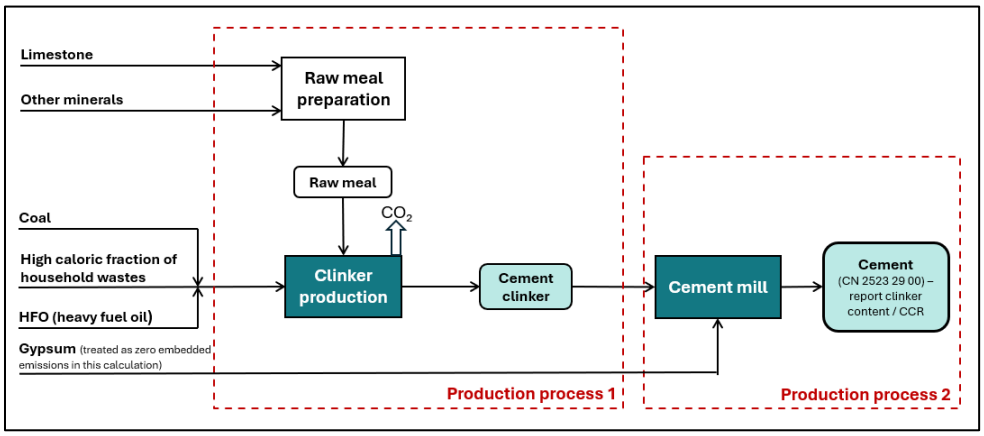


Figure 5-4: shows an overview of an example of cement.

The two relevant production processes defined above are:

- Production process 1 – cement clinker produced in a cement kiln. The system boundaries of this production process have been defined as including inputs of raw materials (limestone and other minerals), fuels (coal, heavy fuel oil (HFO) and fractions of household waste) and electrical energy. The output from the process is cement clinker, which is a relevant precursor for production process 2;
- Production process 2 – cement produced in a cement mill. The system boundaries of this production process have been defined as including the inputs gypsum (which, as a raw material, has no embodied emissions) and precursor cement clinker (which has embodied emissions). The output from the process is cement (with a need to report clinker content/CCR).

Figure 5-5 below shows that in this case, as all the output from production process 1 of precursor cement clinker goes directly into production process 2, it is possible to define a joint production process, in accordance with paragraph A.2.2(6) of the force of law notice (ODT, 344KB), whereby the system boundaries of the production processes are combined.

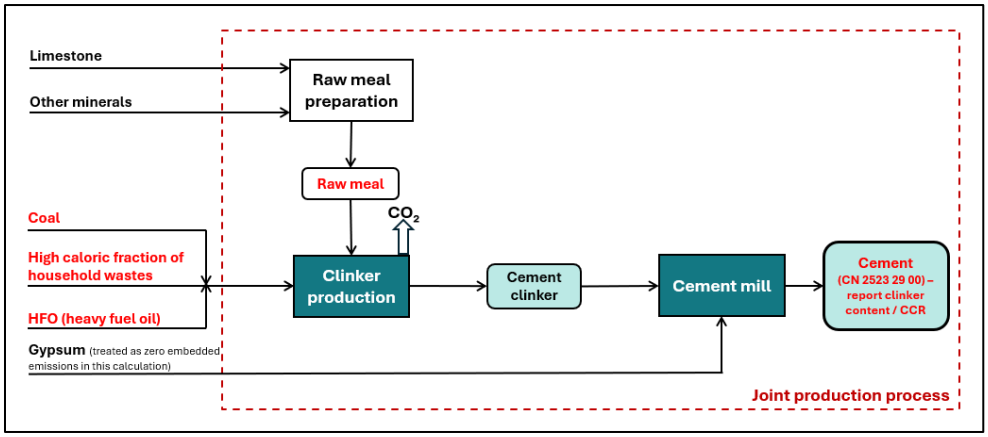


Figure 5-5: shows an example of cement and the joint production process and a complete monitoring approach whereby all the red elements need to be monitored.

The system boundary has been redrawn, compared to Figure 5-4, to encompass both production processes previously defined for each CBAM good.

The inputs and outputs highlighted in red text above are the parameters that would need to be monitored by the operator in order to attribute emissions and determine emissions intensity values within the joint production process.

The relevant emissions that are monitored result from:

- Emissions from fuel combustion – fossil fuels (coal and HFO) and from a mixed fossil/biomass fuel derived from household waste (an alternative fuel);
- Emissions from the process – resulting from the thermal decomposition of carbonates in the raw meal input (produced from limestone and other minerals) to the cement kiln system.

The activity level of cement also needs to be monitored, in terms of the tonnes of clinker contained in the cement goods. As can be seen, the monitoring becomes significantly simpler because the operator has defined a joint production process. However, as the clinker amount is the functional unit for the cement produced, its quantity (as well as the quantity of other inputs used such as gypsum) needs to be monitored for each type of cement produced. The associated embodied emissions of clinker do not have to be monitored separately but are the result of the overall joint production process, divided by the total amount of clinker produced.

The calculation of the emissions intensity values is carried out following the steps in regulation 5 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026, as follows:

Step 1 - identify the relevant monitoring period:

- In this example the relevant monitoring period is 2026.

Step 2 - use the verified emissions data from that monitoring period to identify the amount, in tonnes, of relevant emissions emitted by the installation during the monitoring period, in the production of that type of CBAM good:

- The type of CBAM goods produced at the installation are cement clinker, listed under commodity code 25231000, and other Portland cement, listed under commodity code 25232900;
- Table 1b of the system boundaries document sets out the relevant greenhouse gases for goods produced under each commodity code in the cement sector. In this case the only relevant greenhouse gas is carbon dioxide;
- As stated above, a joint production process has been defined in this case, because all the precursor goods produced at the installation (the cement clinker) are used to produce the complex good (other Portland cement). This means that emissions can be calculated jointly for both of the CBAM goods;
- The operator has monitored their emissions for the period 1 January 2026 to 31 December 2026 in accordance with their monitoring plan, applying the monitoring provisions of section B of the force of law notice (ODT, 344KB).

Table 5-6 below shows the various parameters and calculations which lead into the final calculation of the emissions intensity value for both cement clinker and Portland cement through this production process.

Relevant emissions	**AD (t)**	**NCV (GJ/t)**	**EF (tCO_2/t or tCO_2/TJ)**	**Biomass %**	**Emissions fossil (tCO_2)**	**Emissions biomass (tCO_2)**
Process emissions						
Raw meal (standard factor)	1,255,000		0.525		658,875	
Combustion emissions						
Coal	88,000	25	95		209,000	0
High NCV household waste	25,000	20	83	15%	35,275	6,225
HFO	43,000	40	78		134,160	0
Total relevant emissions					**1,037,310**	

Table 5-6: shows the calculation of relevant emissions for both cement clinker and other Portland cement. Note that in the table AD means activity data, NCV means net calorific value and EF means emissions factor.

- Note that the emission factor used for raw meal above is a standard emission factor given in the section B.9.2.2 of the force of law notice (ODT, 344KB), which states that, as a minimum requirement to determine the emission factor, a standard value of 0.525 tCO_2/t cement clinker is applied. In order to use more accurate values, the operator would need to obtain chemical analyses of the raw meal.
- Note also that the emissions associated with the biomass content of the household waste is calculated separately and is deducted from the total emissions. This is because the biodegradable fraction of municipal waste (given as 15% above) is treated as biomass and is effectively zero-rated for total emissions, in accordance with the criteria for zero rating of biomass emissions set out in section B.3.3 of the force of law notice (ODT, 344KB).

Step 3 - where amounts of relevant emissions identified in step 2 are not amounts of carbon dioxide, convert them into an amount of CO_2e

- For goods produced under these commodity codes the only relevant greenhouse gas is carbon dioxide, so this step is not applicable.

Step 4 - add together all amounts from steps 2 and 3 to produce a total amount, in tonnes, of CO_2e:

- The total emissions is 1,037,310 tCO_2e.

Step 5 - where precursor goods were used in the production of the CBAM good, add all precursor emissions to the amount from step 4. However, where a joint production process has been defined this step can be omitted:

- This step can be omitted because a joint production process has been defined. Note that if any cement clinker produced by the installation were to be diverted and separately sold, the operator would have to provide an emissions intensity value to the purchaser of the cement clinker goods. In order to do so, the operator would need to calculate separate emissions intensity values for both types of CBAM goods produced at the installation, and therefore the use of a joint production process would not be allowed. In such a case the operator would need to update their monitoring plan accordingly.

Step 6 - identify the weight of the type of CBAM good produced by the installation during the monitoring period:

- In this step “weight” means the weight, in tonnes, determined in accordance with the system boundaries document, and the force of law notice. It means the total mass of the goods leaving the production process during the monitoring period measured in functional units and in tonnes of goods;
- Note that in the force of law notice this is referred to as “Activity Level”;

- The definition of functional unit for other Portland cement, commodity code 25232900 is the tonnes of clinker contained in the goods produced under the respective commodity code;
- The operator identifies the "weight" of other Portland cement produced by the installation between 1 January 2026 and 31 December 2026, expressed as tonnes of clinker contained in the cement, by monitoring the activity level of the production process in accordance with the provisions of section E of the force of law notice (ODT, 344KB);
- The details of their calculated activity level, in functional units and in tonnes of goods are shown in Table 5-7 below:

Clinker production (tonnes)	1,255,000
Clinker to cement ratio (CCR)	95%
Other Portland cement production (tonnes)	1,321,053
Functional units (tonnes clinker contained in the goods)	1,255,000

Table 5-7: shows the calculation of activity level for other Portland cement.

Step 7 - divide the figure from step 4 or, where relevant, step 5 by the figure from step 6 to produce an amount, in tCO_2eemitted in the course of the production of a tonne of the type of CBAM good, with adjustment for functional units where relevant, ("the emissions intensity"), rounded to five decimal places:

- The operator divides the figure from step 4 [1,037,310 tCO_2e] by the figure from step 6 [1,255,000 tonnes clinker contained in the goods], to produce an emissions intensity of 0.82654 tCO_2e emitted in the course of the production of a tonne of clinker contained in the other Portland cement;
- Because cement can be sold in different ranges of composition the operator will also need to calculate the emissions intensity of the goods according to the clinker contained in the goods averaged for each range of composition. The formula for this calculation is shown in section I.1.1 of the force of law notice:

$$EI_{g(cki)} = EI_g \times CK_i$$

Where:
$EI_{g(cki)}$ is the emissions intensity of the goods with clinker content CK_i;
EI_g is the emissions intensity expressed in terms of tCO_2e per functional unit;
CK_i is the average clinker content of the goods within a range of composition in tonnes of clinker per tonne of goods.

- In this case the clinker to cement ratio is 95%. Multiplying the

emissions intensity expressed in terms of tCO2e per functional unit by 95% produces an emissions intensity of 0.74389 tCO_2e emitted in the course of the production of a tonne of Other Portland cement, with a clinker content of 95%.

The operator then produces an Operator's Emissions Report, setting out all of the data required in Annex I of the force of law notice (ODT, 344KB).

The operator arranges for their report to be verified by an accredited verifier, who produces a verification report and a verification summary, if requested.

E5.2 Iron and steel sector

E5.2.1 Unit of production and emissions intensity for the iron and steel sector

The quantity of iron and steel sector goods imported into the UK should be expressed in metric tonnes. The operator must record the quantity of CBAM goods produced by the installation in each production process, for the purposes of monitoring and reporting in the operator's emissions report, for submission to the verifier.

Table 5-8 below outlines important parameters for this CBAM goods sector.

Industrial sector	**Iron and steel**
Unit of production	The quantity of goods produced in Tonnes (metric), classified under the same CN code, produced by the installation or production process
Associated activities	Producing, melting or refining iron or steel or ferrous alloys; manufacture of semi-finished and basic steel products
Relevant greenhouse gas	Carbon dioxide (CO_2)
Direct Emissions	Tonnes (metric) of CO_2e
Unit for emissions intensity	Tonnes CO_2e emissions per unit of production, reported separately for each type of CBAM good, by the installation or production process
Unit for embodied emissions	Tonnes (metric) of CO_2e

Table 5-8: shows the key elements that are representative of the iron and steel CBAM goods sector.

Emissions intensity values must be stated in metric tonnes CO_2 equivalent (tCO_2e) emissions per unit of production. The unit of production is defined

by default as “the quantities of goods produced in tonnes classified under the same CN code”, meaning that in most cases emissions intensity values will be stated in metric tonnes of CO_2 equivalent (tCO_2e) emissions, per tonne of goods produced.

This figure should be calculated for the specific installation or production process.

Case studies showing how emissions intensity values are derived in the iron and steel production process is given in section E5.2.13.

The following sections set out how the system boundaries of iron and steel sector goods should be defined and identify elements of the production process that should be included for the purposes of monitoring and reporting in the operator’s emissions report for submission to the verifier.

E5.2.2 Definition and explanation of sector CBAM goods covered

Table 5-9 below lists the relevant goods in scope of CBAM in the iron and steel sector. The CN codes in the central column are the starting point for which ‘production processes’ are to be defined for the purpose of monitoring in line with Schedule 16 of the Finance Act 2026.

Where goods with different CN codes, to which the same unit of production applies, are produced using different production routes within an installation, a single production process shall be used encompassing all production routes. Where the CN codes indicated in this table consist of 4, 5 or 6 digits, all 8-digit CN codes sharing the same initial digits shall be considered included, unless otherwise specified.

Aggregated goods category	CN Code	Description
Sintered Ore	2601 12	Agglomerated iron ores and concentrates, other than roasted iron pyrites
Pig iron	7201	Pig iron and spiegeleisen in pigs, blocks, or other primary forms. Some products under 7205 (Granules and powders, of pig iron, spiegeleisen, iron, or steel) may be covered here
FeMn	7202 1	Ferro-manganese
FeCr	7202 4	Ferro-chromium
FeNi	7202 6	Ferro-nickel
DRI	7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products

Crude steel	7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading 7203)
Iron or steel products	7207	Semi-finished products of iron or non-alloy steel
	7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel
	7224	Other alloy steel in ingots or other primary forms; semi-finished products of other alloy steel
	7205	Granules and powders, of pig iron, spiegeleisen, iron or steel (if not covered under category pig iron)
	7208	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, hot-rolled, not clad, plated or coated
	7209	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, cold -rolled (cold -reduced), not clad, plated or coated
	7210	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, clad, plated or coated
	7211	Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, not clad, plated or coated
	7212	Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, clad, plated or coated
	7213	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel
	7214	Other bars and rods of iron or non-alloy steel, not further worked than forged, hot -rolled, hot -drawn or hot -extruded, but including those twisted after rolling
	7215	Other bars and rods of iron or

		non-alloy steel
	7216	Angles, shapes and sections of iron or non-alloy steel
	7217	Wire of iron or non-alloy steel
	7219	Flat-rolled products of stainless steel, of a width of 600 mm or more
	7220	Flat-rolled products of stainless steel, of a width of less than 600 mm
	7221	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel
	7222	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel
	7223	Wire of stainless steel
	7225	Flat-rolled products of other alloy steel, of a width of 600 mm or more
	7226	Flat -rolled products of other alloy steel, of a width of less than 600 mm
	7227	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel
	7228	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or non-alloy steel
	7229	Wire of other alloy steel
	7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel
	7302	Railway or tramway track construction material of iron or steel, the following: rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates (base plates), rail clips, bedplates, ties and other material specialised

		for jointing or fixing rails
	7303	Tubes, pipes and hollow profiles, of cast iron
	7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel
	7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross - sections, the external diameter of which exceeds 406.4 mm of iron or steel
	7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel
	7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel
	7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge -sections, lock - gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes sections, tubes and the like, prepared for use in structures, of iron or steel
	7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 litres, whether or not lined or heat -insulated, but not fitted with mechanical or thermal equipment
	7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300

		litres, whether or not lined or heat - insulated, but not fitted with mechanical or thermal equipment
	7311	Containers for compressed or liquefied gas, of iron or steel
	7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel
	7326	Other articles of iron or steel

Table 5-9: shows CBAM goods in the iron and steel sector

The aggregated goods categories listed in Table 5-9 above include both finished iron and steel goods and precursor goods (intermediate products) that are consumed in the production of iron and steel. Schedule 16 lists the relevant goods in scope of CBAM in the iron and steel industry sector. The aggregated goods category in the left-hand column defines groups for which joint 'production processes' are to be defined for the purpose of monitoring.

Only input materials listed as relevant precursors to the system boundaries of the production process as specified in the system boundaries document are to be considered. Table 5-10 below shows the possible precursors by aggregated goods category and production route.

Aggregated Goods Category	**Relevant precursors**
Sintered Ore	None
Ferro alloys (FeMn, FeCr, FeNi)	Sintered ore, if used in the process.
Pig iron *Blast furnace route* *Smelting reduction*	Sintered ore; pig iron or direct reduced iron (DRI) from other installations or production processes, if used in the process; FeMn, FeCr, FeNi, if used in the process; hydrogen, if used in the process.
FeMn (Ferro-Manganese), FeCr (Ferro-Chromium), FeNi (Ferro-Nickel)	Sintered ore, if used in the process.
Direct Reduced Iron (DRI)	Sintered ore, if used in the process; hydrogen, if used in the process; pig iron or DRI from other installations or production processes, if used in the process; FeMn, FeCr, FeNi, if used in the process.
Crude steel *Basic oxygen steelmaking*	Pig iron, DRI, if used in the process; FeMn, FeCr, FeNi, if used in the process; crude

Electric arc furnace (EAF)	steel from other installations or production processes, if used in the process.
Iron and steel products	Crude steel, if used in the process; pig iron, DRI, if used in the process; FeMn, FeCr, FeNi, if used in the process; iron or steel products, if used in the process.

Table 5-10: compares goods categories their production routes and possible relevant precursors.

Not all precursors will apply in every case. For example, hydrogen may not currently be used in the process, and where this is the case, it does not need to be accounted for.

Note, in particular, that in some cases an aggregated goods category may be a precursor for its own category. This is best explained by an example:

Example: If an installation produces screws and nuts from steel rods, then the rods are the precursor, but both rods and screws and nuts are included in the same aggregated goods category, iron or steel products. The emissions intensity values of the screws and nuts will be composed of the emissions of the production process (heat applied for making the rods workable, and for annealing of the final product) plus the emissions intensity values of the steel rods. Note that this is important because the mass of the precursor rods and the mass of the final product screws and nuts will not be the same – if 20% of the original mass are cut away (and disposed of as scrap), 100t precursor are required for 80t of final product. In such cases the operator must ensure that the embodied emissions of the precursor correctly take account of the full quantity of precursor consumed in the production process, whilst also ensuring that the activity level of final product excludes the disposed of scrap.

Some types of iron or steel product have been excluded from the scope of CBAM. In particular, these include certain other types of ferro alloys under CN 7202 and CN 7204 – ferrous waste and scrap.

The production of iron and steel sector goods is through a number of different process routes, outlined below.

E5.2.3 Definition and explanation of relevant production processes and routes

The system boundaries of precursors and basic iron and steel finished goods are distinct and may, under certain conditions, be added together to include all processes directly or indirectly linked to the production processes for these goods, including input activities to the process, and

output activities from the process.

In line with the definitions of unit of production, system boundaries and precursors for the iron and steel aggregated goods categories in the force of law notice and the system boundaries document. For the goods under the aggregated goods categories crude steel and iron or steel products, where different unit of production that only differ in size or shape are produced with the same precursors in types, quantities and proportions, a single multifunctional production process shall be defined for that group of goods and the relevant attribution rules shall apply.

Where iron and steel CBAM goods are complex goods and precursors are received (i) under a given CN code produced during different monitoring periods and/or (ii) from multiple installations, embodied emissions shall, by default, be determined using the weighted-average rules, with deviation from the default allowed only where the operator provides sufficient evidence to the verifier to support more granular attribution to a specific installation or subset of installations. Figure 5-6 below shows the variety of different routes by which iron or steel products may be produced.

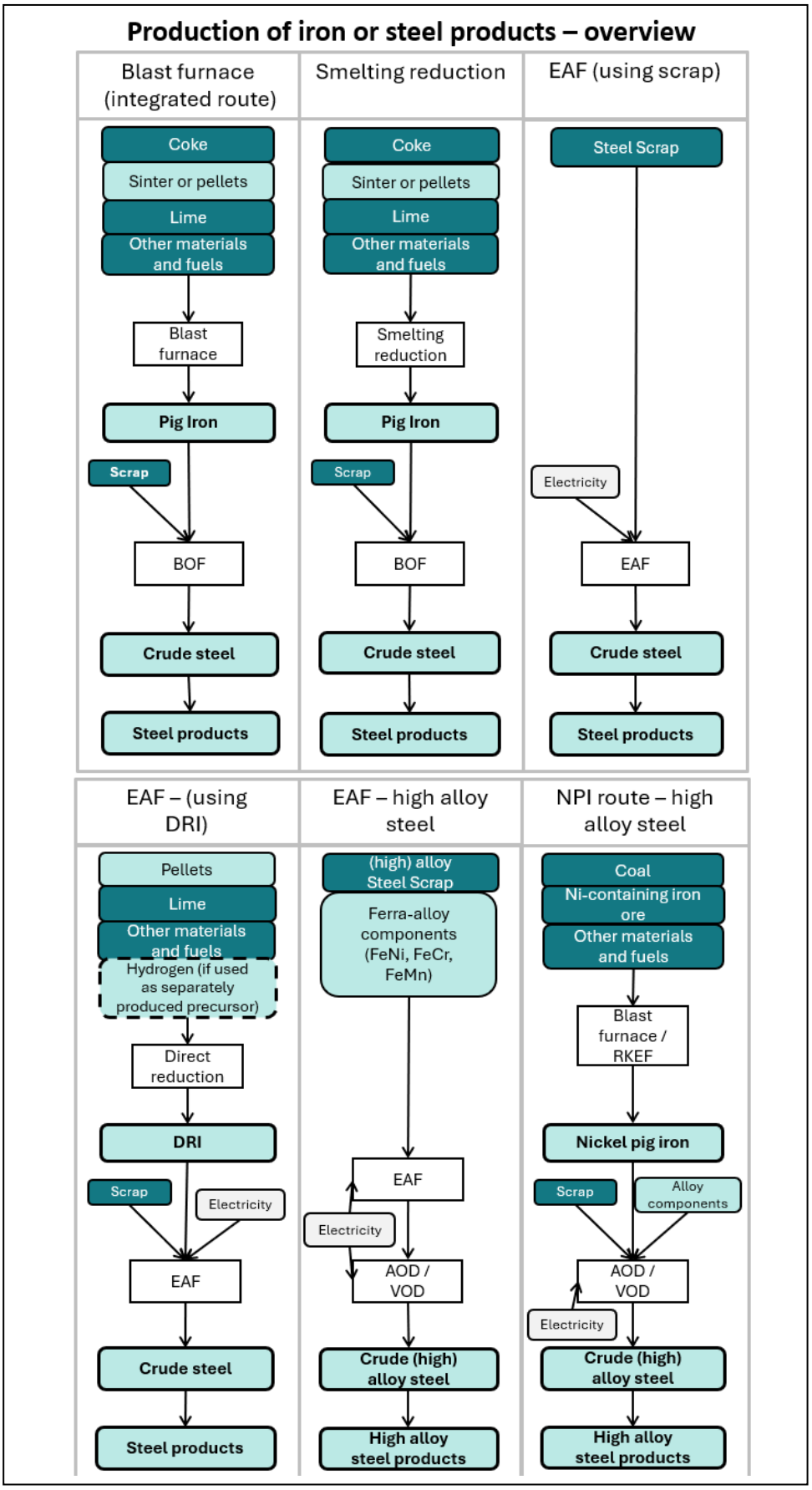


Figure 5-6: shows an overview and example of the system boundaries and

value chain for the production of iron or steel products.

Notes to this figure:

- the green boxes with a dashed outline (e.g. Hydrogen (if used as separately produced precursor)) represent optional precursors or process steps that are only included where they are actually used at the installation;
- unit of production for iron and steel goods: tonnes of goods under the same CN code;
- averaging across routes: where goods with the same unit of production are produced via more than one production route within an installation, specific embodied emissions shall be determined using a weighted average across those routes;
- precursors: where iron and steel goods are complex goods, embodied emissions include the embodied emissions of precursors.

Where actual embodied emissions are calculated, the operator shall prepare an operator's emissions report and get it verified. The operator's emissions report shall be written in English.

The production of precursor and complex goods is by a number of different process routes, outlined in the following sections. The relevant emissions that should be monitored for the iron and steel sector are detailed in section E5.2.12.1.

E5.2.4 Sintered ore production process

This aggregated goods category includes all kinds of iron ore pellet production (for sale of pellets as well as for direct use in the same installation) and sinter production. Pelletisation and sintering are complementary process routes for preparing and agglomerating iron oxide raw materials for use in iron and steel making. In pelletisation, iron oxide raw materials are ground and combined with additives to form pellets, which are then thermally treated. In sintered ore production, iron oxide raw materials are mixed with coke breeze and other additives before the mixture is sintered together in a kiln, forming a porous material similar to clinker, called 'sinter'. Sinter is typically produced and used at the steelworks. Pellets may be produced at the steelworks or at a distance at mine sites.

Note that to the extent covered by CN code 2601 12 00, iron ores used as precursors for ferro-chromium (FeCr), ferro-manganese (FeMn), ferro-nickel (FeNi) may also be covered by this aggregated goods category.

Section 3.13.1 of the system boundaries document defines the system boundaries for direct emissions monitoring for the sintered ore production route, as encompassing:

- all processes emitting CO_2 from process materials such as limestone and other carbonates or carbonate ores;
- all processes emitting CO_2 from all fuels including coke, waste gases such as coke oven gas, blast furnace gas or converter gas;
- directly or indirectly linked to the production process, and materials used for flue gas cleaning.

There are no other CBAM goods commonly used as precursors for this production process. In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of iron ore pellet and sinter production:

- raw material handling and pre-treatment – drying and grinding of iron ore raw materials;
- blending and mixing of raw materials – preparation of raw mixture for pellets and for sinter. Storage of raw mix in bunkers or hoppers at the start of the process;
- iron ore pellets only – forming into pellets and thermal treatment, screening;
- sintered ore only – raw material preparation, sintering in a furnace, followed by crushing, screening, conveying and cooling;
- emissions control – in particular waste gas treatment.

Figure 5-7 below shows the system boundaries of the sinter (or iron ore pellets) production process.

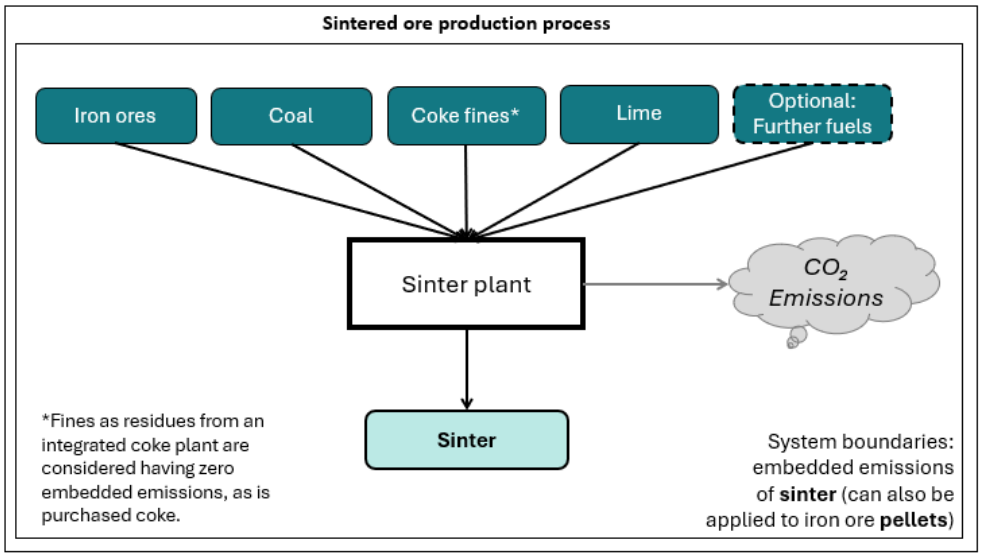


Figure 5-7: shows an example of the system boundaries of the sintered ore production process.

E5.2.5 Ferro-alloy FeMn, FeCr, and FeNi production processes

This process covers the production of the alloys ferro-manganese (FeMn), ferro-chromium (FeCr), and ferro-nickel (FeNi) identified under commodity codes 7202 10, 7202 40, 7202 60 and 7202 29 respectively. Other iron

materials with significant alloy content such as spiegeleisen are not covered here (see section E5.2.6). However, nickel pig iron (NPI) is included if the nickel content is greater than 10%; otherwise, if less than 10% NPI is covered by the pig iron – blast furnace production route.

The different ferro-alloys are produced by reductive smelting with the addition of a reducing agent such as coke to the EAF, along with other additives. Different types of EAF may be used, depending on the ferro-alloy production process; ferro-nickel has an additional calcination and pre-reduction production step prior to smelting. Following EAF smelting, liquid metal alloy is tapped and cast in moulds and the solidified metal is then crushed or granulated, depending on customer requirements.

Section 3.15.1 of the system boundaries document defines the system boundaries for direct emissions monitoring for ferro-alloys FeMn, FeCr, and FeNi pig iron production processes, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 emissions caused by fuel inputs, irrespective of whether they are used for energetic or non-energetic use;
- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from process inputs such as limestone and from flue gas cleaning;
- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from the consumption of electrodes or electrode pastes;
- carbon remaining in the product or in slags or wastes is taken into account by using a mass balance method in accordance with the section entitled 'Mass balance method' in the force of law notice (ODT, 344KB).

A relevant precursor is sintered ore (if used in the process).

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of ferro-alloy installations:

- raw material handling and pre-treatment – pellets and sinter for FeMn and FeCr, calcination and pre-reduction in a rotary kiln for FeNi;
- EAF process – all steps for the EAF process, including charging, melting, primary refining and tapping of the primary furnace;
- decarburisation and secondary metallurgy – if required to produce ferro-alloys with different carbon contents;
- casting plant – including casting and cutting, casting ingots pre-heating stands;
- crushing and granulation;
- emissions control – for treating releases to air, water or ground, including dedusting units, post-combustion unit, slag handling.

Figure 5-8 below shows the system boundaries of the relevant ferro-alloy production processes.

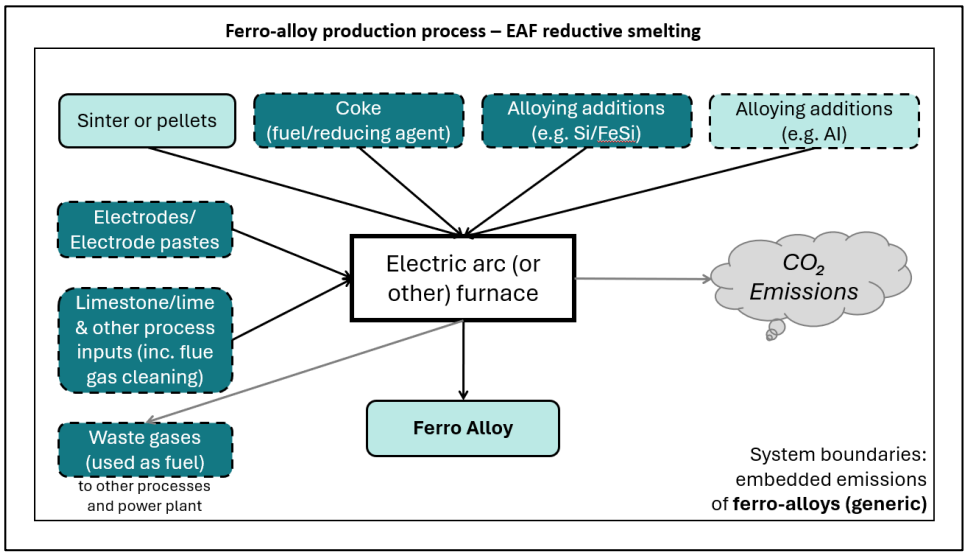


Figure 5-8: shows an example of the system boundaries of the ferro-alloy production process – EAF reductive smelting.

Notes to figure:

- CO_2/CO in waste gases: where waste gases contain CO and are emitted without abatement, the CO component is treated as the molar equivalent of CO_2 for the purpose of determining direct emissions (i.e. counted as CO_2e on a molar basis), in line with the force of law notice for fuel/waste-gas streams;
- optional inputs: inputs shown with dashed outlines are illustrative/optional (used only where they are actually applied in the installation's process route) and do not introduce any standalone "threshold" rule for inclusion. Materials in pale green boxes have embodied emissions (precursor materials and final products, i.e. goods under CBAM). Materials which are considered to have no embodied emissions are shown in dark green boxes;
- system boundary reminder: emissions system boundaries include (as applicable) fuel inputs (energetic and non-energetic use), process inputs such as limestone/carbonates and flue-gas cleaning materials, and emissions from consumption of electrodes/electrode pastes, with carbon retained in products/slag/wastes accounted for via mass balance where required.

Note that raw material inputs for ferro-alloys may include pellets and sinter that are produced under the separate production process (for CN code 2601 12) for sintered iron ore.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (carbon remaining in steel, in wastes

or in slag) the EAF production process. A worked example showing how the mass balance method is applied is given in section E5.2.13.2.

E5.2.6 Pig iron – Blast furnace production route

The blast furnace production route produces liquid pig iron ("hot metal") that may be alloyed (for example spiegeleisen and nickel pig iron or NPI (NPI is covered by this production process if the nickel content is lower than 10%, otherwise if more than 10% it is covered under the ferro-alloy production process)) or non-alloyed. The main production unit for this production process is the blast furnace. Inputs into the blast furnace include iron ore pellets or sintered ore, fuels and other raw materials including those used as reducing agents. Inside the blast furnace iron oxide is reduced to iron metal. The hot metal produced is then tapped and is either cast or is directly converted to crude steel in a sequential step by the basic oxygen converter. This step is covered under a different production process, the crude steel – basic oxygen steelmaking production route.

Section 3.14.1(a) of the system boundaries document defines the system boundaries for direct emissions monitoring for the pig iron – Blast furnace production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 from fuels and reducing agents such as coke, coke dust, coal, fuel oils, plastic wastes, natural gas, wood wastes, charcoal, as well as from waste gases such as coke oven gas, blast furnace gas or converter gas;
- where biomass is used, the provisions of the section entitled 'Criteria for zero-rating of biomass emissions' in the force of law notice shall be taken into account;
- all processes directly or indirectly linked to the production processes emitting CO_2 from process materials such as limestone, magnesite, and other carbonates, carbonate ores; materials for flue gas cleaning;
- carbon remaining in the product or in slags or wastes is taken into account by using a mass balance method in accordance with the section entitled 'Mass balance method' in the force of law notice (ODT, 344KB).

Relevant precursors (if used in the process) are sintered ore; pig iron or DRI from other installations or production processes; ferro-alloys FeMn, FeCr, FeNi; and hydrogen, if used.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of blast furnace installations:

- raw material handling and pre-treatment;

- fuel storage and preparation – for example coal drying and preparation for pulverized coal injection (PCI), vessels preheating stands;
- hot metal production – all steps for the blast furnace process resulting in liquid pig iron, the main unit being the blast furnace, along with hot metal treatment units, blast furnace blowers, blast furnace hot stoves, compressed air production, steam injection in the blast furnace unit, steam generation plant;
- emissions control – for treating releases to air, water or ground, including slag treatment, waste gas treatment, dedusting units, dust briquetting;
- miscellaneous not covered above.

Figure 5-9 below shows the system boundary for the blast furnace production route.

If all the liquid pig iron from the blast furnace was used by the oxygen steelmaking process to produce crude steel, then there would be no need to monitor emissions from the blast furnace production route separately. Instead, a joint production process for crude steel making may be defined.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (carbon remaining in the product, or in wastes or slags) the production process. A worked example showing how the mass balance method is applied is given in section E5.2.13.1.

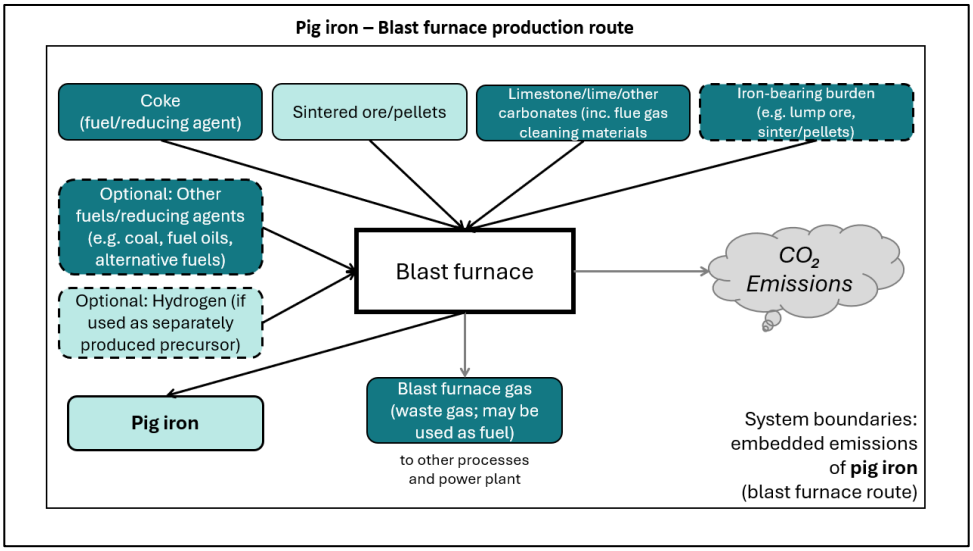


Figure 5-9: shows an example of the system boundaries of the pig iron – blast furnace production route.

Notes to figure:

- hydrogen is shown as an optional input where hydrogen is used as a reducing agent and is treated as a precursor;
- where blast furnace gas or other waste gases are used as fuels, the

associated CO_2 emissions fall within the system boundaries as fuel-related emissions.

E5.2.7 Pig iron – Smelting reduction production route

Smelting reduction produces pig iron from precursor sintered ore, iron ore pellets, or ironmaking residues, using different fuels and reducing agents. The process comprises two steps, the reduction of iron ore followed by melting to produce liquid pig iron/hot metal.

Section 3.14.1(a) of the system boundaries document defines the system boundaries for direct emissions monitoring for the pig iron – smelting reduction production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 from fuels and reducing agents such as coke, coke dust, coal, fuel oils, plastic wastes, natural gas, wood wastes, charcoal, waste gases from the process or converter gas;
- where biomass is used, the provisions of the section entitled 'Criteria for zero-rating of biomass emissions' in the force of law notice shall be taken into account;
- all processes directly or indirectly linked to the production processes emitting CO2 from process materials such as limestone, magnesite, and other carbonate ores; materials for flue gas cleaning;
- carbon remaining in the product or in slags or wastes is taken into account by using a mass balance method in accordance with the section entitled 'Mass balance method' in the force of law notice (ODT, 344KB).

Relevant precursors (if used in the process) are sintered ore; pig iron or DRI from other installations or production processes; ferro-alloys FeMn, FeCr, FeNi; and hydrogen, if used.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of smelting reduction installations:

- raw material handling and pre-treatment;
- fuel storage and preparation;
- smelting reduction process – all steps for the smelting process; resulting in hot metal;
- casting plant;
- emissions control – in particular flue gas cleaning.

Figure 5-10 below shows the system boundaries of the smelting reduction process for producing pig iron.

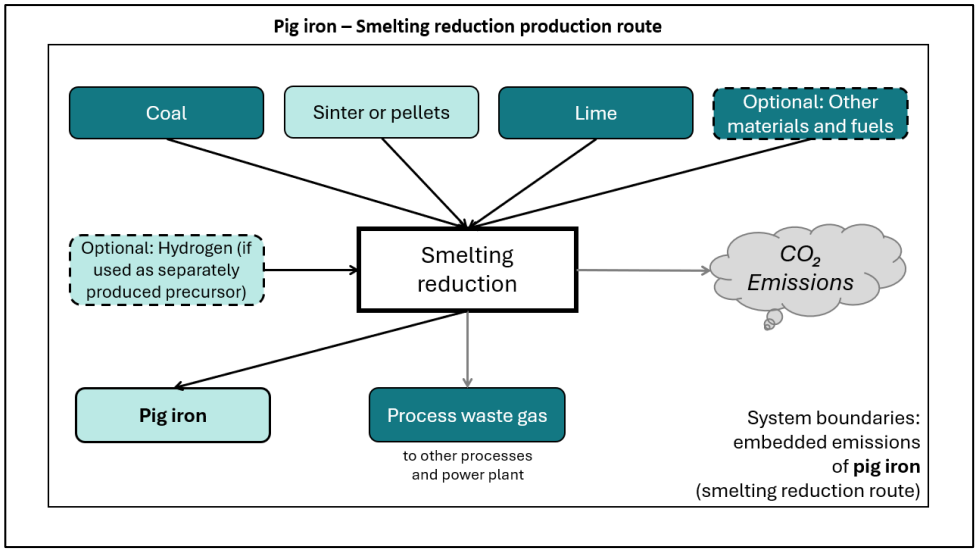


Figure 5-10: shows an example of the system boundaries of the pig iron – smelting reduction production route.

Notes to figure:

- the boxes with a dashed outline (e.g. hydrogen (if used as separately produced precursor) and 'Optional: other materials and fuels') represent optional inputs that are included only where they are actually used at the installation;
- unit of production for iron and steel goods: tonnes of goods under the same CN code;
- precursors: where pig iron is produced as a complex good using precursors, embodied emissions include the embodied emissions of those precursors in accordance with the rules on precursors.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (as carbon remaining in the product, or in wastes or slags) the production process. A worked example showing how the mass balance method is applied is given in section E5.2.13.2.

E5.2.8 Direct Reduced Iron (DRI) production process

Direct reduction involves the production of solid primary iron from high grade iron ores (pellets, sinter or concentrates). There are different technologies that may use different qualities of ores (which may require pelletisation or sintering) and different fuels and reducing agents (natural gas, diverse fossil fuels or biomass, hydrogen). The solid product is called direct reduced iron (DRI). Different types of DRI are produced, for example 'iron sponge' and hot briquetted iron (HBI) as a feedstock in EAFs or for other downstream processes. It is expected that production routes using hydrogen will play a major role in decarbonising the steel industry in coming years.

Section 3.16.1 of the system boundaries document defines the system

boundaries for direct emissions monitoring for the DRI production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 from fuels and reducing agents such as natural gas, fuel oils, waste gases from the process or converter gas;
- where biogas or other forms of biomass are used, the provisions of the section 'Criteria for zero-rating of biomass emissions' in the force of law notice shall be taken into account;
- all processes directly or indirectly linked to the production processes emitting CO_2 from process materials such as limestone, magnesite, and other carbonates, carbonate ores; materials for flue gas cleaning;
- carbon remaining in the product or in slags or wastes is taken into account by using a mass balance method in accordance with the section entitled 'Mass balance method' in the force of law notice (ODT, 344KB).

Relevant precursors (if used in the process) are sintered ore; hydrogen; pig iron or DRI from other installations or production processes; and ferro-alloys FeMn, FeCr, and FeNi.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of DRI installations:

- raw material handling and pre-treatment;
- fuel storage and preparation – coal, natural gas or hydrogen etc.;
- direct reduction process for iron production – all steps for the DRI process, forming into hot briquetted iron (HBI) if applicable;
- emissions control – in particular flue gas cleaning.

Figure 5-11 below shows the system boundaries of the relevant processes for DRI production. Although there are several different processes used in practice, the high-level system boundaries are very similar and can therefore be represented on a single diagram.

Note that where an installation does not sell or transfer DRI produced to other installations, there is no need to monitor emissions from the DRI production process separately. A common production process including steelmaking may be used.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (as carbon remaining in the product, or in wastes or slags) the production process.

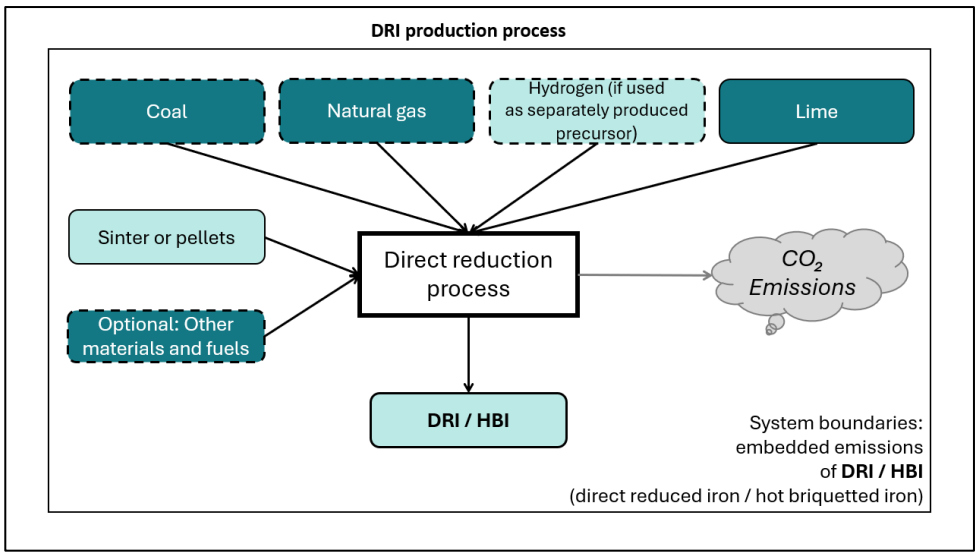


Figure 5-11: shows an example of the system boundaries of the DRI production process.

Notes to figure:

- boxes with a dashed outline represent optional inputs that are only included where they are actually used at the installation (e.g. hydrogen where it is used as a reducing agent/precursor).

E5.2.9 Crude steel – Basic oxygen steelmaking production route

If the basic oxygen steelmaking production route starts with hot metal (liquid pig iron); the hot metal is directly converted to crude steel by the basic oxygen converter or furnace (BOF) as part of a continuous process. Following the converter, a steel decarburisation process by argon oxygen decarburisation (AOD) or vacuum oxygen decarburisation (VOD) may be performed, followed by various secondary metallurgical processes such as vacuum degassing to remove dissolved gases. Crude steel is then cast into its primary forms by continuous casting or ingot casting, which may be followed by hot-rolling or forging to obtain the semi-finished crude steel products (under CN codes 7207, 7218 and 7224).

Section 3.17.1(a) of the system boundaries document defines the system boundaries for direct emissions monitoring for the crude steel – basic oxygen production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 from fuels such as coal, natural gas, fuel oils, waste gases such as blast furnace gas, coke oven gas or converter gas;
- all processes directly or indirectly linked to the production processes emitting CO_2 from process materials such as limestone, magnesite, and other carbonates, carbonate ores; materials for flue gas cleaning;
- carbon entering the process in scrap, alloys, graphite etc. and carbon remaining in the product or in slags or wastes is taken into account

by using a mass balance method in accordance with the section entitled 'Mass balance method' in the force of law notice (ODT, 344KB).

Relevant precursors (if used in the process) are pig iron, DRI; ferro-alloys FeMn, FeCr, and FeNi; and crude steel from other installations or production processes.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of basic oxygen steelmaking installations:

- basic oxygen converter or furnace (BOF);
- decarburisation – AOD or VOD processes, where relevant;
- secondary metallurgy and vacuum degassing;
- casting plant – continuous casting or ingot casting, preheating equipment;
- hot rolling or forging – where relevant, only primary hot-rolling and rough shaping by forging to obtain the semi-finished products;
- all necessary auxiliary activities – such as transfers, re-heating;
- emissions control – in particular flue gas cleaning, dedusting units and slag handling.

Note that only primary hot-rolling and rough shaping by forging to obtain the semi-finished products under CN codes 7207, 7218 and 7224 are included in this aggregated goods category.

Figure 5-12 below shows all other rolling and forging processes are included in the aggregated goods category "iron or steel products":

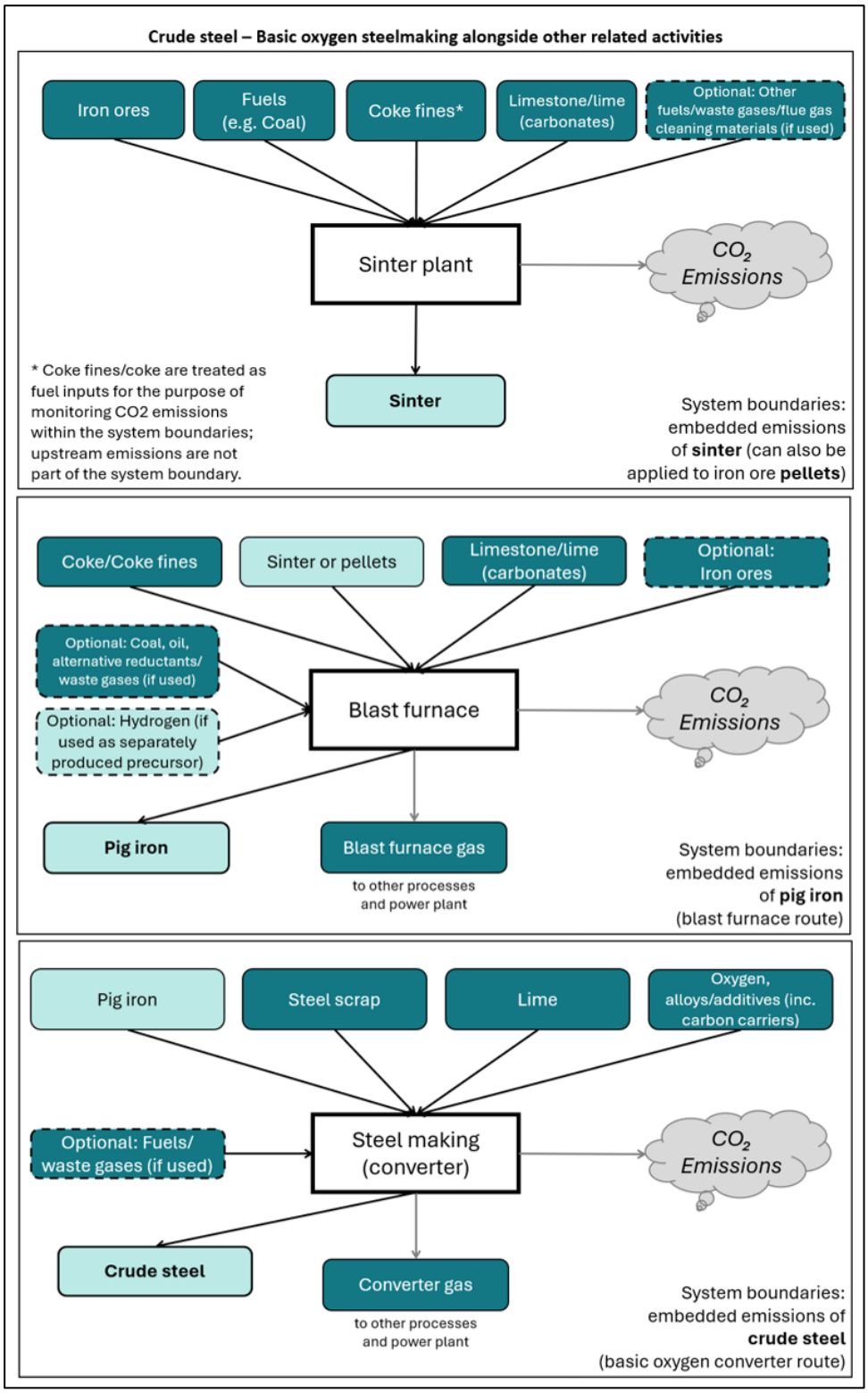


Figure 5-12: shows an example of the system boundaries of crude steel – basic oxygen steelmaking alongside other related activities.

Notes to figure:

- optional inputs/steps (dashed outline): Boxes with a dashed outline represent optional inputs or process elements that are included only where they are actually used at the installation;

- hydrogen as an optional precursor (where shown): Where "hydrogen" is shown, it indicates that hydrogen, if used as a reducing agent/input in the relevant route at the installation, must be treated as a precursor for embodied emissions accounting;
- waste gases: streams such as blast furnace gas and converter gas are shown as process waste gases. Where such gases are used as fuels, they fall within the fuel input boundary for emissions monitoring for the relevant production process;
- unit of production: unit of production for iron and steel goods is tonnes of goods under the same CN code;
- BOF (mass balance): BOF indicates that, for the basic oxygen furnace route, carbon entering and leaving the process (including carbon in scrap and alloying/carbon-bearing additions, and carbon remaining in product, slags or wastes) is accounted for using a mass balance method as required by the applicable monitoring rules for the route;
- averaging across routes within an installation: where goods with the same unit of production are produced via more than one production route within an installation, specific embodied emissions are determined using a weighted average across those routes (to avoid selective reporting);
- precursors and embodied emissions: where iron and steel goods are complex goods, embodied emissions include the embodied emissions of precursors used.

In integrated steel plants, liquid pig iron that is directly charged to the oxygen converter is the product which separates the production process for pig iron (bottom left in Figure 5-12 above) from the production process of crude steel (bottom right in Figure 5-12 above).

The integrated blast furnace / basic oxygen furnace (BF/BOF) steelmaking process is by far the most complex steel making process and is characterised by networks of interdependent material and energy flows between the various production units. Note that coke (top left) is treated as a raw material with no embodied emissions.

When all the liquid pig iron from the blast furnace is used by the oxygen steelmaking process to produce crude steel, there is no need to monitor emissions from the blast furnace production route separately. Instead, a joint production process for crude steel making may be defined.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (carbon remaining in steel product, or in wastes and slags) the production process.

A worked example of how the mass balance method is applied for this production route is given in section E5.2.13.1.

E5.2.10 Crude steel – electric arc furnace (EAF) steelmaking production route

The direct smelting of materials which contain iron is usually performed in an EAF. Feedstocks for EAF routes are metallic iron; in particular ferrous scrap (where only post-consumer scrap is used, it is assumed to have zero embodied emissions) and/or Direct Reduced Iron (DRI). Where significant amounts of DRI are used, one of the various EAF-DRI routes applies. Following EAF smelting, a steel decarburisation process by argon oxygen decarburisation (AOD) or vacuum oxygen decarburisation (VOD) may be performed, followed by various secondary metallurgical processes such as desulphurisation and vacuum degassing to remove dissolved gases. Electricity is the main energy input to the EAF; however, indirect emissions are out of scope of CBAM in the UK.

Section 3.17.1(b) of the system boundaries document defines the system boundaries for direct emissions monitoring for the Crude steel – EAF production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 from fuels such as coal, natural gas, fuel oils, as well as from waste gases such as blast furnace gas, coke oven gas or converter gas;
- all processes directly or indirectly linked to the production processes emitting CO_2 from the consumption of electrodes and electrode pastes;
- all production processes directly or indirectly linked to the production processes emitting CO_2 from process materials such as limestone, magnesite, and other carbonates, carbonate ores; materials for flue gas cleaning;
- carbon entering the process, for example in the form of scrap, alloys and graphite, and carbon remaining in the product or in slags or wastes is taken into account by using a mass balance method in accordance with the section entitled ‘Mass balance method’ in the force of law notice (ODT, 344KB).

Relevant precursors (if used in the process) are pig iron, DRI; ferro-alloys FeMn, FeCr, and FeNi; and crude steel from other installations or production processes.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of EAF steelmaking installations – all relevant activities and production units, such as:

- raw material handling and pre-treatment– scrap drying and pre-heating of raw materials;
- EAF process – all steps for the EAF process, including charging, melting, primary refining and steel and slag tapping of the primary

furnace;

- decarburisation – AOD or VOD processes, where relevant;
- secondary metallurgy and vacuum degassing;
- casting plant – continuous casting or ingot casting, preheating equipment;
- hot rolling or forging – where relevant, only primary hot-rolling and rough shaping by forging to obtain the semi-finished products;
- all necessary auxiliary activities – such as transfers, heating of equipment, re-heating;
- emissions control – in particular flue gas cleaning, dedusting units and slag handling.

Note that only primary hot-rolling and rough shaping by forging to obtain the semi-finished products under CN codes 7207, 7218 and 7224 are included in this aggregated goods category.

Figure 5-13 below shows all other rolling and forging processes are included in the aggregated goods category “iron or steel products”.

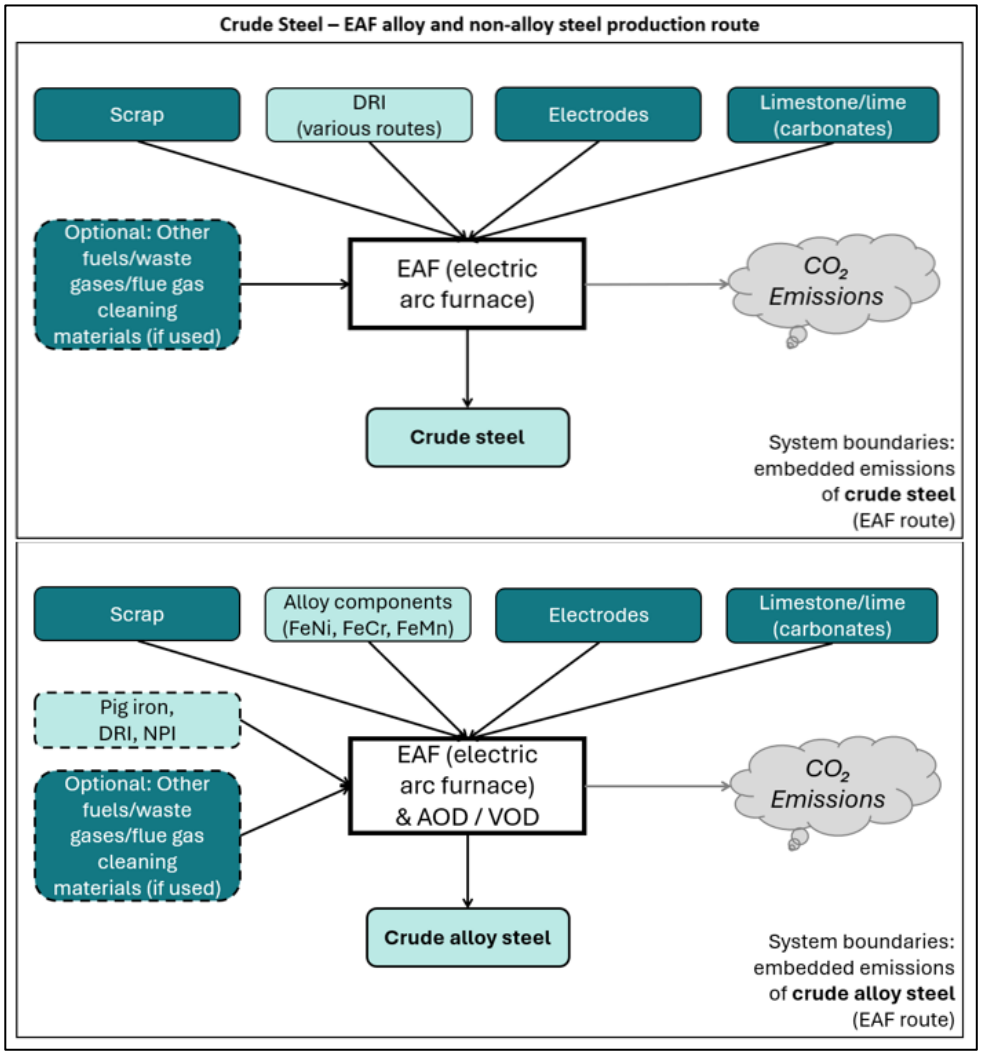


Figure 5-13: shows an example of the system boundaries of the crude steel

– EAF alloy and non-alloy steel production route.

Notes to figure:

- boxes with a dashed outline represent optional inputs that are only included where they are actually used at the installation.

There are several different EAF production routes, for crude steel and crude alloy steel, which are broadly similar and are shown jointly in Figure 5-13 above.

The mass balance method is used to give a complete balance of the amount of carbon entering or leaving (carbon remaining in steel, in wastes and in slag) the EAF production process.

A worked example showing how the mass balance method is applied for this production route is given in section E5.2.13.2.

E5.2.11 Iron or steel products production process

Iron or steel products are produced from the further processing of crude steel, semi-finished products, as well as other final steel products by all kinds of forming and finishing steps, including re-heating, re-melting, casting, hot rolling, cold rolling, forging, pickling, annealing, plating, coating, galvanizing, wire drawing, cutting, welding and finishing.

Section 3.18.1 of the system boundaries document defines the system boundaries for direct emissions monitoring for the iron or steel products production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from combustion of fuels and process emissions from flue gas treatment, including re-heating, re-melting, casting, hot rolling, cold rolling, forging, annealing, coating, galvanizing, wire drawing, pickling and excluding the following processes:
  - plating;
  - cutting;
  - welding;
  - finishing of iron or steel products.

Relevant precursors (if used in the process) are crude steel; pig iron, DRI; ferro-alloys FeMn, FeCr, FeNi; and other iron or steel products.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of iron and steel products:

- raw material preparation – including pre-heating, re-melting and alloying;

- forming processes for iron and steel products – all forming process steps, including casting, hot and cold rolling, shaping by forging, wire drawing;
- pickling annealing, coating, galvanizing;
- emissions control – for treating releases to air, water or ground.

Figure 5-14 below shows the system boundaries from iron and steel products.

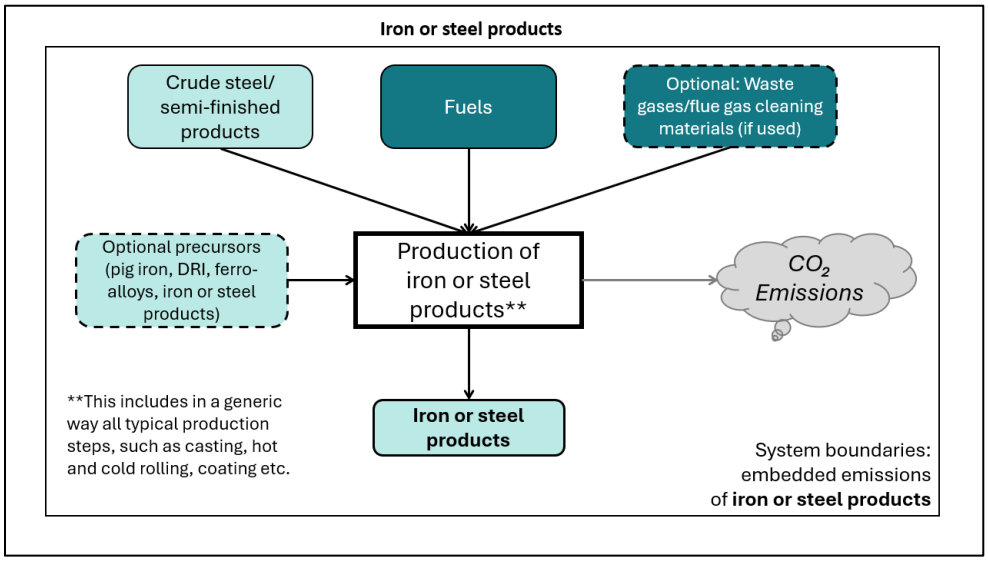


Figure 5-14: shows the system boundaries of iron or steel products.

Notes to figure:

- boxes with a dashed outline represent optional inputs that are only included where they are actually used at the installation. The footnote marker on "Production of iron or steel products" indicates that purchase and maintenance of infrastructure and equipment are excluded from the system boundaries.

Several case studies showing how emissions intensity values are derived for iron to steel products, using the mass balance method, and how the embodied emissions of imports into the UK are calculated, are given in section E5.2.13.

E5.2.12 Sector-specific requirements for monitoring and reporting

Direct emissions intensity values should be monitored in line with the methodology set out in the force of law notice.

E5.2.12.1 Emissions monitoring

Relevant emissions that should be monitored for the iron and steel sector are:

- carbon dioxide emissions (direct) from the fuel combustion process

including waste or off-gases such as blast furnace gas (BFG), from stationary units only (excludes emissions from any mobile machinery such as vehicles);

- carbon dioxide emissions (direct) other than from the combustion process, resulting from the reduction of iron and steel by reducing agents such as coke or natural gas, from the thermal decomposition of carbonate raw materials (such as limestone, dolomite and carbonatic iron ores, including FeCO3), from the carbon content of scrap or alloys, graphite (such as graphite blocks used inside the blast furnace, or electrodes or electrode pastes) or other carbon containing materials entering the process;
- carbon dioxide emissions (direct) resulting from the production of measurable heating (for example steam) and cooling that is consumed within the system boundaries of the production process, regardless of the location of the production of the heat (i.e. from on-site generation or from imports from off-site);
- carbon dioxide emissions (direct) resulting from emissions control (for example from carbonate raw materials such as soda ash used for acidic flue gas cleaning). This is included for any good where this is applicable.

Direct emissions from the different source streams above are not monitored separately but are added together to result in the total direct emissions for the installation or production process.

In deriving total direct emissions, carbon remaining in aggregated iron and steel goods such as pig iron, DRI, crude steel or iron alloys, or in slags or wastes, is also taken into account by using a mass balance method.

E5.2.12.2 Installations that only carry out excluded processes for iron or steel products

Where the installation only carries out processes excluded from the system boundaries (see the system boundaries document), verification obligations still apply if operators want to use actual values. Notably, the verification process will have to establish the following:

- that the installation only operates within the list of excluded processes;
- whether the production process carried out on the installation changed the specific embedded emissions of the goods:
    - for instance, in an installation where only cutting occurs, to compute embodied emissions of precursors, operators shall use the mass of precursors as entering the production process (before cutting), even if emissions from cutting activities will not be accounted for in embodied emissions of the complex good. This means that emissions intensity will increase, even if no emissions in relation to the cutting need to be reported for

CBAM purposes;

- That embodied emissions of precursors, whether based on default values or actual values, are correctly calculated:
    - for instance, the origin of precursors needs to be verified (to establish an exemption if produced in the UK; to check that verification reports exist for precursors where relevant).

As the installation needs to be verified, the operator will have to establish a monitoring plan. In this case, the monitoring plan might be very concise given the absence of process emissions, and combustion emissions. Emissions from excluded process steps do not have to be included in the monitoring plan as a source stream and do not have to be reported in the operator's emissions report.

E5.2.12.3 Additional rules

Attribution of emissions

Given the complexity of production processes in the iron and steel sector, installations producing two or more goods from the groups sintered ore, pig iron, FeMn, FeCr, FeNi, DRI, crude steel, iron or steel products, may monitor and report embodied emissions defining one joint production process, for all the products from these groups covered, if none of the precursors produced within the installation are sold separately.

Aggregation

Where goods under different CN codes are produced using the same (group of) physical processes, they can be considered to form one "multifunctional production process".

As detailed in section A.5 of the force of law notice (ODT, 344KB) for CBAM goods categories under crude steel and iron and steel products, the production processes must be combined where different 'units of production' only differ in size or shape, are produced with the same precursor types, quantities and proportions. In this situation three questions need to be asked, as below, if the answer to all three is yes, the process must be grouped:

- the different units of production (i.e. CN codes) differ only in size or shape: to fulfil this criterion, the descriptions of CN codes must only differ in size or shape – e.g. CN codes referring to different widths or thicknesses of a specific type of product (cast, extruded, rolled or forged products etc.);
- the different units of production are produced with the same precursors in types: to fulfil this criterion, the units of production must be produced with the same precursors in terms of CN codes
- the different units of production are produced with the same;

- precursors in quantities and proportions: to fulfil this criterion, the functional units have to contain these precursors in the same ranges – e.g. if ferro-nickel is a precursor to the different functional units, the functional units of the goods produced have to contain the same ranges of nickel content.

The decision tree shown in Figure 5-15 can be used to determine when different production processes should be grouped:

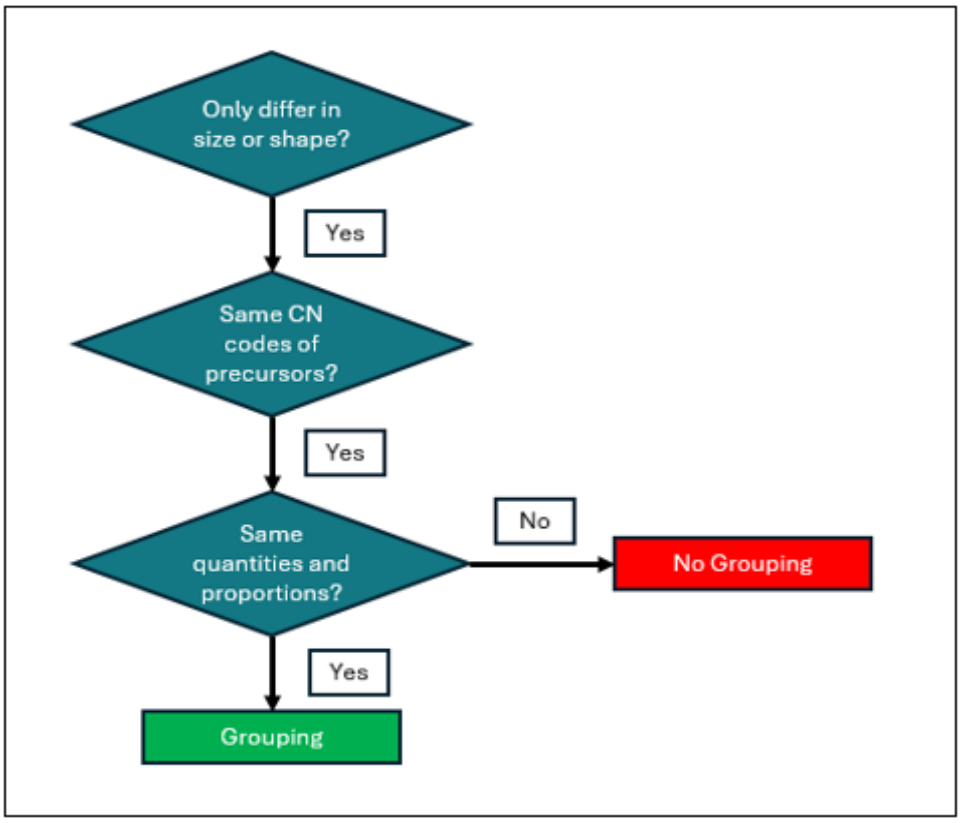


Figure 5-15: shows a decision tree for how different products should or should not be grouped into a multifunctional production process.

In addition to the mandatory grouping outline, the above goods from different 'units of production' that are produced through the same production process may be combined. This is not mandatory but is recommended to help operators in accurately representing their installation and simplifying monitoring when different units of production are produced via shared processes. For example, many CN codes in the steel industry are formed by subsequent hot rolling and cold rolling, i.e. the same physical processes. Therefore, all these CN codes can be considered "co-products" of the same joint production process. Using their respective units of production (tonnes of steel per CN code), the total output (the activity level) of this multifunctional process can be split on a pro rata basis to the goods of each CN code covered.

To help interpreting this provision for iron and steel products, the

following level of grouping are recommended:

- first level of grouping: production processes of goods whose CN codes share the same range in composition of ferroalloys covered by CBAM.
  Example: in an installation carrying out hot-rolling of semi-finished stainless-steel products, all CN codes of semi-finished hot-rolled stainless steel with a nickel content below 2.5% can be grouped in a multifunctional production process: CN codes 7219 12 90, 7219 13 90, 7219 14 90, 7219 21 90.
- second level of grouping: production processes whose CN codes are made of the same material (non-alloy steel, stainless steel);
  Example: in an installation that carries out finishing processes of stainless semi-finished steel products, all CN codes of Chapter 73 of the Harmonized System could be grouped in a multifunctional process: CN codes 7304 11 00, 7304 22 00, 7304 24 00, 7304 41 00.
- third level of grouping: production processes whose processes have emissions with limited contribution in the embedded emissions of the final complex good.
  Example: where an installation uses as precursors semi-finished stainless steel products and carries out on one side hot-rolling and on another side, finishing processes (without hot-rolling): the resulting goods can be grouped under a multifunctional processes (CN codes 7219 12 90, 7219 13 90, 7219 14 90, 7219 21 90, ⋯ and CN codes 7304 11 00, 7304 22 00, 7304 24 00, 7304 41 00, ⋯). This is because goods under these CN codes share the same precursors and embedded emissions of that precursor is contributing to most of the embodied emissions of the final complex goods. In this case, while the hot-rolling and finishing processes might differ in emissions, semi-finished and finished products would be grouped and attributed emissions equally. This will simplify monitoring and calculation with minimal loss of accuracy.

E5.2.12.4 Additional reporting parameters

Table 5-11 below shows the additional information that should be provided by the operator to importers, in the emissions data communication to them.

Aggregated good category	**Reporting requirement**
Sintered Ore	• none
Pig Iron	• the main reducing agent used • mass % of Mn, Cr, Ni, total of other alloy elements
FeMn – Ferro-Manganese	• mass % of Mn and carbon

FeCr – Ferro-Chromium	• mass % of Cr and carbon
FeNi – Ferro-Nickel	• mass % of Ni and carbon
DRI (Direct Reduced Iron)	• the main reducing agent used • mass % of Mn, Cr, Ni, Si, total of other alloy elements
Crude steel	• the main reducing agent of the precursor, if known • content of alloys in steel – expressed as: • mass % of Mn, Cr, Ni, Si, total of other alloy elements • tonnes scrap used for producing one tonne crude steel • % of scrap that is pre-consumer scrap
Iron or steel products	• the main reducing agent used in precursor production, if known • mass % of Mn, Cr, Ni, Si, total of other alloy elements • tonnes scrap used for producing one tonne of the product • % of scrap that is pre-consumer scrap

Table 5-11: compares additional iron and steel sector parameters required in the operator's emissions report.

The operator needs to ensure that they collect all the parameters necessary for their CBAM goods and communicate them to the importers of the goods. The importer will need to report the additional parameters when the goods are imported to the UK under CBAM.

E5.2.13 Worked examples for the iron and steel sectors

E5.2.13.1 Example 1 – integrated steel works and conversion to iron or steel products

The following worked example shows how emissions intensity values are derived for iron and steel sector goods, produced by the blast furnace/basic oxygen furnace (BOF) route. The resulting embodied emissions of imports into the UK are then calculated at the end of the example for reporting by the importer in their annual CBAM declaration for the relevant monitoring period.

For integrated steel making, the installation produces five products, each of which is treated as a separate production process, as each is a separate category of CBAM aggregated goods. It is assumed that only CN codes related to carbon steel are produced, which allows limiting the number of production processes.

Figure 5-16 below gives an outline view of the installation and shows the

system boundaries as a red (and blue) hatched line for each production process. The physical units carrying out each production process have been grouped under 'Sinter plant', 'Blast furnace', 'Linz-Donawitz (LD) converter', and under forming as 'Cold rolling, Hot rolling, Rail mill' and 'Power plant'; relevant inputs and outputs have been identified for each production process.

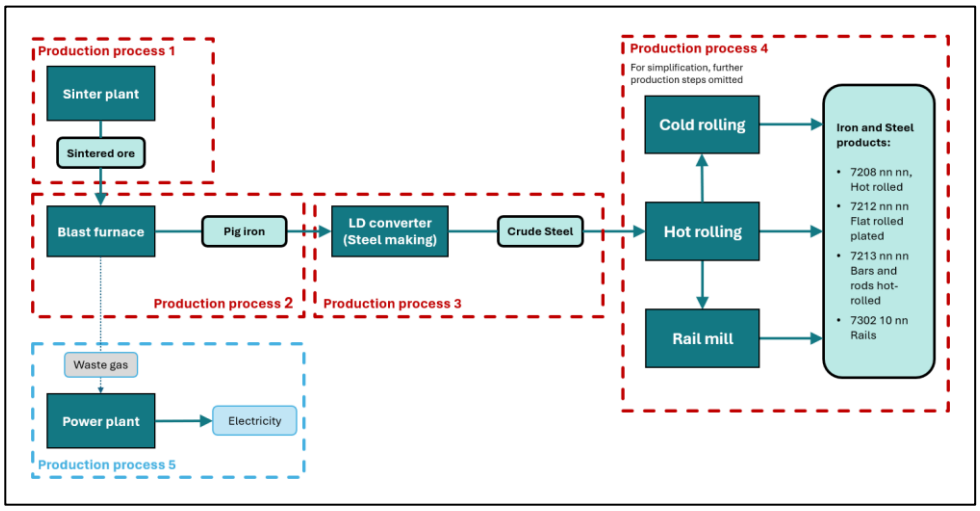


Figure 5-16: shows an overview of an example of carbon steel production – blast furnace route.

The five relevant production processes defined above, and elaborated further in the diagrams below are:

- Production process 1 – sinter ('sintered ore' CN 26011200 – Agglomerated iron ores and concentrates (excl. roasted iron pyrites)) produced in a sinter plant. The system boundaries of this production process have been defined as including inputs of raw materials (iron ore), fuels (coke fines) and electrical energy. The sintered ore output from the process is a relevant precursor for production process 2;
- Production process 2 – pig iron (hot metal) produced by a blast furnace. The system boundaries of this production process have been defined as including inputs of raw materials lime and coke (which are not CBAM goods and therefore not precursors and are treated as having zero embodied emissions for the purposes of this calculation), precursor sintered ore (which has embodied emissions), fuels/reducing agents including coke and plastics waste from households (i.e. a mixed waste fraction containing some biomass). The pig iron output from the process is a relevant precursor for production process 3;
- Production process 3 ‑ crude steel produced by the LD (basic oxygen) converter steelmaking route. The system boundaries of this production process have been defined as including inputs of raw materials lime and steel scrap (which are not CBAM goods and therefore not precursors and are treated as having zero embodied emission for the purposes of this calculation), precursor pig iron

(which has embodied emissions), fuels (natural gas). The crude steel output from the process is a relevant precursor for production process 4;

- Production process 4 – iron or steel products produced by different forming processes (hot rolling, cold rolling and rail mill) to give basic products such as bars, rods, rails and other rolled products. The system boundaries of this production process have been defined as including inputs of crude steel (which has embodied emissions), fuels (natural gas). Outputs from the production process are all within the same aggregated goods category 'iron or steel products' (complex goods produced from the different precursors produced) that are sold;
- Production process 5 – electricity produced from waste gas from blast furnace (production process 2). Blast furnace gas is transferred from production process 2 to production process 5 and energy is recovered through the generation of electricity, for processes 1 to 4.

Figure 5-17 below identifies the different source streams as inputs into the production processes, giving rise to direct emissions.

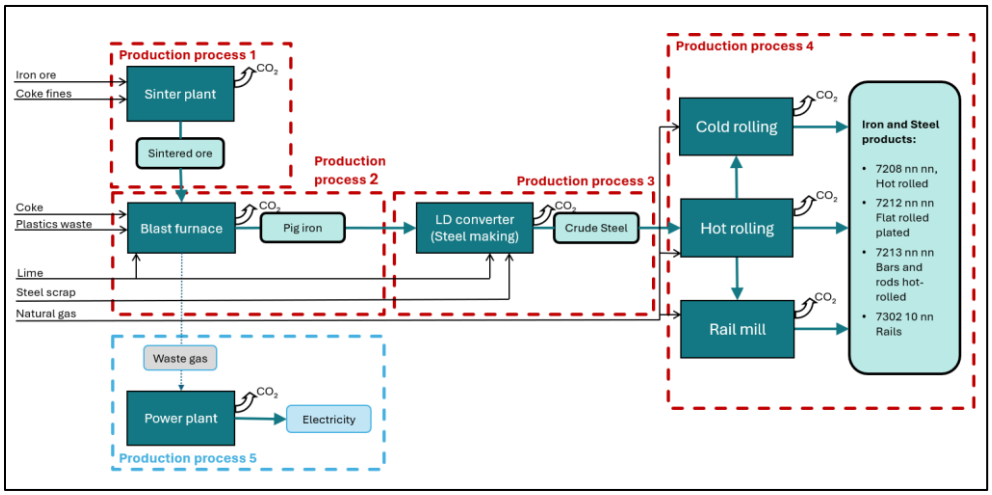


Figure 5-17: *Shows an example for carbon steel production, blast furnace route – Direct emissions and related source streams.*

Direct emissions arise from the combustion of fuels (coke fines, plastic wastes, natural gas) and from the waste gas (blast furnace gas) used for power generation, and from process emissions from coke as reducing agent and the thermal decomposition of carbonate-containing materials (such as lime) and from releases of carbon contained within the different iron and steel materials. Note that coke can also be treated as fuel, although it is primarily used as a reducing agent. However, reporting it like a fuel, i.e. including its NCV, has the advantage that it can be included in an energy balance for consistency checking.

Some of the waste gas (blast furnace gas) that is produced by production process 2 is recovered as a fuel for generating electricity through

production process 5. This electricity is used within the installation, thereby reducing the amount of imported grid electricity that is required.

Given the complexity of production processes in the iron and steel sector, installations producing complex goods using precursors from their own installation's production (in this example: sintered ore, pig iron, DRI, crude steel and iron or steel products) are permitted to monitor embodied emissions by defining one joint production process**,** for all the iron and steel aggregated goods categories covered, provided that the precursors produced are wholly used to make the finished iron or steel products. Figure 5-18 below shows an example of the complete monitoring approach with the parameters that require monitoring shown in red.

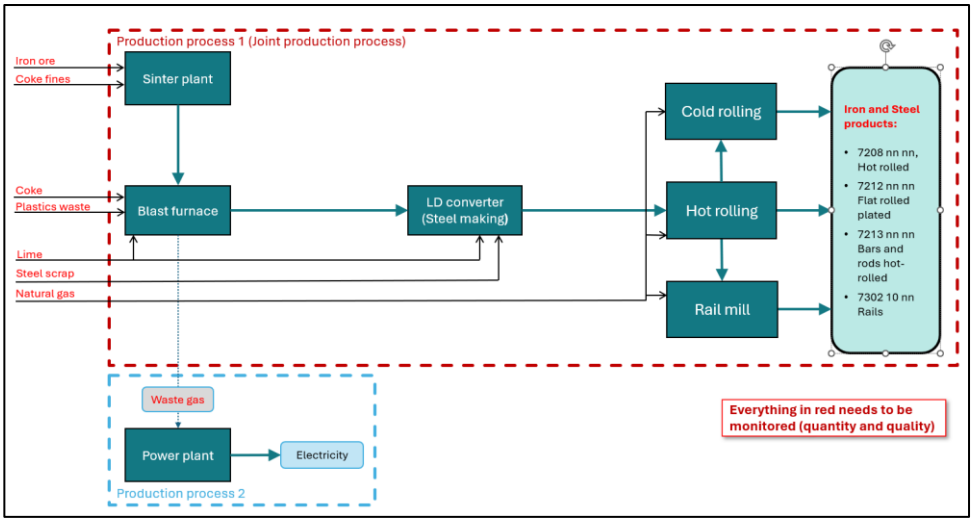


Figure 5-18: shows an example for *carbon steel production, blast furnace route – complete monitoring approach.*

Figure 5-18 provides a complete monitoring approach for all source streams, for the example installation. In this figure a single joint product process system boundary has been drawn around production processes 1 to 4, for iron or steel products. Within the joint product process, emissions for this production route result from:

- Fuel combustion – direct emissions from the combustion of fossil fuels and waste gases;
- Process emissions – direct emissions resulting from the thermal decomposition of carbonates, reductants (coke) and from the carbon content of iron and steel materials, including scrap.

The inputs and outputs highlighted in red text are the parameters that would need to be monitored by the operator in order to attribute emissions and determine specific embodied emissions for the joint production process.

Monitoring encompasses both aspects, quantitative (activity data) and qualitative (calculation factors). The activity levels for the different goods

produced would also need to be monitored. However, applying the joint production process approach, interim products (precursors), in this example sintered ore, pig iron and crude steel, do not have to be monitored. Furthermore, quantities of fuels used in more than one of the production processes do not have to be split by use levels in the production process.

Given the complexity of the installation with its different source streams and material flows, the mass balance method is used to give a complete balance of the amount of carbon entering and leaving the installation. In applying this method, the CO_2 quantities relevant for each source stream are calculated based on the carbon content (CC) in each material, without distinguishing fuels and process materials. Non-emitted carbon leaving the installation in products and residues instead of being emitted is also taken into account, by defining output source streams, which have negative activity data, highlighted in red text in Table 5-12 below.

Consumption levels	**AD (t)**	**CC**	**Bio fraction**	**Emissions (tCO_2)**	**Comments**
Coke fines	50,000	88.0%		161,216.0	
Iron ores	5,600 000	0.023%		4,719.2	
Coke	2,200,000	88.0%		7,093,504.0	
Plastic wastes	70 000	68.4%	16%	147,270.8	Biomass fraction = 28,052 tCO_2
Scrap (external)	800,000	0.210%		6,155.5	
Scrap (internal)	200,000	0.180%		1,319.0	
Lime calcined	280,000	0.273%		2,800.0	
Natural gas	170,000	75.0%		467,160.0	
Other inputs	40,000	10.0%		14,656.0	
Sum				**7,898,800.6**	
Carbon in outputs	AD(t)	CC		**"Emissions" (negative) (tCO_2)**	
Steel	-4,800,000	0.180%		-31,657.0	
Slags	-1,000,000	0.030%		-1,099.0	
Sum				**-32,756.2**	
Total direct emissions of the installation				**7,866,044.4**	

Table 5-12: shows an example calculation for carbon steel production blast furnace route – mass balance for the installation's direct emissions. AD = Activity data, CC = carbon content.

In Table 5-12 above, the carbon content (CC) of the different input and output source streams is converted into its CO_2 equivalent, including for scrap from different sources. Emissions from biomass in the mixed plastic

waste (assuming this is derived from municipal solid waste (MSW)) is zero-rated for emissions. Total direct emissions, net of carbon in outputs, is then calculated.

To avoid double counting of emissions from waste gas used to generate electricity, it is necessary to make a deduction from direct emissions. The activity data for waste gas is calculated from electricity generated, using the information on fuel input and generation efficiency given above, as follows:

- Electricity generated from waste gas: 1,244,133 MWh (measured);
- Total waste gas fuel input: 1,244,133/0.35 efficiency = 3,554,666 MWh;
- Converted to TJ: 3,544,666 x 0.0036 = 12,800 TJ.

The amount to deduct from direct emissions for waste gas used to generate electricity is calculated in table 5-13 below.

				tCO_2/year	Comment
Total direct emissions of the installation				7,866,044	From Table 7-12 above
	AD (TJ)	EF (Nat Gas)	Corr. factor		
Deduction for Waste gases	-12,800	56.1	0.667	– 478,959	Deduction for Waste gases
Total direct emissions of the production process for crude steel products				**7,387,085**	**Revised total direct emissions**

Table 5-13: shows an example calculation for carbon steel blast furnace route – installations' total emissions corrected for waste gas deduction.

Products	**Activity Level (AL)**	**Units**
Precursors		
Pig Iron	4,000,000	t/year
Crude steel	5,000,000	t/year
Iron or steel products		
Sheets	3,500,000	t/year
Bars	800,000	t/year
Rails	500,000	t/year
Total goods produced	**4,800,000**	**t/year**
Internal scrap	200,000	t/year

Table 5-14: shows an example of activity levels for goods produced in the monitoring period.

Using the total emissions data from table 5-12, waste gases from table 5-13 and production data from table 5-14, embodied emissions above these are then calculated for iron or steel products as shown in table 5-15 below.

Total amount of goods produced (steel products)	4,800,000	t/year
Total direct emissions of the production process for steel products	7,387,085	tCO_2/year
Specific direct embodied emissions (Emissions intensity)	1.539	tCO_2e/t steel product
Specific total embodied emissions (Emissions intensity)	**1.539**	**tCO_2e/t steel product**

Table 5-15: shows an example calculation and emissions intensity under the simplified joint production process approach for iron or steel products.

Note: The whole joint production process is formally a 'multifunctional process', with the goods under the different CN codes being 'co-products' (i.e. simultaneously produced in the same process). This means that formally, a 'per mass' attribution approach to the different goods (with unit of production being tonnes of each separate good) would have to be carried out at the end of the calculation. However, as all tonnes of good per CN code are weighted with the same factor (the physical unit 'tonne'), there is nothing more to calculate.

Some operators may have more complex processes than the above example. Where this is the case, the operator can aggregate production processes based on the three grouping levels detailed in section E5.2.12.3. For example, as shown in figure 5-16 if crude steel from Production process 3 is all used in cold rolling, hot rolling and rail mill processes, and not sold or used in another production process, then both can be aggregated into one joint production process. So, Production process 3 and Production process 5 could be combined and the monitoring and calculation of the embodied emissions carried out jointly.

E5.2.13.2 Example 2 – EAF and conversion to iron or steel products

The following example shows how specific embodied emissions are derived for crude steel and iron or steel products, produced by the EAF route. The resulting embodied emissions of imports into the UK are then calculated at the end of the example for reporting.

In this example for the EAF steel making route, the installation produces products falling under two aggregated goods categories, each of which is defined as a single production process.

Figure 5-19 below gives an outline view of the installation and shows the system boundaries as a red hatched line for each production process. The physical units carrying out each production process have been grouped under 'Steel making EAF & AOD', and under forming as 'Cutting and

welding', 'hot rolling to sheets, to bars and annealing'; and relevant inputs and outputs have been identified for each production process.

Note that high-alloy steels are produced in this example. Therefore, not only commodity codes, but different alloy grades define the different goods produced. For reporting under CBAM, the monitoring rules assume that all different alloys within the same aggregated goods category over the whole monitoring period are considered to have the same embodied emissions, i.e. a weighted average of alloy grades is used in order to keep monitoring rules reasonably simple. However, the alloy grade (the content of alloying elements Cr, Mn and Ni, as well as the carbon content) has to be reported as additional information upon import. Therefore, the importer will have to report each commodity code/alloy grade pair separately.

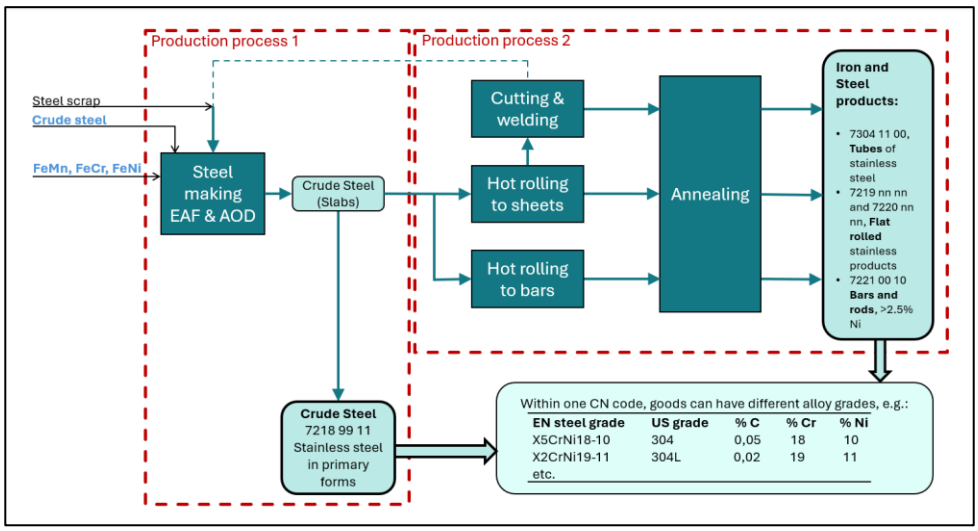


Figure 5-19: shows an overview of an example installation producing high-alloy steel from EAF route.

The two relevant production processes defined above, and elaborated further in the diagrams below are:

- Production process 1 – crude steel produced by the EAF/AOD steel making route as slabs, of different alloy grades. The system boundaries of this production process have been defined as including inputs of steel scrap from production process 2 (steel that is cut off during the production of pipes), precursors crude steel and alloys, fuels (natural gas), graphite electrodes and other additives and electrical energy. The crude steel output from the process is both sold and is a relevant precursor for production process 2. Due to the sale of precursor, the joint production approach is not allowed for this example installation;
- Production process 2 – iron or steel products, of different alloy grades, produced by different forming processes giving basic products such as tubes (cutting, rolling and welding), bars and rods (hot rolling and annealing) and sheets. The system boundaries of this

production process have been defined as including inputs of crude steel (which has embodied emissions), and fuels (natural gas). In line with point 3.18 of the system boundaries document, “plating, cutting, welding and finishing of iron or steel products” are excluded regarding their emissions. However, as such steps may be part of the actual way of making the listed steel goods, they are first to be included in the consideration of system boundaries, and only the respective emissions to be omitted. Outputs from the production process are finished iron or steel products that are sold.

The second diagram Figure 5-20 below identifies the different source streams as inputs into the production processes, giving rise to direct emissions.

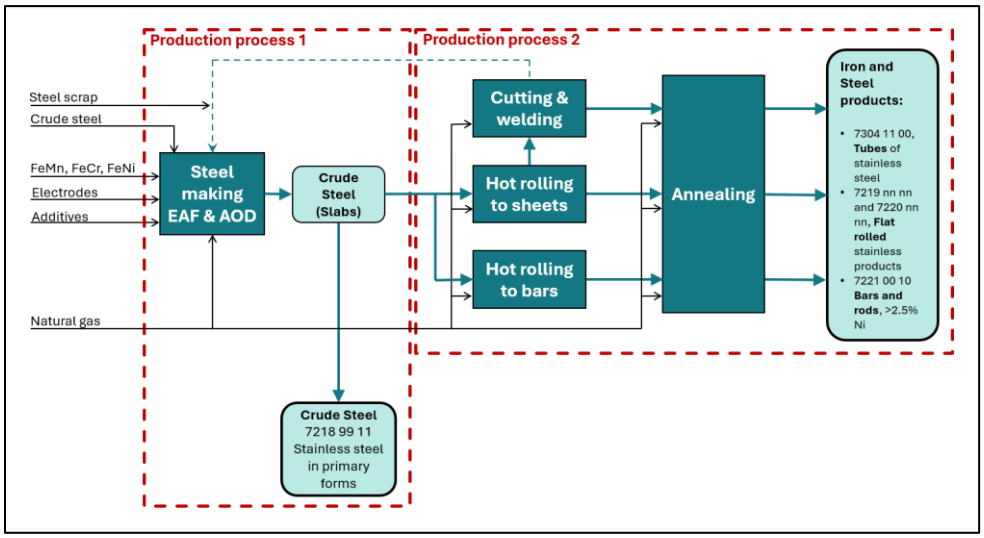


Figure 5-20: shows an example installation producing high-alloy steel from EAF route – source streams relevant for direct emissions monitoring with a calculation-based approach.

Direct emissions arise from the combustion of fuels (natural gas) and from process emissions from graphite electrodes, other additives and from releases of carbon contained within the different iron and steel materials.

The third diagram (Figure 5-21) below provides a complete monitoring approach for all source streams, for the example installation.

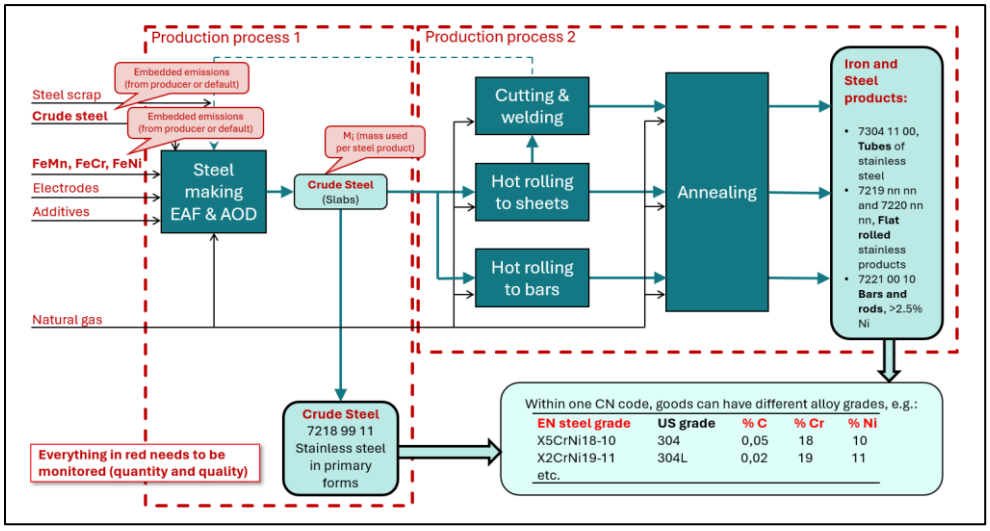


Figure 5-21: shows an example installation producing high-alloy steel via the EAF route – complete monitoring approach. All information in red font needs monitoring.

In the iron and steel example 1 (see section E5.2.13.1), a joint production process approach is used, as all precursors produced by the installation are wholly used in the production of the finished iron and steel goods. However, this approach is not available to the operator in this example, as some of the crude stainless-steel precursor produced by production process 1 is diverted and is sold before it reaches production process 2. Therefore, specific embodied emissions have to be separately derived for each production process at this installation.

The inputs and outputs highlighted in red text in table 5-21 are the parameters that should be monitored by the operator in order to attribute emissions and determine specific embodied emissions for both processes. Monitoring encompasses both aspects, quantitative (activity data) and qualitative (calculation factors). In the case of purchased precursors, it includes the specific embodied emissions.

As in example 1 (see section E5.2.13.1), given the complexity of the installation and different source streams and material flows, the mass balance method is used to give a complete balance of the amount of carbon entering and leaving the installation. In applying this method, the CO2 quantities relevant for each source stream are calculated based on the carbon content (CC) in each material, without distinguishing fuels and process materials. Non-emitted carbon leaving the installation in products instead of being emitted is also taken into account by defining output source streams, which have negative activity data, highlighted in red text in table 5-16 below.

Consumption levels	AD (t)	CC	EF	NCV (GJ/t)	Emissions (tCO_2) Factor	Assumptions/ comments

					3.664	
Steel scrap (market)	1,345,000	0.08%			3,942.5	Converted to CO_2
Natural gas	163,806		56.1	48	441,096.9	IPCC values; EF as tCO_2/TJ
Graphite electrodes	4,468	81.9%			13,407.6	IPCC values
Various additives	89,360		0.45		40,212.0	Limestone, others omitted; EF (tCO_2/t)
Crude steel (purchased)	80,540	0.15%			442.6	
FeNi (28% Ni)	346,773	1.5%			19,058.6	
FeCr (52% Cr)	331,213	5.2%			63,105.4	
FeMn (31% Mn)	60,595	2.8%			6,216.6	
Sum					**587,482.3**	
Carbon in outputs	AD	CC			**Emissions (negative)**	
Steel	-2,140,000	0.180%			-14,114	Steel AL is net of scrap (i.e. scrap deducted)
Slags	-107,232	0.030%			-118	
Sum					**-14,232**	
Total direct emissions of the installation					**573,251**	**tCO_2/year**

Table 5-16: shows an EAF installation and example consumption levels – mass balance method.

In table 5-16 above, the carbon content (CC) of different input and output source streams is converted to the CO_2 equivalent and total direct emissions, net of carbon contained in the outputs (steel and slag from the process) is calculated.

The next table 5-17 below summarises firstly the activity levels of the two production processes. Secondly, it shows how natural gas emissions are attributed to process 2. Energy and emissions data are calculated using the specific energy consumption (SEC) values for bars, sheets and pipes. The balance of direct emissions are then attributed to production process 1, in the lower part of the table.

Production levels	**Tonnes**	**EAF/AOD and (Hot) rolling energy consumption**	**Comment**
		Natural gas GJ/t	
Slabs	2,234,000	0.31	**Process 1** – tonnes produced, EAF
Slabs to	1,007,000		

market			
Bars to market	456,000	5.4	**Process 2** – SEC values used to attribute energy and emissions.
Sheets	771,000	4.45	**Process 2** – SEC values used to attribute energy and emissions.
Sheets to market	221,000		
Sheets to pipes	550,000		
Pipes	456,000	2.8	**Process 2** – SEC values used to attribute energy and emissions.
Scrap (internal recycling)	94,000		Scrap from sheet to pipe conversion (cut-off steel).
Split of emissions		**Direct Emissions (tCO_2)**	
Process 1 (EAF / AOD)		171,005	
Process 2 (rolling etc.)		402,245	
Total		**573,251**	

Table 5-17: shows an EAF installation and example calculation of embodied emissions by production process and product. Note: SEC = Specific energy consumption.

No embodied emissions are attributed to steel scrap from production process 2, which is recycled internally to process 1.

Using the data on the allocation of attributed emissions between the two production processes, in table 5-17, above, specific embodied emissions are then calculated for each CBAM product in the following two tables, for direct emissions. At this stage, the embodied emissions of precursors (purchased steel and alloys in process 1, crude steel in process 2) have to be added.

Table 5-18 below calculates embodied emissions for crude steel slabs. At this point, embodied emissions of precursors are required. In the example it is assumed that the installation is situated in the United States (USA), and the production takes place in the year 2027. All precursors are assumed to be received from US installations, but no verified emissions reports are available. Consequently, the default value for the purposes of CBAM needs to be looked up. Data used in these calculations are:

- Emissions at the installation for process 1 – determined above;
- Embodied emissions of precursors consumed by process 1 - calculated below, for precursors crude steel and alloys purchased;
- The Activity Level for crude steel slabs in the monitoring period. The activity level is the sum of sold slabs and slabs used in process 2.

Precursors		Emission intensity (tCO_2e/t)	Consumption (t)	Direct em. (tCO_2)	
Crude steel	CN 72189110 – Semi-finished products of stainless steel, of rectangular "other than square" cross section, containing by weight >= 2,5% nickel	3.864	80,540	311,207	
FeNi (28% Ni)	CN 720260 – Ferro-nickel	4.176	346,773	1,448,124	
FeCr (52% Cr)	CN 72024110 – Ferro-chromium, containing by weight > 4% but <= 6% carbon	2.280	331,213	934,021	
FeMn (31% Mn)	CN 72021120 – Ferro-manganese, containing by weight > 2% carbon, with a granulometry <= 5 mm and a manganese content by weight > 65%	2.028	60,595	122,887	
Activity Level for process 1 (slabs)				2,234,000	
Emissions at installation					171,005
Embodied emissions of precursors consumed (from totals above)					2,816,238
Total embodied emissions					2,987,243
Specific embodied emissions (tCO_2e/t slab)					**1.337**

Table 5-18: shows an EAF installation and example calculation of total embodied emissions – process 1 (crude steel/slabs).

The calculation for process 2 could be done in a similar way as for process 1. However, for the sake of guidance, table 5-19 below presents the calculation of embodied emissions for complex goods (iron or steel products) by way of using embodied emissions and specific attributed emissions of the 2nd process, i.e. by omitting the activity level and total emissions of the 2nd production process.

Total tonnes produced:		
Bars to market	456,000	t
Sheets to market	221,000	t
Pipes	456,000	t
Total steel products	**1,133,000**	t
Consumption precursor (slabs)	**1,227,000**	t
Mass slabs (crude steel) consumed per t:	**1.083**	t / t
		Direct (tCO_2)
Mass ratio (Mi) precursor	1.083	
Emissions intensity i of precursor		1.337
Emissions per tonne product process 2		0.355
Emission intensity (tCO_2e / t steel product)		**1.783**

Table 5-19: shows an EAF installation and example calculation of embodied emissions of complex goods process 2 – steel products.

When calculating the total embodied emissions of final steel products in process 2 above, the **mass ratio (*Mi*)** of the precursor is taken account. This is the mass of crude steel slabs consumed per tonne of steel products produced, and is calculated as:

- Mass slabs/mass steel products: 1,227,000 / 1,133,000 = **1.083** (as above). The *emissions intensity i* values of the precursor are then adjusted by this ratio i.e.:
- For *emissions intensity i* direct (precursor): 1.337 x 1.083 = 1.448.

Total direct embodied emissions of the complex steel product are then calculated, as above.

E5.2.13.3 Example 3 – production of screws and nuts from purchased steel rods

This is an example typical for many non-integrated manufacturing of steel products, which may be similarly applicable in other sectors such as aluminium production. In this example, the installation purchases precursors that contribute the majority of the embodied emissions, while its own process contributes little to the total embodied emissions.

For the example it is assumed that the installation purchases steel rods of

two qualities (both covered by CBAM themselves):

- Carbon steel rods with the embodied emissions as determined in Example 1;
- Stainless steel rods with embodied emissions as determined in Example 2.

The production process involves:

- Hot rolling of the rods to wires of different diameters;
- Cutting and forging of the wires to screws;
- Cutting and forging of wires following by drilling/machining to nuts.

These processes consume natural gas: therefore, the installation itself has direct emissions. However, the majority of the embodied emissions stem from the precursors. As the process involves cutting and machining, significant amounts of scrap are produced. In line with the rules of the force of law notice, the scrap is attributed zero embodied emissions. Because of the production of scrap, the weight of the precursor used exceeds the weight of the final products. The factor m_i is > 1.

In the example installation, only one aggregated goods category is produced (screws and nuts of different alloy grades), but due to the different steel grades, the products fall under different CN codes and, therefore, must be reported separately. Table 5-20 below shows the two groups of products which should be addressed in separate production processes:

Process	CN code	Descriptions
1	73181290	Wood screws of iron or steel other than stainless (excl. coach screws)
	73181491	Spaced-thread screws of iron or steel other than stainless
	73181499	Self-tapping screws of iron or steel other than stainless (excl. spaced-thread screws and wood screws)
	73181558	Screws and bolts, of iron or steel other than stainless "whether or not with their nuts and washers", with slotted or cross-recessed heads (excl. wood screws and self-tapping screws)
	73181568	Hexagonal-socket head screws and bolts, of iron or steel other than stainless "whether or not with their nuts and washers" (excl. wood screws, self-tapping screws and screws and bolts for fixing railway track construction material)
2	73181210	Wood screws of stainless steel (excl. coach screws)

	73181410	Self-tapping screws, of stainless steel (excl. wood screws)
	73181552	Screws and bolts, of stainless steel "whether or not with their nuts and washers", with slotted or cross-recessed heads (excl. wood screws and self-tapping screws)
	73181562	Hexagonal-socket head screws and bolts, of stainless steel "whether or not with their nuts and washers" (excl. wood screws, self-tapping screws and screws and bolts for fixing railway track construction material)

Table 5-20: shows the two groups of products in this worked example which should be monitored separately.

Therefore, the operator must determine two separate average values for annual direct emissions (i.e. for each of the two production processes). This is aligned with the fact that the percentages of scrap are different for the two main product groups, and because the quantities produced are different.

Table 5-21 below shows the data that the operator has to monitor (input and output quantities, energy consumption, consumption of precursors, specific embodied emissions of the precursors obtained from their producers).

Table 5-22 below presents the calculation of specific embodied emissions of the two product groups, where the installation's own specific emissions are added to the embodied emissions of the precursors. To calculate the specific embodied emissions, Equation 53 from the force of law notice is used. Therefore, the emissions embodied in precursor carbon steel (1.567 tCO_2/t in the example 1) are multiplied by the specific mass consumption of precursor carbon steel, m_i (1.176 in the example 2, as calculated in Table 5-21 below). The same approach is used for precursor high-alloy steel.

Precursors:	Emissions intensity direct (tCO_2e/t)			
Carbon Steel (see Example 1)	1.567			
High alloy steel (see Example 2)	1.783			
Products:	Activity level (t product/yr)	consumed quantity (t steel/yr)	scrap produced (t/yr)	m_i (t precursor/t product)
Carbon steel	17,000.00	20,000.00	3,000.00	1.176

screws and nuts				
High alloy steel screws and nuts	8,200.00	10,000.00	1,800.00	1.220
Energy consumed (average for both products)			Emission factor	
Natural gas (heating, forging)	3.5	GJ/t product	56.1	tCO_2/TJ

Table 5-21: shows an example installation No.3 and the main inputs and outputs.

	Emissions intensity (tCO_2e/t)	*Mi* (t/t)	Emissions Intensity (tCO_2e/t product)
Precursor: carbon steel	1.567	1.176	1.843
Direct emissions (natural gas)			0.196
Total emissions intensity (carbon steel screws and nuts)			**2.039**
Precursor: High alloy steel	1.783	1.220	2.175
Direct emissions (natural gas)			0.196
Total emissions intensity (high alloy steel screws and nuts)			**2.371**

Table 5-22: shows an example installation No.3 and calculation of specific embodied emissions.

E5.3 Fertilisers sector

E5.3.1 Unit of production and emissions intensity

The quantity of nitrogen containing fertiliser sector CBAM goods imported into the UK must be expressed using the functional unit applicable to the relevant fertiliser CBAM good (i.e. kilograms of nitrogen content or the relevant supplementary units, as applicable). The operator must monitor the quantity of CBAM goods produced by installation or production process, for the purposes of calculating the emissions intensity values.

Table 5-23 below outlines important parameters for this CBAM goods sector.

Industrial sector	**Fertilisers**
Production unit of goods	The quantity of goods produced in Tonnes (metric), classified under the same CN code, produced by the installation or production process

	In the case of fertilisers and fertiliser goods, the functional unit is the quantity of nitrogen contained in the goods produced, in kilograms, classified under the same CN code
Associated activities	Producing chemical precursors for nitrogenous fertiliser production, producing nitrogenous fertilisers by physical mixing or chemical reaction, and processing into their final form
Relevant greenhouse gas emissions	Carbon dioxide (CO_2) and nitrous oxide (N_2O)
Direct Emissions	Tonnes (metric) of CO_2e
Unit for emissions intensity	Tonnes CO_2e emissions per functional unit, and per each composition of the goods, reported separately for each type of CBAM good, by the installation or production process
Unit for embodied emissions	Tonnes (metric) of CO_2e per tonne of CBAM goods

Table 5-23: shows the key elements that are representative of the fertilisers CBAM goods sector.

For certain goods, the imported quantities need to be converted to standardised tonnes that are subsequently used for calculating the CBAM obligation. For example, for nitric acid, hydrous solutions of ammonia and nitrogen-containing fertilisers, there will be a need to explicitly state the reference concentration/nitrogen content (and form of nitrogen). Equations 57 and 58 from the force of law notice show how to calculate the emissions intensity value as both tCO_2e per tonne of product and tCO_2e per functional unit respectively.

Emissions must be monitored in metric tonnes CO_2 equivalent (tCO_2e) emissions per functional unit, and per each composition of the goods. The functional unit is defined by default as “the quantities of goods produced in tonnes classified under the same CN code”, meaning that in most cases emissions intensity values will be reported in metric tonnes of CO_2 equivalent (tCO_2e) emissions, per tonne of goods produced. However, there is an exception for fertilisers, and in these cases the functional unit is defined in terms of the content of nitrogen, in kilograms. The reason for this is that the functional unit must be defined in terms of functionality or performance of the product, in particular if they are proportional to a specific parameter of the goods. In the case of fertilisers, nitrogen is the active component that determines the performance of the fertiliser, and it is correlated to the embodied emissions of the product. This figure should be calculated for the specific installation or production process.

Note that case studies showing how emissions intensity values are derived for the mixed fertiliser production process, and how the embodied emissions of imports into the UK are calculated, are given in section

E5.3.10.1 and section E5.3.10.2.

The following sections set out how the system boundaries of fertiliser sector goods should be defined and identify elements of the production process that should be included for the purposes of monitoring and reporting in the operator's emissions report, for submission to the verifier.

E5.3.2 Definition and explanation of sector CBAM goods covered

Table 5-24 below shows the relevant goods in scope of CBAM in the fertilisers sector.

Aggregated goods category	CN Code	Description
Nitric acid	2808 00 00	Nitric acid; sulphonitric acids
Ammonia	2814	Ammonia, anhydrous or in aqueous solution
Mixed fertilisers	2834 21 00	Nitrates of potassium
	3102 (Except: 3102 10)	3102 - Mineral or chemical fertilisers, nitrogenous, Except: - Except 3102 10 (Urea)
	3105 (Except: 3105 60)	Mineral or chemical fertilisers containing 2 or 3 of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; goods of this chapter in tablets or similar forms or in packages of a gross weight not exceeding 10 kg. - Except: 3105 60 - Mineral or chemical fertilisers containing the 2 fertilising elements phosphorus and potassium
Urea	3102 10	Urea, whether or not in aqueous solution

Table 5-24: compares CBAM goods in the fertilisers sector.

The aggregated goods categories listed in table 5-24 above include both finished nitrogenous fertiliser goods and chemical precursor goods (intermediate products) that are consumed in the production of fertiliser.

Only input materials listed as relevant precursors to the system boundaries of the production process as specified in the system boundaries document are to be considered. Table 5-25 below shows the precursors by aggregated goods category and production route.

Aggregated Goods Category	Relevant precursors

Production route	
Ammonia Haber Bosch with steam reforming Haber Bosch with gasification	Hydrogen, if separately produced for use in the process
Nitric Acid	Ammonia (as 100% ammonia)
Urea	Ammonia (as 100% ammonia)
Mixed fertiliser	If used in the process: ammonia (as 100% ammonia), nitric acid (as 100% nitric acid), urea, mixed fertilisers (in particular salts containing ammonium or nitrate)

Table 5-25: shows aggregated goods categories their production routes and possibly relevant precursors.

For the production of mixed fertiliser, not all precursors will apply in every case. Note in particular that in some instances an aggregated goods category (mixed fertiliser itself) may be used as a precursor for its own category, depending on the final formulation of the mixed fertiliser product required.

The final nitrogenous chemical fertiliser goods produced from the relevant precursors (in bulk in integrated plants) are defined as complex goods as they include the embodied emissions from relevant precursor goods.

The production of fertiliser sector goods is by a number of different process routes, outlined below.

E5.3.3 Definition and explanation of relevant production processes and routes

The system boundaries of chemical precursors and fertilisers are distinct and may, under certain conditions, be added together to include all processes directly or indirectly linked to the production processes for these goods, including input activities to the process, and output activities from the process.

Figure 5-22 below shows an overview of the different processes and process routes for the production of nitrogenous fertiliser and its relevant precursors.

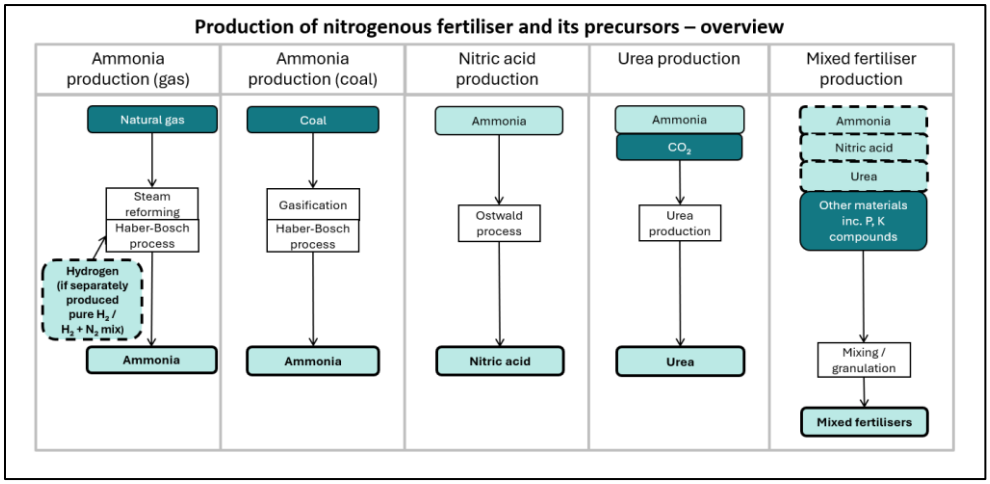


Figure 5-22: shows an overview of an example of the system boundaries and value chain for the production of nitrogenous fertiliser and its precursors.

Urea is used as a precursor in mixed fertiliser production but may also be used as a convenient fertiliser on its own due to its high nitrogen content.

Mixed fertilisers comprise all kinds of nitrogen (N) containing fertilisers, including ammonium nitrate, calcium ammonium nitrate, ammonium sulphate, ammonium phosphates, urea ammonium nitrate solutions, as well as nitrogen-phosphorus (NP), nitrogen-potassium (NK) and nitrogen-phosphorus-potassium (NPK) fertilisers falling under the “Mixed fertilisers” aggregated goods category.

The relevant emissions that must be monitored for the fertilisers sector are detailed in section E5.3.9.1.

E5.3.4 Ammonia – Haber-Bosch with steam reforming production route

Ammonia is synthesised from nitrogen and hydrogen via the Haber-Bosch process. Hydrogen for the process is obtained in this production route by steam reforming natural gas (or biogas) whilst nitrogen is obtained from the air. The overall reaction is highly endothermic, and process heat is supplied by the combustion of natural gas or other gaseous fuel. Any carbon monoxide produced is almost all converted to carbon dioxide. The production of hydrogen is typically fully integrated in the process, so it is unfeasible to distinguish a separate production process of hydrogen. On some occasions, hydrogen produced from other separated production processes can also be used and its embodied emissions shall be accounted for.

Section 3.9.1(a) of the system boundaries document defines the system boundaries for emissions monitoring for the Haber-Bosch process with steam reforming production route, as encompassing:

- all processes directly or indirectly linked to the production process, and from flue gas cleaning;
- all fuels shall be monitored, irrespective of whether used as energetic or non-energetic input;
- where biogas is used, the provisions of the section entitled 'Criteria for zero-rating of biomass emissions' in the force of law notice (ODT, 344KB) shall be taken into account.

A relevant precursor is separately produced hydrogen, if used in the process.

In line with the above definition of system boundaries, the following production steps are included within the system boundaries of the Haber-Bosch with steam reforming process:

- Production of hydrogen by steam reforming natural gas or biogas;
- Synthesis of ammonia – from hydrogen and nitrogen, at high temperature and pressure in the presence of a catalyst; ammonia condensation, purification and storage (if applicable);
- Emissions control – for treating releases to air, water or ground.

The stream of carbon dioxide from the production of ammonia is of high purity and can be separated, captured and transferred elsewhere for other uses for example for urea production.

Note that the ammonia produced is reported as 100% ammonia, whether in hydrous or anhydrous form.

E5.3.5 Ammonia – Haber-Bosch with gasification production route

With this production route, hydrogen is obtained by the gasification of hydrocarbons, typically from heavy feedstocks such as coal, heavy refinery fuels or other fossil feedstock. A synthesis gas containing hydrogen is produced, which has to be purified before it can be used for the next production step. Ammonia is then synthesised from the hydrogen produced and from nitrogen obtained from the air, at high temperature and pressure in the presence of a catalyst. Any carbon monoxide produced is almost all converted to carbon dioxide. The production of hydrogen is typically fully integrated in the process, so it is unfeasible to distinguish a separate production process of hydrogen. On some occasions, hydrogen produced from other separate production processes can also be used and its embodied emissions must be accounted for.

Section 3.9.1(b) of the system boundaries document defines the system boundaries for emissions monitoring for the Haber-Bosch process with gasification production route, as encompassing:

- all processes directly or indirectly linked to the production process, and from flue gas cleaning;

- each fuel input shall be monitored as one fuel stream, irrespective of whether it is used as energetic or non-energetic input.

A relevant precursor is separately produced hydrogen, if used in the process.

In line with the above definition of system boundaries, the following production steps are included within the system boundaries of the Haber-Bosch with gasification process:

- Production of hydrogen by gasification (partial oxidation);
- Synthesis of ammonia – from hydrogen and nitrogen, at high temperature and pressure in the presence of a catalyst; ammonia condensation, purification and storage (if applicable);
- Emissions control – for treating releases to air, water or ground.

Note that the ammonia produced is reported as 100% ammonia, whether in hydrous or anhydrous form.

E5.3.6 Nitric acid (and sulphonitric acids) production process

Nitric acid is mostly produced via the oxidation of ammonia by the Ostwald process. Ammonia is first oxidised in the presence of a catalyst to form nitrogen oxide, which is then further oxidised to nitrogen dioxide, followed by absorption in water in an absorption tower to form nitric acid. The reaction is exothermic and heat and power may be recovered to the process.

Section 3.8 of the system boundaries document defines the system boundaries for emissions monitoring for the nitric acid production route, as encompassing:

- all processes directly or indirectly linked to the production process, and from flue gas cleaning;
- all sources emitting nitrous oxide (N_2O) from the production process, including unabated and abated emissions. Any N_2O emissions from the combustion of fuels are excluded from monitoring.

A relevant precursor is ammonia (as 100% ammonia).

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of the nitric acid process production:

- Raw material preparation – evaporation and filtration of ammonia and process air;
- Oxidation of ammonia – to nitrogen oxide, all process steps;
- Further oxidation and absorption – to nitrogen dioxide and absorption in water to form nitric acid, all process steps;
- Emissions control – for treating releases to air, water or ground.

Note that nitric acid produced is reported as 100% nitric acid.

E5.3.7 Urea production process

Urea is synthesised by reacting ammonia and carbon dioxide together at high pressure, to form ammonium carbamate, which is then dehydrated to form urea.

Section 3.11 of the system boundaries document defines the system boundaries for emissions monitoring for the urea production route, as encompassing:

- all processes directly or indirectly linked to urea production, and from flue gas cleaning;
- where CO_2 is received from another installation as a process input, the amount of CO_2 used as a process input shall be considered an embodied emission in the imported urea.

A relevant precursor is ammonia (as 100% ammonia).

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of the urea production process:

- Raw material preparation – evaporation and filtration of ammonia, CO_2;
- Production of urea – all process steps, from synthesis to particle formation;
- Emissions control – for treating releases to air, water or ground.

The ammonia and CO_2 consumed by this production process are usually delivered from other production processes on the same site.

E5.3.8 Mixed fertilisers production process

A wide range of operations are included in the production of all kinds of nitrogen containing mixed fertilisers (especially ammonium salts and NP, NK and NPK), such as mixing, neutralisation, particle formation (such as by granulation or prilling), irrespective of whether only physical mixing or chemical reactions take place.

Section 3.10 of the system boundaries document defines the system boundaries for emissions monitoring for the mixed fertilizer production route, as encompassing:

- all processes directly or indirectly linked to the production process, such as driers and for heating input materials, and from flue gas cleaning.

Relevant precursors (if used in the process) are ammonia (as 100% ammonia); nitric Acid (as 100% nitric acid); urea; mixed fertilisers (in particular salts containing ammonium or nitrate).

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of the mixed fertiliser production process:

- Raw material preparation;
- Production of mixed fertilizer – all process steps;
- Emissions control – for treating releases to air, water or ground.

A case study showing how emissions intensity values are derived for the mixed fertiliser production process, and how the embodied emissions of imports into the UK are calculated, is given in section E5.3.10.1.

E5.3.9 Sector-specific requirements for monitoring and reporting

Emissions intensity values should be monitored in line with the methodology set out in the force of law notice and outlined in the following section of this guidance document.

E5.3.9.1 Emissions monitoring

Relevant emissions that must be monitored for the fertiliser sector are:

- Carbon dioxide emissions (direct) from the fuel combustion process, from stationary plants only (excludes emissions from any mobile plant such as vehicles);
- Carbon dioxide and nitrous oxide (N_2O) emissions (direct) from the process, in particular:
  - N_2O emissions from the catalytic oxidation of ammonia and/or from the NO_X/N_2O abatement units (but not from combustion);
  - Under certain conditions CO_2 transferred from the production process for ammonia to other installations. However, CO_2 consumed in the production of urea has to be considered as being emitted at the installation, as it does not comply with the requirements for permanently chemically bound CO_2;
- Carbon dioxide emissions (direct) resulting from the production of measurable heating (for example steam) and cooling that is consumed within the system boundaries of the production process, regardless of the location of the production of the heat (i.e. from on-site generation or from imports from off-site);
- Carbon dioxide emissions (direct) resulting from emissions control (for example from carbonate raw materials such as soda ash used for acidic flue gas cleaning). This is included for any good where this is applicable.

Direct emissions from the different source streams above are not reported separately but are added together to result in the total relevant emissions for the installation or production process.

Note that other N_2O emissions resulting from the combustion of fuels are excluded from the system boundaries.

E5.3.9.2 Additional rules

E5.3.9.2.1 Functional unit and attribution of emissions for mixed fertilisers

For fertiliser goods whose functional units are kilograms of nitrogen content and that are sold in different ranges of composition, the operator will need to calculate the emissions intensity values of the goods according to the nitrogen contained in the goods averaged for each range of composition, using the following equation from the force of law notice.

$$EI_{g(Ni)} = EI_g \times N_i$$

Where:
$EI_{g(Ni)}$ is the emissions intensity of the goods with nitrogen content N_i;
EI_g is the emissions intensity calculated in Equations 46 or 53;
N_i is the average nitrogen content of the goods within a range of composition in kilograms (Kg) of nitrogen per tonne of goods.

Note that for goods whose functional units are kg of nitrogen content, and that are sold in custom-made compositions at the request of the client, the operator is required to issue a declaration of nitrogen content for each consignment and with the calculation of emissions intensity values according to the correspondent Equation 57, where N_i will be the specific nitrogen content of the consignment.

In the fertiliser sector, for installations producing CBAM goods where different functional units apply and are produced with the same precursor goods, where the type, quantity and proportions of the CBAM goods are the same substance, and the only difference is in terms of their concentration, the operator must determine a single multifunctional production process. This means that CBAM goods under different commodity codes can be monitored in the same production process and be attributed the same emissions intensity values.

If a chemical substance under the aggregated goods categories of fertilisers is produced as co-product of a multifunctional process, the operator must attribute emissions among the chemical substances based on molar ratio using Equation 34 from section G.2.1 of the force of law notice.

E5.3.9.2.2 Measurable heat produced from exothermic chemical processes

Where an installation consumes measurable heat produced/recovered from an exothermic chemical process other than combustion, such as in the production of ammonia or nitric acid, the amount of recovered heat consumed is determined separately from other measurable heat and is assigned zero CO_2 emissions.

E5.3.9.2.3 Production of electricity

If electricity is produced within the production process, a correction to the attributed emissions has to be made. Where the electricity stems from processes without combustion (for example expansion turbines in ammonia production), the emission factor of that electricity is considered zero.

E5.3.9.2.5 Measurement-based approach for monitoring N_2O emissions

Where there are N_2O emissions from the process (not from combustion) in the fertiliser sector, the operator must monitor these using a Continuous Emission Measurement System (CEMS) installed at a suitable measurement point and use a measurement-based methodology for monitoring purposes. N_2O emissions are only regarded relevant for monitoring in the production of nitric acid. However, where nitric acid or the resulting nitrates (mixed fertilisers) are used as precursor, the related N_2O emissions form an integral part of the embodied emissions, which are expressed as tCO_2e:

$$CO_{2(e)}[t] = N_2O_{annual}[t] \times GWP_{N2O}$$

Where:
N_2O_{annual} is the total annual N_2O emissions, calculated as in section B.6.2 of the force of law notice (ODT, 344KB)
GWP_{N2O} is the Global Warming Potential of N_2O (tCO_2e/tN_2O).

This equation can be found in section B.6.2.4 of the force of law notice (ODT, 344KB).

For determining the flow rate of the flue gas, the force of law notice (ODT, 344KB) states that the mass balance method as mentioned in section B.6.2.5 is preferred overflow measurements.

E5.3.9.3 Additional reporting requirements

Table 5-26 below shows the additional information that should be provided by as an operator to importers, in their emissions data communication to them.

Aggregated good category	Reporting requirement
Ammonia	• Concentration, if hydrous solution • Content of N
Nitric acid	• Concentration (mass %) • Content of N
Urea	• Purity (mass % urea contained, % N contained) • Content of N
Mixed fertilisers	• Content of different forms of nitrogen in mixed fertiliser • Content of N as ammonium (NH_4^+) • Content of N as nitrate (NO_3^-) • Content of N as Urea; Content of N in other (organic) forms • Content of N total

Table 5-26: compares additional fertiliser sector parameters required in the operator's emissions report.

The operator needs to ensure that they collect all the parameters necessary for their CBAM goods and include this data in the operator's emissions report.

E5.3.10 Worked examples for the fertiliser sector

E5.3.10.1 Worked example 1 for the fertiliser sector

The following worked example shows how emissions intensity values expressed relative to the functional unit (kilograms of nitrogen contained with the good) are derived for a particular mixed fertiliser grade, NPK 15-15-15, produced by mixing and granulation.

Figure 5-23 below shows an outline view of the installation and shows the system boundaries as a hatched line for the single production process. The physical units carrying out the production process have been grouped under 'Granulation with Pipe reactor' (including an assumed dryer using natural gas) and the inputs and outputs and sources of emissions have been identified.

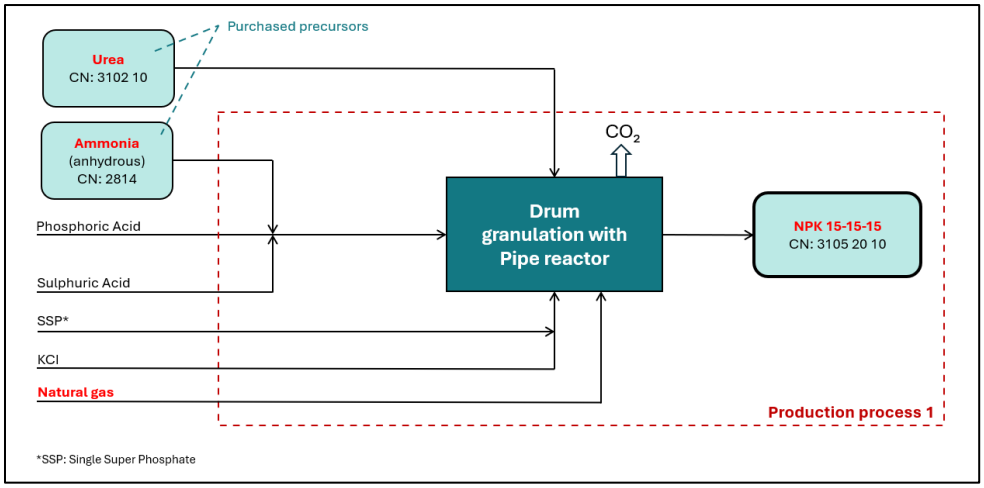


Figure 5-23: shows an overview of an example of fertiliser and a complete monitoring approach for the production of a mixed fertiliser grade – NPK 15-15-15.

Inputs into the production process are raw materials and purchased precursor goods urea and ammonia (anhydrous). Outputs are mixed fertiliser product.

The inputs and outputs highlighted in red text above are the parameters that would need to be monitored by the operator in order to attribute emissions and determine the emissions intensity value relative to the functional unit for the production process.

The relevant emissions that are monitored result from natural gas used in the dryer.

The inputs of precursors (with their emissions intensity values) and the activity level of the mixed fertiliser goods produced also need to be monitored.

A single mixed fertiliser production process can make a wide range of different fertiliser grades (or formulations) using different quantities of precursor. In accordance with paragraph A.5(2) from the force of law notice (ODT, 344KB), a multifunctional production process must be defined when different CBAM fertiliser goods are produced from the same precursor, the type, quantity and proportions of the CBAM good are the same substance the same, but the only difference is their concentration. For example, solid fertilisers under different CN codes with ammonium nitrate content exceeding 80% by weight, with varying percentages of phosphorus and/or potassium content, must be monitored under a multifunctional production process.

The following needs to be monitored:

- The relevant mass of each precursor used over the monitoring period;

- The production 'recipe' of each mixed fertiliser grade (or an analysis of the final product);
- The emissions intensity values of the precursors used to make a given mixed fertiliser grade.

Assuming that the granulation and drying process is similar for all produced fertiliser grades, the relevant emissions of the production process can be monitored over the full monitoring period and then divided by the total activity level of the process, i.e. the total amount of all fertilisers produced in the monitoring period. This gives the value of energy per tonne of fertiliser as used in the calculation in table 5-27 below. If the production process is not similar for all of the produced fertiliser grades, then emissions will need to be monitored separately.

The emissions intensity values are first calculated per functional unit (kg N used in the monitoring period) and then converted into emissions intensity values per tonne of (mixed) fertiliser using equation 57 of the force of law notice (as shown in section E5.3.9.2.1). The production year for both the precursors and the actual production is assumed to be 2026. In this example, default values are used for the precursor goods. Table 5-27 below sets out the process by which the final emissions intensity value for the mixed fertiliser product NPK 15-15-15 is determined.

The emissions intensity value for the mixed fertiliser product is calculated by combining the default emissions intensity values for the precursors and for energy needed for granulation, per tonne of product.

Precursor goods are NH_3 and urea. In order to determine the total emissions intensity value of the mixed fertiliser product, the amount (kg) of each precursor used per tonne of mixed fertiliser product is taken into account, for example for urea the total input mass of precursor per tonne of product is 160kg:

- ammonia (NH_3) emissions intensity value: 0.093t/t x 2.273 tCO_2e/t = 0.211 tCO_2e/t mixed fertiliser product;
- urea emissions intensity value: 0.160 t/t x 1.545 tCO_2e/t = 0.247 tCO_2e/t mixed fertiliser product.

Inputs	**Input mass**	**Precursor emissions intensity values (tCO_2e/t)**	**Total emissions intensity value (tCO_2e/t)**
	(kg/t)		
KCl	251.3	n.a.	n.a.
SSP 17% P_2O_5	200.0	n.a.	n.a.
Phosphoric acid (40% P_2O_5)	300.0	n.a.	n.a.
Sulphuric acid (96 wt-%)	116.0	n.a.	n.a.
NH_3	93.0	2.273	0.211

Urea	160.0	1.545	0.247
Energy needed for granulation (average of monitoring period)			0.018
Total emissions intensity value for mixed fertiliser product NPK 15-15-15			0.476
Total emissions intensity value expressed per functional unit, i.e. t CO_2e/kg N			0.00317

Table 5-27: shows the calculations of the emissions intensity value for NPK 15-15-15 mixed fertiliser.

Relevant emissions arising from the mixing and granulation production process must also be included, as shown in table 5-27 above per tonne of product.

Other chemical raw material inputs (KCI, SSP, phosphoric and sulphuric acids) do not have embodied emissions and do not need to be taken into account.

In order to achieve the value for the total emissions intensity expressed per functional unit (i.e. tCO_2e/kg N), equation 57 from the force of law notice can be used (as shown in section E5.3.9.2.1). The average nitrogen content in the NPK 15-15-15 mixed fertiliser is 15%, so, taking the emissions intensity value of the final CBAM good (0.476 tCO_2e/t) / 150 kg N per tonne of CBAM good = 0.00317.

Note on calculation pathway: in the example above, only a single NPK formulation is produced. Therefore, it is simple to make all calculations per tonne of final fertiliser as presented above. However, if the installation produced many different NPK grades, the approach would be different:

- instead of the specific input of each fertiliser component (precursor and other inputs) expressed as kg/t, the table would have to contain the total amount of each component (in tonnes) used during the production year;
- as the activity level, the total amount of nitrogen contained in all produced NPKs would be calculated (expressed as kg N, not differentiating between ammonia and urea inputs);
- then an average emissions intensity value per NPK would be calculated, expressed as tCO_2e/ kg N;
- finally, for each NPK the embodied emissions per tonne would be calculated from the value per kg N and the N content.

E5.3.10.2 Worked example 2 for the fertiliser sector

This shows how emissions intensity values expressed relative to the functional unit (kilograms of nitrogen contained with the good) are derived

for another mixed fertiliser grade, Potassium Nitrate (KNO_3), produced from a joint production process with the precursor Nitric Acid.

Figure 5-24 below shows an outline view of the installation and shows the system boundaries as a hatched line for the single production process. The physical units carrying out the production process have been grouped under 'Chemical reaction' (including an assumed heating/combustion unit using natural gas) and the inputs and outputs and sources of emissions have been identified.

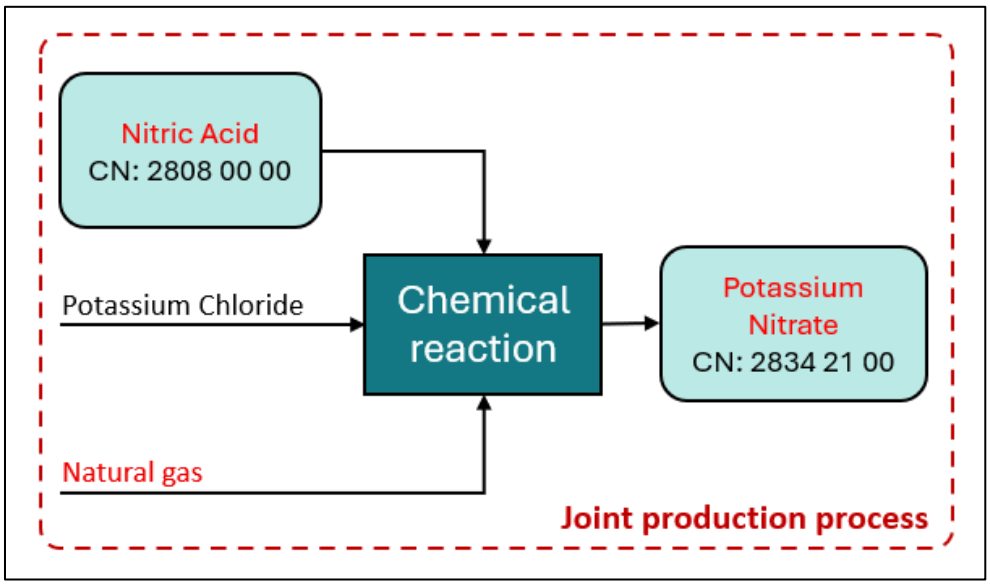


Figure 5-24: shows an overview of an example of fertiliser and a complete monitoring approach for the production of a mixed fertiliser grade – Potassium Nitrate (KNO_3).

Inputs into the production process are raw materials and the precursor good Nitric Acid. The output is Potassium Nitrate (KNO_3), under the aggregated goods category of mixed fertilisers (commodity code 2834 21 00).

The inputs and outputs highlighted in red text above are the parameters that would need to be monitored by the operator in order to attribute emissions and determine the emissions intensity value relative to the functional unit for the final product.

The relevant emissions that are monitored in this example result from the production of the precursor Nitric Acid, releasing nitrous oxide (N_2O), and the natural gas used to heat the chemical reaction for the production of the complex CBAM good Potassium Nitrate (KNO_3), releasing carbon dioxide (CO_2).

The calculation of the emissions intensity values is carried out following the steps in regulation 5 of the Carbon Border Adjustment Mechanism

(Emissions and Verification) Regulations 2026, as follows:

Step 1 – identify the relevant monitoring period:

- The relevant monitoring period is 2026.

Step 2 – use the verified emissions data from that monitoring period to identify the amount, in tonnes, of relevant emissions emitted by the installation during the monitoring period, in the production of that type of CBAM good:

- The CBAM good produced at the installation is Potassium Nitrate (KNO_3), listed under commodity code 2834 21 00, in the aggregated goods category of mixed fertilisers;
- Table 1c of the system boundaries document sets out the relevant greenhouse gases for goods produced under each commodity code in the fertilisers sector. The relevant greenhouse gases are carbon dioxide (CO_2) and nitrous oxide (N_2O);
- A joint production process has been defined in this case, because the precursor good produced at the installation (the nitric acid) is used to produce the complex CBAM good (Potassium Nitrate – CN code 2834 21 00, under the aggregated goods category of mixed fertilisers). This means that emissions can be calculated jointly for both of the CBAM goods;
- The operator has monitored their emissions for the period 1 January 2026 to 31 December 2026 in accordance with their monitoring plan, applying the monitoring provisions of section B of the force of law notice (ODT, 344KB). The details of their emissions monitoring are shown in Table 5-28 below.

	AD (t)	**NCV (GJ/t)**	**EF (tCO_2/t Or tCO_2/TJ)**	**Emissions from fossil fuels (tCO_2)**
Precursor emissions (tCO_2e)				
Nitric Acid (HNO_3)	62,500	n.a.	n.a.	[*25t N_2O*] 6,625
Mixed fertiliser Potassium Nitrate (KNO_3) emissions (tCO_2e)				
Natural gas	11,512.6	0.038	57.15	25,000
Total relevant emissions				**31,625**

Table 5-28: compares the relevant emissions for both the precursor good and mixed fertiliser potassium nitrate (KNO_3). Note that the figures used are illustrative and do not represent default emissions factors.

Step 3 – where amounts of relevant emissions identified in step 2 are not amounts of carbon dioxide, convert them into an amount of CO_2e.

- Since nitrous oxide is relevant under this commodity code, the N_2O

emissions must be converted to tCO_2e in accordance with regulation 8 of the Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. Nitrous oxide has a global warming potential of 265 tCO_2e per tonne of N_2O. So, since the process emitted 25t N_2O, this would be reported as 6,625 tCO_2e.

Step 4 – add together all amounts from steps 2 and 3 to produce a total amount of tCO_2e.

- The total amount of CO_2eemissions is 25,000 tCO_2 + 6,625 tCO_2e (from the N_2O) = 31,625 tCO_2e.

Step 5 – where precursor goods were used in the production of the CBAM good, add all precursor emissions to the amount from step 4. However, where a joint production process has been defined this step can be omitted.

- This step can be omitted because a joint production process has been defined. Note that if any nitrogen/precursor CBAM goods produced by the installation were to be diverted and separately sold, the operator would have to provide an emissions intensity value to the purchaser of the nitrogen goods. In order to do so, the operator would need to calculate separate emissions intensity values for both types of CBAM goods produced at the installation, and therefore the use of a joint production process would not be allowed. In such a case, the operator would need to update their monitoring plan accordingly.

Step 6 – identify the weight of the type of CBAM good produced by the installation during the monitoring period.

- In this step "weight" means the weight, in tonnes, determined in accordance with the system boundaries document, and the force of law notice. It means the total mass of the goods leaving the production process during the monitoring period measured in functional units and in tonnes of goods;
- Note that in the force of law notice this is referred to as "Activity Level";
- The definition of the functional unit for mixed fertilisers (nitrates of potassium), commodity code 2834 21 00 is the kilograms of nitrogen contained in the goods produced under the respective commodity code;
- The operator identifies the "weight" of mixed fertiliser produced by the installation between 1 January 2026 and 31 December 2026, expressed as kilograms of nitrogen contained in the fertiliser and tonnes of goods produced, by monitoring the activity level of the production process in accordance with the provisions of section E of the force of law notice (ODT, 344KB);
- The details of their calculated activity level, in functional units and in tonnes of goods are shown in table 5-29 below.

Potassium nitrate (KNO_3) production (tonnes)	100,000
Nitrogen to fertiliser ratio	13.9%
Functional unit (kilograms of nitrogen contained in the goods)	13,900,000

Table 5-29: shows the calculated activity level in functional units and in tonnes of goods.

Step 7 – divide the figure from step 4 or, where relevant, step 5 by the figure from step 6 to produce an amount tCO_2e emitted in the course of the production of a tonne of the type of CBAM good ("the emissions intensity"), rounded to five decimal places.

- The operator divides the figure from step 4 [31,625 tCO_2e] by the figure from step 6 [13,900,000 kilograms of nitrogen contained in the goods], to produce an emissions intensity of 0.00227518 tCO_2e/kg of nitrogen contained within the good. This can also be expressed as 2.27518 tCO_2e/t N;
- Because fertiliser can be sold in different ranges of composition, the operator will also need to calculate the emissions intensity of the goods according to the nitrogen contained in the goods averaged for each range of composition. The formula (equation 57) for this calculation is shown in section I.1.1(14) of the force of law notice (ODT, 344KB):

$$EI_{g(Ni)} = EI_g \times N_i$$

Where:
$EI_{g(Ni)}$ is the emissions intensity of the CBAM goods with nitrogen content N_i;
EI_g is the emissions intensity calculated in Equations 46 or 53;
N_i is the average nitrogen content of the CBAM goods within a range of composition in kilograms (Kg) of nitrogen per tonne of goods.

- Potassium nitrate contains 13.9% nitrogen, equivalent to 139 kg nitrogen per tonne of product. So, 0.0027518 tCO_2e/kg N x 139 kg N/t CBAM good = 0.31625 tCO_2e/t. Therefore, we can say that this process has given an emissions intensity value of 0.31625 tCO_2e/t Potassium Nitrate.

E5.4 Aluminium sector

E5.4.1 Unit of production and emissions intensity

The quantity of aluminium goods imported into the UK must be expressed in metric tonnes. The operator must record the quantity of CBAM good(s)

produced by the installation or production process, for the purposes of monitoring and reporting in the operator's emissions report, for submission to the verifier.

Table 5-30 below outlines important parameters for this CBAM goods sector.

Industrial sector	**Aluminium**
Production unit of goods	The quantity of goods produced in Tonnes (metric), classified under the same CN code, produced by the installation or production process
Associated activities	Producing unwrought aluminium from alumina, or secondary raw materials (aluminium scrap), by metallurgical, chemical or electrolytic means; manufacture of semi-processed and finished aluminium products
Relevant greenhouse gases	Carbon dioxide (CO_2) and perfluorocarbons (CF_4 and C_2F_6)
Direct Emissions	Tonnes (metric) of CO_2e
Unit for emissions intensity	Tonnes CO_2e emissions per functional unit, and per each composition of the goods, reported separately for each type of CBAM goods, by the installation or production process
Units for embodied emissions	Tonnes (metric) of CO_2e per tonne of CBAM goods

Table 5-30: shows the key elements that are representative of the aluminium CBAM goods sector.

Emissions should be reported in metric tonnes CO_2 equivalent (tCO_2e) emissions per tonne of output. This figure should be calculated for the specific installation or production process.

Note that a case study showing how emissions intensity values are derived for aluminium products, and how the embodied emissions of imports into the UK are calculated, is given in section E5.4.8.

The following sections set out how the system boundaries of aluminium sector goods should be defined and identify elements of the production process that should be included for the purposes of monitoring.

E5.4.2 Definition and explanation of sector goods covered

Table 5-31 below shows the relevant goods in scope of CBAM in the aluminium sector.

Aggregated goods category	**CN Code**	**Description**
Unwrought aluminium	7601	Unwrought aluminium

Aluminium products	7603	Aluminium powders and flakes
	7604	Aluminium bars, rods and profiles
	7605	Aluminium wire
	7606	Aluminium plates, sheets and strip, of a thickness exceeding 0.2 mm
	7607	Aluminium foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.2 mm
	7608	Aluminium tubes and pipes
	7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)
	7610	Certain Aluminium structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures
	7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7613 00 00	Aluminium containers for compressed or liquefied gas
	7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated
	7616	Other articles of aluminium

Table 5-31: compares CBAM goods in the aluminium sector.

The aggregated goods categories listed in table 5-31 above include both finished aluminium goods and the precursor good 'unwrought aluminium' that is itself used in the production of aluminium goods.

Only input materials listed as relevant precursors to the system boundaries of the production process as specified in the system boundaries document are to be considered.

Table 5-32 below shows the precursors by aggregated goods category and production route.

Aggregated Goods Category	**Relevant precursors**
Unwrought aluminium	None for primary (electrolytic) smelting For secondary melting (recycling) – unwrought aluminium from other sources, if used in the process
Aluminium products	Unwrought aluminium, if used in the production process (treat primary and secondary aluminium separately, if data is known) Aluminium products, if used in the production process

Table 5-32: compares aggregated goods categories their production routes and possibly relevant precursors.

Table 1a of the system boundaries document lists the relevant goods in scope of CBAM in the aluminium sector.

The aluminium goods listed above include most types of aluminium product manufactured. Aluminium products are defined as complex goods as they include the embodied emissions from the precursor unwrought aluminium.

The production of aluminium sector goods is through a number of different process routes, outlined below.

E5.4.3 Definition and explanation of relevant production processes and routes

The system boundaries of the precursor unwrought aluminium and of aluminium products are distinct and may, under certain conditions, be added together to include all processes directly or indirectly linked to the production processes for these goods, including input activities to, and output activities from the process (see section E5.4.7.2). The purchase and maintenance of infrastructure and equipment are excluded from the system boundaries.

Figure 5-25 below shows the system boundaries and value chain of aluminium products.

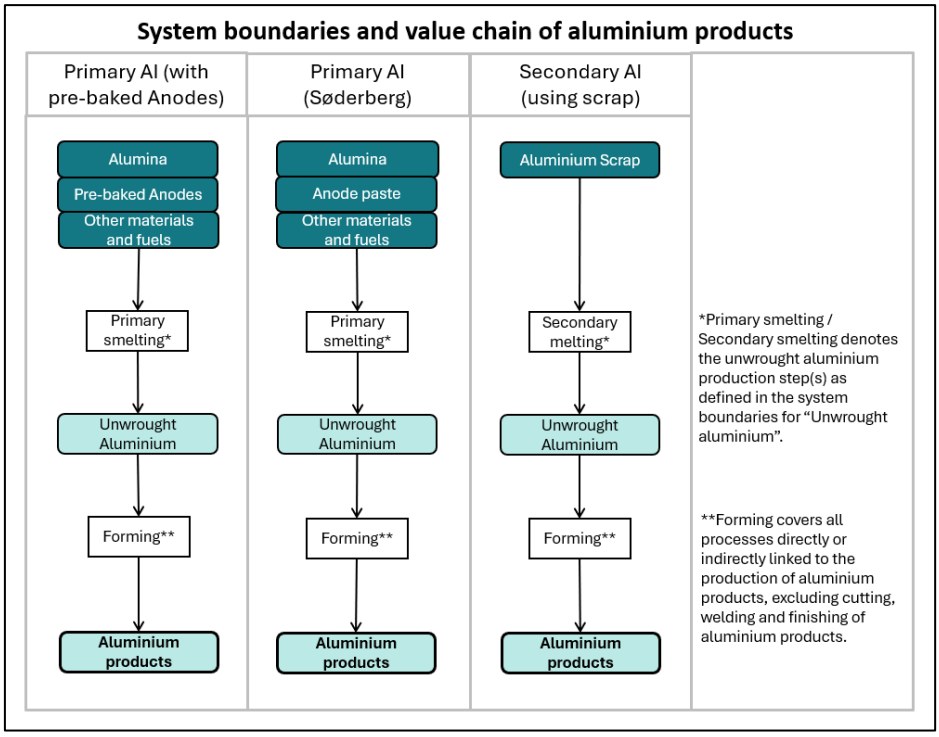


Figure 5-25: shows the system boundaries and value chain of aluminium products.

The difference in primary aluminium smelting route in the above diagram is due to the different electrode materials used (pre-baked versus Søderberg anodes), while the secondary aluminium route uses aluminium scrap instead of alumina as input.

The relevant emissions that should be monitored for the aluminium sector are detailed in section E5.4.7.1.

E5.4.4 Unwrought Aluminium - Primary (electrolytic) smelting production route

Primary aluminium is produced by the electrolysis of alumina in electrolytic cells. Alumina is purified aluminium oxide produced by beneficiation of bauxite ore via the Bayer process. Production of alumina usually takes place at a different site to primary aluminium production for logistical and power supply reasons. During electrolysis, aluminium is reduced and oxygen from the alumina is liberated and combines with the carbon anode to form carbon dioxide and carbon monoxide – the carbon anodes in the primary aluminium process are therefore continuously consumed during the process.

Primary aluminium cell systems vary according to the type of anode used. The 'Pre-baked' electrolytic cell uses multiple pre-baked carbon anodes that must be regularly replaced. The 'Søderberg' electrolytic cell uses a

single continuous carbon anode, which is self-baked in situ within the cell by means of the heat released during the electrolytic process within the smelter; 'green' anode paste briquettes are added at the top while the anode is consumed at the bottom. Molten aluminium is deposited at the cathode and collects at the bottom of the cell, where it is periodically withdrawn by vacuum siphons into crucibles before being transported to the casting plant. At the casting plant molten aluminium is held in holding furnaces for further processing prior to casting metal ingots, blocks, billets, slabs or similar; small quantities of clean commercial scrap may also be added at this stage.

Section 3.2.1(a) of the system boundaries document defines the system boundaries for direct emissions monitoring for the primary (electrolytic) smelting production route, as encompassing:

- all processes directly or indirectly linked to the production process emitting carbon dioxide (CO_2) emissions from the consumption of electrodes or electrode pastes;
- all processes directly or indirectly linked to the production process emitting CO_2 emissions from any fuels used (such as for drying and pre-heating of raw materials, heating of electrolysis cells, heating required for casting);
- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from any flue gas treatment, from soda ash or limestone if relevant;
- perfluorocarbon emissions caused by anode effects monitored in accordance with the heading entitled 'Requirements for determining perfluorocarbon emissions' in the force of law notice (ODT, 344KB).

There are no relevant precursors for this production process.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of primary aluminium installations:

- Raw material preparation – including storage of various additive constituents;
- Electrolytic cell system for aluminium production process – all steps;
- Casting plant – all steps including holding furnaces, conveying systems, further metal processing (metal treatment, alloying and homogenisation) and casting;
- Emissions control – for treating releases to air, water or ground;
- The process materials consumed by the primary aluminium production route – alumina, pre-baked carbon anodes, 'green' anode paste briquettes, cryolite and other additives – are treated as raw materials and so have zero embodied emissions.

Details on the special rules for the aluminium sector for determining emissions from PFCs are given in section E5.4.7.2, and a case study

showing how the emissions intensity values for aluminium sector goods are derived is given in section E5.4.8.

Figure 5-26 below shows the system boundaries of the primary smelting production route for producing unwrought aluminium.

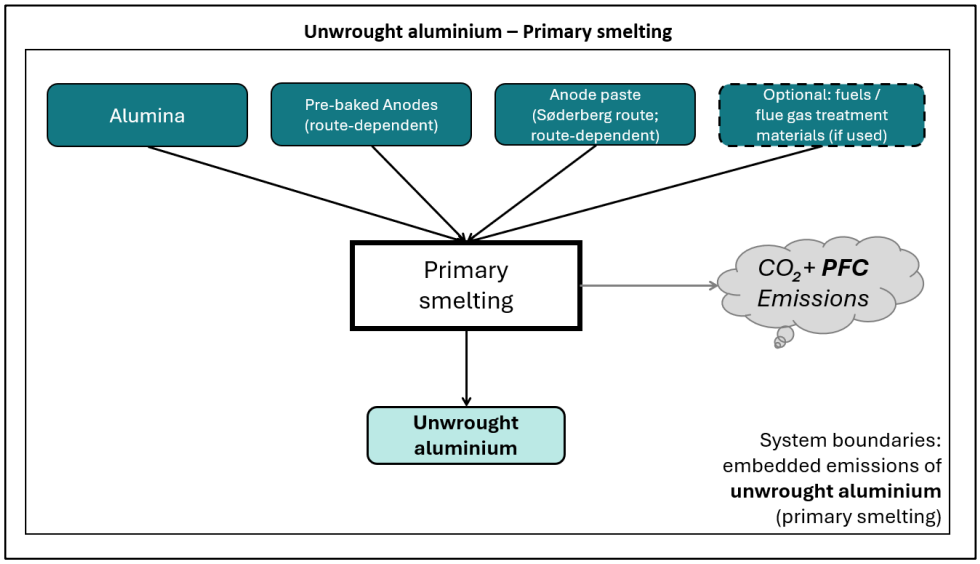


Figure 5-26: shows the system boundaries of unwrought aluminium – primary smelting.

Boxes with a dashed outline represent optional inputs that are only included where they are actually used at the installation. The "Pre-baked anodes" and "Anode paste (Søderberg route)" boxes represent alternative anode systems (route-dependent), not additional optional inputs.

E5.4.5 Unwrought aluminium – Secondary melting (recycling) production route

Secondary aluminium is produced mainly from post-consumer aluminium scrap collected for recycling (although unwrought aluminium may also be separately added). Scrap is sorted according to type (cast or wrought alloy) and the sort of pre-treatment measures required (for example de-coating and de-oiling) and is then re-melted in the appropriate type of furnace (typically rotary or reverberatory, but induction furnaces may also be used) before further processing including: alloying, melt treatment (addition of salt or chlorination) and finally casting metal ingots, blocks, billets, slabs or similar. Typical fuels used are natural gas, LPG or fuel oil.

Section 3.2.1(b) of the system boundaries document defines the system boundaries for direct emissions monitoring for the secondary melting (recycling) production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from any fuels used for drying and pre-

heating of raw materials, used in melting furnaces, in pre-treatment of scrap such as de-coating and de-oiling, and combustion of the related residues, and fuels required for casting of ingots, billets or slabs;

- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from any fuels used in associated activities such as treatment of skimmings and slag recovery;
- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from any flue gas treatment, from soda ash or limestone if relevant.

A relevant precursor is unwrought aluminium from other sources, if used in the process.

In line with the above definition of system boundaries, the following production steps are included within the system boundaries of secondary aluminium:

- Raw material preparation – including sorting, pre-treatment (de-coating, de-oiling), drying and pre-heating of scrap;
- Furnace system for aluminium production process – all steps, including furnace charging, melting and holding furnaces;
- Casting plant – all steps including holding furnaces, conveying systems, further metal processing (metal treatment, alloying and homogenisation) and casting;
- Emissions control – for treating releases to air, water or ground.

Figure 5-27 below shows the system boundaries of the relevant processes for secondary aluminium production.

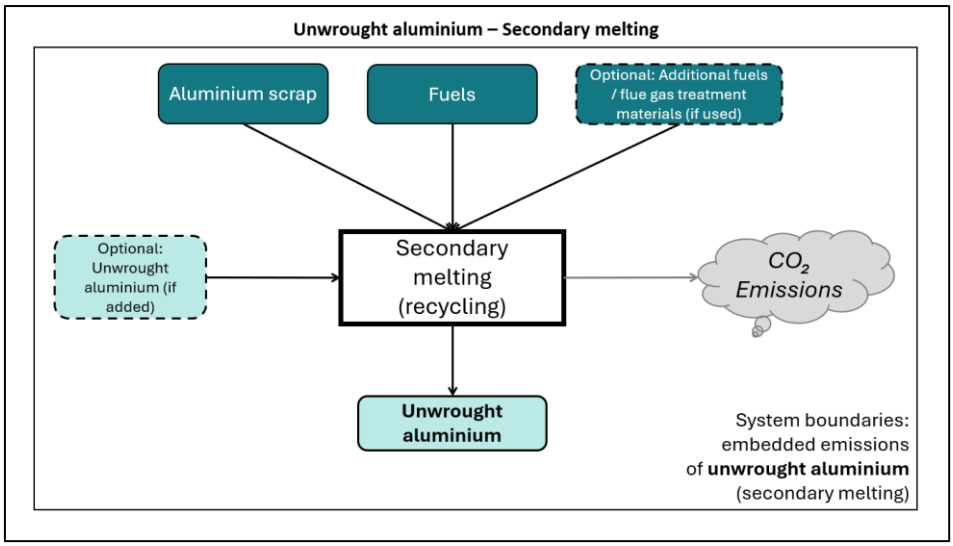


Figure 5-27: shows the system boundaries of unwrought aluminium – secondary melting.

There are no PFC emissions from the secondary aluminium process.

Aluminium scrap is the main material input to the secondary melting production route. Scrap (whether pre-consumer or post-consumer) is treated as a raw material and so has zero embodied emissions.

E 5.4.6 Aluminium products production process

Aluminium products are produced by the further processing of precursor unwrought aluminium (alloyed or un-alloyed). Aluminium products are produced by a variety of forming processes including extrusion, casting, hot and cold rolling, forging and drawing. Extrusion is a common process used to produce aluminium profiles. Hot and cold rolling may be used to produce plate, sheet and foil. Casting may be used to produce complex forms.

Section 3.3.1 of the system boundaries document defines the system boundaries for direct emissions monitoring for the aluminium products production route, as encompassing:

- all processes directly or indirectly linked to the production processes emitting CO_2 emissions from combustion of fuels and process emissions from flue gas treatment, excluding the following processes: cutting, welding and finishing of aluminium products.

Relevant precursors are unwrought aluminium, if used in the production process (primary and secondary aluminium should be treated separately, if data is known, as each has different embodied emissions), and aluminium products, if used in the production process.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of basic aluminium products installations:

- Raw material preparation – including pre-heating, re-melting and alloying;
- Forming processes – all forming process steps for basic aluminium products, including (but not limited to): extrusion, casting, hot and cold rolling, forging, drawing;
- Finishing activities – including sizing, annealing, surface preparation and treatment and further fabrication;
- Emissions control – for treating releases to air, water or ground.

Figure 5-28 below shows the system boundaries of the relevant processes for aluminium products.

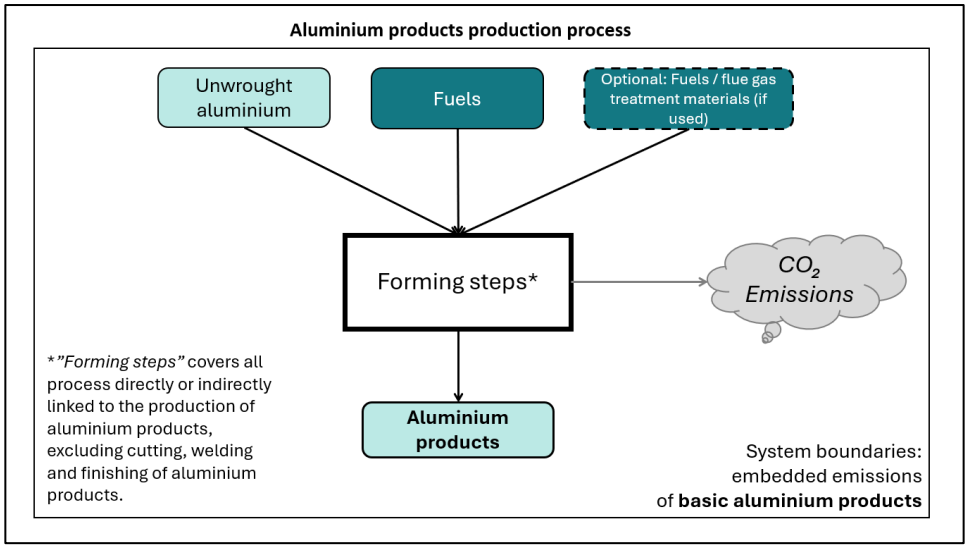


Figure 5-28: shows the system boundaries of the aluminium products production process.

There are no PFC emissions resulting from aluminium products forming processes.

Also note that the quantity of aluminium products shall be reported in accordance with the applicable CN code and the functional unit (tonnes), without applying a standalone mass-threshold adjustment for non-aluminium components (for example lining or insulation).

A case study showing how the emissions intensity values for aluminium sector goods are derived is given in section E5.4.8.

E5.4.7 Sector-specific requirements for monitoring and reporting

Relevant emissions should be monitored in line with the methodology set out in the force of law notice.

E5.4.7.1 Emissions monitoring

Relevant emissions that must be monitored and reported for the aluminium sector are:

- Carbon dioxide emissions (direct) resulting from the consumption of pre-baked carbon anodes or green anode paste during electrolysis – emissions result from the reaction of the carbon electrode with oxygen from the alumina or from other sources of oxygen such as from air. There are also emissions associated with the self-baking (coking) of green anode paste in situ in the Søderberg process;
- Carbon dioxide emissions (direct) resulting from furnaces (for example holding, pre-heating, re-melting and annealing), where heated by the combustion of fuels used for the furnaces, from stationary plant only (excludes emissions from any mobile units such

as vehicles);

- Carbon dioxide emissions (direct) resulting from the production of measurable heating (for example steam) and cooling, that is consumed within the system boundaries of the production process, regardless of the location of the production of the heating and cooling (i.e. from on-site generation or from imports from off-site);
- PFC (perfluorocarbon) emissions (direct) for CF_4 and C_2F_6 only, formed during brief upset conditions known as the 'Anode Effect', when alumina levels drop too low and the electrolytic bath itself undergoes electrolysis;
- Carbon dioxide emissions (direct) resulting from emissions control (for example from carbonate raw materials such as soda ash used for acidic flue gas cleaning).

Note that emissions related to the production of pre-baked carbon anodes (even if produced on the same site) and alumina are excluded from the system boundary, i.e. they are not CBAM goods themselves and therefore not precursors with embodied emissions.

Relevant emissions from the different source streams above are not reported separately but are added together to result in the total relevant emissions for the installation or production process.

Where the installation only carries out processes excluded from the system boundaries, verification obligations still apply if operators want to use actual values. Notably, the verification process will have to establish the following:

- that the installation only operates within the list of excluded processes;
- whether the production process carried out on the installation changed the emissions intensity value of the goods:
    - for instance, in an installation where only cutting occurs, to compute the embodied emissions of precursors, operators must use the mass of the precursors entering the production process (before cutting), even if emissions from cutting activities will not be accounted for in the embodied emissions of the complex good. This means that the emissions intensity value will increase, even if no emissions need to be monitored for CBAM purposes, in relation to the cutting;
- that embodied emissions of precursors, whether based on default values or actual values, are correctly calculated. For instance, the origin of precursors needs to be verified (to establish exemption if produced in the UK; to check that verification reports exist for precursors where relevant).

As the installation needs to be verified, the operator will have to establish a monitoring plan. In this case, the monitoring plan might be very concise

given the absence of process emissions and combustion emissions. Emissions from excluded process steps do not have to be included in the monitoring plan as a source stream and do not have to be monitored for the operator's emissions report.

E5.4.7.2 Additional rules

Attribution of emissions

Given the complexity of production processes in the aluminium sector, installations producing two or more goods from the aggregated goods categories 'unwrought aluminium' or 'aluminium products', may be monitored defining one joint production process for all the products from these groups covered, provided no intermediate product (i.e. precursor to one of the processes) is sold or otherwise transferred out of the installation.

Where different CBAM aluminium goods are produced through the same process, the operator may define a single multifunctional production process and apply a single emissions intensity value for each of the CBAM goods. Further information regarding the multifunctional production process can be found in section A.5 of the force of law notice (ODT, 344KB).

Determining PFC process emissions

Additional rules also apply for determining PFC emissions (CF_4 and C_2F_6 only) from primary aluminium production. However, where primary aluminium is used as a precursor, the related PFC emissions form part of the emissions intensity value of the final product.

Two different calculation-based methods are available in accordance with sections B.7.1 and section B.7.2 of the force of law notice (ODT, 344KB). Both methods are considered equivalent, but as each requires different data, the operator should choose the method that is most appropriate for their installation's process control equipment:

- '**Slope method'** (**Method A**) – where the 'anode effect minutes per cell-day' (AEM) are recorded. The AEM expresses the frequency of anode effects (number of anode effects / cell-day) multiplied by the average duration of anode effects (anode effect minutes / occurrence);
- '**Overvoltage method'** (**Method B)** – where the 'anode effect overvoltage' (AEO) per cell [mV] is recorded. The AEO is determined as the integral of (time × voltage above the target voltage) divided by the time (duration) of data collection.

Calculation Method A – Slope Method

The following equations for determining PFC emissions must be used under method A:

$$CF_4 emissions\ [t] = AEM \times (SEF_{CF4}/1000) \times Pr_{Al}$$

$$C_2F_6\ emissions\ [t] = CF_4 emission \times F_{C2F6}$$

Where:
AEM is the anode effect minutes/cell-day;
SEF_{CF4} is the slope emission factor expressed in (kg CF_4 / t Al produced) / anode effect minute/cell-day). Where different cell-types are used, different SEF may be applied as appropriate;
Pr_{Al} is the production of primary aluminium [t] during the monitoring period;
FC_2F_6 is the weight fraction of C_2F_6/t CF_4.

The anode effect minutes per cell-day expresses the frequency of anode effects (number anode effects / cell-day) multiplied by the average duration of anode effects (anode effect minutes / occurrence):

$$AEM = frequency \times average\ duration$$

Emission factor: The emission factor for CF_4 (slope emission factor, SEF_{CF4}) expresses the amount [kg] of CF_4 emitted per tonne of aluminium produced per anode effect minute per cell-day. The emission factor (weight fraction F_{C2F6}) of C_2F_6 expresses the amount [kg] of C_2F_6 emitted proportionate to the amount [kg] of CF_4 emitted.

Table 5-33 below shows the technology-specific emission factors related to activity data for the slope method.

Technology	**Emission factor for CF_4 (SEF_{CF4}) [(kg CF_4/t Al) / (AE-min/cell-day)]**	**Emission factor for C_2F_6 (F_{C2F6}) [tC_2F_6/tCF_4]**
Legacy Point Feed Pre Bake (PFPB L)	0.122	0.097
Modern Point Feed Pre Bake (PFPB M)	0.104	0.057
Modern Point-Fed Prebake without fully automated anode effect intervention strategies for PFC emissions (PFPB MW)	– (*)	– (*)
Centre Worked Prebake (CWPB)	0.143	0.121
Side Worked Prebake (SWPB)	0.233	0.280
Vertical Stud Søderberg	0.058	0.086

(VSS)		
Horizontal Stud Søderberg (HSS)	0.165	0.077

Table 5-33: compares technology-specific emission factors related to activity data for the slope method.

(*) The installation has to determine the factor by own measurements. If this is technically not feasible or involves unreasonable costs, the values for CWPB methodology shall be used.

Calculation Method B – Overvoltage Method

For the overvoltage method, the following equations shall be used from the force of law notice:

$$CF_4 emissions[t] = OVC \times (AEO/CE) \times Pr_{Al} \times 0.001$$

$$C_2F_6 emissions[t] = CF_4 emission \times F_{C2F6}$$

Where:
OVC is the overvoltage coefficient ('emission factor') expressed in kg CF_4 per tonne of aluminium produced per mV overvoltage;
AEO is the anode effect overvoltage per cell [mV] determined as the integral of (time × voltage above the target voltage) divided by the time (duration) of data collection;
CE is the average current efficiency of aluminium production [%];
Pr_{Al} is the annual production of primary aluminium [t];
F_{C2F6} is the weight fraction of C_2F_6 [t C_2F_6 / t CF_4].

The term AEO/CE (Anode effect overvoltage/current efficiency) expresses the time-integrated average anode effect overvoltage (mV overvoltage) per average current efficiency (%).

Table 5-34 below shows the technology-specific emission factors related to the overvoltage activity data.

Technology	**Emission factor for CF_4 ((kg CF_4/t Al)/mV)**	**Emission factor for C_2F_6 (tC_2F_6/tCF_4)**
Centre Worked Prebake (CWPB)	1.16	0.121
Side Worked Prebake (SWPB)	3.65	0.252

Table 5-34: compares technology-specific emission factors related to overvoltage activity data.

- **Minimum requirement** for both methods: Technology-specific emission factors given in table 2 of the force of law notice (ODT, 344KB) are used;

- **Recommended improvement:** Installation-specific emission factors for CF_4 and C_2F_6 are established through continuous or intermittent field measurements at least every 3 years or after significant changes in the installation, taking into account industry best practice guidelines.

Calculating CO_2e emissions from PFC emissions

The following formula (Equation 23) may be used to calculate CO_2e from CF_4 and C_2F_6 emissions, using the global warming potential (GWP) for these gases:

$$PFC\ emissions[tCO_{2(e)}] = CF_4 emissions[t] \times GWP_{CF4} + C_2F_6 emissions[t] \times GWP_{C2F6}$$

Please see paragraph 8 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 for relevant GWP values.

Furthermore, fugitive emissions of PFC are taken into account calculated from the emissions measurable in a duct or stack ('point source emissions') using the collection efficiency of the duct:

$$PFC\ emissions(total) = PFC\ emissions\ (duct)/collection\ efficiency$$

The collection efficiency shall be measured when the installation-specific emission factors are determined.

E5.4.7.3 Additional reporting requirements

Table 5-35 below shows the additional information that should be provided by the operator to importers, in the communication of the emissions data.

Aggregated good category	Reporting requirement
Unwrought aluminium	Tonnes of scrap used for producing one tonne of the unwrought aluminium product. % of scrap that is pre-consumer scrap Content of alloys in aluminium: If the total content of elements other than aluminium exceeds 1%, the total percentage of such elements
Aluminium products	Tonnes of scrap used for producing one tonne of the unwrought aluminium product. % of scrap that is pre-consumer scrap Content of alloys in aluminium: If the total content of

	elements other than aluminium exceeds 1%, the total percentage of such elements

Table 5-35: compares additional aluminium sector parameters requested in the operator's emissions report.

These parameters depend on the goods produced. Alloying elements play a minor role and are not reflected in the commodity code classification of aluminium goods. Note that any alloying elements contained in unwrought aluminium, that are not defined as CBAM precursor goods, are excluded from the determination of mass and embodied emissions of the unwrought aluminium or resulting product good.

The operator needs to ensure that they collect all the parameters necessary for their CBAM goods and communicate them to the importers of the goods.

E5.4.8 Worked example for the aluminium sector

The following worked example shows how emissions intensity values are derived for aluminium sector goods. In this example the installation produces products from two aggregated goods categories, unwrought aluminium and aluminium products, each of which is defined as a single production process, as the intermediate product is sold. Therefore, a joint production process is not possible. All goods produced from the category "Aluminium products" belong to CN codes that comply with the criterion to differ only in size or shape, but having the same composition. Therefore, these CN codes may be grouped into one production process, also known as a "multifunctional production process", as in this example.

Figure 5-29 below gives an outline view of the installation and shows the system boundaries as a hatched line for each production process. The physical units carrying out each production process have been grouped under 'Primary smelting' and 'Forming steps' and the different inputs and outputs and sources of emissions have been identified for each production process.

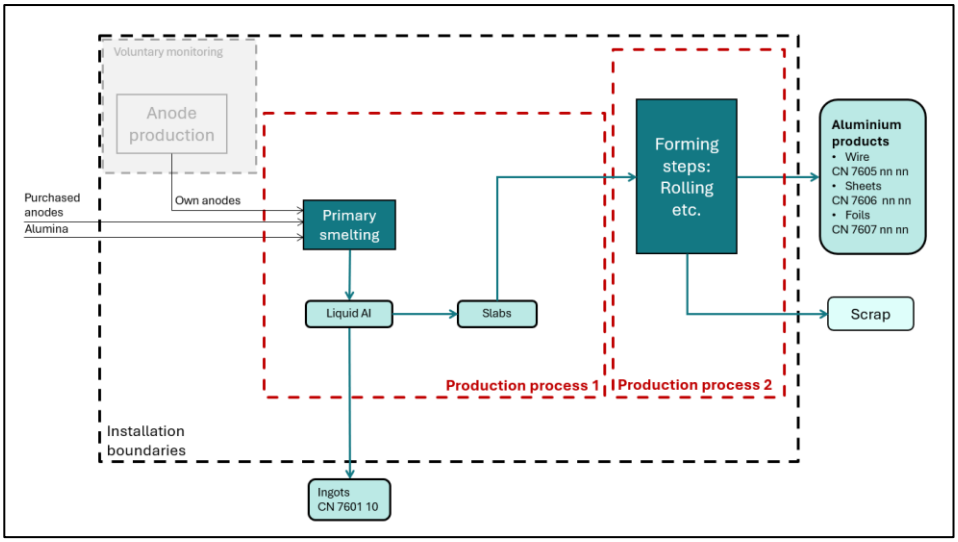


Figure 5-29: shows an overview of an example of aluminium.

The two production processes defined above are:

- Production process 1 – primary smelting process route producing unwrought aluminium as ingots (which may be sold) and slabs, which are transferred to production process 2. Raw material inputs are anodes, both manufactured on site and purchased from elsewhere, and alumina;
- Production process 2 – different forming processes producing a range of aluminium products, such as wire, sheets and foils. Raw material inputs are unwrought aluminium slabs transferred from production process 1. There is also scrap from this process. This is sent off-site for recycling.

Figure 5-30 below shows sources of direct emissions from the installation.

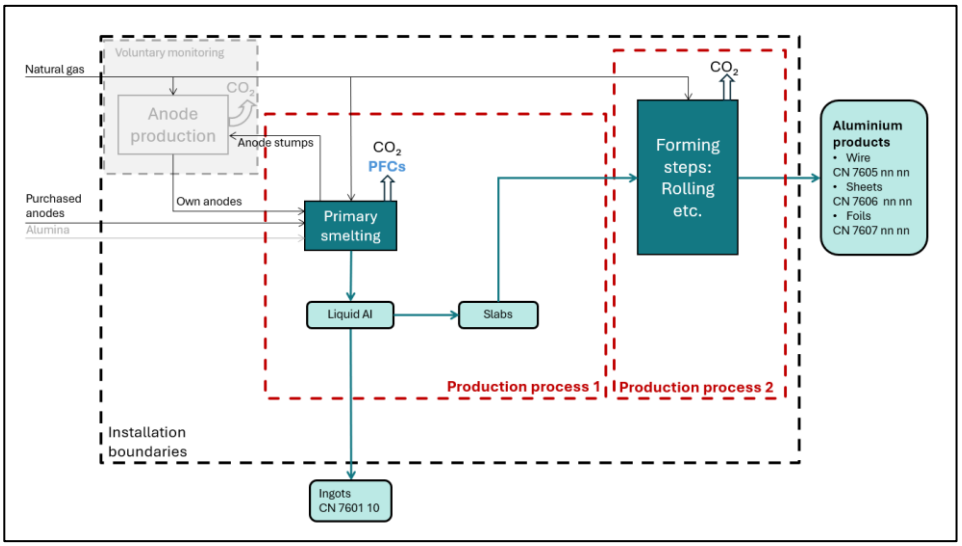


Figure 5-30: shows an example of aluminium– and the identification of source streams for the monitoring of relevant emissions.

Relevant emissions above result from fuel combustion in both production

processes, and from the primary smelting process - from the consumption of carbon anodes and from the formation of PFCs.

Note that on-site anode production is omitted from monitoring, as anodes are raw materials and are therefore considered to have zero embodied emissions. For monitoring the anode consumption, the difference of anode input and anode stumps recycled result in the activity data of anode consumption.

Figure 5-31 below shows a complete monitoring approach for all source streams for the installation.

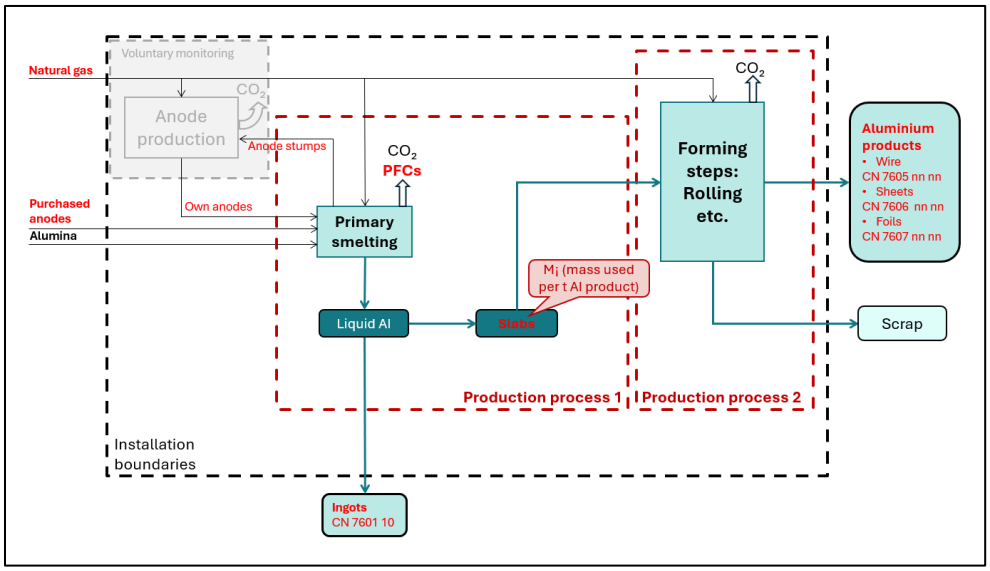


Figure 5-31: shows an example of aluminium and a complete monitoring approach.

The inputs and outputs highlighted in red text in Figure 5-31 are the parameters that would need to be monitored by the operator in order to attribute emissions and determine the emissions intensity values for both production processes.

The relevant emissions that are monitored in this example result from:

- Direct CO_2 emissions from fuel (natural gas) combustion, and from the process resulting from the consumption of carbon anodes;
- Direct emissions of PFCs formed during the electrolysis process;
- In the case of production process 2, embodied emissions in precursors (the slabs produced in process 1).

The inputs of precursors (with embodied emissions) and the activity level of the aluminium goods produced by each production process also need to be monitored.

Table 5-36 below summarises the inputs and outputs from the two production processes that are monitored in order to determine total

emissions intensity values.

Production:	**Ingots & liquid aluminium, total**	**200,000 t**
	Ingots (sale):	80,000 t
	Primary aluminium into process 2 (slabs)	120,000 t
	Aluminium products (process 2)	
	Wire (commodity code 7605)	45,000 t
	Sheets (commodity code 7606)	60,000 t
	Foils (commodity code 7607)	8,000 t
	Total Aluminium products (process 2)	**113,000 t**
	Scrap sold	7,000 t
Inputs:	Alumina	380,000 t
	Electrodes (sum self-produced and purchased, minus stumps)	69,000 t
	Natural gas (12,219 t for process 1 & 1,962 t for process 2)	14,181 t

Table 5-36: compares the inputs and production levels of the aluminium example.

Whilst some unwrought aluminium is sold off site in the form of ingots (80 000 tonnes), 120 000 tonnes is used as a precursor in production process 2, and there is scrap of 7 000 tonnes at the end. No emissions are attributed to aluminium scrap, which as scrap has zero embodied emissions.

Table 5-37 below summarises the calculation of relevant emissions and their attribution to each production process.

Relevant emissions CO_2e	**Emissions**	**Units**
From electrodes (using factor 3,664 tCO_2/t C):	252,816	tCO_2
From natural gas (NCV = 48 GJ/t, EF=56.1 tCO2/TJ):	32,902	tCO_2
From PFCs (using a method described in section E5.4.7.2	25,282	tCO_2e
Total Process 1 (primary aluminium)	**311,000**	tCO_2e
Total process 2 (final aluminium products), emissions from natural gas	5,283	tCO_2
Total relevant emissions of the installation	**316,283**	tCO_2e

Table 5-37: shows an aluminium – installation's total relevant emissions.

Using the data in the tables above, emissions intensity values are then calculated separately for each aggregated goods category as shown below in table 5-38 below.

	Production levels (t)		Process total emissions (tCO_2e)	Mass ratio (Mi) of precursor (t/t)	Emissions intensity value (tCO_2e/t)
Process 1 (unwrought aluminium – ingots and slabs)					
	Product				
	Ingots	80,000			
	Slabs	120,000			
	Total	**200,000**	**311,000**		**1.555**
Process 2 (final aluminium products)					
Precursor	Slabs	120,000		1.062	1.651
Aluminium products		113,000	5,283		0.047
Total emissions intensity value of final aluminium products					**1.698**

Table 5-38: shows an example calculation of specific embodied emissions of complex final aluminium goods.

When calculating the total embodied emissions of final aluminium products above, the mass ratio (M_i) of the precursor is taken account. This is the mass of unwrought aluminium slabs consumed per tonne of aluminium products, and is calculated as:

- Mass slabs/mass aluminium products: 120,000 t / 113,000 t = 1.062 t/t (as above).

The emissions intensity values of the precursor are then adjusted by this ratio i.e.:

- For emissions intensity value (precursor): 1.555 tCO_2e/t x 1.062 t/t = 1.651 tCO_2e/t.

Total emissions intensity values of the final complex aluminium product are calculated by adding the emissions intensity values of the precursor (adjusted by the M_i) to the emissions of the production process for aluminium products, as above.

E5.5 Chemicals sector - hydrogen

E5.5.1 Functional unit and emissions intensity

The quantity of hydrogen imported into the UK must be expressed in metric tonnes (as pure hydrogen). The operator must record the quantity of hydrogen produced by the installation or production process, for the purposes of monitoring and for use in the calculation of emissions intensity values in accordance with the CBAM regulations.

Table 5-39 below outlines important parameters for this CBAM goods sector.

Industrial sector	Chemicals – Hydrogen
Unit of production	The quantity of goods produced in tonnes (metric) pure hydrogen, produced by the installation or production process.
Associated activities	Producing hydrogen by steam reforming or partial oxidation of hydrocarbons, water electrolysis, Chlor-Alkali electrolysis or production of sodium chlorate.
Relevant greenhouse gases	Carbon dioxide (CO_2)
Direct Emissions	Tonnes (metric) of CO_2e
Unit for emissions intensity	Tonnes (metric) CO_2e emissions per functional unit, and per each composition of the goods, reported separately for each type of CBAM good, by the installation or production process.
Unit for embodied emissions	Tonnes (metric) CO_2e emissions per tonne of CBAM good, reported separately for each type of good, by installation.

Table 5-39: compares they key elements that are representative of the hydrogen CBAM goods sector.

Emissions must be reported in metric tonnes CO_2 equivalent (tCO_2e) emissions per tonne of output. This figure must be calculated for the specific installation or production process.

Note that a case study showing how emissions intensity values are derived, for hydrogen produced by the steam reforming production route, and how the embodied emissions of imports into the UK are calculated, is given in section E5.5.7.

The following sections set out how the system boundaries of different hydrogen production routes should be defined and identify elements of the production process that must be included for monitoring purposes.

E5.5.2 Definition and explanation of sector CBAM goods covered

Table 5-40 below lists the relevant goods in scope for CBAM in the hydrogen industry sector. The CN codes in the central column are the starting point for which 'production processes' are to be defined for the purpose of monitoring at installation level in a manner consistent with the System boundaries document.

Aggregated goods category	CN Code	Description
Hydrogen	2804 10 00	Hydrogen

Table 5-40: compares CBAM goods in the hydrogen sector.

Table 1d of the system boundaries document lists the relevant goods in

scope of CBAM in the hydrogen industry sector. The aggregated goods define groups for which joint 'production processes' are to be defined for the purpose of monitoring.

Hydrogen is defined as simple good, as the raw materials and fuels used in its manufacture are considered to have zero embodied emissions.

There are no relevant precursors for hydrogen. However, hydrogen may itself be a relevant precursor for other processes, where it is separately produced for use as a chemical feedstock to produce ammonia, or to produce pig iron or direct reduced iron (DRI).

The production of hydrogen is by a number of different process routes, outlined below.

E5.5.3 Definition and explanation of relevant production processes and routes

Hydrogen can be produced from various feedstocks including plastic wastes, but currently it is derived mostly from fossil fuels. Hydrogen production units are typically integrated into larger industrial processes for example as for an installation producing ammonia.

Figure 5-32 below shows the variety of different routes by which hydrogen may be produced.

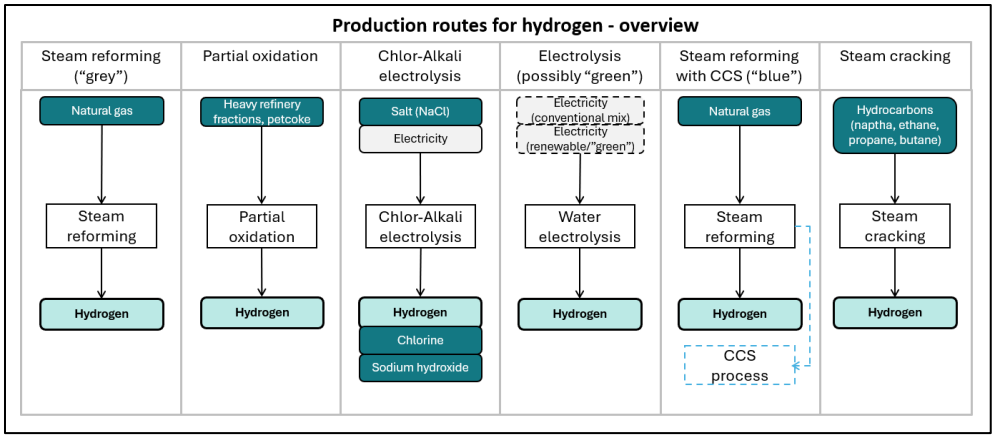


Figure 5-32: shows an overview of the system boundaries of the different production routes for hydrogen.

The system boundaries for relevant emissions monitoring for hydrogen include all processes directly or indirectly linked to hydrogen production, and all fuels used in the production of hydrogen.

The relevant emissions that should be monitored for the hydrogen sector are detailed in section E5.5.6.1.

Note that other production routes for hydrogen are possible, for example hydrogen produced as a by-product from the production of ethylene, but that only the production of pure hydrogen or mixtures of hydrogen with nitrogen usable in ammonia production shall be considered. Not covered are the production of synthesis gas or of hydrogen within refineries or organic chemical installations, where the hydrogen is exclusively used within those plants, and not used for the production of goods under the CBAM Regulations.

E5.5.4 Hydrogen – Steam reforming and partial oxidation production route

The fossil gas (methane) feedstock for this process is converted to carbon dioxide and hydrogen through primary and secondary steam reformation. The overall reaction is highly endothermic and process heat is supplied by the combustion of natural gas or other gaseous fuel. Carbon monoxide produced is almost all converted to carbon dioxide by the process.

Section 3.12.1(a) of the system boundaries document defines the system boundaries for emissions monitoring for the steam reforming (or partial oxidation) production routes, as encompassing:

- all processes directly or indirectly linked to hydrogen production and the separation of hydrogen and carbon monoxide, and flue gas cleaning;
- all fuels used in the hydrogen production process irrespective of their energetic or non-energetic use, and fuels used for other combustion processes including for the purpose of producing hot water or steam.

There are no relevant precursors for this production process.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of a hydrogen (steam reformation) installation:

- Raw material pre-treatment – natural gas desulphurization;
- Steam reformation – primary and secondary, H_2/CO generation;
- Shift conversion – carbon monoxide to carbon dioxide and hydrogen;
- Separation & purification – CO_2 removal, separation processes as present including cryogenic, adsorption, absorption, membrane, hydrogenation (methanation);
- Emissions control – for treating releases to air, water or ground.

The stream of carbon dioxide produced by the steam reforming process is very pure and is separated and captured for further use, for example for urea production. A variation on this process may be with permanent geological storage i.e. carbon capture and sequestration (CCS). Where CO_2

is captured and permanently stored or chemically bound in accordance with the CBAM rules, this is reflected in the determination of embodied emissions in line with the force of law notice.

A worked example for the calculation of specific embodied emissions for hydrogen produced by the steam reforming production route is given in section E5.5.7.

E5.5.5 Hydrogen – Steam cracking production route

Hydrogen is produced as a co-product of the thermal cracking of hydrocarbons using feedstocks such as naphtha and natural gas condensates (i.e. ethane, propane and butane) alongside the simultaneous production of light olefins such as of ethylene and propylene.

Section 3.12.1(b) of the system boundaries document defines the system boundaries for emissions monitoring for the steam reforming (or partial oxidation) production routes, as encompassing:

- all processes directly linked to hydrogen production;
- all processes directly or indirectly linked to the production processes, and from flue gas cleaning.

There are no relevant precursors for this production process.

In line with the above definition of systems boundaries, the following production steps are included within the system boundaries of a hydrogen (steam cracking) installation:

- production of hydrogen as a co-product of the steam cracking of hydrocarbons – mixing of hydrocarbon feedstocks with steam, cracking of hydrocarbons in furnaces, generation of hydrogen as a by-product, and collection;
- gas cooling, drying and purification – removal of water vapour and other impurities from hydrogen gas;
- emissions control – for treating releases to air, water or ground.

E5.5.6 Sector-specific requirements for monitoring and reporting

Relevant emissions should be monitored in line with the methodology set out in the force of law notice.

E5.5.6.1 Emissions monitoring

Relevant emissions that should be monitored for the hydrogen sector are:

- Carbon dioxide emissions (direct) from the fuel combustion process in the hydrogen or synthesis gas production process, primary and secondary steam reforming of natural gas, or partial oxidation other

hydrocarbons; from stationary plant only (excludes emissions from any mobile units such as vehicles);

- Carbon dioxide emissions (direct) resulting from the production of measurable heating (for the purpose of producing hot water or steam) and cooling that is consumed within the system boundaries of the production process, regardless of the location of the production of the heat (i.e. from on-site generation or from imports from off-site);
- Carbon dioxide emissions (direct) from electrolysis are minimal and so where these emissions are significant, they are likely to result from ancillary plant;
- Carbon dioxide emissions (direct) resulting from emissions control (for example from carbonate raw materials such as soda ash used for acidic flue gas cleaning).

Direct emissions from the different source streams above are not reported separately but are added together to result in the total relevant emissions for the installation or production process.

E5.5.6.2 Additional rules

Exclusions

The operator should note that only the production of pure hydrogen or mixtures of hydrogen with nitrogen usable in ammonia production shall be considered. Not covered are the production of synthesis gas or of hydrogen within refineries or organic chemical installations, where the hydrogen is exclusively used within those plants and not used for the production of goods under the CBAM Regulations.

E5.5.6.3 Additional reporting requirements

There is no additional reporting required for hydrogen.

E5.5.7 Worked example for the hydrogen sector

The following worked example shows how the emissions intensity value is derived for hydrogen produced by the steam reforming production route.

The resulting embodied emissions of imports into the UK are then calculated at the end of the example for reporting purposes.

Figure 5-33 below gives an outline view of the installation and shows the system boundaries as a hatched line for the single production process. The physical units carrying out the production process have been grouped

under ‘steam reforming’ and the inputs and outputs and sources of emissions have been identified.

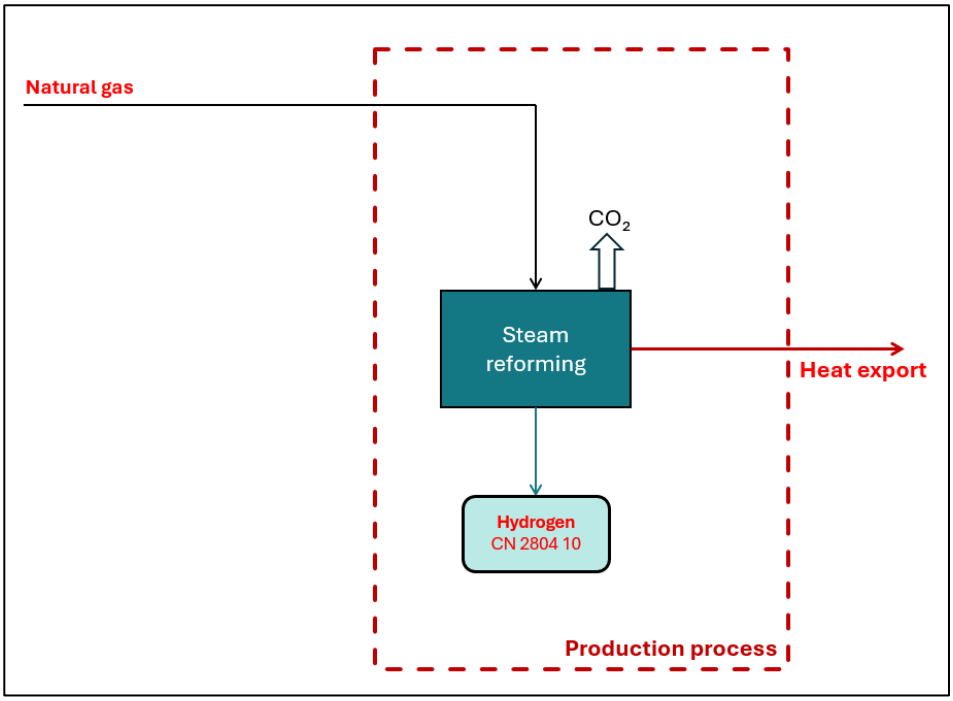


Figure 5-33: shows an overview of an example of hydrogen and a complete monitoring approach.

A single production process is defined for steam reforming. Inputs are natural gas (both as a raw material/feedstock for the process, and as a fuel). Outputs are hydrogen product and heat exported to other parts of the installation or to a district heating network.

The inputs and outputs highlighted in red text in Figure 5-33 above are the parameters that would need to be monitored by the operator in order to attribute emissions and determine the emissions intensity value for the production process.

The relevant emissions that are monitored in this example result from:

- Emissions from fuel combustion and from the steam reforming process;
- For the purpose of calculating attributed emissions of the process, an equivalent of emissions associated with the heat export needs to be determined and subtracted from attributed emissions. The latter section explains that for cases of heat of unknown origin, as a default, natural gas with a boiler efficiency of 90% is to be used, if no other data sources can be used. This gives a value of 62.3 tCO_2/TJ.

The activity level of the hydrogen good produced also needs to be monitored.

Table 5-41 below summarises the inputs and outputs from the process that are monitored for determining the relevant emissions.

Direct emissions	**AD (t)**	**NCV (GJ/t)**	**Energy (TJ)**	**EF (tCO_2/TJ)**	**Emissions (tCO_2)**
Input natural gas	190,000	48	9,120	56.1	511,632
Heat export			-800	62.3	-49,867
Total direct emissions of the installation					**461,765**

Table 5-41: shows an example calculation of the total relevant emissions attributed to hydrogen net emissions for a heat export.

Total relevant emissions of the installation result from one single source stream (natural gas). There is no need to distinguish combustion and process emissions for this purpose. In this example, these are wholly attributed to the hydrogen product, net of emissions attributed to a heat export. If the almost pure CO_2 produced by this process were to be captured and transferred to a geological CO_2 storage site, the related emissions could be deducted, provided the receiving installation carries out monitoring under CBAM or an equivalent MRV system.

Table 5-42 below shows the calculation of the emissions intensity value of the hydrogen product.

Product	**Activity level (t)**	**Process total emissions (tCO_2)**	**Emissions intensity value (tCO_2e/tH_2)**
Hydrogen	55,000	461,765	**8.396**

Table 5-42: shows the calculation of the emissions intensity value of an example hydrogen product.

F6.0 Accreditation and Verification

F6.1 Introduction

This section of the guidance has been designed to help:

- accreditation bodies understand what they need to do when accrediting verifiers for CBAM;
- verifiers understand what they need to follow to maintain accreditation to verify CBAM emissions;
- auditors understand what they need to complete as part of the CBAM auditing process;
- CBAM goods manufacturers understand what is involved with the CBAM verification process.

As per the previous sections of this guidance, this has been written in non-legislative language and looks at the accreditation and verification requirements that need to be followed for the liable person to be able to report actual emissions for the CBAM goods they import into the UK.

In addition to this section of the guidance, it is advisable that the reader refer to the following documents:

- The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
- The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB).

As per the other sections of this guidance, The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) will be referred to as 'the force of law notice'.

F6.1.1 Definitions

The accreditation and verification process for CBAM has its own unique set of definitions which are different to those listed in the previous sections of this guidance. The full list of definitions relevant for accreditation and verification can be found in section J.1 of force of law notice (ODT, 344KB) and in Table 2 of Annex V.

The key definitions that are used throughout this section of the guidance are:

- 'Accreditation' means the third-party assessment of conformity against the requirements set out in The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 and the force of law notice (ODT, 344KB);
- 'Accreditation Body' means an organisation who is a full member of the Global Accreditation Cooperation Incorporated (ACI) and can

provide accreditation for those organisations who wish to undertake verification activities on operators who produce CBAM goods that are to be imported into the UK. For example, in the UK this would be the United Kingdom Accreditation Service (UKAS);

- 'Assessor' means the individual who assesses the performance of a verifier on behalf of the accreditation body;
- 'Auditor' means an individual who forms part of the verification team and is responsible for conducting the verification of the operator's emissions report;
- 'Material misstatement' means a misstatement that, either individually or when aggregated with other misstatements, exceeds the materiality level set in section J.7.10 of the force of law notice (ODT, 344KB);
- 'Misstatements' means an error in the reported emissions data, not considering the uncertainty associated with measuring instruments or laboratory analyses that have been used by the operator;
- 'Non-conformities' means:
  - any act or omission by the operator that is contrary to the monitoring plan or the monitoring methodology as required by the force of law notice or The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
  - any act or omission by the verifier that is contrary to the requirements of the force of law notice or The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
- 'Non-compliance' means any act or omission by the operator that is contrary to the requirements of the force of law notice or the Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
- 'Reasonable assurance' means a high but not absolute level of assurance, expressed positively in the verification opinion statement, as to whether the emissions report from the operator is free from material misstatements;
- 'Verification opinion Statement' means the verifier's verdict on whether the data on the operator's CBAM emissions report contains material misstatements in accordance with paragraph J.8.1(2) of the force of law notice (ODT, 344KB);
- 'Verification report' has the meaning defined in Regulation 15(1) of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. This verification report is provided by the verifier to the operator producing the CBAM goods in which the verification was completed;
- 'Verification risk' means the risk the verifier expresses an inappropriate verification opinion statement where the CBAM emissions report is not free of misstatements;

- ‘Verification team’ means the team undertaking the verification activity on behalf of the verifier and are responsible for completing the CBAM verification process. The team can comprise of:
    - the lead auditor;
    - auditors;
    - technical experts (where required);
- ‘Verifier’ has the meaning defined in Regulation 12 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. The verifier is the person or organisation that has been accredited by the accreditation body to carry out CBAM verification activities.

F6.1.2 Principles

The principles for the verification of emissions for those CBAM goods that are to be imported into the UK closely follow the verification principles of the UK ETS. This is due to:

- the same type of data being collated by the operator;
- similar calculations used to determine the CBAM emissions;
- the requirements for the verifier to undertake a site visit and produce a verification report and verification summary;
- the need for verifiers to be independent;
- a similar approach for verifiers to become accredited so they can undertake CBAM verification activities.

In terms of the CBAM emissions report, again this closely follows the principles of an ETS scheme, as the CBAM emissions data must have the verification opinion by an eligible verifier of either:

- verified as satisfactory – where the verifier has concluded with reasonable assurance that the emissions report is free from material misstatements; or
- verified as satisfactory with comments – where the emissions report is free from material misstatements, but the report contains uncorrected non-material misstatements, non-conformities or non-compliances, or where the verifier wishes to recommend improvements to the monitoring and reporting process.

Likewise, there may be situations where the verifier may issue a negative verification opinion statement. This is given when the verifier identifies uncorrected material misstatements or is unable to conclude with reasonable assurance that there are no material misstatements. When such an opinion is given, the liable person cannot report this data to HMRC.

To allow the verifier to verify the data as satisfactory, the verifier needs reasonable assurance that the emissions data is free from material

misstatements. The verifier needs to minimise the verification risk by conducting verification activities.

During the verification process, the verifier may identify the following, which are similar to the verification principles for ETS:

- misstatements – the verifier will need to determine whether these are material individually or when combined with other misstatements. When determining the materiality of misstatements, the verifier will apply the materiality level as well as their own judgement;
- non-conformities or non-compliances – the verifier will determine if these lead to a material misstatement or create sufficient doubt so that the verifier is unable to minimise the verification risk to an acceptable level so they can conclude the verification with reasonable assurance about the absence of material misstatements.

Further details on the opinions of the verifier can be found in section F6.9.1.

There are differences between verification for ETS and verification for CBAM. One of these differences relates to the accreditation of verifiers. The rules around accreditation and the accreditation bodies are explained in section F6.2.

F6.1.3 CBAM Timeline

To ensure the operator and liable person can comply with the requirements of the CBAM, it is important they have a clear indication of the timeline for:

- collecting data;
- arranging verification activities;
- reporting CBAM emissions data to HMRC.

Table F6-1 below shows the timeline for the first year of the CBAM, together with the key tasks that the operator and liable person should and will need to complete to ensure compliance.

1 January 2027	CBAM in the UK goes live
1 January 2027 onwards	The liable person who imports more than £50,000 of CBAM goods within a 12-month period from the following industrial sectors must register and comply with the CBAM reporting and payment requirements: • aluminium; • cement; • fertilisers; • hydrogen; • iron and steel.

1 January 2027 onwards	The operator producing CBAM goods that are to be imported into the UK must: • establish a monitoring plan and supplementary procedures for the monitoring and calculation of the CBAM emissions data; • undertake monitoring of the fuels and materials used to produce CBAM goods; • where precursor goods are used, liaise with the manufacturer of those goods, so they are aware of the emissions data that they need to provide; • undertake regular reviews of the collected data.
From October 2027 onwards	Recommendation: operator to liaise with and appoint a verifier.
From January 2028	Operator collates data and produces a CBAM emissions report and sends the report to their appointed verifier.
January 2028 onwards	The verifier: • reviews the CBAM emissions report; • arranges and completes a site visit; • produces a verification report/verification summary; • Independent review completed on verification report/verification summary; • verification report/verification summary issued to the operator producing the CBAM goods to be imported into the UK.
Before 31 May 2028	The operator sends verification report/verification summary to the liable person.
By 31 May 2028	Liable person submits CBAM data to HMRC for the 2027 compliance year.

Table 6-1: shows the timeline and key tasks for CBAM compliance.

The timeline shown above is for the current reporting process where there is only one reporting deadline for the liable person to submit the CBAM emissions data to HMRC. In the future there will be quarterly opportunities for the liable person to report CBAM emissions data to HMRC.

F6.2 General requirements for accreditation bodies

This section of the guidance focuses on the role of the accreditation body, and the tasks they need to complete to accredit verifiers.

The role of the accreditation body in CBAM is to assess whether verifiers understand and are able to comply with the requirements of the CBAM legislation, and if so, accredit verifiers for CBAM, enabling them to verify the emissions for the CBAM goods that are to be imported into the UK.

In order to be eligible to accredit verifiers for CBAM, the accreditation body must:

- be a full member of the Global Accreditation Cooperation Incorporated (Global ACI). Full members of the Global ACI are

required to be signatories to the Global ACI's multilateral recognition agreement (MRA);
- meet the requirements specified in a notice published by the Commissioners, for example the force of law notice;
- comply with the requirements of ISO/IEC 17011:2017 Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies. This includes the requirements that relate to their impartiality during the accreditation process and the receipt of complaints etc. In practice, all signatories of the Global ACI's MRA are required to be compliant with ISO/IEC 17011 and undergo peer evaluation to assess their compliance with this standard;
- peer evaluated in accordance with the procedures of the Global ACI for its ability to accredit against the following standards:
    - ISO/IEC 17029:2019 Conformity assessment — General principles and requirements for validation and verification bodies;
    - ISO 14065:2020 General principles and requirements for bodies validating and verifying environmental information.

In practice, this means that the accreditation bodies should be signatories to the verification and validation level 2 scope of the Global ACI MRA and the level 4 scope of the Global ACI MRA corresponding to ISO 14065, in order to be eligible to accredit verifiers for CBAM.

Accreditation bodies based in any country, not just in the UK or Europe, can be eligible to accredit verifiers for CBAM. This is as long as they meet the eligibility criteria set out above and comply with the requirements for accreditation bodies when accrediting verifiers set out in the force of law notice and explained below.

The accreditation bodies must recognise the equivalence of accreditations for the CBAM performed by other accreditation bodies that meet the requirements set out in The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

F6.3 Applications for accreditation

In general, an accreditation body may consider an application for accreditation for CBAM from a verifier where the verifier is established in the same country as the accreditation body. For example, if an accreditation body is based in Turkey, they will consider applications from verifiers who are also based in Turkey.

An accreditation body may only consider an application for accreditation for CBAM submitted by a verifier which is not established in the same country as the accreditation body where one of the following applies:

- there is no accreditation body in the country where the verifier is established;
- there is an accreditation body in the country where the verifier is established, but it does not meet the eligibility requirements set out in Regulation 15 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 and paragraphs J.2(1) and J.2(2) of the force of law notice (ODT, 344KB) (see section F6.2 above);
- the verifier has been informed by the accreditation body of the country where the verifier is established that it does not perform accreditation for CBAM.

F6.3.1 Application documentation

The accreditation body may only consider an application for CBAM accreditation from a verifier where the verifier has provided documentation to support its application.

The documentation the verifier must include in its application for CBAM accreditation should include:

- the requested scope of accreditation – i.e. the activity groups for which the verifier wishes to be accredited to verify emissions under CBAM (see section F6.3.3.2);
- a description of the competency to carry out the procedures and processes referred to in the following sections of the force of law notice (ODT, 344KB):
    - section J.6.8 – Additional procedures;
    - section J.7 – CBAM verification process;
    - section J.6.1 – Verification Standard;
    - section J.6.7 – Quality management system;
- a description of the competency criteria referred to in the following sections of the force of law notice:
    - section J.6.2(2)(a) – general competency criteria for all personnel undertaking CBAM verification activities;
    - section J.6.2(2)(b) – competence criteria that are specific to the scope of accreditation for each member undertaking CBAM verification activities, in particular the lead auditor, auditor, and technical expert;
- the results of the competency process referred to in the following sections of the force of law notice including:
    - section J.6.2 - Competency requirements for verifiers;
    - other relevant documentation on the competency of all personnel involved in the verification activities as referred to in:
        - section J.6.4 - Competence requirements for CBAM auditors;
        - section J.6.5. – Competence requirements for the independent reviewer;

- a description of the process to ensure the impartiality and independence, including records on impartiality and the independence of the applicant and the personnel involved in the verification activities as per section J.6.10.5 of the force of law notice (ODT, 344KB);
- the list of the technical experts in verification and key personnel involved in the verification of the operator's CBAM emissions report;
- a description of the additional procedures and processes that are referred to in the following sections of the force of law notice:
  - section J.6.8 – Additional procedures;
  - section J.7 – CBAM Verification Process;
- the standards referred to in section J.6.1 of the force of law notice (ODT, 344KB), including:
  - ISO/IEC 17029:2019 Conformity Assessment – General principles and requirements for validation and verification bodies;
  - ISO 14065:2020 General principles and requirements for bodies validating and verifying environmental information;
- the records referred to in section J.6.9 of the force of law notice (ODT, 344KB) which include:
  - demonstrating ongoing compliance with the CBAM requirements;
  - making information available to the operator and to those; referred to in the standards in section J.6.1 of the force of law notice (ODT, 344KB);
  - notifying the accreditation body to which it is accredited if there are any significant changes regarding the accreditation or status of operation;
- if applicable, any relevant evidence of proven competency in applying the international standards referred to in section J.6.1 of the force of law notice (ODT, 344KB).

The accreditation body may ask for further information from the applicant to fully assess the application for accreditation.

F6.3.2 Requests for accreditation from applicants accredited for the UK Emissions Trading Scheme

Where a verifier is already accredited for the UK Emissions Trading Scheme (UK ETS) under the Implementing Regulation (EU) 2018/2067 of 19 December 2018, as it forms part of domestic law, the verifier may apply for an extension of its scope of accreditation to the CBAM.

When assessing an application for an extension of scope from a verifier accredited for UK ETS, accreditation bodies must consider activity groups under CBAM to be equivalent to the corresponding activity groups under

UK ETS as set out in the Table 6-2 below and also contained within Annex IV of the force of law notice (ODT, 344KB).

CBAM activity group No	**Scope of accreditation**	**Activity groups pursuant to Annex I to Implementing Regulation (EU) 2018/2067 of 19 December 2018 as it forms part of domestic law, as amended from time to time**
	Aggregated goods category	
I	Calcined clay Cement clinker Cement Aluminous cement	1a, 1b, 6, 98
II	Hydrogen Ammonia	1a, 1b, 8, 98
III	Nitric acid	1a, 1b, 9, 98
IV	Urea Mixed fertilisers	1a, 1b, 98
V	Sintered ore Pig iron DRI (direct reduced iron) Crude steel	1a, 1b, 3, 98
VI	Ferro alloys (FeMn, FeCr, FeNi)	1a, 1b, 4, 98
VII	Unwrought aluminium	1a, 1b, 4, 5, 98
VIII	Iron or steel products Aluminium products	1a, 1b, 4, 98
	Other activities	
L	Carbon capture, utilisation and storage (CCUS)	10, 11

Table 6-2: shows the scope of accreditation for verifiers.

Additionally, as part of the CBAM accreditation process, the verifier can demonstrate their knowledge with the CBAM activity group if they are already certified under Annex 1 of the Implementing Regulation (EU) 2018/2067 of 19 December 2018. For example, if the verifier is accredited under ETS for the following activity groups, they could also be accredited for the associated CBAM activity groups:

- 1a – Combustion of fuels in installations, where only commercial standard fuels as defined in Commission Implementing Regulation (EU) 2018/2066 are used, or where natural gas is used in category A or B installations;
- 1b – Combustion of fuels in installations, without restrictions;

- 3 – Production of coke, Metal ore (including sulphide ore) roasting or sintering, including pelletisation, and Production of pig iron or steel (primary or secondary fusion) including continuous casting;
- 98 – Other activities pursuant to Article 10a of Directive 2003/87/EC.

Where a verifier is accredited to or can demonstrate compliance with other international standards and programmes that may be relevant to its ability to comply with CBAM requirements, the accreditation body must consider these while assessing the verifier application for accreditation under CBAM.

F6.3.3 Assessment of applications for accreditation

F6.3.3.1 Application assessment

Only after the submission of a fully completed application for accreditation will the accreditation body start their assessment process. There is no defined period for the completion of this assessment.

During the assessment of the verifier, the accreditation body must determine whether the verifier:

- meets the requirements set out in the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
- is able to carry out CBAM verification activities in line with the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

In the case of a reassessment (section F6.4.2) or an extraordinary assessment (section F6.4.3), the accreditation body must also determine whether the verifier is carrying out CBAM verification activities in line with the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

Only when the accreditation body is satisfied that the above conditions are true, may the accreditation body grant the verifier accreditation for the CBAM.

F6.3.3.2 Scope of accreditation and activity groups

The accreditation body will only provide accreditation where the verifier has demonstrated knowledge and competence in one or more of the CBAM activity groups as set out in Annex IV of the force of law notice.

For example, if a verifier applies for accreditation against the CBAM Activity Group V (Sintered ore, Pig iron, DRI (direct reduced iron) and Crude steel),

if successful, they will only be accredited to undertake verification activities against this CBAM activity group.

F6.3.3.3 Extension of scope

Verifiers can apply to the accreditation body for an extension to their current scope of CBAM accreditation. When such applications are made, the accreditation body must assess these applications to determine whether the verifier meets the following (also referred to in this section of the guidance):

- requirements set out in the force of law notice (ODT, 344KB) (section J.3.3(1)) and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 for verification activities;
- are able to undertake CBAM verification activities as set out in the force of law notice (ODT, 344KB) (section J.3.3(1)) and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

Once an application for an extension to the scope of accreditation has been received, assessed and granted by the accreditation body, the additional scope of accreditation will be added to the accreditation certificate of the verifier.

The addition of the new extension of scope does not change the expiry date of the verifier's existing CBAM accreditation certificate. For example, if the expiry of the verifier's current CBAM accreditation certificate is November 2028 and the extension to their scope of accreditation is granted in March 2028, then the expiry of the new scope of accreditation and the original scope of accreditation would be November 2028.

During the reassessment process, the accreditation body will consider the previous scope of accreditation and the new scope of accreditation.

F6.3.3.4 During the assessment

During the assessment process for CBAM, the accreditation body will need to undertake several activities in order to assess the suitability of the applicant. This assessment process can include:

1) assessing the suitability of the information provided by the verifier in accordance with section J.3.1 of the force of law notice (ODT, 344KB) and referred to in section F6.3;
2) the completion of a site visit to the premises of the verifier with the aim to:
    - review a sample of the internal verification documentation in order to understand the quality of the verification process;

- assess the quality management system as this will cover elements including the document control process, the record retention process, the review process etc.;
- assess the procedures or processes for verification activities to ensure they are established, capture all elements of verification and are suitably documented so they can be accessed by all employees who may require them;
- witness the performance and competence of personnel involved in verifying emissions against the requirements of the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. This will provide reassurance that the staff undertaking the verification activities are competent in the completion of their duties and will ensure the verification activities are being undertaken in line with the requirements of CBAM in the UK.

The accreditation body may also assess any existing accreditation of verifiers. These could be for example, any accreditation the verifiers may have for UK ETS or other schemes which require monitoring and verification requirements which are similar to the monitoring and verification requirements for the CBAM in the UK.

If there are existing accreditations, the verification body will consider the following:

- the complexity of the scope of the existing accreditation to assess its compatibility with the requirements for the CBAM;
- the complexity of the quality management system that has been implemented by the verifier;
- the procedures and information on the verification processes;
- if the verifier is already accredited to the Implementing Regulation (EU) 2018/2067 of 19 December 2018, for the relevant group of activities listed in Annex I of that Regulation;
- other international standards and programmes against which the verifier is already accredited and are compatible with the requirements for the CBAM within the UK;
- any relevant evidence provided in accordance with section J.6.1 of the force of law notice (ODT, 344KB).

The verifier may choose to outsource certain CBAM verification activities, for example when they have been asked to undertake a verification of a CBAM activity group for which they are not currently accredited. In this situation, the accreditation body must carry out the activities referred to in section J.3.3(3)(b) and section J.3.3(3)(c) of the force of law notice (ODT, 344KB) and referred to in point 2 above of the activities of the outsourced body.

F6.3.3.5 Competence requirements for assessors

During the assessment of an application for CBAM accreditation, the accreditation body must ensure the person they appoint to assess an application (the assessor) has the following skills and/or knowledge to carry out the assessment:

- knowledge of the accreditation process for the CBAM;
- knowledge of verification activities;
- knowledge of the monitoring and calculation process for the determination of CBAM emissions;
- knowledge of other applicable legislation, international standards and guidelines;
- the competence and understanding required to assess against the CBAM;
- verification activities in relation to the scope of accreditation;
- knowledge and skills associated with data and information auditing.

F6.3.3.6 Technical experts in accreditation

There may be situations where the accreditation body does not have the necessary skills or knowledge on a particular subject to assess an application made by a verifier. In these situations, the accreditation body can involve a 'technical expert' to assist in their assessment of the application for accreditation.

Where a technical expert has been employed, the accreditation body must ensure this technical expert has:

- knowledge of accreditation for the relevant verification activities;
- knowledge of the monitoring and calculation process for the determination of CBAM emissions;
- knowledge and expertise in the relevant subject matter where the technical expert has gained this knowledge and expertise from:
    - professional experience working in a relevant sector producing CBAM goods;
    - professional experience in providing technical expertise or technical consultation services to manufacturers in a relevant sector.

F6.3.3.7 Application outcome and accreditation certificate

Once the accreditation body has completed its review of the verifier's application for CBAM accreditation (including the renewal of an accreditation or an extension of scope of accreditation), the accreditation body must report its findings to the applicant.

Where the accreditation body has identified that the applicant is not in compliance with any CBAM requirements, it must report these non-conformities to the applicant and give them an opportunity to take corrective action. The accreditation body may only grant CBAM accreditation where the applicant has submitted a response to the accreditation body outlining the actions taken, or the actions they plan to take to resolve the issues. The accreditation body will consider if the actions taken are sufficient and effective. The accreditation body may request further evidence or carry out a follow-up assessment to determine whether the implementation of the corrective action is sufficient and effective.

Where the accreditation body concludes that the applicant meets the relevant requirements set out in section F6.3.3.1 and that any non-conformities have been adequately addressed, the accreditation body will issue an accreditation certificate (or in the case of a reassessment, an updated accreditation certificate). The accreditation certificate must have a validity period of no longer than five years, and the accreditation body must reassess the verifier before the end of this period in accordance with section F6.4.2.

The accreditation body must issue the accreditation certificate in English, and the certificate must contain the following information:

- the identity of the accreditation body;
- the name of the verifier;
- a unique accreditation identification reference for the verifier;
- the scope of accreditation and the relevant CBAM activity groups;
- the country of establishment of the accreditation body and verifier;
- the date of accreditation;
- the date of the expiry of the accreditation;
- a reference to the normative documents used for the assessment.

F6.3.3.8 Information, confidentiality and professional secrecy

The accreditation body must regularly review and publish information relating to its accreditation activities for the CBAM as required by section J.4.3 of the force of law notice (ODT, 344KB). This information must include:

- the fact that the accreditation body undertakes accreditation for the CBAM;
- a list of verifiers that the accreditation body has accredited for the CBAM, along with copies of the accreditation certificates of these verifiers in English.

During the accreditation process, the accreditation body may gain access to information that is confidential or commercially sensitive. The accreditation body must have processes in place to safeguard the

confidentiality of this information to ensure that it is not made publicly available.

F6.4 Control of the Accredited Verifiers

F6.4.1 Annual surveillance

On an annual basis, and within the first 12 months of a CBAM accreditation certificate being granted, the accreditation body must carry out surveillance on each verifier they have accredited. The purpose of annual surveillance is to ensure verifiers are operating in accordance with the verification requirements of the force of law notice.

During the annual surveillance, the accreditation body must assess a representative sample of the verifier's activities in line with the scope of its accreditation, to ensure that the assessment covers a wide range of the verifier's CBAM verification activities.

This assessment must consist of an assessment of the verifier to determine whether it is compliant with CBAM requirements relating to internal verification documentation, quality management system and processes and procedures. It must also consist of witnessing the performance and assessing the competence of a representative number of personnel involved in verification activities. In contrast to the initial assessment and reassessment of the verifier, these assessment activities may be conducted on site or virtually.

Where the verifier outsources certain verification activities, the accreditation body must also carry out these assessment activities on the premises of the outsourced body.

When undertaking annual surveillance, the accreditation body will plan these visits with the help of the verifier to ensure they are completed in a way to allow the accreditation body to effectively assess the activities of the verifier. Once the surveillance visit has been completed, the accreditation body will confirm if the verifier continues to be accredited for CBAM.

F6.4.2 Reassessment

The accreditation body must undertake a re-assessment of a verifier before the expiry of its CBAM accreditation certificate.

As part of the re-assessment process, the accreditation body will assess the ability of the verifier to undertake verification activities in line with their CBAM accreditation certificate. The re-assessment will be conducted in

line with the requirements contained in section J.3.3(1) of force of law notice (ODT, 344KB) and referred to in section F6.3, as per the original CBAM assessment.

This means the accreditation body will:

- ensure the verifier complies with the requirements for verifiers as set out in the CBAM legislation;
- ensure the verifier can and are carrying out CBAM verification activities in line with the requirements of the legislation.

In planning the re-assessment process, the accreditation body will ensure they are able to assess a representative sample of the activities that are carried out by the verifier. This ensures the re-assessment covers the scope of the verifier's CBAM accreditation certificate.

F6.4.3 Extraordinary assessment

During the validity period of a CBAM accreditation certificate, the accreditation body may complete an extraordinary assessment of any aspects of the verifier's competency or activities. The aim of this assessment is to establish if the verifier is continuing to meet the requirements of the CBAM legislation.

The accreditation body may decide to conduct an extraordinary assessment (among other circumstances) in response to:

- a complaint in relation to the verifier;
- other information questioning the compliance of the verifier with the CBAM requirements;
- notification from the verifier regarding significant changes that might affect its accreditation.

If following this extraordinary assessment, the accreditation body establishes that the verifier does not meet the requirements of the force of law notice, the accreditation body must take actions as outlined in section J.3.6 of the force of law notice (ODT, 344KB) and referred to in section F6.3.2.

F6.4.4 Complaints

The accreditation body must accept and investigate complaints regarding the activities of a CBAM accredited verifier.

When a complaint is received, the accreditation body must:

- investigate the complaint to establish if the complaint is valid. This can also involve engaging with the verifier in which the complaint relates and providing them with an opportunity to provide any observation on the complaint;

- ensure all information is reviewed before identifying and taking appropriate actions to address the complaint;
- ensure the following is documented:
  - a record of the complaint, including all communication with the complainant, the verifier and any other relevant person;
  - the action taken to address the complaint;
- provide a response to the complainant.

The accreditation body must complete all the above actions within three months of receipt of the complaint.

F6.4.5 Suspension, reduction of scope and withdrawal of accreditation

The accreditation body must have processes in place for the suspension, reduction of scope and withdrawal of accreditation for the CBAM. The accreditation body must take these actions where they are requested by the verifier, and where circumstances listed in the sections below are met. The accreditation body may also choose to take appropriate action in circumstances beyond those set out below.

Where the accreditation body decides to suspend, withdraw or reduce the scope of an accreditation, it must notify the verifier, with the sanction taking effect on or after the day the verifier is notified.

The notice issued by the accreditation body must provide the following information:

- the actions the verifier will need to complete to restore their CBAM accreditation;
- the appeal route for the decision of the notice.

The accreditation body must consider an appeal from the verifier against its decision.

F6.4.5.1 Suspension and reduction of scope

The accreditation body must suspend or reduce the scope of accreditation of a verifier where the verifier has:

- committed a serious breach of the verification requirements as set out in the force of law notice;
- persistently and repeatedly failed to meet the verification requirements set out in the force of law notice.

The accreditation body may only revoke the decision to suspend an accreditation, where it has concluded that the verifier has addressed the

reason behind the original suspension of accreditation and is compliant with all relevant CBAM requirements.

F6.4.5.2 Withdrawal of accreditation

The accreditation body can withdraw the accreditation of a verifier where:

- the verifier has failed to rectify the shortcomings that constituted the decision to suspend their accreditation;
- a member of the management of the verifier or a member of the personnel involved in the CBAM verification activities has been found guilty of fraud;
- the verifier has intentionally provided false information;
- the verifier has intentionally concealed information.

F6.5 Requirements for a verifier

This section of the guidance looks at the requirements verifiers need to comply with internally within their own organisation to be eligible to undertake CBAM accreditation.

Verifiers undertaking CBAM verification activities, must document, implement and maintain the activities and procedures defined in the force of law notice and explained further in this section of the guidance.

It is important that verifiers are aware of the scope of their accreditation as stated in their CBAM accreditation certificate which is provided by the accreditation body. They must ensure the CBAM verification activities they complete are only conducted in accordance with the activities covered by this scope of accreditation. If there is the need for the scope of accreditation to be expanded, the process stated in section J.3.5 of the force of law notice (ODT, 344KB) and covered in section F6.3.3.3 will need to be followed.

F6.5.1 Verification standards

Verifiers wishing to verify emissions for the CBAM, must be accredited for the CBAM by an eligible accreditation body that meets the requirements explained in section F6.2, section F6.3 and section F6.4.

Verifiers must also be accredited to and comply with the following international standards:

- ISO/IEC 17029:2019 Conformity Assessment – General principles and requirements for validation and verification bodies;
- ISO 14065:2020 General principles and requirements for bodies validating and verifying environmental information.

F6.5.2. Competency requirements for verifiers

Verifiers wishing to undertake CBAM verification activities, must establish, document, implement and maintain procedures to ensure all of the verification team are competent in the tasks allocated to them.

For this process, the verifier will need to establish, document, implement and maintain the following:

- competence criteria of the verification team completing CBAM verification activities. This includes:
  - lead auditor;
  - auditor;
  - technical experts;
  - independent reviewer;

  Further information on the competency for the above roles can be found in section F6.5.4.1, section F6.5.4.2, section F6.5.4.3 and section F6.5.4.4;
- ensuring the continued and regular evaluation of the competency of the verification team;
- ensuring the verification team receive ongoing training in line with their CBAM verification activities;
- processes to assess if the CBAM verification activities fall within the scope of the CBAM accreditation;
- a system to assess the competency of the verification team against the scope of CBAM accreditation;
- ensuring the most appropriate personnel and are selected to form the verification team as per section F6.5.4.1, section F6.5.4.2, section F6.5.4.3 and section F6.5.4.4;
- a system to ensure the verification team are competent to carry out verification activities;
- ensuring the CBAM verification activities can be completed within the required timeframe.

F6.5.3 Monitoring and evaluation

The verifier on at least an annual basis must assess the performance of the verification team, including the:

- lead auditor;
- auditor(s);
- technical expert;
- independent reviewer.

The purpose of this assessment is to ensure the persons who are in the above roles have the skills and knowledge to carry out CBAM verification activities.

This assessment should be conducted in accordance with the systems and processes outlined in section F6.5.2. Where the verifier considers it appropriate, they may undertake such assessment during a CBAM verification. This will allow the assessment of the persons whilst they are actually completing the verification activities that they are being assessed against. If this is the chosen route, the person undertaking the assessment must not have any influence or any input into the verification activities that are being completed. The person who is undertaking the assessment should only be in attendance to assess the performance of the personnel who are completing the CBAM verification process.

When the verifier is planning such an assessment, they should use the competence criteria established in accordance with the requirements explained in section F6.5.2.

If during the assessment, personnel have failed to demonstrate their competence for their assigned task, the verifier must arrange for additional training or further supervision as deemed required. The verifier must monitor their performance until they are able to demonstrate competence in the tasks allocated to them when completing a CBAM verification process.

F6.5.4. Competency of the verification team

When the verifier has received a request to complete a CBAM verification, it must establish a verification team comprising of the following roles:

- Lead auditor;
- Auditors;
- Technical expert (where required);
- Independent reviewer.

The verifier must ensure the verification team as a whole and each member of the verification team has the necessary competence to carry out the verification activities and the verification tasks assigned to them. The personnel who form the verification team must be monitored and evaluated in accordance with section F6.5.3.

In line with the verification requirements for ETS, for CBAM verification the verification team must comprise of at least one lead auditor. However, the verification team can have as many auditors and technical experts that are deemed necessary to enable the completion of the CBAM verification.

The following sections (section F6.5.4.1, section F6.5.4.2, section F6.5.4.3 and section F6.5.4.4) provides an indication into the responsibilities and competencies of each member of the verification team. The verifier must ensure that at least one member of the verification team undertaking the CBAM verification process has:

- technical competence and an understanding of the requirements to assess the specific technical monitoring and reporting aspects as referred to in the force of law notice, and this relates to the activities performed by the operator being audited;
- the ability to communicate effectively in the language that is required to examine the information provided by the operator.

F6.5.4.1 Lead auditor

The lead auditor is the person who takes overall responsibility for the completion of the verification activities, which includes the management of the verification team. As the result of the wide range of activities and responsibilities of the lead auditor, the appointed person must satisfy the following conditions:

- meet the competence requirements of an auditor, as stated in section F6.5.4.2;
- have demonstrated competency to communicate effectively in English in matters relating to verification;
- have knowledge of all the CBAM verification requirements.

F6.5.4.2 Auditor

The verifier must ensure all the auditors who form part of the CBAM verification team are competent to assess the CBAM monitoring plans and verify emissions in accordance with the requirements of the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

This means the auditors will need to have awareness of the following to enable CBAM verification activities to be completed:

- CBAM accreditation and verification activities – this ensures the auditors are aware of the requirements for CBAM verification. This also provides confidence to the operator that the CBAM verification process is being completed correctly and in line with the required standards;
- perform verification related activities – this ensures the auditors are aware of the tasks they need to complete as part of the verification process, including the understanding of the emissions report produced by the operator, as this enables the auditor to conclude if the reported data is acceptable;
- sector specific knowledge and experience – having this knowledge will help the auditors understand the activities performed at the installation. It will also help with the understanding of the monitoring and reporting process which relate to the activities performed by the operator;

- awareness of legislation, verification standards and guidelines for the CBAM – this for example includes awareness of the Finance Act 2026, The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026, System Boundaries document, force of law notice, verification standards as referred to in section F6.3.2 etc.

It is important for auditors to have knowledge and experience of the following:

- data and information auditing and the methodologies used for such auditing processes – this will help the auditors with the interpretation of the monitoring data from the operator;
- materiality application of materiality levels and the assessment of material misstatements – this is needed to enable the auditor to assess if the emissions report is free of material misstatements and the reported data is in line with the materiality level stated in section F6.7.7;
- risk analysis and risk control – this will help the auditor when reviewing the information provided by the operator. It enables the auditor to identify areas of risk during the course of the audit process and the review of the controls that have been implemented to manage the risk;
- techniques for the sampling and assessment of data – this will be a key task that will be completed by the auditor, so it is vital that the auditor has the skills and experience of dealing with and the interpretation of a large volume of data;
- checking data flow activities – it is vital for CBAM that the auditor has this skill to enable them to trace the raw data used as part of the emission calculations back to the source data. This source data could be meter readings (either direct or indirect), weighbridge records, invoices, usage logs, stocktake readings etc.;
- information/IT systems – due to the large amount of data being collected, operators will likely use IT systems for the storage and interpretation of the data (e.g. excel etc). Therefore, it is vital the auditor has IT skills to enable them to review this data to ensure its free of errors, either in the data itself or in the calculations performed by the IT systems;
- checking control systems and procedures – a requirement of CBAM is the establishment of a monitoring plan which is supported by other documentation such as procedures and work instructions. The auditor will need experience of reviewing such control documents to ensure the operator has established and implemented suitable control systems for the collected data.

F6.5.4.3 Technical expert

There may be cases where the verifier does not have the required level of

competence with a particular element of the verification process. In these cases, the verifier can employ the services of a technical expert. When selecting a technical expert, the verifier must ensure they have:

- a detailed knowledge, competency, and expertise in the specific area that the verifier requires support;
- a sufficient understanding of the issues referred to in the following sections of the force of law notice (ODT, 344KB):
    - J.6.4(4)(a) – knowledge of accreditation, of verification activities and of the monitoring and calculation of embodied emissions pursuant to CBAM and other applicable legislation, international standards and guidelines;
    - J.6.4(4)(b) – knowledge and experience of data and information auditing;
    - J.6.4(4)(c). – the ability to perform the activities related to the verification of an operator's emissions report.

The above points are also covered in section F6.5.4.2 of this guidance.

When a technical expert has been appointed by a verifier, they must undertake the tasks given to them by either the auditors (including the lead auditor) or the independent reviewer. These two roles must maintain the responsibility for the conclusion of the verification process when a technical expert has been employed.

The verifier must ensure when a technical expert has been employed, they remain impartial and independent of the operator on which a CBAM verification audit is being completed. If during the course of the work the technical expert discovers anything that may affect their ability to remain impartial, they should raise this immediately with the lead auditor or independent reviewer.

F6.5.4.4 Independent reviewer

The independent reviewer is responsible for reviewing the CBAM verification report and the CBAM verification summary documents. The aim of the independent review (see section F6.8.10) is to ensure the verification process has been completed in line with the requirements for CBAM verification.

The verifier must ensure the independent reviewer has the ability and authority to review all internal verification documentation relating to the CBAM verification process and is able to make comments on the completed verification report and summary.

As the role of the independent reviewer is wide-reaching, the verifier must ensure the person selected for this role has the competency to undertake the activities asked of them. The independent reviewer must have at least

the same competency as an auditor as defined in section J.6.4(4) of the force of law notice (ODT, 344KB) and referred to in section F6.5.4.2.

Additionally, the independent reviewer must have the necessary competency to undertake the following as defined in section J.6.5(2) of the force of law notice (ODT, 344KB):

- analyse information to confirm its completeness and integrity;
- enquire about any missing information;
- challenge contradictory information;
- review the data trail with the aim to assess if the internal verification documentation is complete and provides sufficient information to support the conclusions of the auditors undertaking the verification process;
- can communicate effectively in English.

The independent reviewer must not have carried out any of the verification activities that are subject to their review.

F6.5.5 Quality management system

Verifiers must establish, implement and maintain a quality management system to ensure the procedures and processes that are used as part of the CBAM verification activities are continually reviewed and improved. This quality management system is needed to ensure the verifier complies with the requirements of the international standards which are referred to in section F6.5.1 and also referenced in section J.6.1. of the force of law notice (ODT, 344KB).

F6.5.6 Additional procedures

A verifier will need to maintain compliance with the documentation required within the international standards referenced in section F6.5.1 and referred to in section J.6.1 of the force of law notice (ODT, 344KB). However, the verifier will also need to establish and follow any internal procedures, processes and arrangements as referenced in section J.6.8 of the force of law notice. This includes:

- procedures for the communication with those operators who are in receipt of a CBAM verification audit, and other relevant parties such as other operators who may require CBAM audits, the accreditation body etc.;
- procedures to ensure the confidentiality of all information obtained and provided by the operator during the CBAM verification process;
- processes for issuing a revised CBAM verification report where errors have been identified after the verification report has been issued and these errors are:
    - in the verification report;

    - in the data supplied by the operator;
- procedures for the outsourcing of verification activities to organisations outside the control of the verifier;
- procedures to ensure the verifier takes full responsibility for the verification activities that are performed by the verification team;
- processes to ensure the proper and continuing functioning of the quality management system that is referred to in section F6.5.5 and referenced in section J.6.7 of the force of law notice (ODT, 344KB). This includes the completion of:
    - a review of the quality management system, which must be completed at least once per 12-month period, within a period not exceeding 15 months between reviews;
    - an internal audit that must be completed at least once per 12-month period, with a period not exceeding 15 months between internal audits.

F6.5.7 Records and communication

A verifier will be required to manage and maintain records of its CBAM verification activities. This ensures they are able to demonstrate compliance with the requirements of the CBAM verification process as referred to in the force of law notice and within this section of the guidance.

These records could include, but are not limited to the following:

- records and decisions of completed CBAM verification audits;
- information provided by operators;
- details of the competency of the verification team etc.

If requested, the verifier must make relevant records available to the operator and any other relevant parties who may request to see the records as per the international standards as referred to in section F6.5.1 and section J.6.1 of the force of law notice (ODT, 344KB).

The verifier must make the accreditation body aware of any significant changes to their operational activities that might affect either the scope of accreditation or scope of operation.

F6.5.8 Impartiality and independence

This section of the guidance looks at the requirements the verifier must undertake to ensure they and their verification team remain impartial and independent whilst undertaking CBAM verification activities. It is important verifiers remain impartial and independent whilst undertaking verification activities. This represents the cornerstone of credible verification processes. It ensures the outcome of the verification activities are trustworthy and free from external influence.

If verifiers do not remain independent, they will have conflicts of interest which may pressure them to alter the verification findings. Without impartiality, personal bias or poor verification methodologies can compromise the truth during the verification activities.

F6.5.8.1 General requirements

During the course of their business activities, verifiers will have dealings with several organisations. It is expected that during these interactions they will deal with operators who undertake similar activities and produce the same CBAM goods. In these cases, it is important that the verifier remains impartial throughout their interactions with operators, and they do not have dealings that could affect their impartiality and independence as referenced below and referred to in section J.6.10.1 of the force of law notice (ODT, 344KB).

Verifiers must not undertake any verification activities that could result in an unacceptable risk to their impartiality or where they may have a conflict of interest. This applies both to members of the verification team and any contracted third parties such as technical experts etc.

Verifiers must apply the requirements relating to their impartiality and independence as per the international standards referenced in section F6.5.1 and referred to in section J.6.1 of the force of law notice (ODT, 344KB).

Verifiers must ensure they are:

- independent from the operator where a CBAM verification is taking place;
- impartial whilst carrying out the CBAM verification activities
- are not any part of the same legal entity and are not:
    - an operator;
    - the owner of an operator;
    - owned by an operator.

Further information on conflict of interest is referred to in section F6.5.8.3, while information relating to impartiality and independence is referred to in section F6.5.8.5.

F6.5.8.2 Unacceptable risks

As part of the management of impartiality and conflict of interest, the verifier will need to develop procedures to help them identify and manage unacceptable risks. If a verifier does not have these procedures in place, there could be an increased risk during the CBAM verification activities.

An unacceptable risk would have considered to have occurred when any part of the verification team, including technical experts, or any part of the same legal entity as the verifier has:

- provided consultation services to an operator for the development of their CBAM monitoring plan and procedures, and it is these documents and procedures that are being verified as part of the CBAM verification activities;
- provided technical assistance to the operator for the development and maintenance of the system that is used for CBAM monitoring and reporting processes.

In both the above situations, if the verifier continued with the verification process, they would effectively be verifying their own work which will lead to an unacceptable risk and a conflict of interest.

F6.5.8.3 Conflict of interest

During CBAM verification activities, verifiers must be aware of any potential conflict of interests that may occur during the verification activities. A conflict of interest could occur in the following situations:

- the relationship between the verifier and operator is based on:
  - common ownership;
  - common governance;
  - common management or personnel;
  - shared resources;
  - common finance;
  - common contracts or marketing;
- the operator has received consultation services or technical assistance from an organisation that has a relationship with the verifier, which could threaten the impartiality of the CBAM verification process.

Further information relating to the last point above, can be found in section J.6.10.3(2) of the force of law notice (ODT, 344KB).

F6.5.8.4 Outsourcing of verification activities

During the CBAM verification activities (the pre-contract stage or during the verification activities), the verifier may consider outsourcing various aspects of the verification process such as the auditors, technical experts etc. However, there are 3 elements of the CBAM verification process that must not be outsourced. These include:

- the independent review;
- the drafting of the verification report;
- the issue of the verification report.

The verifier cannot outsource the independent review element of the verification process.

There may be occasions where the verifier will need to outsource certain CBAM verification activities. In these cases, the verifier must in accordance with ISO 14065 and ISO17029:

- retain full responsibility for the CBAM verification process and for the completion of the CBAM verification report;
- have procedures or processes in place for outsourcing activities to other bodies;
- where CBAM verification activities have been outsourced, evidence must be retained to demonstrate that the outsourced bodies comply with the competency requirements as per section F6.5 and the independence and impartiality requirements as referenced in section F6.5.8.5;
- obtain consent from the operator to use the outsourced bodies as part of the CBAM verification process;
- have documented legal agreements in place with the outsourced body for the provision of the work for the CBAM verification process.

It is important the verifier has procedures and process for the management of outsourced activities. These procedures and processes will form part of the annual surveillance checks that are completed by the verification body to which the verifier is accredited.

F6.5.8.5 Consecutive verifications of the same installation

Where the verifier is employed year after year by the same operator, there is a risk that the verifier's impartiality could become compromised. Therefore, when selecting a verification team and before assigning the verification activities, the verifier must assess the risks to their impartiality and take action to mitigate these where necessary.

To mitigate these risks, section J.6.10.6 of the force of law notice (ODT, 344KB) sets out that, if an individual has been a lead auditor for the verification of an installation for five years in a row, and no other individuals have acted as lead auditor in that time, that individual must take a three-year break from providing verification services to that installation.

F6.6 CBAM verification process

This section of the guidance looks at the verification activities that are to be undertaken by the auditors who are completing the verification process on an operator manufacturing CBAM goods.

F6.6.1 General obligations of the verifier

The purpose of the verification process is to determine whether the emissions data monitored by the operator, has been monitored in accordance with the requirements of the CBAM legislation, and whether the verifier can have reasonable assurance that the data is accurate and free of material misstatements. To have reasonable assurance, the verifier must obtain sufficient evidence from the operator that demonstrates that there are no material misstatements.

To establish this, the verifier must assess the following during the verification process:

- whether the operator's emissions report is complete and meets the requirements of section A.7 of the force of law notice (ODT, 344KB);
- whether the operators monitoring arrangements are in line with the monitoring plan provided to the verifier;
- whether the operator can provide evidence demonstrating that the data in the operator's emissions report are free of material misstatements in accordance with the materiality threshold reference in section F6.7.7 and referred to in section J.7.10 of the force of law notice (ODT, 344KB);
- whether the operator can provide information supporting its data flow activities, control system and any procedures to improve their monitoring and reporting activities.

F6.6.2 Mutual recognition of verifiers

Where an installation uses precursor goods, it may choose to use actual values obtained from the installation producing the precursor goods when calculating the precursor emissions. If it does so, it must ensure these emissions have been verified in line with the requirements set out in the force of law notice and The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. However, the emissions from the precursor good's do not need to be verified by the same verifier who is verifying the emissions of the complex good.

Where the emissions from the precursor goods have been verified as satisfactory by a verifier that is accredited for CBAM by an eligible accreditation body, the verifier of the complex CBAM good's emissions should recognise this as equivalent to conducting its own verification of the precursor's emissions. This should include accepting the verification report or verification summary of the emissions of the precursor goods as evidence.

F6.7 Verification contractual tasks

Before a verifier can complete their CBAM verification activities, they need to obtain an understanding of the activities undertaken by the operator. The aim of this, is to ensure the verifier can undertake the verification activities in line with their scope of accreditation and to ensure there is no conflict of interest as referenced in section F6.5.8.

As a minimum, the verifier should undertake the following:

1. evaluate the risks in undertaking the CBAM verification process;
2. review the information supplied by the operator to determine the scope of the verification activities and to assess if the scope falls in line with the accreditation certificate;
3. determine if competent personnel and resources are available for the selection of the verification team;
4. assess whether they are capable of successfully completing the CBAM verification activities within the specified timeframe;
5. determine if there are any potential conflicts of interests in completing the CBAM verification activities.

The operator should provide the verifier with all relevant information that has been requested, to enable them to carry out the activities as referenced in section F6.7.2.

F6.7.1 Time allocation

When the verifier is determining the time constraints for the verification activities, they should consider the following:

- the complexity of the installation;
- the complexity of the monitoring plan and associated procedures;
- the materiality level;
- the complexity and completeness of the data flow system that is used by the operator;
- the location of information and the data relating to the calculated CBAM emissions.

The verifier should ensure that the verification contract provides for the possibility for time to be charged in addition to the time agreed in the contract, where such additional time is found to be needed for the strategic analysis, risk analysis or other verification activities. The situations where the additional time may be needed should include at least the following:

- during the verification where the data flow activities, control activities or logistics of the operator are more than initially anticipated;
- where misstatements, non-conformities, insufficient data or errors in the data sets are identified by the verifier during the verification.

The verifier should record the time allocated in their internal verification documentation.

F6.7.2 Strategic analysis

Before starting the CBAM verification process, the verifier will need to determine the nature, scale and complexity of the verification tasks they have been asked to undertake. This ensures the verifier can achieve the objective of obtaining reasonable assurance over the accuracy of the operator's emissions data. To achieve this the verifier can undertake a strategic analysis which covers all the activities undertaken by the operator.

As part of this strategic analysis the verifier should collect and review the information referred to in section F6.7.3, as well as any information obtained from previous verifications of the installation.

The verifier must review this information in order to identify and assess:

- the activities carried out by the operator requiring CBAM verification;
- the monitoring plan and the specifics of the monitoring methodology laid down in the monitoring plan;
- the nature, scale and complexity of emission sources and source streams as well as the technical connections between production processes, production routes and other installations;
- the measurement equipment described in the monitoring plan;
- the origins of, and the application of, calculation factors and other primary data sources;
- the data flow activities and the control systems for this data.

When reviewing and assessing the operator's monitoring plan, the verifier should assess:

- if the monitoring plan received from the operator, is the most recent version;
- if there were any non-conformities or recommendations for improvements in the previous CBAM verification report;
- if there have been any changes to the monitoring plan during the monitoring period.

The conclusions of the verifier's strategic analysis of the installation will inform the verifier of the risks that the operator's emissions data may contain errors (see section F6.7.4). This in turn can be used in the setting out of the verification plan to indicate the verification activities to be undertaken for the verifier to be able to conclude with reasonable assurance that the operator's emissions data is free from material misstatements.

F6.7.3 Information from the operator

To allow the verifier to complete the strategic analysis and to identify if the activity of the operator falls inside the scope of accreditation, the operator will need to provide the verifier with at least the following information:

- a description of the installation and the relevant production processes that are relevant for the manufacture of CBAM goods;
- the latest version of the monitoring plan as referenced in section D.4.5.1 and referred to in section A.6 of the force of law notice (ODT, 344KB);
- a description of any changes that the operator has made to the installation or to the approach to monitor CBAM emissions since the last CBAM verification activities were completed;
- a description of procedures that have been established for the management of data flow and data control activities;
- a summary of the control system that has been established for CBAM data;
- a simplified uncertainty assessment for the monitoring equipment used for CBAM, that is under the control of either the operator or others;
- the CBAM emissions report that requires verification;
- where CBAM verification has taken place in previous years, a copy of the emission report;
- if the CBAM verification was completed by a different verifier, a copy of the verification report;
- where non-conformities or recommendations for improvements were identified in the previous CBAM verification report, information on how these have been addressed;
- where applicable, information relating to the emission intensities and verification reports of precursors used by the operator that they do not produce and where relevant, evidence of the time of their production;
- information on any databases and data sources used by the operator for monitoring and reporting purposes;
- any other relevant information deemed necessary to allow the verifier to plan for and carry out the CBAM verification process;
- if the emissions embodied in a precursor good is exempt from CBAM because the precursor has been produced in the United Kingdom, evidence that the precursor goods have been produced in the UK.

F6.7.4 Risk analysis

To ensure the verifier can obtain reasonable assurance that the operator's emission data is free from material misstatements (see section F6.7.7), the verifier needs to plan its activities in such a way so they can obtain sufficient certainty regarding the presence or absence of misstatements.

For the verifier to undertake this, they need to understand the risks involved in verifying the operator's emissions.

The force of law notice sets out three types of risks, these are:

- inherent risk;
- control risk;
- verification risk.

'**Inherent risk**' – means the chance that a parameter in the operator's emissions report (e.g. a meter reading, factor, material analysis result, etc.) contains misstatements which could be material. This is before taking into consideration any control systems that the operator has put in place to minimise these risks. These failures could include:

- errors due to the failure of monitoring equipment such as fuel meters, weighbridges, etc.;
- errors introduced during the management of the flow data, such as errors introduced between the manual reading of meters and the input of the data into electronic spreadsheets;
- incorrect calculations used in the determination of the emission data or the incorrect conversion of the units for fuels, materials etc.

'**Control risk**' – means the chance that a parameter in the operator's emissions report contains misstatements which could be material and these are not detected and corrected by the operator's control systems. This may include:

- failure of automated controls such as the failure of data loggers/pressure and temperature correctors on fuel metering systems which leads to incorrect data is being generated, etc;
- failure to effectively carry out internal audits of the data where errors have not been identified. For example, where audits have not identified errors in electronic spreadsheets such as errors in equations, calculations or where the same electronic spreadsheets have been used over multiple years but the equations in the spreadsheet have not been updated to reflect the current reporting period.

'**Verification risk**' – means the chance that the verifier incorrectly verifies data as satisfactory where that data contains material misstatements and is a product of the inherent risks and the control risks.

To be able to effectively plan verification activities at an installation such that the verifier reduces the verification risk to an acceptable level, the verifier must identify and analyse the inherent risks associated with the installation, the control activities that are in place, and the control risks resulting from the control activities.

When analysing these risks, the verifier should consider the findings of the:

- strategic analysis;
- the information provided by the operator;
- the materiality level.

This means the verifier must ensure the risk analysis takes into account the risks resulting from the scale and complexity of the installation, its emission sources and connections between the emission sources so that the verifier is aware of all the risks across the whole installation producing CBAM goods.

Where the verifier identifies that the operator has failed to identify all the relevant inherent risks and control risks in its risk assessment, the verifier should inform the operator of these issues and any additional findings they may feel relevant to their verification activities.

Where the verifier obtains additional information during the verification process which has an impact on its risk analysis, they should revise the risk analysis, and where appropriate, modify or repeat verification activities to reflect the updated risk analysis.

F6.7.5 Verification plan

Based on the information provided by the operator and the conclusions of the strategic analysis and the risk analysis, the verifier should prepare a verification plan setting out the verification activities that the verifier will conduct during the verification.

The purpose of this verification plan is to help the verifier to reduce verification risk to an acceptable level and enable them to determine, with reasonable assurance whether the operator's emissions data contains material misstatements.

The verification plan must contain at least the following:

- a verification programme describing the nature and scope of the verification as well as when and how these activities are to be carried out;
- a test plan setting out the scope and methods of testing the installation's control activities and procedures for control activities;
- a data sampling plan setting out the scope and methods of sampling data points underlying the aggregated emissions data in the operator's emissions report.

When determining the sampling activities and sample size for testing the control activities in the test plan, the operator should consider the inherent risks, relevant control activities and the objective of minimising verification risks to enable the verifier to conclude with reasonable assurance whether there are errors in the data.

When determining the sampling activities and sampling size for the sampling plan, the verifier must consider:

- the inherent risks and control risks;
- the results of the preliminary analytical procedures conducted on the data as referenced in section F6.8.1 and referred to in section J.7.12(4)(a) of the force of law notice (ODT, 344KB);
- the objective to produce a CBAM verification opinion statement with reasonable assurance;
- the materiality level as referenced in section F6.7.7;
- the materiality of the contribution of the data in question for the overall emissions data.

Where the verifier identifies additional risks or concludes that risks are lower than anticipated, the verifier should update the verification plan to reflect these changes.

F6.7.6 Physical site visits by verifier

The completion of a physical site visit by the verifier is an important aspect of the CBAM verification process. A physical site visit allows the verifier to obtain a better understanding of the nature of the installation and the activities that are completed by the operator during the manufacture of CBAM goods and the production of its emission report.

As a result, the verifier must conduct a physical site visit to the installation at least once during the verification process. However, there are circumstances (explained in section F6.7.6.1 and section F6.7.6.2) where this requirement can be waived entirely or where a physical site visit can be replaced with a virtual site visit.

The purpose of the site visit is to:

- assess the measuring devices and monitoring systems at the operator;
- conduct interviews with staff employed by the operator;
- carry out the required verification activities;
- assess the boundaries of the installation and the production processes of the CBAM goods;
- assess the completeness of source streams, emissions sources, and technical connections;
- gather information and evidence to establish if the operator's emissions report is free from material misstatements.

Depending on the results of the risk analysis, the verifier may also decide to visit other locations associated with the operator. For example, locations owned by the operator where manufacturing activities are undertaken for the final CBAM good being produced.

F6.7.6.1 Conditions for the waiver of a CBAM site visit

The verifier may choose to waive the requirement to carry out a physical site visit entirely if the following conditions are met:

- the same verifier has carried out a physical site visit during the last two monitoring periods immediately preceding the current monitoring period;
- the verifier has sufficient understanding of how the installation functions, its production processes, its monitoring and reporting systems and its control system;
- the verifier does not consider a physical site visit necessary given the nature and complexity of the operators monitoring and reporting system and the inherent and control risks;
- the verifier can obtain and access all information required for the verification remotely;
- the verifier's risk analysis indicates that waiving the physical site visit would not increase the verification risk to an unacceptable level;
- the installation has not undergone any significant changes since the last physical site visit, including:
    - new production processes or production routes;
    - the closing of a production process or production routes;
    - changes in joint production processes of precursor goods and complex goods (see section D4.4);
    - changes in the technical connections between production processes or production routes - for example:
        - new fuels are used, or fuels have been removed from the manufacture of the CBAM good;
        - the introduction of new raw materials;
        - the use of a new source of measurable heat;
        - waste gases are used;
        - a change to the goods produced by the installation;
        - a change to the production process, including the equipment used to manufacture the CBAM good;
        - the use of precursor goods (third party manufacturing) in the production of the final CBAM good; etc.
    - where actual values are used for precursors, changes relating to the precursors produced at the installation or received from other installations;
    - changes in the monitoring methodology;
    - other changes that the verifier considered during the strategic analysis or risk analysis, which requires a significantly different verification approach than was used in the previous verification.

F6.7.6.2 Conditions for the replacement of a physical site visit with a virtual site visit

The verifier may choose to conduct a virtual site visit in place of a physical site visit where the following conditions are met:

- the completion of a physical site visit is prevented due to serious, extraordinary and unforeseeable circumstances outside the control of the operator which cannot be overcome using reasonable efforts, within a reasonable timeframe. Examples include travel restrictions due to conflict or pandemic-related lockdowns;
- the results of the risk analysis indicate that the replacement of the physical site visit with a virtual site visit does not increase the verification risk to an unacceptable level;
- the verifier has identified and taken all necessary measures to reduce the verification risk to an acceptable level, so that reasonable assurance can be obtained, whilst ensuring the CBAM emissions report is free from material misstatements.

The only difference between a virtual and a physical site visit, is with a physical site visit, the verifier attends the installation in person.

A physical site visit may be replaced with a virtual site visit where all the following are met:

- the same verifier has carried out a physical site visit during the last two monitoring periods immediately preceding the current monitoring period;
- the verifier has sufficient understanding of the installation's functioning, its production processes, its monitoring and reporting system and its control system;
- the verifier does not consider a physical site visit necessary given the nature and complexity of the operators monitoring and reporting system and the inherent and control risks;
- the verifier can obtain and access all information required for the verification remotely;
- the verifier's risk analysis indicates that undertaking either a virtual site visit or waiving a physical site visit, is based on the results of the risk analysis and the verifier has taken action to reduce the risks of the verification to an acceptable level so that the CBAM emissions report is free from material misstatements and non-conformities;
- the installation has not undergone any significant changes since the last physical site visit, including:
    - new production processes or production routes;
    - the closing of a production process or production route;
    - changes in joint production processes of precursor goods and complex goods (see section D4.4);

- changes in the technical connections between production processes or production routes - for example:
    - new fuels are used, or fuels have been removed from the manufacture of the CBAM good;
    - the introduction of new raw materials;
    - the use of a new source of measurable heat;
    - waste gases are used;
    - a change to the goods produced by the installation;
    - a change to the production process, including the equipment used to manufacture the CBAM good;
    - the use of precursor goods (third party manufacturing) in the production of the final CBAM good; etc.
- where actual values are used for precursors, changes relating to the precursors produced at the installation or received from other installations;
- changes in the monitoring methodology;
- other changes that the verifier considered during the strategic analysis or risk analysis, which requires a significantly different verification approach than was used in the previous verification.

Where the verifier undertakes a virtual site visit, the purpose of the site visit should be the same (as far as possible) as for a physical site visit. To this end, the verifier may consider undertaking the following to ensure the verification can be completed and a verification opinion given:

- undertake a virtual walk around of the installation (for example via video call) where at least the following can be inspected:
    - the production process;
    - the measurement devices used to measure fuel or material usage;
    - fuel/material storage locations;
- complete virtual meetings (e.g. video calls) with individuals who undertake CBAM monitoring activities.

Where the verifier chooses to undertake a virtual site visit, the operator should assist the verifier in the completion of the verification activities by undertaking the following:

- assist the verifier to complete a virtual walk round of the installation;
- ensure all employees who undertake CBAM monitoring activities are available to meet with the verifier;
- ensure the verifier is provided with all the information required to complete the CBAM verification. This could include the sharing of documentation before or during the verification or providing the verifier with access to online systems used for CBAM compliance.

F6.7.7 Materiality levels

One of the key objectives of verification is for the verifier to be able to determine with reasonable assurance whether the operator's emissions data is free of material misstatements.

Misstatements are errors contained within the operator's emissions data, such as typos, measurement errors or calculation errors. These may be material or non-material.

In general, a misstatement that meets the materiality level must be considered material by the verifier. The materiality level is defined in the force of law notice as being **5% of the total emissions intensity** of the CBAM good. This means that where an error results in an impact on the emissions intensity of a CBAM good that is greater than 5%, it must be considered material.

However, the verifier must also use its expert judgement when determining whether misstatements are material. For example, the verifier must use its judgement to determine whether individual misstatements that by themselves do not meet the threshold of 5% of the overall emissions intensity, are to be considered material if the cumulative impact of the misstatements meets the materiality threshold. Likewise, the verifier must also use its judgement in cases where a misstatement has a substantial impact on a parameter other than emissions intensity but does not have a material impact on overall emissions intensity.

An example of the assessment of materiality is as follows:

- The operator producing the CBAM good consumes 3,000 tonnes of gas/diesel oil annually which is metered through a flow meter.
- The uncertainty is of the flow meter is 8% instead of 6% as stated in their monitoring plan.
- The difference between 6% and 8% of the annual Gas/Diesel Oil consumption is 2% or 60 tonnes of Gas/Diesel Oil.
- As this is less than the 5% materiality threshold, this results in a non-material misstatement being identified for the Gas/Diesel Oil consumption.

F6.8 Verification activities

The following section of this guidance looks at the verification activities the verifier should complete as part of the CBAM verification process.

The verifier should implement the activities identified in the verification plan, which have been designed to reduce the verification risks to an acceptable level. This allows the verifier to determine, with reasonable assurance whether the emissions data from the operator contains any material misstatements. The verifier should check how the operator has

implemented and maintained its monitoring plan. This is to ensure it is consistent with the requirements of the CBAM legislation.

The verifier should conduct a review of the analytical procedures, data verification and check the correct application of the monitoring plan.

As part of the above, the verifier should check the following:

- the data flow activities and the systems used as part of the data flow;
- the documentation of the control activities to ensure they are documented, implemented, maintained and are effective to mitigate inherent risks;
- the procedures listed in the monitoring plan to ensure they are appropriate and effective to:
    - mitigate the inherent risks;
    - mitigate the control risks;
- the monitoring plan is documented sufficiently and maintained.

F6.8.1 Analytical procedures

During the verification process, the verifier will conduct an analytical procedure assessment. This is to ensure the plausibility and completeness of the data produced by the operator to ensure:

- there are no data gaps in the presented data;
- the identification of any outliers in the data set (i.e. data that is different to the rest of the data set);
- there are no errors in the data;
- it covers the whole data set used by the operator;
- it covers the control activities for the data set used by the operator.

The verifier must assess the data collected by the operator to identify any areas of risk. Where these have been identified, the verifier must amend the verification process as appropriate, to address these identified risks. As a minimum, the verifier must:

- assess the plausibility of fluctuations and trends over time or between comparable items;
- identify outliers, unexpected data and data gaps.

In applying analytical procedures, the verifier must undertake the following as per section J.7.12(4) of the force of law notice (ODT, 344KB):

- preliminary analytical procedures – are conducted on the aggregated data and this feeds into the development of the verification plan;
- substantive analytical procedures – checks whether the underlying data support the aggregated data and whether there are any outliers or structural errors;

- final analytical procedures – checks to ensure all errors that are identified are corrected.

It is important that where the verifier identifies outliers, fluctuations, trends, data gaps and data that is inconsistent and differs significantly from the expected amounts, they obtain clarification from the operator as to the cause of these differences. In response the operator should provide evidence to the verifier. Upon receipt of this evidence, the verifier shall assess the impact on the verification plan and the verification activities.

F6.8.2 Data verification

The verifier must verify the data contained within the operator's emissions report. Data verification may include:

- tracing the data in the report back to the primary source of the data, which may include:
  - the review of the use of data in calculations;
  - establishing where the data used in the calculations originated;
  - review any data held in spreadsheets;
  - review where the data in spreadsheets originated from, for example notebooks, log sheets etc.;
- a crosscheck of the data with external sources, e.g. cross-checking data used in the calculations with the data contained in invoices, half hour metering data etc.;
- performing reconciliations;
- checking thresholds;
- appropriating the provided data to carry out recalculations to confirm that the data stated in the CBAM emissions report is correct.

As part of the data verification process, the verifier must consider the details contained in the monitoring plan and any procedures established for CBAM compliance.

When reviewing the monitoring plan or procedures, the verifier must review the following:

- the boundaries of the operator;
- the boundaries of the production processes and production routes;
- the completeness of the source streams and emission sources;
- any technical connections between CBAM installation production processes and with other installations or non-CBAM production processes;
- the consistency of the data reported in the CBAM emission report;
- the consistency of the primary data sources;
- data from the primary data source compared to the corroborating data source, if available;
- where the operator has applied a measurement-based methodology, the measured values against the respective corroborating calculation;

- the activity levels of the production processes;
- the reliability and accuracy of the data used to produce the CBAM emission report.

F6.8.3 Verification of the correct monitoring methodology

The verifier must confirm that the monitoring arrangements at the installation have been implemented in accordance with the monitoring plan, and that the monitoring plan is compliant with the CBAM requirements for the monitoring methodology as set out in the force of law notice. To do this, the verifier must check:

- whether the data is complete or whether there are data gaps;
- if the approach taken to addressing data gaps is appropriate and does not lead to an underestimation of emissions;
- if the operator's sampling plan has been correctly applied;
- whether data has been attributed to production processes correctly and in line with the requirements of the force of law notice and the system boundaries document;
- whether activity levels have been monitored correctly and based on the correct application of the definitions of aggregated goods categories;
- where precursor goods from another installation are used:
    - any emissions used were verified as satisfactory by an eligible verifier in accordance with the CBAM requirements;
    - any emissions used, relate to an appropriate monitoring period (and whether there is sufficient evidence of the actual time of production where that is used as the monitoring period);
    - any default values used are correct, as published by the UK Government;
    - if any exemptions of emissions of UK produced precursor goods have been applied correctly;
- in cases where bioliquids are used for energy generation, the operator is able to demonstrate and has evidence that the bioliquid complies with the sustainability criteria set out in section D4.6.3 of this guidance;
- in cases where CO_2 and N_2O are transferred out of the installation producing CBAM goods for geological carbon capture and storage and permanent carbon capture, the approach for the determination of these captured emissions has been applied correctly as per section D4.6.5.

F6.8.4 Precursor goods used but not produced at the installation

Where the operator uses actual values for any precursor good used during the manufacture of their CBAM good, the verifier must confirm that the precursor emissions have been verified as satisfactory by an eligible verifier, in accordance with the CBAM requirements.

The verifier must check that the operator possesses a verification report for the precursor good. It must also confirm that this verification report meets the following conditions:

- at the time the verification report was issued, the verifier carrying out the verification process held a valid accreditation certificate to the required scope to undertake the verification process;
- the verifier's opinion statement indicates that the operator's emissions report was verified as satisfactory;
- the verification report for the precursor good covers a monitoring period that is appropriate for the precursor good.

Where the operator has used a precursor good that has been produced in the United Kingdom whose emissions are exempt from CBAM, the verifier must confirm whether the operator possesses sufficient evidence that the precursor good is of UK origin. Evidence of origin may include:

- address of the installation at which the precursor good was produced, including location and identifying details;
- Certificate of Origin;
- supplier declaration confirming UK origin;
- production, purchase or supply documentation identifying the origin of the precursor good;
- verification reports relating to the precursor good;
- records demonstrating the production route and supply chain of the precursor good;
- bills of materials and production process information demonstrating substantial transformation in the UK;
- commercial invoices linking the precursor good to the imported CBAM good;
- commercial documents, including record of movement of goods in the UK;
- UK customs duty documents, including eligibility for relief;
- repayment or remission of duty documents;
- evidence of UK origin materials, already carbon taxed, in reimported goods;
- other similar documentation that the verifier considers appropriate evidence.

Where the verifier is unable to confirm that the above requirements are met, it must take the appropriate action to address the resulting non-compliance in line with the section F6.8.6 and section F6.8.7 and determine whether the impact of this non-compliance is considered material.

F6.8.5 Sampling

As part of the CBAM verification activities, the verifier will need to undertake sampling activities. These activities could be on the:

- data used for the CBAM emission report;
- checking the conformity of the control activities;
- checking any procedures that the operator has established.

The sampling methods that the verifier will be required to undertake, will be specific to the installation being verified and the justification will be based on the results of the verifier risk analysis as referenced in section F6.7.4.

Should the verifier identify a non-conformity or a misstatement during the sampling of the operator's information, the verifier will need to clarify the results with the operator. The operator will need to explain the reason for this non-conformity or misstatement to allow the verifier to assess the impact of the non-conformity or misstatement on the reported CBAM data. Following the assessment of the information provided by the operator to the verifier, the verifier must assess the impact on the reported data. Following this review, the verifier must determine if:

- additional verification activities are needed;
- the sample size needs to be increased;
- any elements of the data need to be corrected by the operator.

Following the completion of the sampling activities on the operator's data and where required the data relating to precursor goods that may be used by the operator, the verifier will need to document the results of this sampling activity within their internal verification documentation. Additionally, any additional checks the verifier has undertaken should also be documented within their internal verification documentation.

F6.8.6 Addressing misstatements, non-conformities and non-compliances

The verifier must raise any misstatements, non-conformities or non-compliances that it identifies with the operator without undue delay and must ask the operator to take action to correct these issues.

Where the operator has corrected any misstatements, non-conformities or non-compliances, the verifier must document this within the verification documentation.

F6.8.7 Uncorrected misstatements, non-conformities and non-compliances

Where the operator has not corrected misstatements, non-conformities or non-compliances that has been identified by the verifier, the verifier must

ask the operator to explain the causes of these and the reasons for not correcting them.

The verifier must then use its judgement to determine the materiality of the outstanding misstatements, non-conformities and non-compliances.

The verifier must determine whether uncorrected misstatements, individually or when aggregated with other misstatements, have a material impact on the total emissions intensity reported for each CBAM good. They must also consider the size and nature of the misstatement and the circumstances of its occurrence when determining the materiality of the misstatement. If the operator's emissions report contains uncorrected misstatements that the verifier considers material, then the verifier cannot issue a verification opinion statement indicating that the data has been verified as satisfactory.

The verifier must determine whether any uncorrected non-conformities have an impact on the reported data and whether this would lead to a material misstatement.

The verifier must determine whether uncorrected non-compliances have an impact on the reported data and whether this would lead to a material misstatement.

Where non-conformities or non-compliances have a clear impact on the data, the verifier must determine whether this impact would lead to a material misstatement, either individually or when aggregated with other misstatements. Where the impact of the non-conformities or non-compliances on the reported data is not clear (for example, if the control system set out in the monitoring plan has not been implemented or if the operator does not possess adequate evidence that precursor emissions have been adequately verified), the verifier should use its judgement to determine whether any potential impact would result in a material misstatement.

The verifier should also consider the objective of determining with reasonable assurance whether the operator's emissions report is free of material misstatements. If the presence of uncorrected non-conformities or non-compliances means that the verifier does not have adequate evidence to reach a conclusion with reasonable assurance, then this must be reflected in the verification opinion statement.

The verifier must ensure that the decision by the operator not to correct a misstatement, non-conformity or non-compliance is documented within their verification documentation, and any uncorrected misstatements, non-conformities or non-compliances are recorded on the verification report.

F6.8.8 Addressing outstanding non-material non-conformities

Where non-conformities have been identified for the previous monitoring period, the verifier must assess whether the operator has corrected these, even where they were considered to be non-material.

If the verifier has not corrected the non-conformities, the verifier must consider whether the failure to address them has increased the risk of misstatements, and whether these could be material. If the verifier considers that this increases the risk of material misstatements and this means the verifier is unable to conclude with reasonable assurance that the operator's emissions data is free from material misstatements, the verifier must reflect this when issuing the verification opinion statement.

The verifier must document whether the operator has corrected these non-conformities in its verification report and in its internal verification documentation.

F6.8.9 Improvements in the CBAM monitoring and reporting process

When conducting the verification process, the verifier may identify recommendations for improvement to the operator's monitoring arrangements and control activities. Where it has identified areas for improvement, the verifier must include these within the verification report. These recommendations for improvements may relate to:

- the risk assessment;
- the development, documentation, implementation and update of data flow activities and control activities;
- the evaluation of the control system;
- the development, documentation, implementation and update of procedures;
- the monitoring and reporting of emissions, including measuring and reducing risks to enhancing monitoring and reporting efficiency.

When communicating these recommendations for improvements, the verifier must not give the operator advice or consult on developing parts of the monitoring and reporting process in order to maintain its impartiality.

Should the verifier identify that there were recommended improvements in the verification report for the previous monitoring period, the verifier must investigate how the operator has addressed these recommended improvements. If the verifier identifies that the operator has not undertaken any action on the recommended improvements, the verifier must assess the impact on the misstatements and non-conformities.

F6.8.10 Independent review

Before issuing the verification report, the verifier must submit the verification documentation and the draft verification report to an independent reviewer for the independent review.

The purpose of the independent review is to determine whether the verification process has been conducted in accordance with the CBAM requirements and whether the procedures for verification activities have been correctly carried out. This includes assessing whether the evidence gathered during the verification process is sufficient to enable the verifier to determine with reasonable assurance whether the operator's emissions data contains material misstatements. As a result of this, the independent review must cover the full verification process up to the production of the draft verification report.

If the independent reviewer identifies that the verification process has not followed all the requirements of the legislation or that the verifier has concluded that the operator's emissions data is free from material misstatements, but this has been based on inadequate evidence, the independent reviewer should review this with the lead auditor. The lead auditor should take the appropriate actions to address these concerns, such as obtaining the required evidence or including a different verification opinion on the verification report. The verifier must not issue the verification report until the appropriate corrective actions have been completed.

If following the initial independent review, there are changes made to the verification report, it is important that these changes are subject to a further independent review and before the verification report is issued.

The independent reviewer must meet the conditions described in section F6.5.4.4. It is important that this person is not part of the verification team and has not been part of any of the verification activities that are subject to their review. This is to ensure the review can be truly independent. It is important to note that the independent review cannot be outsourced by the verifier.

F6.8.11 Authentication of the verification report

Once the independent review has been completed and the CBAM verification report is ready to be issued, the verifier must arrange for the verification report to be authenticated based on the conclusions of the independent reviewer. The person who authenticates the verification report must be duly authorised to do so.

F6.8.12 Internal verification documentation

The verifier must compile internal verification documentation during the verification process, and this must be retained for five years. This allows the independent reviewer to come to a judgement on the verification process and allow for review of the verification by an accreditation body where relevant. The following section of the guidance looks at what verification documentation the verifier needs to manage and who has access to the documentation.

F6.8.12.1 Compilation of the internal CBAM verification documentation

To enable the verifier to complete the CBAM verification process, they will need to establish internal documentation that covers the CBAM verification process. This documentation must cover the following:

- the outcome of the CBAM verification activities that have been completed by the verifier;
- information received from the operator prior to starting the CBAM verification process as referenced in section F6.7.3 and referred to in section J.7.5 of the force of law notice (ODT, 344KB);
- the strategic analysis as referenced in section F6.7.2 and referred to in section J.7.4 of the force of law notice (ODT, 344KB);
- the risk analysis as referenced in section F6.7.4 and referred to in section J.7.5 of the force of law notice (ODT, 344KB);
- the verification plan as referenced in section F6.7.5 and referred to in section J.7.6 of the force of law notice (ODT, 344KB);
- justifications for not completing a physical site visit as referenced in section F6.7.6 and referred to in section J.7.7 of the force of law notice (ODT, 344KB);
- information to support the verification opinion statement including if any misstatements were classed as material misstatements;
- results of the independent review as referenced in section F6.8.10 and referred to in section J.7.21 of the force of law notice (ODT, 344KB);
- results of the authentication process as referenced in section F6.8.11 and referred to in section J.7.22 of the force of law notice (ODT, 344KB).

When the verifier is drafting the verification documentation as referenced above, they must ensure the document is drafted so that it can be understood by others not directly involved in the CBAM verification such as the independent reviewer or the accreditation body.

F6.8.12.2 Access to the internal verification documentation

If the verifier receives a request from the accreditation body for access to the internal verification documentation or other relevant information to allow them to evaluate how the verifier has conducted the verification activities, the verifier must provide access within 30 days of receiving the request.

F6.9 CBAM verification documentation

Once the verifier has completed all its CBAM verification activities, they must provide the operator with a verification report. The contents and the issue of the verification report is covered in the following sections of this guidance.

The purpose of the verification report is to compile the key information in the operator's emissions report that the verifier has verified and to set out the verifier's opinion statement on this information.

Where the verifier's opinion is that the data has been verified as satisfactory (including if there are comments), the data on the verification report can be reported by the liable person to HMRC on the CBAM return. Where this is the case, the verification report (or the relevant good-specific verification summary) must be shared with the liable person and retained by the liable person as evidence that the data being reported has been verified. As a result, the verification report must be written in English.

F6.9.1 Verification report

The verification report must contain at least the contents set out in Annex II of the force of law notice (ODT, 344KB). This means it will contain key information from the operator's emissions report that the verifier has verified.

The verification report will also contain the opinion of the verifier. The verifier's verification opinion statement may be one of the following:

- **verified as satisfactory** – this is where the verifier has concluded with reasonable assurance that the operator's emissions report is free from material misstatements.
  If this is the verifier's opinion statement, the data can be reported to HMRC;
- **verified as satisfactory with comments** – this is where the CBAM emissions report is free from material misstatements, but the report contains uncorrected non-material misstatements, non-conformities or non-compliances, or where the verifier wishes to recommend improvements to the CBAM monitoring and reporting process.
  If this is the verifier's opinion statement, the data can be reported to HMRC;

- **negative verification statement** – this is where the CBAM emissions report contains material misstatements or non-conformities that the operator did not correct before the verification report was issued, or where the verifier could not obtain sufficient evidence to conclude with reasonable assurance that the CBAM emissions report was free from material misstatements.
  If this is the verifier's opinion statement, the data cannot be reported to HMRC.

The report must also contain a verification summary as per Annex III of the force of law notice (ODT, 344KB) for each CBAM good produced by the operator. This verification summary may be shared with the liable person in place of the full verification report.

The purpose of the verification summary is to allow the operator to share the emissions data relating to a particular CBAM good. It also allows the operator to provide evidence that the data has been verified to the liable person without sharing the full details of the operator's other production processes.

The verification summary will contain key emissions information relating to the CBAM good in particular, as well as identification of the installation, its operator and the verifier, without containing information about other production processes at the installation. The full contents of the verification summary are set out in Annex III of the force of law notice (ODT, 344KB).

F6.9.2 Issuing the verification report to the operator

Once the verifier has completed all their verification activities, they must issue the verification report (including the verification summary) to the operator in English. These documents must be issued to the operator as soon as reasonably possible after the conclusion of the CBAM verification. Prior to issuing the verification report, the verifier must ensure there is not another verification report that has been issued to the operator which covers the same monitoring period.

The verifier must issue the verification report in a non-editable document that can be widely shared.

Should the operator identify inaccuracies in the original verification report, as per section F6.5.6, the verifier shall address these inaccuracies and issue an updated verification report.

F6.9.3 Issuing the verification report to others

It is the liable person's responsibility to ensure that they have the necessary evidence in the form of the verification report or verification summary when they report the CBAM values to HMRC. The liable person should receive this from the operator rather than from the verifier. The ultimate responsibility is on the liable person to ensure they obtain the verification report or verification summary.

ANNEX

ANNEX I - Template of the operator's emissions report

Template containing the minimum elements to be contained in the operator's emissions report:

1. Identification of the operator and the installation:
   (a) name of the operator;
   (b) corporate or activity registration number of the operator;
   (c) full address;
   (d) the installation under verification, identified by the following data:
      i. name of the installation;
      ii. applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;
      iii. full address;
      iv. geographical coordinates of the installation's main emission source.
2. Summary of the installation's monitoring plan, containing at least the following information:
   (a) list of all CBAM production processes and routes carried out at the installation;
   (b) list of all non-CBAM production processes carried out at the installation;
   (c) list of the five most important (by mass) goods produced per production process, identified by commodity code;
   (d) list of the five most important (by energy content provided) fuels used at the installation;
   (e) list of the five most important (by emissions) materials used at the installation leading to process emissions;
   (f) if continuous emissions measurement is used at the installation, the relevant greenhouse gases and the five biggest emissions sources, to which it is applied;
   (g) whether any zero-rated fuels are used and how the operator demonstrates the applicability of zero-rating of the fuels;
   (h) whether measurable heat is imported from or exported to other installations or non-CBAM entities, and an identification of those installations or non-CBAM entities.
3. Whether waste gases are produced and used in the installation, or imported from or exported to other installations, or non-CBAM entities, and an identification of those installations or non-CBAM entities;
4. Whether CO_2 transfer applies, and the identity and contact data of a responsible person of the receiving installations, non-CBAM entities, or transport infrastructure or entities to which it is transferred;
5. The total direct emissions of the installation during the monitoring period;
6. If applicable, for new installations, time period (in months) used for the monitoring of emissions;

7. Total goods produced at the installation and per production process, and the quantity produced;
8. If relevant, non-CBAM goods produced per production process and the quantity produced;
9. For each of the goods:
   (a) the emissions intensity of each of the goods;
   (b) the emissions intensity of each of the compositions of the goods, where applicable.
   (c) information on the data quality and methods used, in particular if the emissions intensity has been completely determined based on monitoring, or whether any of the default values made available in accordance with paragraph 11(1) Schedule 17 to the Finance Act 2026 have been used;
   (d) the share of emissions intensity for which default values were used.
10. Total emissions of the installation, including:
   (a) activity data per production process and calculation factors for each source stream used;
   (b) emissions of each emission source monitored using a measurement-based methodology;
   (c) emissions determined by other methods;
   (d) quantities of CO_2 received from other installations, or non-CBAM entities, or exported to other installations, or non-CBAM entities, for the purpose of geological storage or as input to products in which the CO_2 is permanently chemically bound;
   (e) information about data gaps and estimates used.
11. A balance of imported, produced, consumed, and exported measurable heat and waste gases per production process;
12. The quantity of each type of precursor, produced at the installation and used by that installation, excluding precursors produced in the production process in accordance with section I.1. of this notice;
13. The quantity of each type of precursor, produced at the installation and used in each production process, excluding precursors produced in the production process in accordance with section I.1. of this notice;
14. The quantity of each type of precursor, produced outside the installation, and used by the installation;
15. The quantity of each type of precursors, produced outside the installation, and used in each production process;
16. Data on each type of precursor that was used by the installation, and for which default values were used, excluding precursors produced in the production process in accordance with section I.1. of the force of law notice (ODT, 344KB):
   (a) commodity code;
   (b) name of the good;
   (c) country of origin, where it is known and where the precursor was produced outside the installation;
   (d) the applicable default value.
17. Data on each type of precursor that was used by the installation, and for which actual values were used, excluding precursors produced in the production process in accordance with section I.1. of the force of law notice (ODT, 344KB):

(a) commodity code;
(b) name of the good;
(c) country of origin, where the precursor was produced outside the installation;
(d) monitoring period, and indication of whether it was determined using the default monitoring period or the actual time of production;
(e) emissions intensity.

18. Where an installation producing complex goods receives, from another installation, precursors under a given commodity code produced during different monitoring periods, the emissions intensity to be used for that precursor in accordance with paragraph 5 of section I.1.1 of the force of law notice (ODT, 344KB);
19. Where the production process of a complex good used a precursor under a given commodity code obtained from multiple installations, the emissions intensity to be used for that precursor, and an indication whether they were determined by using the default method laid down in paragraph 6 of section I.1.1. of the force of law notice (ODT, 344KB) or by calculating the embodied emissions of the precursor obtained from a specific installation or subset of installations in accordance with paragraph 7 of section I.1.1 of the force of law notice (ODT, 344KB);
20. The quantity of precursors produced at the installation and used in each production process, excluding precursors produced in the production process, in accordance with section I.1. of the force of law notice (ODT, 344KB);
21. Information on the operator and the installation of origin of the precursor:
    (a) name of the operator;
    (b) name of the installation;
    (c) applicable monitoring period.
22. Information on how the attributed direct emissions of each production process were calculated;
23. The activity level and attributed emissions of each production process.
24. A list of all relevant goods produced measured in the functional unit for each commodity code, including precursors not covered by separate production processes than the complex goods in accordance with section I.1. of the force of law notice (ODT, 344KB);
25. Quantity of goods per production route, as follows:
    (a) quantities of each good, measured in the functional unit for each commodity code;
    (b) where the functional unit pursuant to section I.1. of the force of law notice (ODT, 344KB) is different from the tonnes of goods per commodity code, quantities of goods expressed in functional unit produced in the monitoring period per production process;
26. The values for the sector-specific parameters required for each good in accordance with Point 2 of the Annex in the force of law notice (ODT, 344KB).

ANNEX II - Format of the Verification Report

The verification report shall be prepared based on the following:

1. GENERAL IDENTIFICATION DATA
   - 1.1 Identification of the operator and the installation:
     - (a) name of the operator;
     - (b) corporate or activity registration number of the operator;
     - (c) full address;
     - (d) the installation under verification, identified by the following data:
       - i. name of the installation;
       - ii. applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;
       - iii. full address in English;
       - iv. geographical coordinates of the installation, expressed in longitude and latitude, including six decimals.
   - 1.2 Identification of the verification report:
     - (a) unique identifier of the verification report;
     - (b) applicable monitoring period.
   - 1.3 Identification of the verifier
     - (a) name of the verifier;
     - (b) address of the verifier;
     - (c) where the verifier has outsourced verification activities, the address(es) of office(s) of the outsourced verification team;
     - (d) accreditation number of the verifier;
     - (e) name of the accreditation body;
     - (f) country of establishment of the accreditation body;
     - (g) expiration date of the accreditation;
     - (h) scope of accreditation.
2. INFORMATION ON THE VERIFICATION
   - 2.1 Verification team:
     - (a) name of the lead auditor;
     - (b) name of all members of the verification team, including auditors and any technical experts that have been used;
   - 2.1 Details on physical and virtual site visits:
     - (a) if applicable, date of the physical site visits and number of days spent on-site;
     - (b) date of the last physical site visit;
     - (c) if applicable, date and detailed explanation of reasons for carrying out a virtual site visit;
     - (d) if applicable, detailed explanation of reasons for waiving the obligation to carry out a physical site visit;
     - (e) if applicable, date and location of other visits relating to the verification.
   - 2.2 Basis of verification work:
     - (a) objectives of the verification;
     - (b) scope of the verification;
     - (c) scope of accreditation required to perform the verification;

(d) date and version number of the monitoring plan used for the verification (if applicable);
(e) criteria used to verify the operator's report;
(f) materiality levels applied.

2.3 Installation and data verification:

(a) summary of the installation's monitoring plan, containing at least the following information:
  i. list of all CBAM production processes and routes carried out at the installation;
  ii. information on how the attributed direct emissions of each production process were calculated;
  iii. whether any zero-rated fuels are used, and how the operator demonstrates the applicability of zero-rating of the fuels;
  iv. whether measurable heat is imported from or exported to other installations or non-CBAM entities;
  v. whether waste gases are produced and used in the installation, or imported from or exported to other installations or non-CBAM entities;
  vi. whether CO_2 capture is used;

(b) a compilation of the data verified, consisting of the following:
  i. the total direct emissions of the installation during the monitoring period;
  ii. the attributed emissions of each production process;
  iii. quantities of each good measured in the functional unit for each commodity code;
  iv. the emissions intensity of each good produced;

2.4 Data verification of precursors

(a) data on each type of precursor that was used by the installation, and for which default values were used, excluding precursors produced in a joint production process in accordance with A.1.2(9) of the force of law notice (ODT, 344KB):
  i. commodity code;
  ii. name of the good;
  iii. country of origin, where it is known, and where the precursor was produced outside the installation;
  iv. the applicable default value;
  v. Quantity of the precursor used.

(b) data on each type of precursor that was used by the installation, and for which actual values were used, excluding precursors produced in a joint production process in accordance with A.1.2(9) of the force of law notice (ODT, 344KB):
  i. commodity code;
  ii. name of the good;
  iii. country of origin;
  iv. monitoring period, and indication of whether it was determined using the default monitoring period or the actual time of production;
  v. emissions intensity of the good;

vi. quantity of the precursor used;
vii. information on the operator and on the installation of origin of the precursor:
    a. name of the operator;
    b. name of the installation;
viii. information on the verifier who verified the precursor's actual values:
    a. name of the verifier;
    b. address where the verifier is established;
    c. where the verifier outsourced verification activities, address(es) of office(s) from where some verification activities were outsourced;
    d. name of the lead auditor;
    e. accreditation number of the verifier;
    f. name of the accreditation body;
    g. country of establishment of the accreditation body;
    h. expiration date of the accreditation;
    i. scope of accreditation required to perform the verification;
    j. whether the verification report concludes with reasonable assurance that the report is free from material misstatements and material nonconformities;
    k. date of issuance of the verification report;

(c) where an installation producing complex goods, receives precursors under a given commodity code produced during different monitoring periods from another installation, the emissions intensity to be used for that precursor in accordance with subparagraph I.1.1(7) of force of law notice (ODT, 344KB);

(d) where the production process of a complex good uses a type of precursor obtained from multiple installations, the emissions intensity to be used for that precursor, calculated in accordance with subparagraph I.1.1(6) of the force of law notice (ODT, 344KB).

2.5 Verification opinion statement:

(a) the verifier's overall verification opinion statement in line with section 2 of J.8.1. above of the force of law notice (ODT, 344KB);

(b) where applicable, information on material misstatements found and corrected;

(c) where applicable, information of material non-conformities found and corrected;

(d) where applicable, information on remaining misstatements that were not corrected before the issuance of the verification report and whether they are material;

(e) where applicable, information on remaining non-conformities that were not corrected before the issuance of the verification report and whether they are material;

(f) where applicable, information on remaining non-compliance that was not corrected before the issuance of the verification report and whether they are material;

(g) where applicable, recommendations for improvement;

(h) date and signature by an authorised person on behalf of the verifier, including their name.

2.6 Optionally, good-specific verification summary (as outlined in Annex III of the force of law notice (ODT, 344KB).

ANNEX III - Verification Summary

1. GENERAL IDENTIFICATION DATA
   - 1.1 Identification of the operator and the installation:
     - (a) name of the operator;
     - (b) corporate or activity registration number of the operator;
     - (c) full address;
     - (d) the installation under verification, identified by the following data:
       - i. name of the installation;
       - ii. applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;
       - iii. full address in English;
       - iv. geographical coordinates of the installation, expressed in longitude and latitude, including six decimals.
   - 1.2 Identification of the verification summary
     - (a) unique identifier of the verification report;
     - (b) applicable monitoring period.
2. IDENTIFICATION OF THE VERIFIER
   - 2.1 Identification of the verifier:
   - (a) name of the verifier;
   - (b) address of the verifier;
   - (c) where the verifier has outsourced verification activities, the address(es) of office(s) of the outsourced verification team;
   - (d) accreditation number of the verifier;
   - (e) name of the accreditation body;
   - (f) country of establishment of the accreditation body;
   - (g) expiration date of the accreditation;
   - (h) scope of accreditation.
3. EMISSION SUMMARY
   - 3.1 the total direct emissions of the installation during the monitoring period;
   - 3.2 the attributed emissions of the specific CBAM good to which the verification summary relates;
   - 3.3 quantities of the good to which the verification summary relates;
   - 3.4 the emissions intensity of the good to which the verification summary relates;
   - 3.5 Data verification of precursors;
     - (a) data on each type of precursor that was used by the installation, and for which default values were used, excluding precursors produced in a joint production process in accordance with A.1.2(9) of the force of law notice (ODT, 344KB):
       - i. commodity code;
       - ii. name of the good;
       - iii. the applicable default value;
       - iv. Quantity of the precursor used.
     - (b) data on each type of precursor that was used by the installation, and for which actual values were used, excluding precursors produced in a joint production process in accordance with A.1.2(9) of the force of law notice (ODT, 344KB):

i. commodity code;
ii. name of the good;
iii. country of origin;
iv. monitoring period, and indication of whether it was determined using the default monitoring period or the actual time of production;
v. emissions intensity of the good;
vi. quantity of the precursor used;
vii. information on the operator and on the installation of origin of the precursor:
    a. name of the operator;
    b. name of the installation;
viii. information on the verifier who verified the precursor's actual values:
    a. name of the verifier;
    b. address where the verifier is established;
    c. accreditation number of the verifier;
    d. name of the accreditation body;
    e. country of establishment of the accreditation body;
    f. expiration date of the accreditation;
    g. whether the verification report concludes with reasonable assurance that the report is free from material misstatements and material nonconformities;
    h. date of issuance of the verification report;

(c) where an installation producing complex goods, receives precursors under a given commodity code produced during different monitoring periods from another installation, the emissions intensity to be used for that precursor in accordance with subparagraph I.1.1(7) of the force of law notice (ODT, 344KB);

(d) where the production process of a complex good uses a type of precursor obtained from multiple installations, the emissions intensity to be used for that precursor, calculated in accordance with subparagraph I.1.1(6) of the force of law notice (ODT, 344KB).

4. VERIFICATION OPINION STATEMENT

a. the verifier's overall verification opinion statement in line with section 2 of J.8.1. above of the force of law notice (ODT, 344KB);

b. date and signature by an authorised person on behalf of the verifier, including their name.

ANNEX IV: List of Abbreviations

Abbreviation	Full term
AD	Activity Data
AEM	Anode Effect Minutes
AEO	Anode Effect Overvoltage
AL	Activity Level
AOD	Argon Oxygen Decarburisation.
BAT	Best Available Techniques
BF	Biomass Fraction
BFG	Blast Furnace Gas
BOF	Basic Oxygen Furnace
BOFG	Basic Oxygen Furnace Gas
BREFs	Best Available Techniques reference documents
CBAM	Carbon Border Adjustment Mechanism, the
CCR	Clinker to Cement Ratio
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CCUS	Carbon Capture, Utilisation and Storage
CEMS	Continuous Emission Measurement Systems
CF	Conversion Factor
CFP	Carbon footprint of products
CHP	Combined Heat and Power
CKD	Cement Kiln Dust
COG	Coke Oven Gas
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
EF	Emission Factor
EFTA	European Free Trade Area
EORI	Economic Operator Registration and Identification
ETS	Emissions Trading System
EU ETS	EU Emissions Trading System
EUA	EU Allowances (used in the EU ETS)
EUR	Euro (currency)
FAR	Free Allocation Rules (Regulation 2019/331)
GHG	Greenhouse Gas
GWP	Global Warming Potential
HBI	Hot Briquetted Iron
HS	Harmonised System (for international trade)
IEA	International Energy Agency
ISO	International Organization for Standardization
LULUCF	Land-use, land change and forestry (criteria)
MMD	Monitoring Methodology Documentation
MRR	Monitoring and Reporting Regulation (Regulation 2018/2066)157

MRV	Monitoring, Reporting and Verification
MS	Member State(s)
MWh	Megawatt-hour
NCV	Net Calorific Value
NPI	Nickel pig iron
OF	Oxidation Factor
PCI	Pulverised Coal Injection
PEMS	Predictive Emission Monitoring System
PFC	Perfluoro-carbon
PoS	Proofs of Sustainability
RED II	Renewable Energy Directive (recast) (RED II)
SEE	Specific embodied emissions
TARIC	Integrated Tariff of the European Union database
TJ	Terajoules
TSO	Transmission System Operator
UCC	Union Custom Code
UN/LOCODE	United Nations Code for Trade and Transport Locations

ANNEX V: List of Definitions

Table 1: Monitoring and Reporting Definitions

Term	Definition
'Accuracy'	means the closeness of the agreement between the result of a measurement and the true value of the particular quantity or a reference value determined empirically using internationally accepted and traceable calibration materials and standard methods, taking into account both random and systematic factors;
'Activity data'	means the quantity of fuels or materials consumed or produced by a process relevant for the calculation-based methodology, expressed in terajoules, mass in tonnes or, for gases, volume in normal cubic metres;
'Activity level'	means the quantity of goods to which the same functional unit applies which are in the system boundaries of a production process during the CBAM monitoring period;
'Aggregated goods categories'	means the classifications used to group similar products together for CBAM emission calculation and reporting;
'Agricultural, aquaculture, fisheries and forestry residues'	means residues that are directly generated by agriculture, aquaculture, fisheries and forestry and that do not include residues from related industries or processing;
'Attributed emissions'	means the part of the installation's emissions during the monitoring period that are caused by the production process of CBAM goods;
'Batch'	means a quantity of fuel or material that has been representatively sampled, characterised, and transferred as one shipment or continuously over a specified period of time;
'Biofuel'	means liquid fuel for transport produced from biomass;
'Biogas'	means gaseous fuels produced from biomass;
'Bioliquids'	mean liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass;
'Biomass'	means the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin;
'Biomass fraction'	means the ratio of carbon stemming from biomass to the total carbon content of a fuel or material, expressed as a fraction;

'CBAM good'	means a good specified by Schedule 16 of the Finance Act 2026;
'CCUS system'	means a group of operators/installations that are technically connected to a network that captures and transports CO_2 for either use in the production of goods, or for geological storage;
'Calculation factors'	means net calorific value, emission factor, preliminary emission factor, oxidation factor, conversion factor, carbon content or biomass fraction;
'Calibration'	means the set of operations, which establishes, either in the specifications of the measuring instrument and/or the standards it is compliant with, the relations between values indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values of a quantity realised by a reference standard;
'Carbon dioxide equivalent'	has the meaning given in regulation 8 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Co-product'	means any of two or more products produced from the same production process;
'Combustion emissions'	means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen;
'Commodity code'	means a code assigned to a classification of goods by the Goods Classification Table as per Schedule 16 of the of the Finance Act 2026;
'Complex good'	means a good made using one or more precursor goods;
'Conservative'	means that a set of assumptions that have been defined in order to ensure there is no under-estimation of the reported emissions or over-estimation of production of heat or goods occurs;
'Continuous emission measurement' (CEM)	means a set of operations having the objective to determining the amount by means of periodic measurements, applying either measurements in the stack or extractive procedures with a measuring instrument located close to the stack, whilst excluding measurement methodologies based on the collection of individual samples from the stack;
'Control system'	means the operator's risk assessment and the whole set of control activities, that an operator has established and documented to manage the requirements of CBAM;
'Conversion factor'	means the ratio of carbon emitted as CO_2 to the total carbon contained in the source stream before the emitting process takes place, expressed as a fraction, considering CO emitted to the atmosphere as the molar equivalent amount of CO_2;

'Data flow activities'	means the activities related to the acquisition, processing and handling of data that are required to enable the operator's emissions report to be drafted from primary source data;
'Data set'	means one type of data, either at installation level or at the production process level which is relevant in the following circumstances: (a) the amount of fuel, material consumed or produced by a production process that is relevant for the calculation-based methodology which is expressed in either terajoules or mass in tonnes or for gases as volume in normal cubic metres, including for waste gases; (b) a calculation factor; (c) the net quantity of measurable heat, and the relevant parameters required for determining this quantity, in particular: i. mass flow of heat transfer medium; and ii. enthalpy of transmitted and returned heat transfer medium, as specified by composition, temperature, pressure and saturation; (d) the amount of non-measurable heat, specified by the relevant quantities of fuels used for the production of heat and the NCV of the fuel mix; (e) the amount of CO_2 transferred between installations; (f) the amount of precursor goods received from outside the production process, and their relevant parameters, such as country of origin, used production route, and emissions intensity;
'Default value'	means the amount of carbon dioxide equivalent specified for a tonne of CBAM good or precursor good(b) in a notice published by the Treasury under paragraph 11(1) of Schedule 17 of the Finance Act 2026;
'Direct emissions'	means emissions related to the production processes of CBAM goods. This includes (but is not limited to) emissions from the production of heating and cooling consumed during the production processes, irrespective of whether the heating or cooling was produced on or off site;
'Embodied emissions'	means emissions that are attributable to the production of a CBAM good;
'Emission'	mean the release of greenhouse gases into the atmosphere resulting from the production of goods;
'Emission factor' (EF)	means the average emission rate of a greenhouse gas relative to the activity data of a source stream assuming complete oxidation for combustion and complete conversion for all other chemical reactions

'Emission intensity'	has the meaning given by step 7 of regulation 5, and for a precursor good the meaning set out in a notice under regulation 7 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Emission source'	means a separately identifiable part of an installation or a process within an installation, from which relevant greenhouse gases are emitted;
'Fossil carbon'	has the meaning given in section 1 of the system boundaries document;
'Fossil fraction'	means the ratio of fossil carbon to the total carbon content of a fuel or material, expressed as a fraction;
'Fugitive emissions'	means irregular or unintended emissions from sources that are not localised, or too diverse or too small to be monitored individually;
'Functional unit'	means the amount of goods produced in tonnes (t) classified under the same commodity code. This term is referred to as 'weight' in accordance with Regulation 2 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026. Exceptions to this are as follows: For fertilisers, the following shall constitute the functional unit: a. for commodity codes 2808 00 00, 2814, 3105, the kilograms of nitrogen contained in the goods under the respective commodity codes; b. for the commodity codes of fertiliser other than the ones listed in point (a) above, the supplementary units as laid down in the CBAM regulations of the goods produced under the respective commodity codes. For commodity codes 2523 10 00, 2523 21 00, 2523 29 00, and 2523 90 00, the tonnes of clinker contained in the goods produced under the respective commodity codes shall constitute the functional unit.
'GHG'	means Greenhouse Gas emissions such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O);
'Heat meter'	means a thermal energy meter or any other device used to measure and record the amount of thermal energy produced based upon flow volumes and temperatures;
'Importer'	Means the person on whose behalf the good is imported;
'Inherent CO_2'	means CO_2 which is part of a source stream;
'Installation'	means a stationary industrial unit where CBAM goods, either solely or alongside other goods, are manufactured or processed;
'Joint production process'	means the chemical or physical processes carried out to produce goods, under multiple CN codes, to which different functional units apply, where precursors relevant for complex goods are produced in the same installation as

	the complex goods, and where the respective precursors are not transferred out for sale or use in other production processes, and the operator covers the production of these precursors and complex goods under a joint production process;
'Legal metrological control'	means the control exercised by a public authority or regulator of the measurement task or device that is intended for the field of application for reasons of public interest, public health, public safety, public order, protection of the environment, the levying of taxes and duties, the protection of consumers and for fair trading;
'Measurable heat'	means a net heat flow transported through identifiable pipelines or ducts using a heat transfer medium, in particular, steam, hot air, water, oil, liquid metals and salts, for which a heat meter is or could be installed;
'Measurement point'	means the emission source for which continuous emission measurement systems (CEMS) is used for emission measurement, or the cross section of a pipeline system for which the CO_2 flow is determined using continuous measurement systems;
'Measurement system'	means a complete set of measuring instruments and equipment used for the monitoring and calculation of emissions;
'Minimum requirements'	means monitoring methods using the minimum efforts allowed for determining data in order for the results of emission data acceptable for the purpose of CBAM;
'Mixed fuel'	means a fuel which contains both biomass and fossil carbon;
'Mixed material'	means a material which contains both biomass and fossil carbon;
'Monitoring period'	means a period of a calendar year;
'Monitoring plan'	means a structured document used by the manufacturers of CBAM goods to track, calculate, and report the greenhouse gas emissions within CBAM goods;
'Multifunctional process'	means a process that has multiple outputs or whose outputs feed into several different production processes;
'Multifunctional production process'	means the chemical or physical processes carried out to produce goods under multiple CN codes, to which different functional units apply, and its specified system boundaries regarding inputs, outputs, and corresponding emissions; where the goods to which different functional units apply are produced through the same processes;
'Net calorific value' (NCV)	means the specific amount of energy released as heat when a fuel or material undergoes complete combustion with oxygen under standard conditions, less the heat of vaporisation of any water formed;

'Non-CBAM entity'	means another party involved in the transfer of heat, waste gases or CO_2 with the installation;
'Non-CBAM good'	means any good produced in the installation that is not specified by paragraph 1 of Schedule 16 of the Finance Act 2026;
'Non-measurable heat'	means all heat other than measurable heat;
'Operator'	means any person who operates or controls an installation;
'Operator's emissions report'	has the meaning set out in section A.7 of the force of law notice (ODT, 344KB);
'Oxidation factor' (OF)	means the ratio of carbon oxidised to CO_2 as a consequence of combustion to the total carbon contained in the fuel, expressed as a fraction, considering carbon monoxide (CO) emitted to the atmosphere as the molar equivalent amount of carbon dioxide (CO_2);
'Perfluorocarbons'	means tetrafluoromethane and hexafluoroethane;
'Precursor good'	means a CBAM good which is used in the production of another CBAM good and is identified as relevant to determining the emissions embodied in that CBAM good in the system boundaries document;
'Preliminary emission factor'	means the assumed total emission factor of a fuel or material based on the carbon content of its biomass fraction and fossil fraction before multiplying it by the fossil fraction to produce the emission factor;
'Process emissions'	has the meaning given in section 1 of the system boundaries document;
'Produced'	has the meaning given in regulation 2 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Production process'	1. for goods under the same CN code and to which the same functional unit applies, the chemical or physical processes carried out to produce those goods and the specified system boundaries regarding inputs, outputs, and corresponding emissions; 2. a multifunctional production process; or 3. a joint production process where an operator elects to use this process for the purposes of the [emissions report].
'Production route'	means a specific technology used in a production process to produce goods. One production process usually relates to one group of CBAM goods produced (the 'aggregated goods categories'). However, in some cases more than one production route can exist for producing these goods;
'Proxy data'	means annual values which are empirically substantiated or derived from accepted sources and which an operator uses to substitute a data set for the purpose of ensuring complete reporting

'Recommended improvements'	means monitoring methods which ensure that data is more accurate or less prone to mistakes than by mere application of the minimum requirements;
'Relevant emissions'	means the specified types of emissions(c) produced by the specified production processes for a CBAM good or a precursor good, as the case may be, as set out in the system boundaries document;
'Residue'	means a substance that is not the end product that a production process directly seeks to produce; it is not a primary aim of the production process, and the process has not been deliberately modified to produce it;
'Simple goods'	means goods produced in a production process requiring exclusively input materials and fuels having zero embodied emissions;
'Source stream'	means either of the following: (a) a specific fuel type, raw material or product giving rise to emissions of relevant greenhouse gases at one or more emission sources as a result of its consumption or production; (b) a specific fuel type, raw material or product containing carbon and included in the calculation of greenhouse gas emissions using a mass balance method.
'Standard conditions'	means temperature of 273.15 K and pressure conditions of 101.325 Pa defining normal cubic metres (Nm^3);
'Standard values'	means default factors that are used to determine the embodied emissions of a CBAM good. They are either Type I values or Type II values which operate on a hierarchical level where Type II values have a higher accuracy than Type I values;
'System boundary'	means the group of chemical or physical processes included within the calculation of the embodied emissions of goods that fall under the same aggregated goods category;
'System boundaries document'	means the document entitled "Carbon Border Adjustment Mechanism: System Boundaries Document", version 1.00 dated 10th July 2026 which specifies: (a) which emissions, including emissions of precursor goods, are to be taken into account when determining the emissions embodied in a CBAM good(a); (b) which production processes, including the production processes of precursor goods, are to be taken into account when determining the emissions embodied in CBAM goods; (c) which goods are precursor goods for a CBAM good; (d) how to determine the weight of a CBAM good.
'Technical feasibility'	means the proven realistic ability to implement, monitor, report, and verify greenhouse gas emissions using available, reliable, and commercially technologies;

'Tonne'	means metric tonne, and any figure in tonnes must be rounded to the nearest tonne, unless the context otherwise requires;
'tonne of CO_2e'	means one metric tonne of carbon dioxide ('tCO_2'), or an amount of any other greenhouse gas adjusted to the equivalent global warming potential of CO_2;
'Uncertainty'	means a parameter, that is associated with the result of a quantity which characterises the dispersion of the value where it could reasonably be attributed to the particular quantity, including the effects of a systematic as well as that of random factors which are expressed in a percentage and describes a confidence interval around the mean value comprising of 95% of inferred values taking into account any asymmetry of the distribution of values;
'Unreasonable costs'	mean the cost of improving the monitoring methodologies that exceed the associated benefits, specifically where costs surpass a calculated threshold;
'Waste'	means any substance or object which the holder discards or intends or is required to discard, excluding substances that have been intentionally modified or contaminated in order to meet this definition;
'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 as process emissions;

Table 2: Accreditation and Verification Definitions

Term	**Definition**
'Accreditation'	means the third-party attestation by an accreditation body of conformity to standards and specified requirements set out in The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026 and The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB);
'Accredited for the UK Emissions Trading Scheme'	means that a third party has attested that a person conforms with the requirements of Implementing Regulation (EU) 2018/2067 of 19 December 2018 (as it forms part of domestic law);
'Accreditation Body'	has the meaning given in Regulation 2 and defined in Regulation 13 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Assessor'	means an individual who assesses the performance of a verifier on behalf of the accreditation body;
'Auditor'	means an individual who forms part of the verification team responsible for conducting the verification of the operator's emissions report;

'Competence'	means the ability to apply knowledge and skills to carry out an audit of an activity;
'Control Risk'	means the susceptibility of a parameter in the operator's emissions report to misstatements which could be material either individually or when aggregated with other misstatements which will not be prevented or detected and corrected by the control system;
'Control Activities'	means any acts carried out or measures implemented by the operator to mitigate inherent risks;
'Control System'	means the operator's risk assessment and the whole set of control activities that an operator has established and documented to manage the requirements of CBAM;
'Global ACI'	means Global Accreditation Cooperation Incorporated
'Independent Reviewer'	means an individual who is independent of the verification team and has the responsibility for reviewing and approving the verification report;
'Inherent Risk'	means the susceptibility of a parameter in the operator's emissions report to misstatements which could be material either individually or when aggregated with other misstatements, before taking into consideration the effect of any control activities;
'Internal Verification Documentation'	means the internal documentation compiled by the verification team to record all documentary evidence and justifications made as part of the verification process;
'ISO'	means the International Organization for Standardization;
'IEC'	means the International Electrotechnical Commission;
'Lead Auditor'	means an auditor in charge of directing and supervising the verification team, who is responsible for performing, and reporting on, the verification of an operator's emissions report;
'Level of Assurance'	means the degree of assurance the verifier provides on the verification report based on the objective of reducing the verification risk according to the circumstances of the verification engagement;
'Materiality Level'	means the quantitative threshold above which misstatements, individually or when aggregated with other misstatements, are to be considered material by the verifier;
'Material Misstatement'	means a misstatement that, either individually or when aggregated with other misstatements, exceeds the materiality level;
'Material Non-conformity'	means a non-conformity that causes a material misstatement;
'Misstatement'	means an error in the reported data, not considering the uncertainty associated with measuring instruments or laboratory analyses;

'Non-compliance'	means any act or omission by the operator that is contrary to the requirements of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB) or The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.
'Non-conformity'	means one of the following: • for the purpose of the verification of the operator's emissions report, any act or omission by the operator that is contrary to the requirements of the monitoring plan or the monitoring methodology applicable to the installation as required by The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB) or The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026; • for the purposes of accreditation of verifiers, any act or omission by the verifier that is contrary to the requirements of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB) or The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Normative Documents'	means external, cited publications such as other standards, technical specifications, or codes of practice that are mandatory for the correct application, interpretation, and implementation of a specific ISO standard.
'Operator's Emissions Report'	has the meaning set out in section A.7 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB);
'Reasonable Assurance'	has the meaning given in section A.1. of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB);
'Scope of Accreditation'	means the CBAM activity groups to which accreditation is sought or has been granted;
'Site'	means the geographical location of the installation to which the operator's emissions report that is subject to verification refers to;
'Technical Expert'	means an individual with detailed knowledge and expertise on a specific subject matter needed for verification or accreditation activities who is independent of the organisation being audited;
'Verification'	means the activities carried out by a verifier to issue a CBAM verification opinion statement;
'Verification Opinion Statement'	means the verifier's verdict on whether the data on the operator's emissions report contains material misstatements in accordance with paragraph J.8.1(2) of The

	Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB);
'Verification Report'	has the meaning given in Regulation 2 and defined in Regulation 15(1) of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Verification Risk'	means the risk the verifier expresses an inappropriate verification opinion statement where the operator's emissions report is not free of misstatements;
'Good-specific Verification Summary'	means the summary of the verification report that is produced by the verifier in accordance with Annex III of The Carbon Border Adjustment Mechanism Regulations (Emissions and Verification) Force of Law Notice;
'Verification Team'	means the team comprising of the lead auditor, auditors and technical experts who are responsible for completing the CBAM verification process for a given installation;
'Verified Emission Data'	has the meaning given in Regulation 2 and defined in Regulation 10 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026;
'Verifier'	has the meaning given in Regulation 2 and defined in Regulation 12 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Regulations 2026.

ANNEX VI – Standard values for emission calculations

Standard factors used in the monitoring of direct emissions at installation level

Fuel emission factors related to net calorific values (NCV)

Table 1: Fuel emission factors related to net calorific value and net calorific values per mass of fuel.

Fuel type description	**Emission factor (tCO_2/TJ)**	**Net calorific value (TJ/Gg)**	**Source**
Crude oil	73.3	42.3	IPCC 2006 GL
Orimulsion	77.0	27.5	IPCC 2006 GL
Natural gas liquids	64.2	44.2	IPCC 2006 GL
Motor gasoline	69.3	44.3	IPCC 2006 GL
Kerosene (other than jet kerosene)	71.9	43.8	IPCC 2006 GL
Shale oil	73.3	38.1	IPCC 2006 GL
Gas/Diesel oil	74.1	43.0	IPCC 2006 GL
Residual fuel oil	77.4	40.4	IPCC 2006 GL
Liquefied petroleum gases	63.1	47.3	IPCC 2006 GL
Ethane	61.6	46.4	IPCC 2006 GL
Naphtha	73.3	44.5	IPCC 2006 GL
Bitumen	80.7	40.2	IPCC 2006 GL
Lubricants	73.3	40.2	IPCC 2006 GL
Petroleum coke	97.5	32.5	IPCC 2006 GL
Refinery feedstocks	73.3	43.0	IPCC 2006 GL
Refinery gas	57.6	49.5	IPCC 2006 GL
Paraffin waxes	73.3	40.2	IPCC 2006 GL
White spirit and SBP	73.3	40.2	IPCC 2006 GL
Other petroleum products	73.3	40.2	IPCC 2006 GL
Anthracite	98.3	26.7	IPCC 2006 GL
Coking coal	94.6	28.2	IPCC 2006 GL
Other bituminous coal	94.6	25.8	IPCC 2006 GL
Sub-bituminous coal	96.1	18.9	IPCC 2006 GL
Lignite	101.0	11.9	IPCC 2006 GL
Oil shale and tar sands	107.0	8.9	IPCC 2006 GL
Patent fuel	97.5	20.7	IPCC 2006 GL
Coke oven coke and lignite coke	107.0	28.2	IPCC 2006 GL
Gas coke	107.0	28.2	IPCC 2006 GL
Coal tar	80.7	28.0	IPCC 2006 GL
Gas works gas	44.4	38.7	IPCC 2006 GL
Coke oven gas	44.4	38.7	IPCC 2006 GL

Blast furnace gas	260	2.47	IPCC 2006 GL
Oxygen steel furnace gas	182	7.06	IPCC 2006 GL
Natural gas	56.1	48.0	IPCC 2006 GL
Industrial wastes	143	n.a.	IPCC 2006 GL
Waste oils	73.3	40.2	IPCC 2006 GL
Peat	106.0	9.76	IPCC 2006 GL
Waste tyres	85.0	n.a.	WBCSD CSI
Carbon monoxide	155.2	10.1	J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995
Methane	54.9	50.0	J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995

Table 2: Fuel emission factors related to net calorific value and net calorific values per mass of biomass material.

Biomass material	**Preliminary EF (tCO_2/TJ)**	**NCV (GJ/t)**	**Source**
Wood/Wood waste (air dry)	112	15.6	IPCC 2006 GL
Sulphite lyes (black liquor)	95.3	11.8	IPCC 2006 GL
Other primary solid biomass	100	11.6	IPCC 2006 GL
Charcoal	112	29.5	IPCC 2006 GL
Bio gasoline	70.8	27.0	IPCC 2006 GL
Biodiesels	70.8	37.0	IPCC 2006 GL
Other liquid biofuels	79.6	27.4	IPCC 2006 GL
Landfill gas	54.6	50.4	IPCC 2006 GL
Sludge gas	54.6	50.4	IPCC 2006 GL
Other biogas	54.6	50.4	IPCC 2006 GL
Municipal waste (biomass fraction)	100	11.6	IPCC 2006 GL

Emission factors related to process emissions

Table 3: Stoichiometric emission factor for process emissions from carbonate decomposition (Method A)

Carbonate	**Emission factor (tCO_2/t Carbonate)**
$CaCO_3$	0.440
$MgCO_3$	0.522
Na_2CO_3	0.415
$BaCO_3$	0.223
Li_2CO_3	0.596
K_2CO_3	0.318

$SrCO_3$	0.298
$NaHCO_3$	0.524
$FeCO_3$	0.380
General	Emission factor = $[M(CO_2)] /\{Y*[M(x)] +Z*[M(CO_3)]\}$ X = metal M(x) = molecular weight of X in (g/mol) $M(CO_2)$ = molecular weight of CO_2 in (g/mol) $M(CO_3)$ = molecular weight of CO_3 in (g/mol) Y = stoichiometric number of X Z = stoichiometric number of CO_3

Table 4: Stoichiometric emission factor for process emissions from carbonate decomposition based on alkali earth oxides (Method B)

Oxide	**Emission factor (t CO_2/ t Oxide)**
CaO	0.785
MgO	1.092
BaO	0.287
general: XYOZ	Emission factor = $[M(CO_2)]/\{Y*[M(x)]+Z*[M(O)]\}$ X = alkali earth or alkali metal M(x) = molecular weight of X in [g/mol] $M(CO_2)$ = molecular weight of CO_2 [g/mol] M(O) = molecular weight of O [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of O = 1

Table 5: Emission factors for process emissions from other process materials (production of iron or steel, and processing of ferrous metals)

Input or output material	**Carbon content (tC/t)**	**Emission factor (tCO_2/t)**
Direct reduced iron (DRI)	0.0191	0.07
EAF carbon electrodes	0.8188	3.00
EAF charge carbon	0.8297	3.04
Hot briquetted iron	0.0191	0.07
Oxygen steel furnace gas	0.3493	1.28
Petroleum coke	0.8706	3.19
Pig iron	0.0409	0.15
Iron/iron scrap	0.0409	0.15
Steel/steel scrap	0.0109	0.04

*G*lobal warming potentials for non-CO_2 greenhouse gases

Table 6: Global warming potentials

Gas	**Global warming potential**
N_2O	265 tCO_2e / tN_2O
CF_4	6,630 tCO_2e / tCF_4
C_2F_6	11,100 tCO_2e / tC_2F_6

ANNEX VII – CBAM Commodity Codes

Below is the list of Commodity Codes for each type of CBAM goods. The source for these codes is Schedule 16 of the Finance Act 2026.

CBAM Goods – Cement Sector

Commodity Code	Description
2507 00 80	Other kaolinic clays
2523 10 00	Cement clinkers
2523 21 00	White Portland cement, whether or not artificially coloured
2523 29 00	Other Portland cement
2523 30 00	Aluminous cement
2523 90 00	Other hydraulic cements

CBAM Goods – Hydrogen Sector

Commodity Code	Description
2804 10 00	Hydrogen

CBAM Goods – Fertiliser Sector

Commodity Code	Description
2808 00 00	Nitric acid; sulphonitric acids
2814	Ammonia, anhydrous or in aqueous solution
2834 21 00	Nitrates of potassium
3102	Mineral or chemical fertilisers, nitrogenous
3102 Except: 3102 10	Mineral or chemical fertilisers, nitrogenous *Except:* *Urea*
3102 10	Urea, whether or not in aqueous solution
3105 Except: 3105 60	Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus, and potassium; other fertilisers; goods of this chapter in tables or similar forms or in packages of a gross weight not exceeding 10 kg Except: Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium

CBAM Goods – Iron & Steel

Commodity Code	Description

2601 12	Agglomerated
72 Except: 7202 2 7202 30 7202 50 7202 70 7202 80 7202 91 7202 92 7202 93 7202 99 10 7202 99 30 7202 99 80	Iron and Steel Except: Ferro-silicon Ferro-silico-manganese Ferro-silico-chromium Ferro-molybdenum Ferro-tungsten and ferro-silico-tungsten Ferro-titanium and ferro-silico-titanium Ferro-vanadium Ferro-niobium Ferro-phosphorus Ferro-silico-magnesium Other
7201	Pig iron and spiegeleisen in pigs, blocks, or other primary forms Some products under 7205 (Granules and powders, of pig iron, spiegeleisen, iron, or steel) may be covered here
7202 1	Ferro-manganese
7202 4	Ferro-chromium
7202 6	Ferro-nickel
7203	Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products
7205	Granules and powders, of pig iron, spiegeleisen, iron or steel (if not covered under category pig iron)
7206	Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading 7203)
7207	Semi-finished products of iron or non-alloy steel
7208	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, hot-rolled, not clad, plated or coated
7209	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, cold-rolled (cold-reduced), not clad, plated or coated
7210	Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, clad, plated or coated
7211	Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, not clad, plated or coated
7212	Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, clad, plated or coated
7213	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel
7214	Other bars and rods of iron or non-alloy steel, not further worked than forged, hot-rolled, hot-drawn or hot-extruded, but including those twisted after rolling
7215	Other bars and rods of iron or non-alloy steel
7216	Angles, shapes and sections of iron or non-alloy steel
7217	Wire of iron or non-alloy steel

7218	Stainless steel in ingots or other primary forms; semi-finished products of stainless steel
7219	Flat-rolled products of stainless steel, of a width of 600 mm or more
7220	Flat-rolled products of stainless steel, of a width of less than 600 mm
7221	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel
7222	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel
7223	Wire of stainless steel
7224	Other alloy steel in ingots or other primary forms; semi-finished products of other alloy steel
7225	Flat-rolled products of other alloy steel, of a width of 600 mm or more
7226	Flat-rolled products of other alloy steel, of a width of less than 600 mm
7227	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel
7228	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or non-alloy steel
7229	Wire of other alloy steel
7301	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel
7302	Railway or tramway track construction material of iron or steel, the following: rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish- plates, chairs, chair wedges, sole plates (base plates), rail clips, bedplates, ties and other material specialised for jointing or fixing rails
7303	Tubes, pipes and hollow profiles, of cast iron
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel
7305	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm of iron or steel
7306	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel
7307	Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel
7308	Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes sections, tubes and the like, prepared for use in structures, of iron or steel
7309	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity

	exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7310	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7311	Containers for compressed or liquefied gas, of iron or steel
7318	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel
7326	Other articles of iron or steel

CBAM Goods – Aluminium Sector

Commodity Code	**Description**
7601	Unwrought aluminium
7603	Aluminium powders and flakes
7604	Aluminium bars, rods and profiles
7605	Aluminium wire
7606	Aluminium plates, sheets and strip, of a thickness exceeding 0.2 mm
7607	Aluminium foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.2 mm
7608	Aluminium tubes and pipes
7609 00 00	Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)
7610	Aluminium structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures
7611 00 00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7612	Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
7613 00 00	Aluminium containers for compressed or liquefied gas
7614	Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated
7616	Other articles of aluminium

ANNEX VIII – CBAM Unreasonable Costs Justification

Unreasonable Cost Justification UK CBAM

- This tool can be used to assess whether applying a specific monitoring methodology would incur unreasonable costs, in line with Section A4 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB).
- This sheet in the tool should be used to assess the unreasonable nature of costs with regard to calculation factors (Net Calorific Value, Emission Factor and Carbon Content).
- Yellow boxes are inputs for the operator; blue boxes show outputs.
- It is not mandatory that operators use this table, but it ensures all elements are captured when assessing technical feasibility.

It should be noted that as per Point 7(a) of Section A.4 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB) total costs less than £2,000 shall always be considered justified.

Sampling and analysis or Gas Chromatograph (GC) analysis	

Average Emissions

Source stream reference (e.g. F1):	

Year	Emissions (tCO_2)

Average Emissions (tCO_2) (average of the above):	
1% Improvement Factor (of the above):	
Improvement Factor (the above x £20):	

Costs

Type of Cost	Number of Depreciation Years	Cost, £

Total cost per year (sum of the above costs):	£0.00
Justification acceptable:	**Yes or No**

Explanation of Costs

Please provide notes on what your costs have been based on, for example purchase and installation of GC analyser:

The basis of the number of depreciation years should also be explained.

ANNEX IX – CBAM Technical Feasibility Justification

Technical Feasibility Justification UK CBAM

- This table can be used to provide justification for not applying a specific monitoring methodology based on technically feasibility in line with Section A4 of The Carbon Border Adjustment Mechanism (Emissions and Verification) Force of Law Notice (Draft) (ODT, 344KB).
- It is not mandatory that operators use this table, but it ensures all elements are captured when assessing technical feasibility.

Source Stream or Fuel	Current approach	Proposed approach	Justification for using the proposed approach

Supporting Documentation

Document Reference	Description