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ANNEXES 1 to 9

ANNEXES

Commission Implementing Regulation (EU) …/...

laying down the rules for the application of Regulation (EU) 2023/956 of the European Parliament and of the Council as regards reporting obligations for the purposes of the carbon border adjustment mechanism during the transitional period

ANNEX I

Information to be submitted in the CBAM reports

The reporting declarant shall include the information and follow the CBAM report structure listed in table 1, when submitting the CBAM report.

The reporting declarant shall fill in the fields marked as mandatory for completing the CBAM report.

Optional fields can be filled in by the reporting declarant to ensure greater transparency of the data reported. Conditional fields must be filled in by the reporting declarant if certain conditions are met.

Table 1: Mandatory, optional and conditional fields in the CBAM report

CBAM Report Structure	Mandatory (M), Optional (O), or Conditional (C)
Report issue date	M
Draft report ID	M
Report ID	
Reporting Period	M
Year	M
Total goods imported	M
Total emissions	M
--QR declarant	M
Identification number	M
Name	M
Role	M
---- Address	M
Country of establishment	M
Sub-division	O
City	M
Street	O
Street additional line	O
Number	O
Postcode	C
P.O. Box	O
--Importer	C
Identification number	M
Name	M
----Address	M
Country of establishment	M
Sub-division	O
City	M
Street	O
Street additional line	O
Number	O
Postcode	C
P.O. Box	O
--National competent authority	M
Reference number	M
--Signatures	M

----Report confirmation	M
Report global data confirmation	M
Date and Place of signature	M
Signature	M
Name and position of person signing	M
----Type of applicable reporting rules confirmation	C
Other applicable reporting rules confirmation	M
--Remarks	O
Additional information	M
CBAM goods imported	M
Goods item number	M
--Commodity code	M
Harmonized System sub-heading code	M
Combined nomenclature code	M
----Commodity details	M
Description of goods	M
--Country of origin	M
Country code	M
--Imported quantity per customs procedure	M
Sequence number	M
----Procedure	M
Requested procedure	M
Previous procedure	O
----Area of import	O
Area of import	M
----Goods measure (per procedure)	M
Net mass	C
Supplementary units	C
Type of measurement unit	M
----Special references for goods	O
Additional information	M
--Goods properties parameters	O
Sequence number	M
Parameter ID	M
Parameter name	M
Description	O
Type of parameter value	M
Parameter value	M
Additional Information	O
TARIC Code	O
CUS code	O
--Goods measure (imported)	M
Net mass	C
Supplementary units	C
Type of measurement unit	M
--Goods imported total emissions	M
Good overall emissions	M
Good direct emissions	M

Good indirect emissions	M
Type of measurement unit for emissions	M
--Supporting documents (for Goods)	O
Sequence number	M
Type	M
Country of document issuance	O
Reference number	M
Document line item number	O
Issuing authority name	O
Validity start date	O
Validity end date	O
Description	O
----Attachments	O
Filename	M
URI	O
MIME	M
Included binary object	M
--Remarks	O
Additional information	M
--CBAM Goods Emissions	M
Emissions sequence number	M
Country of production	M
----Installation operator	O
Operator ID	M
Operator Name	M
------Address	M
Country code	M
Sub-division	O
City	M
Street	O
Street additional line	O
Number	O
Postcode	C
P.O. Box	O
------Contact Details	M
Name	M
Phone number	M
e-mail	M
----Installation	O
Installation ID	M
Installation name	M
Economic activity	O
------Address	M
Country of establishment	M
Sub-division	O
City	O
Street	O
Street additional line	O
Number	O
Postcode	C

P.O. Box	O
Plot or parcel number	O
UNLOCODE	O
Latitude	O
Longitude	O
Type of coordinates	O
----Goods measure (Produced)	M
Net mass	C
Supplementary units	C
Type of measurement unit	M
----Installation emissions	M
Installation overall emissions	M
Installation direct emissions	M
Installation indirect emissions	M
Type of measurement unit for emissions	M
----Direct Embedded Emissions	M
Type of determination	M
Type of applicable reporting rules	M
Applicable reporting rules	C
Specific (direct) embedded emissions	M
Type of measurement unit	M
----Indirect Embedded Emissions	M
Type of determination	M
Specific (indirect) embedded emissions	M
Type of measurement unit	M
Electricity consumed	M
Emission factor	M
Source of emission factor	M
Other source indication	C
Source of electricity	M
----Production method & Qualifying parameters	M
Sequence number	M
Method ID	M
Method name	M
Additional Information	O
------Direct Emissions qualifying parameters	O
Sequence number	M
Type of determination	M
Parameter ID	M
Parameter name	M
Description	O
Type of parameter value	M
Parameter value	M
Additional information	O
------Indirect Emissions qualifying parameters	C
Sequence number	M
Type of determination	M
Parameter ID	M
Parameter name	M

Description	O
Type of parameter value	M
Parameter value	M
Additional information	O
----Supporting Documents (for emissions definition)	O
Sequence number	M
Type of emissions document	M
Country of document issuance	O
Reference number	M
Document line item number	O
Issuing authority name	O
Validity start date	O
Validity end date	O
Description	O
------Attachments	O
Filename	M
URI	C
MIME	M
Included binary object	M
----Carbon price already paid	O
Sequence number	M
Type of instrument	M
Instrument reference description	M
Declared amount	M
Currency	M
Exchange rate	M
Amount (EURO)	M
Country code	M
------Products covered under price paid	M
Sequence number	M
Type of product covered	M
CN of product covered	C
Quantity of emissions covered	M
Quantity covered by free allocation	M
Supplementary information	O
Additional information	C
--------Goods measure (Covered)	O
Net mass	C
Supplementary units	C
Type of measurement unit	M
----Remarks	C
Sequence number	M
Additional Information	M

ANNEX II
Production routes for goods

1. MAPPING OF CN CODES TO AGGREGATED GOODS CATEGORIES

Table 1 defines aggregated goods categories for each CN code covered by Annex I to Regulation (EU) 2023/956. Those categories are used for the purpose of defining system boundaries of production processes for the determination of embedded emissions to specify further requirements for CBAM goods.

Table 1: Mapping of CN codes to aggregated goods categories

CN code	Aggregated goods category	Greenhouse gas
Cement		
2507 00 80 – Other kaolinic clays	**Calcined clay**	Carbon dioxide
2523 10 00 – Cement clinkers	**Cement clinker**	Carbon dioxide
2523 21 00 – White Portland cement, whether or not artificially coloured 2523 29 00 – Other Portland cement 2523 90 00 – Other hydraulic cements	**Cement**	Carbon dioxide
2523 30 00 – Aluminous cement	**Aluminous cement**	Carbon dioxide
Electricity		
2716 00 00 – Electrical energy	**Electricity**	Carbon dioxide
Fertilizer		
2808 00 00 – Nitric acid; sulphonitric acids	**Nitric acid**	Carbon dioxide and nitrous oxide
3102 10 – Urea, whether or not in aqueous solution	**Urea**	Carbon dioxide and nitrous oxide
2814 – Ammonia, anhydrous or in aqueous solution	**Ammonia**	Carbon dioxide
2834 21 00 – Nitrates of potassium 3102 – Mineral or chemical fertilisers, nitrogenous except 3102 10 (Urea) 3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers - Except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium	**Mixed fertilizers**	Carbon dioxide and nitrous oxide
Iron and Steel		

CN code	Aggregated goods category	Greenhouse gas
2601 12 00 – Agglomerated iron ores and concentrates, other than roasted iron pyrites	**Sintered Ore**	Carbon dioxide
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	**Pig Iron**	Carbon dioxide
7202 1 – Ferro-manganese	**FeMn**	Carbon dioxide
7202 4 – Ferro-chromium	**FeCr**	Carbon dioxide
7202 6 – Ferro-nickel	**FeNi**	Carbon dioxide
7203 – Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products	**DRI**	Carbon dioxide
7206 – Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading 7203) 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	**Crude steel**	
7205 – Granules and powders, of pig iron, spiegeleisen, iron or steel (if not covered under category pig iron) 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 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	**Iron and steel products**	Carbon dioxide

CN code	Aggregated goods category	Greenhouse gas
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 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment		

CN code	Aggregated goods category	Greenhouse gas
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 l, 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		

Aluminium		
7601 – Unwrought aluminium	**Unwrought aluminium**	Carbon dioxide and perfluoro-carbons
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	**Aluminium products**	Carbon dioxide and perfluoro-carbons

CN code	Aggregated goods category	Greenhouse gas
7614 – Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated 7616 – Other articles of aluminium		

Chemicals		
2804 10 000 – Hydrogen	**Hydrogen**	Carbon dioxide

2. PRODUCTION ROUTES, SYSTEM BOUNDARIES AND RELEVANT PRECURSORS

2.1 Cross-sectoral rules

Goods definitions according to the CN classification as set out in Section 1 of this Annex shall be applied. For determining the activity level (quantity produced) of the good as denominator in equations 50 and 51 (Section F.1 of Annex III), the monitoring rules of Section F.2 of Annex III shall apply.

Where several production routes are used in the same installation for producing goods falling under the same CN code, and where those production routes are assigned separate production processes, the embedded emissions of those goods are calculated as weighted average across all used production routes.

For the monitoring of direct emissions, all emission sources and source streams associated with the production process shall be monitored, taking into account specific requirements laid down in Sections 2.2 to 2.19 of this Annex, where relevant, and the rules laid down in Annex III.

Where CO_2 capture is used, the rules of Section B.8.2 of Annex III shall apply.

For the monitoring of indirect emissions, the total electricity consumption of each production process shall be determined, within the system boundaries defined in line with Sections 2.2 to 2.19 of this Annex and in accordance with Section A.5 of Annex III, where relevant. The relevant emission factor of electricity is determined in accordance with Section D.2 of Annex III.

2.2 Calcined clay

2.2.1. Special provisions

Clays falling under CN code 2507 00 80 which are not calcined, are assigned embedded emissions of zero. They are to be included in the CBAM report, but no additional information from the producer of the clay is required. The following provisions relate only to clays falling under that CN code and that are calcined.

2.2.2. Production route

For calcined clay, direct emissions monitoring shall encompass:

– 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.

Relevant precursors: none.

2.3 Cement clinker

2.3.1 Special provisions

No distinction shall be made between grey and white cement clinker.

2.3.2 Production route

For cement clinker, direct emissions monitoring shall encompass:

- 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 of limestone and shales, or alternative raw materials such as fly ash used in the raw meal in the kiln and raw materials used for flue gas scrubbing.
- The additional provisions of Section B.9.2 of Annex III shall apply.

Relevant precursors: none.

2.4 Cement

2.4.1 Special provisions

None.

2.4.2 Production route

For cement, direct emissions monitoring shall encompass:

- All CO_2 emissions from fuel combustion, where relevant for drying of materials.

Relevant precursors:

- Cement clinker;
- Calcined clay, if used in the process.

2.5 Aluminous cement

2.5.1 Special provisions

None.

2.5.2 Production route

For aluminous cement, direct emissions monitoring shall encompass:

- All CO_2 emissions from fuel combustion directly or indirectly linked to the process.
- Process emissions from carbonates in raw materials, if applicable, and flue gas cleaning.

Relevant precursors: none.

2.6 Hydrogen

2.6.1 Special provisions

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 hydrogen is exclusively used within those plants and not used for the production of goods listed in Annex I to Regulation (EU) 2023/956.

2.6.2 Production routes

2.6.2.1 Steam reforming and partial oxidation

For those production routes, direct emissions monitoring shall encompass:

– All processes directly or indirectly linked to hydrogen production, 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.

–

Relevant precursors: none.

2.6.2.2 Electrolysis of water

For that production route, direct emissions monitoring shall encompass, if relevant:

– All emissions from fuel use directly or indirectly linked to the hydrogen production process and from flue gas cleaning.

Indirect emissions: Where the produced hydrogen has been certified to comply with [Commission Delegated Regulations (EU) …/... ([1]) and (EU) …/… ([2])], an emission factor of zero for the electricity may be used. In all other cases, the rules on indirect embedded emissions (Section D of Annex III) shall apply.

Relevant precursors: none.

Attribution of emissions to products: Where the co-produced oxygen is vented, all emissions of the production process are attributed to hydrogen. Where by-product oxygen is used in other production processes at the installation or sold, and where direct or indirect emissions are not equal to zero, the emissions of the production process are attributed to hydrogen based on molar proportions using the following equation:

$$Em_{H_2} = Em_{total}\left(1 - \frac{\frac{m_{O_2,sold}}{M_{O_2}}}{\frac{m_{H_2,prod}}{M_{H_2}} + \frac{m_{O_2,prod}}{M_{O_2}}}\right) \qquad \text{(Equation 1)}$$

Where:

([1]) Commission Delegated Regulation (EU) …/... of 10.2.2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin

([2]) Commission Delegated Regulation (EU) …/... of 10.2.2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels

Em_{H_2}	Either direct or indirect emissions attributed to hydrogen produced over the reporting period, expressed in tonnes of CO_2
Em_{total}	Either direct or indirect emissions of the whole production process over the reporting period, expressed in tonnes of CO_2
$m_{O_2,sold}$	Mass of oxygen sold or used in the installation over the reporting period, expressed in tonnes
$m_{O_2,prod}$	Mass of oxygen produced over the reporting period, expressed in tonnes
$m_{H_2,prod}$	Mass of hydrogen produced over the reporting period, expressed in tonnes
M_{O_2}	Molar mass of O_2 (31,998 kg/kmol)
M_{H_2}	Molar mass of H_2 (2,016 kg/kmol)

2.6.2.3 Chlor-Alkali electrolysis and production of chlorates

For those production routes, direct emissions monitoring shall encompass, if relevant:

– All emissions from fuel use directly or indirectly linked to the hydrogen production process and from flue gas cleaning.

Indirect emissions: Where the produced hydrogen has been certified to comply with [Commission Delegated Regulations (EU) …/...([1]) and (EU) …/…([2])], an emission factor of zero for the electricity may be used. In all other cases, the rules on indirect embedded emissions (Section D of Annex III) shall apply.

Relevant precursors: none.

Attribution of emissions to products: As hydrogen is considered a by-product in this production process, only a molar proportion of the overall process is attributed to the fraction of hydrogen sold or used as a precursor within the installation. Provided that direct or indirect emissions are not equal to zero, the emissions of the production process are attributed to hydrogen used or sold using the following equations:

Chlor-Alkali electrolysis:

$$Em_{H_2,sold} = Em_{total}\left(\frac{\frac{m_{H_2,sold}}{M_{H_2}}}{\frac{m_{H_2,prod}}{M_{H_2}}+\frac{m_{Cl_2,prod}}{M_{Cl_2}}+\frac{m_{NaOH,prod}}{M_{NaOH}}}\right) \quad \text{(Equation 2)}$$

Production of Sodium Chlorate:

$$Em_{H_2,sold} = Em_{total}\left(\frac{\frac{m_{H_2,sold}}{M_{H_2}}}{\frac{m_{H_2,prod}}{M_{H_2}}+\frac{m_{NaClO_3,prod}}{M_{NaClO_3}}}\right) \quad \text{(Equation 3)}$$

Where:

$Em_{H_2,sold}$	Either direct or indirect emissions attributed to hydrogen sold or used as precursor over the reporting period, expressed in tonnes of CO_2

Em_{total}	Either direct or indirect emissions of the production process over the reporting period, expressed in tonnes of CO_2
$m_{H_2,sold}$	Mass of hydrogen sold or used as precursor over the reporting period, expressed in tonnes
$m_{H_2,prod}$	Mass of hydrogen produced over the reporting period, expressed in tonnes
$m_{Cl_2,prod}$	Mass of chlorine produced over the reporting period, expressed in tonnes
$m_{NaOH,prod}$	Mass of sodium hydroxide (caustic soda) produced over the reporting period, expressed in tonnes, calculated as 100% NaOH
$m_{NaClO_3,prod}$	Mass of sodium chlorate produced over the reporting period, expressed in tonnes, calculated as 100% $NaClO_3$
M_{H_2}	Molar mass of H_2 (2,016 kg/kmol)
M_{Cl_2}	Molar mass of Cl_2 (70,902 kg/kmol)
M_{NaOH}	Molar mass of NaOH (39,997 kg/kmol)
M_{NaClO_3}	Molar mass of $NaClO_3$ (106,438 kg/kmol)

2.7 Ammonia

2.7.1 Special provisions

Both hydrous and anhydrous ammonia shall be reported jointly as 100% ammonia.

Where CO_2 from ammonia production is used as feedstock for the production of urea or other chemicals, point (b) of Section B.8.2 of Annex III shall apply. Where a deduction of CO_2 is allowed according to that section and where it would lead to negative specific embedded direct emissions of ammonia, the specific embedded direct emissions of ammonia shall be zero.

2.7.2 Production routes

2.7.2.1 Haber-Bosch process with steam reforming of natural gas or biogas

For that production route, direct emissions monitoring shall encompass:

- All fuels directly or indirectly linked to ammonia production, and materials used for 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 Section B.3.3 of Annex III are to be applied .
- Where hydrogen from other production routes is added to the process, it shall be treated as a precursor with its own embedded emissions.

Relevant precursors: separately produced hydrogen, if used in the process.

2.7.2.2 Haber-Bosch process with gasification of coal or other fuels

That route applies where hydrogen is produced by gasification of coal, heavy refinery fuels or other fossil feedstock. Input materials may include biomass, for which the provisions of Section B.3.3 of Annex III are to be taken into account.

For that production route, direct emissions monitoring shall encompass:

– All fuels directly or indirectly linked to ammonia production, and materials used for 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.

– Where hydrogen from other production routes is added to the process, it shall be treated as a precursor with its own embedded emissions.

Relevant precursors: separately produced hydrogen, if used in the process.

2.8 Nitric acid

2.8.1 Special provisions

Amounts of nitric acid produced shall be monitored and reported as 100% nitric acid.

2.8.2 Production route

For nitric acid, direct emissions monitoring shall encompass:

– CO_2 from all fuels directly or indirectly linked to nitric acid production, and materials used for flue gas cleaning;

– N_2O emissions from all sources emitting N_2O from the production process, including unabated and abated emissions. Any N_2O emissions from the combustion of fuels are excluded from monitoring.

Relevant precursors: Ammonia (as 100% ammonia).

2.9 Urea

2.9.1 Special provisions

Where the CO_2 used in the production of urea stems from ammonia production, it is accounted for as subtraction in the embedded emissions of ammonia as precursor of urea, if the provisions of Section 2.7 of this Annex allow such deduction. However, where ammonia produced without direct fossil CO_2 emissions is used as a precursor, the used CO_2 may be deducted from the direct emissions of the installation producing the CO_2, provided that the delegated act adopted pursuant to Article 1(21)(f) of Directive (EU) 2023/959 ([3]) defines urea production as a case where CO_2 is permanently chemically bound so that it does not enter the atmosphere under normal use, including any normal activity taking place after the end of the life of the product. Where such deduction would lead to negative specific direct embedded emissions of urea, the specific direct embedded emissions of urea shall be zero.

2.9.2 Production route

([3]) OJ L 130, 16.5.2023, P. 134.

For urea, direct emissions monitoring shall encompass:

- CO_2 from all fuels directly or indirectly linked to urea production, and materials used for flue gas cleaning;
- Where CO_2 is received from another installation as process input, the CO_2 received and not bound in urea shall be considered an emission, if not already counted as emission of the installation where the CO_2 was produced, under an eligible monitoring, reporting and verification system.

Relevant precursors: Ammonia (as 100% ammonia).

2.10 Mixed fertilizers

2.10.1 Special provisions

This section applies to the production of all kinds of nitrogen containing fertilizers, including ammonium nitrate, calcium ammonium nitrate, ammonium sulphate, ammonium phosphates, urea ammonium nitrate solutions, as well as nitrogen-phosphorus, nitrogen-potassium and nitrogen-phosphorus-potassium fertilizers. All kinds of operations are included such as mixing, neutralisation, granulation, prilling, irrespective of whether only physical mixing or chemical reactions take place.

The amounts of different nitrogen compounds contained in the final product shall be recorded in accordance with Regulation (EU) 2019/1009 laying down rules on the making available on the market of EU fertilising products:

- 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.

The direct and indirect emissions of the production processes falling under this aggregated goods category may be determined for the whole reporting period and attributed to all mixed fertilizers on a pro-rata basis per tonne of final product. For each fertilizer grade, embedded emissions are calculated separately taking into account the relevant mass of precursors used and applying average embedded emissions during the reporting period for each of the precursors.

2.10.2 Production route

For mixed fertilisers, direct emissions monitoring shall encompass:

- CO_2 from all fuels directly or indirectly linked to fertilizer production, such as fuels used in driers and for heating input materials, and materials used for flue gas cleaning.

Relevant precursors:

- Ammonia (as 100% ammonia), if used in the process;
- Nitric Acid (as 100% nitric acid), if used in the process;
- Urea, if used in the process
- Mixed fertilizers (in particular salts containing ammonium or nitrate), if used in the process.

2.11 Sintered Ore

2.11.1 Special provisions

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. To the extent covered by CN code 2601 12 00, also iron ores used as precursors for ferro-chromium (FeCr), ferro-manganese (FeMn) or ferro-nickel (FeNi) may be covered.

2.11.2 Production route

For sintered ore, direct emissions monitoring shall encompass:

- CO_2 from process materials such as limestone and other carbonates or carbonatic ores,
- 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.

Relevant precursors: None.

2.12 FeMn (Ferro-Manganese), FeCr (Ferro-Chromium) and FeNi (Ferro-Nickel)

2.12.1 Special provisions

This process covers only the production of the alloys identified under CN codes 7202 1, 7202 4 and 7202 6. Other iron materials with significant alloy content such as NPI (nickel pig iron) or spiegeleisen are not covered.

Where waste gases or other flue gases are emitted without abatement, CO contained in the waste gas shall be considered as the molar equivalent of CO_2 emissions.

2.12.2 Production route

For FeMn, FeCr and FeNi, direct emissions monitoring shall encompass:

- CO_2 emissions caused by fuel inputs, irrespective of whether they are used for energetic or non-energetic use;
- CO_2 emissions from process inputs such as limestone and from flue gas cleaning;
- 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors: Sintered ore, if used in the process.

2.13 Pig Iron

2.13.1 Special provisions

This aggregated goods category includes non-alloyed pig iron from blast furnaces as well as alloy-containing pig irons (e.g., nickel pig iron “NPI”, spiegeleisen), irrespective of the physical form (e.g. ingots, granules). In integrated steel plants, liquid pig iron (“hot metal”) directly charged to the oxygen converter is the product

which separates the production process for pig iron from the production process of crude steel. Where the installation does not sell or transfer pig iron to other installations, there is no need to monitor emissions from pig iron production separately. A common production process including crude steel making and, subject to the rules of Section A.5 of Annex III, further downstream production may be defined.

2.13.2 Production routes

2.13.2.1 Blast furnace route

For that production route, direct emissions monitoring shall encompass:

- 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 Section B.3.3 of Annex III are to be taken into account;
- CO_2 from process materials such as limestone, magnesite and other carbonates, carbonatic 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors:

- 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.

2.13.2.2 Smelting reduction

For this production route, direct emissions monitoring shall encompass:

- 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, etc.
- Where biomass is used, the provisions of Section B.3.3 of Annex III are to be taken into account;
- CO_2 from process materials such as limestone, magnesite and other carbonates, carbonatic 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors:

- Sintered ore;
- Pig iron or DRI from other installations or production processes, if used in the process;
- FeMn, FeCr, FeNi if used in the process.

2.14 DRI (Direct Reduced Iron)

2.14.1 Special provisions

There is only one production route defined, although different technologies may use different qualities of ores, which may require pelletisation or sintering, and different reducing agents (natural gas, diverse fossil fuels or biomass, hydrogen). Therefore, precursors sintered ore or hydrogen may be relevant. As products, iron sponge, hot briquetted iron (HBI) or other forms of direct reduced iron may be relevant, including DRI which is immediately fed to electric arc furnaces or other downstream processes.

Where the installation does not sell or transfer DRI to other installations, there is no need to monitor emissions from DRI production separately. A common production process including steel making and, subject to the rules of Section A.5 of Annex III, further downstream production may be used.

2.14.2 Production route

For this production route, direct emissions monitoring shall encompass:

– CO_2 from fuels and reducing agents such as natural gas, fuel oils, waste gases from the process or converter gas, etc.

– Where biogas or other forms of biomass are used, the provisions of Section B.3.3 of Annex III are to be taken into account;

– CO_2 from process materials such as limestone, magnesite and other carbonates, carbonatic 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors:

– 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.

2.15 Crude steel

2.15.1 Special provisions

The system boundaries shall cover all necessary activities and units for obtaining crude steel:

– if the process starts from hot metal (liquid pig iron), the system boundaries shall include the basic oxygen converter, vacuum degassing, secondary metallurgy, argon oxygen decarburisation / vacuum oxygen decarburisation, continuous casting or ingot casting, and all necessary auxiliary activities such as transfers, re-heating and flue gas cleaning;

– if the process uses an electric arc furnace, the system boundaries shall include all relevant activities and units such as the electric arc furnace itself, secondary metallurgy, vacuum degassing, argon oxygen decarburisation / vacuum oxygen decarburisation, continuous casting or ingot casting, and

all necessary auxiliary activities such as transfers, heating of raw materials and equipment, re-heating and flue gas cleaning.

2.15.2 Production routes

2.15.2.1 Basic oxygen steelmaking

For that production route, direct emissions monitoring shall encompass:

– CO_2 from fuels such as coal, natural gas, fuel oils, waste gases such as blast furnace gas, coke oven gas or converter gas, etc.

– CO_2 from process materials such as limestone, magnesite and other carbonates, carbonatic 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors:

– Pig iron, DRI, if used in the process;

– FeMn, FeCr, FeNi if used in the process.

2.15.2.2 Electric arc furnace

For that production route, direct emissions monitoring shall encompass:

– 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.

– CO_2 from the consumption of electrodes and electrode pastes;

– CO_2 from process materials such as limestone, magnesite and other carbonates, carbonatic ores; materials for flue gas cleaning;

– Carbon entering the process, e.g. 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 approach in accordance with Section B.3.2 of Annex III.

Relevant precursors:

– Pig iron, DRI, if used in the process;

– FeMn, FeCr, FeNi if used in the process.

2.16 Iron and steel products

2.16.1 Special provisions

Subject to the rules of Section A.5 of Annex III and Sections 2.11 to 2.15 of this Annex, the production process for iron and steel products may apply to the following cases:

- System boundaries cover as one process all steps of an integrated steel plant from production of pig iron or DRI, crude steel, semi-finished products as well as final steel products under the CN codes listed in Section 1 of this annex.

- System boundaries cover the production of crude steel, semi-finished products and final steel products under the CN codes listed in Section 1 of this Annex;

- System boundaries cover the production of final steel products under the CN codes listed in section 1 of this annex starting from crude steel, semi-finished products or from other final steel products under the CN codes listed in Section 1 which are either received from other installations or produced within the same installation but under a separate production process.

Double counting or gaps in the monitoring of production processes of an installation shall be avoided. The following production steps shall be covered by the production process of "iron or steel products":

- All production steps for producing goods covered by the CN codes given in Section 1 of this Annex for the aggregated goods category "iron and steel products", which are not already covered by separate production processes for pig iron, DRI or crude steel, as required by Sections 2.11 to 2.15 of this Annex and as applied at the installation;

- All production steps applied at the installation, starting from crude steel, including, but not limited to: re-heating, re-melting, casting, hot rolling, cold rolling, forging, pickling, annealing, plating, coating, galvanizing, wire drawing, cutting, welding, finishing.

For products that contain more than [5 %] by mass of other materials, e.g. insulation materials in CN code 7309 00 30 (Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, Lined or heat-insulated), only the mass of iron or steel shall be reported as the mass of the goods produced.

2.16.2 Production route

For iron and steel products, direct emissions monitoring shall encompass:

- All CO_2 emissions from combustion of fuels and process emissions from flue gas treatment, related to production steps applied at the installation, including, but not limited to: re-heating, re-melting, casting, hot rolling, cold rolling, forging, pickling, annealing, plating, coating, galvanizing, wire drawing, cutting, welding and finishing of iron and steel products.

Relevant precursors:

- Crude steel, if used in the process;

- Pig iron, DRI, if used in the process;

- FeMn, FeCr, FeNi, if used in the process;

- Iron and steel products, if used in the process.

2.17 Unwrought aluminium

2.17.1 Special provisions

This aggregated goods category includes non-alloyed as well as alloyed aluminium, in physical form typical for unwrought metals, such as ingots, slabs, billets or granules. In integrated aluminium plants, liquid aluminium directly charged to the production of aluminium products is included, too. Where the installation

does not sell or transfer unwrought aluminium to other installations, there is no need to monitor emissions from unwrought aluminium production separately. A common production process including unwrought aluminium and, subject to the rules of Section A.5 of Annex III, further processes to produce aluminium products may be defined.

2.17.2 Production routes

2.17.2.1 Primary (electrolytic) smelting

For that production route, direct emissions monitoring shall encompass:

– CO_2 emissions from the consumption of electrodes or electrode pastes;

– CO_2 emissions from any fuels used (e.g. for drying and pre-heating of raw materials, heating of electrolysis cells, heating required for casting);

– 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 Section B.7 of Annex III.

Relevant precursors: none.

2.17.2.2 Secondary melting (recycling)

Secondary melting (recycling) of aluminium uses aluminium scrap as main input. However, where unwrought aluminium from other sources is added, it is treated like a precursor. Furthermore, where the product of this process contains more than [5%] alloying elements, the embedded emissions of the product are calculated as if the mass of alloying elements were unwrought aluminium from primary smelting.

For that production route, direct emissions monitoring shall encompass:

– 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;

– CO_2 emissions from any fuels used in associated activities such as treatment of skimmings and slag recovery;

– CO_2 emissions from any flue gas treatment, from soda ash or limestone if relevant;

Relevant precursors:

– Unwrought aluminium from primary smelting, if used in the process.

2.18 Aluminium products

2.18.1 Special provisions

Subject to the rules of Section A.5 of Annex III and Section 2.17 of this Annex, the production process for aluminium products may apply to the following cases:

– System boundaries cover as one process all steps of an integrated aluminium plant from production of unwrought aluminium to semi-finished products as well as aluminium products under the CN codes listed in Section 1 of this annex;

– System boundaries cover the production of aluminium products under the CN codes listed in Section 1 of this annex starting from semi-finished products or from other aluminium products under the CN codes listed in Section 1 which are either received from other installations or produced within the same installation but under a separate production process.

Double counting or gaps in the monitoring of production processes of an installation shall be avoided. The following production steps shall be covered by the production process of "aluminium products":

– All production steps for producing goods covered by the CN codes given in Section 1 of this Annex for the aggregated goods category "aluminium products", which are not already covered by separate production processes for unwrought aluminium, as required by Section 2.17 of this Annex and as applied at the installation;

– All production steps applied at the installation, starting from unwrought aluminium, including, but not limited to: re-heating, re-melting, casting, rolling, extruding, forging, coating, galvanizing, wire drawing, cutting, welding, finishing.

Where the product contains more than [5%] alloying elements, the embedded emissions of the product are shall be calculated as if the mass of alloying elements were unwrought aluminium from primary smelting.

2.18.2 Production route

For aluminium products, direct emissions monitoring shall encompass:

– All CO_2 emissions from fuel consumption in processes forming aluminium products, and flue gas cleaning.

Relevant precursors:

– 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.

2.19 Electricity

2.19.1 Special provisions

For electricity, only direct emissions shall be monitored and reported. The emission factor for electricity is determined in accordance with Section D.2 of Annex III.

2.19.2 Production routes

For electricity, direct emissions monitoring shall encompass:

– Any combustion emissions and process emissions from flue gas treatment.

Relevant precursors: none.

ANNEX III

Rules for determining data including on emissions data at installation level, attributed emissions of production processes, embedded emissions of goods, and the carbon price paid

A. DEFINITIONS AND PRINCIPLES

A.1. Definitions

For the purpose of Annexes I to VI the following definitions shall apply:

(1) 'activity data' means any of the following:

(a) with respect to produced goods, the quantity of goods produced (expressed in MWh if electricity is concerned, or in tonnes for other goods);

(b) with respect to the determination of emissions, data on the amount of fuels or materials consumed or produced by a process relevant for the calculation-based monitoring methodology, expressed in terajoules, mass in tonnes or (for gases) volume in normal cubic metres, as appropriate;

(2) 'reporting period' means a period that the operator of an installation has chosen to use as reference for the determination of embedded emissions;

(3) 'source stream' means any 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 methodology;

(4) 'emission source' means a separately identifiable part of an installation or a process within an installation, from which relevant greenhouse gases are emitted;

(5) 'uncertainty' means a parameter, associated with the result of the determination of a quantity, that characterises the dispersion of the values that could reasonably be attributed to the particular quantity, including the effects of systematic as well as of random factors, expressed in per cent, and describes a confidence interval around the mean value comprising 95% of inferred values taking into account any asymmetry of the distribution of values;

(6) 'calculation factors' means net calorific value, emission factor, preliminary emission factor, oxidation factor, conversion factor, carbon content or biomass fraction;

(7) 'combustion emissions' means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen;

(8) 'emission factor' 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;

(9) ‘oxidation factor’ 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 CO_2;

(10) ‘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;

(11) ‘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;

(12) ‘calibration’ means the set of operations, which establishes, under specified conditions, 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;

(13) ‘conservative’ means that a set of assumptions is defined in order to ensure that no under-estimation of reported emissions or over-estimation of production of heat, electricity or goods occurs;

(14) ‘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;

(15) ‘waste’ means 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;

(16) ‘residue’ means a substance that is not the end product(s) 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;

(17) ‘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;

(18) ‘legal metrological control’ means the control by a public authority or regulator of the measurement tasks intended for the field of application of a measuring instrument, 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 fair trading;

(19) ‘data flow activities’ mean activities related to the acquisition, processing and handling of data that are needed to draft an emissions report from primary source data;

(20) ‘measurement system’ means a complete set of measuring instruments and other equipment, such as sampling and data processing equipment, used to determine variables

such as the activity data, the carbon content, the calorific value or the emission factor of the greenhouse gas emissions;

(21) ‘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;

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

(a) the chemical, electrolytic or pyrometallurgical reduction of metal compounds in ores, concentrates and secondary materials;

(b) the removal of impurities from metals and metal compounds;

(c) the decomposition of carbonates, including those used for flue gas cleaning;

(d) chemical syntheses of products and intermediate products where the carbon bearing material participates in the reaction;

(e) the use of carbon containing additives or raw materials;

(f) the chemical or electrolytic reduction of metalloid oxides or non-metal oxides such as silicon oxides and phosphates.

(23) ‘batch’ means an amount of fuel or material representatively sampled and characterised, and transferred as one shipment or continuously over a specific period of time;

(24) ‘mixed fuel’ means a fuel which contains both biomass and fossil carbon;

(25) ‘mixed material’ means a material which contains both biomass and fossil carbon;

(26) ‘preliminary emission factor’ means the assumed total emission factor of a fuel or material based on the carbon content of its biomass fraction and its fossil fraction before multiplying it by the fossil fraction to produce the emission factor;

(27) ‘fossil fraction’ means the ratio of fossil and inorganic carbon to the total carbon content of a fuel or material, expressed as a fraction;

(28) ‘biomass fraction’ means the ratio of carbon stemming from biomass to the total carbon content of a fuel or material, expressed as a fraction;

(29) ‘continuous emission measurement’ means a set of operations having the objective of determining the value of a quantity 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;

(30) ‘inherent CO_2’ means CO_2 which is part of a source stream;

(31) ‘fossil carbon’ means inorganic and organic carbon that is not biomass;

(32) ‘measurement point’ means the emission source for which continuous emission measurement systems (CEMS) are used for emission measurement, or the cross-section of a pipeline system for which the CO_2 flow is determined using continuous measurement systems;

(33) ‘fugitive emissions’ means irregular or unintended emissions from sources that are not localised, or too diverse or too small to be monitored individually;

(34) ‘standard conditions’ means temperature of 273,15 K and pressure conditions of 101 325 Pa defining normal cubic metres (Nm^3);

(35) ‘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 when it is not possible to generate all the required data or factors in the applicable monitoring methodology;

(36) ‘measurable heat’ means a net heat flow transported through identifiable pipelines or ducts using a heat transfer medium, such as, in particular, steam, hot air, water, oil, liquid metals and salts, for which a heat meter is or could be installed;

(37) ‘heat meter’ means a thermal energy meter or any other device to measure and record the amount of thermal energy produced based upon flow volumes and temperatures;

(38) ‘non-measurable heat’ means all heat other than measurable heat;

(39) ‘waste gas’ means a gas containing incompletely oxidised carbon in a gaseous state under standard conditions which is a result of any of the processes listed in point (21);

(40) ‘production process’ means the parts of an installation in which chemical or physical processes are carried out to produce goods under an aggregated goods category defined in Table 1 of Section 1 of Annex II, and its specified system boundaries regarding inputs, outputs and corresponding emissions;

(41) ‘production route’ means a specific technological option used in a production process to produce a good under an aggregated goods category;

(42) ‘data set’ means one type of data, either at installation level or production process level as relevant in the circumstances, as any of the following:

(a) the amount of fuels or materials consumed or produced by a production process as relevant for the calculation-based monitoring methodology, expressed in terajoules, mass in tonnes, or for gases as volume in normal cubic metres, as appropriate, including for waste gases;

(b) a calculation factor;

(c) net quantity of measurable heat, and the relevant parameters required for determining this quantity, in particular:

– mass flow of heat transfer medium, and

– enthalpy of transmitted and returned heat transfer medium, as specified by composition, temperature, pressure and saturation;

(d) quantities of non-measurable heat, specified by the relevant quantities of fuels used for producing the heat, and the net calorific value (NCV) of the fuel mix;

(e) quantities of electricity;

(f) quantities of CO_2 transferred between installations;

(g) quantities of precursors received from outside the installation, and their relevant parameters, such as country of origin, used production route, specific direct and indirect emissions, carbon price paid;

(h) parameters relevant for a carbon price paid;

(43) 'minimum requirements' means monitoring approaches using the minimum efforts allowed for determining data in order to result in emission data acceptable for the purpose of Regulation (EU) 2023/956;

(44) 'recommended improvements' means monitoring approaches which are proven means to ensure that data are more accurate or less prone to mistakes than by mere application of minimum requirements, and which may be chosen on a voluntary basis;

(45) 'misstatement' means an omission, misrepresentation or error in the operator's reported data, not considering the uncertainty permissible for measurements and laboratory analyses;

(46) 'material misstatement' means a misstatement that, in the opinion of the verifier, individually or when aggregated with other misstatements, exceeds the materiality level or could affect the treatment of the operator's report by the competent authority;

(47) 'reasonable assurance' means a high but not absolute level of assurance, expressed positively in the verification opinion, as to whether the operator's report subject to verification is free from material misstatement;

(48) 'eligible monitoring, reporting and verification system' means the rules established by the jurisdiction in which the installation is located, for monitoring, reporting and verification for the purpose of a mandatory carbon pricing scheme, or the monitoring, reporting and verification rules governing a greenhouse gas emission reduction project carried out in the relevant installation, or compulsory emission monitoring schemes.

A.2. Overall approach

1. For the purpose of determining embedded emissions of goods listed in Annex I to Regulation (EU) 2023/956 it is necessary to perform the following activities:

(a) The relevant production processes relating to goods produced in the installation are identified using the aggregated goods categories as defined in Section 1 of Annex II, as well as the relevant production routes listed in Section 2 of Annex II, taking into account the rules for setting system boundaries of production processes in accordance with Section A.5 of this Annex.

(b) At the level of the installation producing the goods, the direct emissions of the greenhouse gases specified for those goods in Annex II are monitored in line with the methods provided in Section B of this Annex.

(c) Where measurable heat is imported to, produced in, consumed in or exported from the installation, net heat flows and the emissions associated with the production of that heat have to be monitored in line with the methods provided in Section C of this Annex.

(d) For the purpose of monitoring indirect emissions embedded in the goods produced, the consumption of electricity in the relevant production processes shall be monitored in line with the methods provided in Section D.1 of this Annex. Where electricity is produced within the installation or by an installation at the same site, the emissions associated with that electricity production shall be monitored in order to determine its emission factor for eletricity. Where the installation receives electricity from the grid, the emission factor for electricity needs to be determined in line with Section D.2.3 of this Annex. Any quantities of electricity transferred between production processes or exported from the installation shall be monitored, as well.

(e) The direct emissions at the installations, with heat production and consumption, electricity production and consumption, and any relevant waste gas streams have to be attributed to the production processes associated with the goods produced by applying the rules provided in Section F of this Annex. The emissions attributed to the production process are then used to calculate the specific direct and indirect embedded emissions of the goods produced, applying the Section F of this Annex.

(f) Where Section 2 of Annex II defines relevant precursors for goods produced in the installations, making those goods 'complex goods', the embedded emissions of the relevant precursor have to be determined in line with Section E of this Annex, and are added to the embedded emissions of that complex good produced, by applying the rules provided in Section G of this Annex. Where a precursor is itself a complex good, that process is repeated recursively until no more precursors are at stake.

(g) For the purpose of quarterly reporting in accordance with Article 35 of Regulation (EU) 2023/956, it is necessary to report information on any carbon price paid, including any carbon price paid for emissions embedded in relevant precursor materials as defined by Article 3(29) of that Regulation.

2. Where an operator cannot adequately determine actual data for one or more data sets, by applying approaches provided in Section A.4 of this Annex, and where no other method for closing data gaps is available, the preliminary default made available and published by the Commission may be used for communication to reporting declarants in line with Section I of this Annex. In that case, a short explanation of the reasons for not using actual data shall be added.

3. Monitoring shall cover a reporting period which ensures that non-representative data due to short-time fluctuations in the production processes and data gaps are avoided to the highest extent feasible. The default reporting period is a calendar year. However, the operator may choose as alternative:

– If the installation has a compliance obligation under an eligible monitoring, reporting and verification system, that system's reporting period may be used, if it covers at least three months;

– The operator's fiscal year provided such period ensures higher data quality than the use of the calendar year.

The embedded emissions of goods shall be calculated as average of the reporting period chosen.

4. Regarding emissions not under the control of the operator, the operator shall use data obtained for the latest available reporting period as provided by the supplier. Emissions not under the control of the operator include:

– indirect emissions where electricity is received from the grid;

– emissions from electricity and heat imported from other installations;

embedded direct and indirect emissions of precursors received from other installations.5. Emissions data over a full reporting period are expressed in tonnes $CO_{2(e)}$ rounded to full tonnes.

All parameters used to calculate the emissions are rounded to include all significant digits for the purpose of calculating and reporting emissions.

Specific direct and indirect embedded emissions are expressed in tonnes of $CO_{2(e)}$ per tonne of good, rounded to include all significant digits. For the purpose of the CBAM report, a maximum of 5 digits after the comma are reported.

A.3. Monitoring principles

For the monitoring of actual data at installation level, and for data sets necessary for attributing emissions to goods, the following principles apply:

(a) Completeness: The monitoring methodology shall cover all parameters necessary to determine the embedded emissions of all goods covered by Annex I of Regulation (EU) 2023/956 in accordance with the methods and formulae contained in this Annex.

– Direct emissions at installation level include combustion and process emissions.

– Direct embedded emissions include the attributed emissions of the relevant production process in accordance with Section F of this Annex, based on direct emissions at the installation, emissions related to relevant heat flows and to material flows between process system boundaries, including waste gases, if relevant. Direct embedded emissions furthermore include the direct embedded emissions of relevant precursors.

– Indirect emissions at the installation level cover the emissions related to electricity consumption within the installation.

– Indirect embedded emissions include the indirect emissions of the goods produced within the installation, and the indirect embedded emissions of relevant precursors.

For each parameter an appropriate determination approach in accordance with Section A.4 of this Annex shall be selected, ensuring that neither double counting nor data gaps occur.

(b) Consistency and comparability: Monitoring and reporting shall be consistent and comparable over time. To that end, in the selected data determination approaches shall be laid down in a written monitoring methodology documentation and use so that methods are used consistently. The methodology shall be changed only if objectively justified. Relevant reasons include:

- changes in the i configuration of the instalation in the technology used, in the input materials and fuels, or in the goods produced;
- new data sources or monitoring approaches have to be introduced because of changes of trade partners responsible for data used in the monitoring methodology;
- the accuracy of the data can be improved, data flows can be simplified or the control system can be improved.

(c) Transparency: Monitoring data shall be obtained, recorded, compiled, analysed and documented monitoring data, including assumptions, references, activity data, emission factors, calculation factors, data on embedded emissions of purchased precursors, measurable heat and electricity, default values of embedded emissions, information on a carbon price paid, and any other data relevant under this Annex, in a transparent manner that enables the reproduction of the determination of emissions data by the operator's personnel as well as by independent third parties, such as accredited verifiers. Documentation shall include a record of all changes of methodology.

Complete and transparent records shall be kept at the installation of all data relevant for determining embedded emissions of the goods produced, including necessary supporting documents, for at least 4 years after the reporting period. The operator shall be able to make those data and documents available to the Commission and the competent authority.

(d) Accuracy: The chosen monitoring methodology shall ensure that emission determination is neither systematically nor knowingly inaccurate. Any source of inaccuracies shall be identififed and reduced as far as possible. Due diligence shall be exercised to ensure that the calculation and measurement of emissions exhibit the highest achievable accuracy.

Where data gaps have occurred or are expected to be unavoidable, substitute data shall consist of conservative estimates. Further cases where emissions data shall be based on conservative estimates include:

- carbon monoxide (CO) emitted to the atmosphere shall be calculated as the molar equivalent amount of CO_2.
- all biomass emissions in mass balances and for transferred CO_2, where it is not possible to determine the biomass content in materials or fuels, the emissions shall be considered to be from fossil carbon.

(e) Integrity of methodology: The chosen monitoring methodology shall enable reasonable assurance of the integrity of emission data to be reported. Emissions shall be determined using the appropriate monitoring methodologies set out in this Annex. Reported emission data shall be free from material misstatement, avoid bias in the selection and presentation of information, and provide a credible and balanced account of the embedded emissions of installation's produced goods.

Optional measures to increase the quality of the data to be reported may be applied, in particular the data flow and control activities in line with Section H of this Annex.

(f) Cost-effectiveness: In selecting a monitoring methodology, the improvements from greater accuracy shall be balanced against additional costs. Monitoring and

reporting of emissions shall aim for the highest achievable accuracy, unless that is technically not feasible or incurs unreasonable costs.

(g) Continuous improvement: It shall be regularly checked if monitoring methodologies can be improved. If verification of emissions data is performed, any recommendations for improvements included in the verification reports shall be considered for implementation within a reasonable timeframe, unless the improvement would incur unreasonable costs or would be technically not feasible.

A.4. Approach for choosing the most best available data source

(1) For the determination of embedded emissions of goods, and for underlying data sets, such as emissions of individual source streams or emission sources, quantities of measurable heat, or other heat sources, the overarching principle is to select always the best available data source. For this purpose, the following guiding principles apply:

(a) Monitoring methods described in this Annex are preferred. If for a specific data set there is no monitoring method described in this Annex, or it would incur unreasonable costs or is technically not feasible, monitoring methods from another eligible monitoring, reporting and verification system may be used, if they cover the required data set. Where such methods are not available, not technically feasible, or would incour unreasonable costs, indirect methods for determination of the data set in accordance with point (2) may be used. Where such methods are not available, not technically feasible, or would incour unreasonable costs, preliminary default values made availableavaiable and published by the Commission shall be used.

(b) For direct or indirect determination methods, a method is deemed suitable where it is ensured that any metering, analyses, sampling, calibrations and validations for the determination of the specific data set are carried out by applying methods defined in relevant EN or ISO standards. Where such standards are not available, national standards may be used. Where no applicable published standards exist, suitable draft standards, industry best practice guidelines or other scientifically proven methodologies shall be used, limiting sampling and measurement bias.

(c) Within one approach mentioned in point (a), measurement instruments or laboratory analyses under the operator's control shall be preferred over intruments or methods under the control of another legal entity, such as the supplier of fuel or materials or trade partners regarding goods produced.

(d) Measuring instruments shall be selected such that they exhibit the lowest uncertainty in use without incurring unreasonable costs. Instruments under legal metrological control are preferred, except where other instruments with significantly lower uncertainty in use are available. Instruments shall be used only in environments appropriate according to their use specification.

(e) Where laboratory analyses are used, or where laboratories carry out sample treatment, calibrations, method validations, or activities relating to continuous emissions measurements, the requirements of Section B.5.4.3 of this Annex apply.

(2) Indirect determination methods: Where no direct metering or analysis approach is available for a required data set, in particular for cases where net measurable heat going

into different production processes needs to be determined, an indirect determination method may be used, such as:

(a) calculation based on a known chemical or physical process, using appropriate accepted literature values for the chemical and physical properties of substances involved, appropriate stoichiometric factors and thermodynamic properties such as reaction enthalpies, as appropriate;

(b) calculation based on the installation's design data such as the energy efficiencies of technical units or calculated energy consumption per unit of product;

(c) correlations based on empirical tests for determining estimation values for the required data set from non-calibrated equipment or data documented in production protocols. For that purpose it shall be ensured that the correlation satisfies the requirements of good engineering practice and that it is applied only to determine values which fall into the range for which it was established. The validity of such correlations shall be evaluated at least once a year.

(3) To determine the most best available data sources, the data source highest in the ranking presented under point (1) and already available at the installation shall be selected. However, if it is technically feasible to apply a data source higher in the ranking without incurring unreasononable costs, such better data source shall be applied without undue dalay. If different data sources are available for the same data set at the same level in the ranking presented under point (1), the data source which ensures the clearest data flow with lowest inherent risk and control risk regarding misstatements shall be chosen.

(4) The data sources chosen under point (3) are referred to as ‘primary data sources’ and shall be used for regular determination and reporting of embedded emissions.

(5) To the extent feasible without incurring unreasonable costs, for the purpose of the control system in accordance with Section H of this Annex, additional data sources or methods for determining data sets shall be identified which allow corroboration of the primary data sources (referred to hereinafter as ‘corroborating data sources’). The selected corroborating data sources, if any, shall be laid down in the monitoring methodology documentation.

(6) Recommended improvements: It shall be checked regularly, but at least once per year, whether new data sources have become available, for the purpose of improving the monitoring approaches. In case such new data sources are considered more accurate in accordance with the ranking presented under point (1), they shall be laid down in the monitoring methodology documentation and be applied from the earliest date possible.

(7) Technical feasibility: Where a claim is made that applying a specific determination methodology is technically not feasible, a justification for this fact shall be laid down in the monitoring methodology documentation. It shall be re-assessed during the regular checks in line with point (6). That justification shall be based on whether the installation has technical resources capable of meeting the needs of a proposed data source or monitoring approach that can be implemented in the required time for the purposes of this Annex. Those technical resources shall include availability of required techniques and technology.

(8) Unreasonable costs: Where a claim is made that applying a specific determination methodology for a data set incurs unreasonable costs, a justification for this fact shall be laid down in the monitoring methodology documentation. It shall be re-assessed during the regular checks in line with point (6). The unreasonable nature of the costs is determined as follows.

Costs for determining a specific data set is considered unreasonable where the operator's cost estimation exceeds the benefit of a specific determination methodology. To that end, the benefit shall be calculated by multiplying an improvement factor with a reference price of EUR 20 per tonne of $CO_{2(e)}$ and costs shall include an appropriate depreciation period based on the economic lifetime of the equipment, where applicable.

The improvement factor shall be:

(a) the improvement of estimated uncertainty in a measurement, expressed in per cent, multiplied with the estimated related emissions over the reporting period. Related emissions means:

- the direct emissions caused by the source stream or emission source concerned;
- emissions attributed to a quantity of measurable heat;
- the indirect emissions related to the quantity of electricity concerned;
- embedded emissions of a material produced or of a precursor consumed.

(b) 1 % of the related emissions, where no improvement of measuring uncertainty is involved;

Measures relating to the improvement of an installation's monitoring methodology shall not be deemed to incur unreasonable costs up to an accumulated amount of EUR 2 000 per year.

A.5. Approach to dividing installations into production processes

Installations shall be divided into production processes with system boundaries which ensure that relevant inputs, outputs and emissions can be monitored in accordance with Sections B to E of this Annex and direct and indirect emissions can be attributed to groups of goods defined in Section 1 of Annex II, by applying the rules of Section F of this Annex.

Division of installations shall be done using the following approach:

(a) One production process shall be defined for each of the aggregated goods categories defined in Section 1 of Annex II and relevant at the installation.

(b) By way of derogation from point (a), separate production processes may be defined for each production route where different production routes in accordance with Section 2 of Annex II for the same aggregated goods category are applied in the same installation, or where the operator selects voluntarily different goods or groups of goods for separate monitoring. More disaggregated definition of production processes may also be used where it is in accordance with an eligible monitoring, reporting and verification system applicable at the installation.

Where the first sub-paragraph is applied, the embedded emissions of the goods produced during a reporting period shall be calculated as the weighted average of the embedded emissions from all production routes for the same aggregated goods category during the reporting period.

(c) By way of derogation from point (a), where at least a part of the precursors relevant for a complex good are produced in the same installation as the complex good, and where the respective precursors are not transferred out of the installation for sale or use in other installations, the production of precursors and complex good may be covered by a joint production process. Separate calculation of embedded emissions of the precursors is omitted in that case.

(d) For the duration of the transitional period referred to in Article 32 of Regulation (EU) 2023/956, the following sectoral derogations from point (a) may be applied:

- Installations producing two or more goods from the groups sintered ore, pig iron, FeMn, FeCr, FeNi, DRI, crude steel, iron and steel products, may monitor and report embedded emissions defining one joint production process for all the products from these groups covered.

- Installations producing two or more goods from the groups unwrought aluminium or aluminium products, may monitor and report embedded emissions defining one joint production process for all the products from these groups covered.

- Installations producing mixed fertilizers may simplify the monitoring of the respective production process by determining one uniform value of embedded emissions per tonne of nitrogen contained in the mixed fertilizers, irrespective of the chemical form of nitrogen (ammonium, nitrate or urea forms).

(e) Where a part of the installation serve the production of goods not covered by Annex I to Regulation (EU) 2023/956, that part shall be – as a recommended improvement – monitored as one additional production process for the purpose of corroborating the completeness of the installation's total emissions data.

B. MONITORING OF DIRECT EMISSIONS AT INSTALLATION LEVEL

B.1 Completeness of source streams and emission sources

The boundaries of the installation and its production processes shall be clearly known to the operator and defined in the monitoring methodology documentation, taking into account the sector-specific requirements laid down in Section 1 of Annex II as well as Section B.9 of this Annex:

- As a minimum, all relevant greenhouse gas emissions emission sources and source streams associated directly or indirectly with the production of goods listed in Section 1 of Annex II shall be covered.

- It is a recommended improvement to cover all emission sources and source streams of the total installation, in order to perform plausibility checks and to control the energy and emissions efficiency of the installation as a whole.

- All emissions from regular operations shall be included, as well as from abnormal events, including start-up, shut-down and emergency situations, over the reporting period.

- Emissions from mobile machinery for transportation purposes are to be excluded.

B.2 Choice of monitoring approach

Applicable approaches and methods are:

1. The calculation-based approach, which consists in determining emissions from source streams on the basis of activity data obtained by means of measurement systems and additional parameters from laboratory analyses or standard values. The calculation-based methodology may be implemented according to the standard method or the mass balance method.

2. The measurement-based approach, which consists in determining emissions from emission sources by means of continuous measurement of the concentration of the relevant greenhouse gas in the flue gas and of the flue gas flow.

Until 31 December 2024, the level of embedded emissions may be calculated using one of the following methods, if they lead to similar coverage and accuracy of emissions data compared to the methods listed in point (a) and (b):

1. Methods used under eligible monitoring, reporting and verification systems.

2. Other methods, with any of the following applicable monitoring rules:

   a) a carbon pricing scheme where the installation is located, or

   b) an emission monitoring scheme at the installation which can include verification by an accredited verifier, or

   c) compulsory emission monitoring schemes.

The operator shall choose the approach that gives the most accurate and reliable results, except where sector-specific requirements in accordance with Section B.9 require one particular method. The allowed approaches may be combined such that different parts of the installation's emissions are monitored by either of the allowed methodologies.

The monitoring methodology documentation shall clearly identify:

- For which source stream the calculation-based standard method or the mass balance method is used, including the detailed approach for each relevant parameter given in Section B.3.4 of this Annex;

- For which emission source a measurement-based approach is used, including the details relevant pursuant to Section B.6 of this Annex;

- By means of a suitable diagram and process description of the installation, evidence that there is neither double counting nor data gaps in the emissions of the installation.

The installation's emissions are determined by

$$Em_{Inst} = \sum_{i=1}^{n} Em_{calc,i} + \sum_{j=1}^{m} Em_{meas,j} + \sum_{k=1}^{l} Em_{other,k} \qquad \text{(Equation 4)}$$

Where:

Em_{Inst} … (direct) Emissions of the Installation expressed in tonnes $CO_{2(e)}$

$Em_{calc,i}$ … Emissions from source stream *i* determined using a calculation based approach expressed in tonnes $CO_{2(e)}$

$Em_{meas,j}$ … Emissions from emission source *j* determined using a measurement based approach expressed in tonnes $CO_{2(e)}$

$Em_{other,k}$ … Emissions determined by another approach, index *k* expressed in tonnes $CO_{2(e)}$

B.3 Formulae and parameters for the calculation-based approach for CO_2

B.3.1 Standard method

Emissions are calculated separately for each source stream as follows:

B.3.1.1 Combustion emissions:

Combustion emissions are calculated using the standard methodology as follows:

$$Em_i = AD_i \cdot EF_i \cdot OF_i \quad \text{(Equation 5)}$$

Where:

Em_i…Emissions [t CO_2] caused by fuel *i*

EF_i…Emission factor [t CO_2 / TJ] of fuel *i*

AD_i…Activity data [TJ] of fuel *i*, calculated as $AD_i = FQ_i \cdot NCV_i$ (Equation 6)

FQ_i… Fuel quantity consumed [t or m^3] of fuel *i*

NCV_i… Net Calorific value (lower heating value) [TJ/t or TJ/m^3] of fuel *i*

OF_i…Oxidation factor (dimensionless) of fuel *i*, calculated as

$$\mathrm{OF} = 1 - \mathrm{C_{ash}}/\mathrm{C_{total}} \quad \text{(Equation 7)}$$

C_{ash}… Carbon contained in ash and flue gas cleaning dust

C_{total}… Total carbon contained in the fuel combusted

It is allowed to always use the conservative assumption that *OF* equals 1 in order to reduce monitoring efforts.

Where the operator has evidence that higher accuracy can be achieved by such approach, it is acceptable to modify that approach as follows:

- Activity data is expressed as fuel quantity (i.e. in t or m^3),
- *EF* is expressed in t CO_2/t fuel or t CO_2/m^3 fuel, as applicable, and
- *NCV* can be omitted from the calculation. However, it is a recommended improvement to report NCV for allowing consistency checking and monitoring of the energy efficiency of the whole production process.

If the emission factor of a fuel *i* is to be calculated from the analyses of carbon content and NCV, the following equation is used:

$$EF_i = CC_i \cdot f/NCV_i \quad \text{(Equation 8)}$$

If the emission factor of a material or fuel expressed in t CO_2/t is to be calculated from an analysed carbon content, the following equation is used:

$$EF_i = CC_i \cdot f \quad \text{(Equation 9)}$$

Where *f* is the ratio of molar mass of CO_2 to C: *f* = 3.664 t CO_2/t C

As the emission factor of biomass shall be zero provided that the criteria given in Section B.3.3 are met, this fact can be taken into account for mixed fuels (i.e. fuels which contain both fossil and biomass components) as follows:

$$EF_i = EF_{pre,i} \cdot (1 - BF_i) \quad \text{(Equation 10)}$$

Where:

$EF_{pre,i}$… preliminary emission factor of fuel *i* (i.e. emission factor assuming the total fuel is fossil)

BF_i… Biomass Fraction (dimensionless) of fuel *i*

For fossil fuels and where the biomass fraction is not known, BF_i is set to the conservative value zero.

B.3.1.2 Process emissions:

Process emissions are calculated using the standard methodology as follows:

$$Em_j = AD_j \cdot EF_j \cdot CF_j \quad \text{(Equation 11)}$$

Where:

AD_j…Activity data [t of material] of material *j*

EF_j…Emission factor [t CO_2 / t] of material *j*

CF_j…Conversion factor (dimension-less) of material *j*

It is allowed to always use the conservative assumption that $CF_j = 1$ in order to reduce monitoring efforts.

In case of mixed process input materials which contain inorganic as well as organic forms of carbon, the operator may choose

– to determine a total preliminary emission factor for the mixed material by analysing the total carbon content, and using a conversion factor and – if applicable – biomass fraction and net calorific value related to that total carbon content; or

– to determine the organic and inorganic contents separately and treat them as two separate source streams.

For emissions from the decomposition of carbonates, the method giving the more accurate results may be chosen for each source stream from the following two methods, taking into account available measurement systems for activity data and methods for determining the emission factor:

– Method A (Input based): The emission factor, conversion factor and activity data are related to the amount of material input into the process. The standard emission factors of pure carbonates as given in Table 3 in Annex VIII are used, taking into account the composition of the material as determined in line with Section B.5 of this Annex.

– Method B (Output based): The emission factor, conversion factor and activity data are related to the amount of output from the process. The standard emission factors of metal oxides after decarbonatisation as given in Table 4 in Annex VIII are used, taking into account the composition of the relevant material as determined in line with Section B.5 of this Annex.

For CO_2 process emissions other than from carbonates, only method A may be applied.

B.3.2 Mass balance method

The CO_2 quantities relevant for each source stream are calculated based on the carbon content in each material, without distinguishing fuels and process materials. Carbon leaving the installation in products instead of being emitted is taken into account by output source streams, which have therefore negative activity data.

The emissions corresponding to each source stream are calculated as

$$Em_k = f \cdot AD_k \cdot CC_k \quad \text{(Equation 12)}$$

Where

AD_k…Activity data [t of material i] of material k; for outputs, AD_k is negative

f…ratio of molar mass of CO_2 to C: f = 3.664 t CO_2/t C

CC_k…carbon content of material k (dimensionless and positive)

If the carbon content of a fuel k is to be calculated from an emission factor expressed in t CO_2/TJ, the following equation is used:

$$CC_k = EF_k \cdot NCV_k / f \quad \text{(Equation 13)}$$

If the carbon content of a material or fuel k is to be calculated from an emission factor expressed in t CO_2/t, the following equation is used:

$$CC_k = EF_k / f \quad \text{(Equation 14)}$$

For mixed fuels (i.e. fuels which contain both fossil and biomass components) or mixed materials, the biomass fraction may be taken into account, provided that the criteria given in Section B.3.3 are met as follows:

$$CC_k = CC_{pre,k} \cdot (1 - BF_k) \quad \text{(Equation 15)}$$

Where:

$CC_{pre,k}$… preliminary carbon content of fuel k (i.e. emission factor assuming the total fuel is fossil)

BF_k… Biomass Fraction of fuel k (dimensionless)

For fossil fuels or materials and where the biomass fraction is not known, BF isset to the conservative value zero. Where biomass is used as input material or fuel, and output materials contain carbon, the overall mass balance shall treat the biomass fraction conservatively, i.e. the fraction of biomass in total output carbon shall not exceed the total fraction of biomass contained in input materials and fuels, except if the operator provides evidence of a higher biomass fraction in the output materials by a “trace the atom” (stoichiometric) approach or by ^{14}C analyses.

B.3.3 Criteria for zero-rating of biomass emissions

Where biomass is used as a fuel for combustion, it shall fulfil the criteria of this section. Where the biomass used for combustion does not comply with these criteria, its carbon content shall be considered as fossil carbon.

– The biomass shall comply with the sustainability and the greenhouse gas emissions saving criteria laid down in paragraphs 2 to 7 and 10 of Article 29 of Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. ([4])

– However, biomass contained in or produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues are required to fulfil only the criteria laid down in Article 29(10) of Directive (EU) 2018/2001. This point shall also apply to waste and residues that are first processed into a product before being further processed into fuels.

– Electricity, heating and cooling produced from municipal solid waste shall not be subject to the criteria laid down in Article 29(10) of Directive (EU) 2018/2001.

([4]) OJ L 328, 21.12.2018, p. 82.

- The criteria laid down in paragraphs 2 to 7 and 10 of Article 29 of Directive (EU) 2018/2001 shall apply irrespective of the geographical origin of the biomass.

- The compliance with the criteria laid down in paragraphs 2 to 7 and 10 of Article 29 of Directive (EU) 2018/2001 shall be assessed in accordance with Articles 30 and 31(1) of that Directive.

B.3.4 Relevant parameters

In line with the formulae given in Sections B.3.1 to B.3.3 of this Annex, the following parameters have to be determined for each source stream:

- Standard method, combustion:
  - Minimum requirement: Fuel quantity (t or m^3), Emission factor (t CO_2 /t or t CO_2/m^3)
  - Recommended improvement: Fuel quantity (t or m^3), NCV (TJ/t or TJ/$m^{3)}$, Emission factor (t CO_2 /TJ), Oxidation factor, Biomass fraction, evidence for meeting the criteria of Section B.3.3.
- Standard method, process emissions:
  - Minimum requirement: Activity data (t or m^3), Emission factor (t CO_2 /t or t CO_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.
- Mass balance:
  - Minimum requirement: Material quantity (t), Carbon content (t C /t material)
  - Recommended improvement: Material quantity (t), Carbon content (t C /t material), NCV (TJ/t), biomass fraction, evidence for meeting the criteria of Section B.3.3.

B.4 Requirements for activity data

B.4.1 Continual or batch-wise metering

Where quantities of fuels or materials, including goods or intermediate products, have to be determined for a reporting period, one of the following methods may be chosen and laid down in the monitoring methodology documentation:

- based on continual metering at the process where the material is consumed or produced;

- based on aggregation of metering of quantities separately (batch-wise) delivered or produced taking into account relevant stock changes. For this purpose the following shall apply:
  - the quantity of fuel or material consumed during the reporting period is calculated as the quantity of fuel or material imported during the reporting period, minus the quantity of fuel or material exported, plus the quantity of fuel or material in stock at the beginning of the reporting period, minus the quantity of fuel or material in stock at the end of the reporting period;
  - the the production levels of goods or intermediate products is calculated as the quantity exported during the reporting period, minus the quantity imported, minus the quantity of product or

material in stock at the beginning of the reporting period, plus the quantity of product or material in stock at the end of the reporting period. For avoiding any double counting, products of a production process returned into the same production process are deducted from production levels.

Where it is technically not feasible or would incur unreasonable costs to determine quantities in stock by direct measurement, those quantities may be estimated based on one of the following:

- data from previous years and correlated with appropriate activity levels for the reporting period;
- documented procedures and respective data in audited financial statements for the reporting period.

Where the determination of quantities of products, materials or fuels for the entire reporting period is technically not feasible or would incur unreasonable costs, the the next most appropriate day may be chosen to separate a reporting period from the following one. It is to be reconciled accordingly to the reporting period required. The deviations involved for each product, material or fuel are to be clearly recorded to form the basis of a value representative for the reporting period and to be considered consistently in relation to the next year.

B.4.2 Operator's control over measurement systems

The preferred approach for determining quantities of products, materials or fuels is that the operator of the installation uses measurement systems under its own control. However, measurement systems outside the operator's own control, in particular if under the control of the supplier of the material or fuel, may be used in the following cases:

- where the operator does not have an own measurement system available for the determination of the respective data set;
- where determination of a data set by the operator's own measurement system is technically not feasible or would incur unreasonable costs;
- where the operator has evidence that the measurement system outside the operator's control gives more reliable results and is less prone to risks of misstatements.

In such case, applicable data sources are the following:

- amounts from invoices issued by a trade partner, provided that a commercial transaction between two independent trade partners takes place;
- direct readings from the measurement systems.

B.4.3 Requirements for measurement systems

The operator shall have an understanding of the uncertainty associated with metering quantities of fuels and materials, including the influence of the operating environment and, where applicable, the uncertainty of stock determination. The operator shall choose the measurement instruments of lowest uncertainty available without incurring unreasonable costs and fit for the environment they are used in, in accordance with applicable technical standards and requirements. If available, instruments subject to legal metrological control shall be preferred. In this case, the maximum permissible error in service allowed by the relevant national legislation on legal metrological control for the relevant measuring task may be used as the uncertainty value.

Where a measurement instrument needs to be replaced because of malfunction or because calibration demonstrates that requirments are not met anymore, it shall be replaced by instruments that ensure meeting the same or a better uncertainty level compared to the existing instrument.

B.4.4 Recommended improvement

It is considered a recommended improvement to achieve a measurement uncertainty comensurate with the total emissions of the source stream or emission source, with lowest uncertainty for the biggest parts of the emissions. For orientation purposes, for emissions of more than 500 000 t CO_2 per year, the uncertainty over the full reporting period taking into account stock changes, if applicable, shall be 1,5 % or better. For emissions below 10 000 t CO_2 per year, uncertainty lower than 7,5 % is acceptable.

B.5 Requirements for calculation factors for CO_2

B.5.1 Methods for determining calculation factors

For the determination of calculation factors required for the calculation-based approach, one of the following approaches may be chosen:

- use of standard values;
- use of proxy data based on a empirical correlations between the relevant calculation factor and other properties better accessible to measurement;
- use of values based on laboratory analysis.

Calculation factors shall be determined consistently with the state used for related activity data, referring to the fuel's or material's state in which the fuel or material is purchased or used in the emission causing process, before it is dried or otherwise treated for laboratory analysis. Where such an approach incurs unreasonable costs or where higher accuracy can be achieved, activity data and calculation factors may be consistently reported referring to the state in which laboratory analyses are carried out.

B.5.2 Applicable standard values

- Type I standard values, applicable only if no type II value is available for the same parameter and material or fuel, shall be the following:
  - Standard factors provided in Annex VIII;
  - Standard factors contained in the latest IPCC guidelines for GHG inventories;
  - Values based on laboratory analyses carried out in the past (not older than 5 years) and established as representative for the fuel or material;
- Type II standard values, shall be the follwing:
  - 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;
  - values published by national research institutions, public authorities, standardisation bodies, statistical offices etc. for the purpose of more disaggregated emissions 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 analyses carried out in the past (not older than 2 years) and established as representative for the fuel or material.

In order to ensure consistency over time, any standard values used shall be laid down in the monitoring methodology documentation, and only changed if there is evidence that the new value is more adequate and representative for the fuel or material used than the previous one. Where the standard values change on an annual basis, the authoritative applicable source of that value shall be laid down in the monitoring methodology documentation instead of the value itself.

B.5.3 Establishing correlations for determining proxy data

A proxy for the carbon content or emission factor may be derived from the following parameters, in combination with an empirical correlation determined at least once per year in accordance with the requirements for laboratory analyses given in Section B.5.4 of this Annex as follows:

- density measurement of specific oils or gases, including those common to the refinery or steel industry;

- net calorific value for specific coal types.

The correlation has to satisfy the requirements of good industrial practice and may be applied only to values of the proxy which fall into the range for which it was established.

B.5.4 Requirements for laboratory analyses

Where laboratory analyses are required for determining properties (including moisture, purity, concentration, carbon content, biomass fraction, net calorific value, density) of products, materials, fuels or waste gases, or for establishing correlations between parameters for the purpose of indirect determination of required data, the analyses shall comply with the requirements of this section.

The result of any analysis shall be used only for the delivery period or batch of fuel or material for which the samples have been taken, and for which the samples were intended to be representative. When determining a specific parameter, the results of all analyses made shall be used with regard to that parameter.

B.5.4.1 Use of standards

Any analyses, sampling, calibrations and validations for the determination of calculation factors shall be carried out by applying methods based on corresponding ISO standards. Where such standards are not available, the methods shall be based on suitable EN or national standards or requirements laid down in an eligible monitoring, reporting and verification system. Where no applicable published standards exist, suitable draft standards, industry best practice guidelines or other scientifically proven methodologies may be used, limiting sampling and measurement bias.

B.5.4.2 Recommendations on sampling plan and minimum frequency of analyses

The minimum frequencies for analyses for relevant fuels and materials listed in Table 2 shall be used. Another analysis frequency may be used in the following cases:

- where the table does not contain an applicable minimum frequency;

– where an eligible monitoring, reporting and verification system provides for another minimum alaysis frequency for the same type of material or fuel;

– where the minimum frequency listed in Table 2 would incur unreasonable cost;

– where it can be demonstrated that based on historical data, including analytical values for the respective fuels or materials in the reporting period immediately preceding the current reporting period, any variation in the analytical values for the respective fuel or material does not exceed 1/3 of the uncertainty in determining the activity data of the relevant fuel or material.

Where an installation operates for part of the year only, or where fuels or materials are delivered in batches that are consumed over more than one reporting period, a more appropriate schedule for analyses may be chosen, provided that it results in a comparable uncertainty as under the last point of the previous subparagraph.

Table 1: Minimum analyses frequencies

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

Samples shall be representative for the total batch or time period of deliveries for which they are taken. In order to ensure representativeness, the heterogenety of the material has to be taken into account, as well as all other relevant aspects such as the avilable sampling

equipment, possible segregation of phases or local distribution of particle sizes, stability of samples, etc. The sampling approach is to be laid down in the monitoring methodology documentation.

It is considered a recommended improvement to use a dedicated sampling plan for each relevant material of fuel, following applicable standards, containing the relevant information on methodologies for the preparation of samples, including information on responsibilities, locations, frequencies and quantities, and methodologies for the storage and transport of samples.

B.5.4.3 Recommendations for laboratories

Laboratories used to carry out analyses for the determination of calculation factors shall be accredited in accordance with ISO/IEC 17025, for the relevant analytical methods. Laboratories not accredited may be used for the determination of calculation factors only where there is evidence that access to accredited laboratories is technically not feasible or would incur unreasonable costs, and that the non-accredited laboratory is sufficiently competent. A laboratory is considered sufficiently competent if it complies with all of the following:

- it is economically independent of the operator, or at least organisationally shielded from influence by the management of the installation;
- it applies the applicable standards for the analyses requested;
- it employs personnel competent for the specific tasks assigned;
- it appropriately manages the sampling and sample preparation, including control of sample integrity;
- it regularly carries out quality assurance on calibrations, sampling and analytical methods, by suitable methods, including regular participation in proficiency testing schemes, applying analytical methods to certified reference materials, or inter-comparison with an accredited laboratory;
- it manages equipment appropriately, including by maintaining and implementing procedures for calibration, adjustment, maintenance and repair of equipment, and record keeping thereof.

B.5.5 Recommended methods for determination of calculation factors

It is considered a recommended improvement to apply standard values only for source streams which correspond to minor emission quantities, and to apply laboratory analyses for all major source streams. The following list presents the applicable methods in sequence of increasing data quality:

i. type I standard values;
ii. type II standard values;
iii. correlations for determining proxy data;
iv. analyses carried out outside the operator’s control, e.g. by the supplier of the fuel or material, contained in purchase documents, without further information on the methods applied;

v. analyses in non-accredited laboratories, or in accredited laboratories, but with simplified sampling approaches;

vi. analyses in accredited laboratories, applying best practice regarding sampling.

B.6 Requirements for measurement-based approach for CO_2 and N_2O

B.6.1 General provisions

A measurement-based approach requires the use of a Continuous Emission Measurement System (CEMS) installed at a suitable measurement point.

For the monitoring of N_2O emissions, the use of the measurement-based approach, is mandatory. For CO_2 it shall be used only if there is evidence that it leads to more accurate data than the calculation-based approach. The requirements on uncertainty of measurement systems pursuant to Section B.4.3 of this Annex apply.

CO emitted to the atmosphere shall be treated as the molar equivalent amount of CO_2.

Where several emission sources exist in one installation and cannot be measured as one emission source, the operator shall measure emissions from those sources separately and add the results to obtain the total emissions of the gas in question over the reporting period.

B.6.2 Method and calculation

B.6.2.1 Emissions of a reporting period (annual emissions)

The total emissions from an emission source over the reporting period are determined by summing up over the reporting period all hourly values of the measured greenhouse gas concentration multiplied by the hourly values of the flue gas flow, where the hourly values are averages over all individual measurement results of the respective operating hour, applying the formula:

$$GHG\ EM_{total}[t] = \sum_{i=1}^{HoursOp}\left(GHG\ conc_{hourly,i} \cdot V_{hourly,i}\right) \cdot 10^{-6}[t/g] \quad \text{(Equation 16)}$$

Where:

GHG Em$_{total}$ … total annual GHG emissions in tonnes

GHG conc$_{hourly,\ i}$ … hourly concentrations of GHG emissions in g/Nm^3 in the flue gas flow measured during operation for hour or shorter reference period *i*;

$V_{hourly,\ i}$ … flue gas volume in Nm^3 for hour or shorter reference period *i* (i.e. integrated flow over the reference period);

HoursOp = total number of hours (or shorter reference periods) for which the measurement-based methodology is applied, including the hours for which data has been substituted in accordance with Section B.6.2.6 of this Annex;

The index I refers to the individual operating hour (or reference periods).

Hourly averages for each measured parameter shall be calculated before further processing, by using all data points available for that specific hour. Where data for shorter reference periods can be generated without additional cost, those periods shall be used for the determination of the annual emissions.

B.6.2.2 Determination of GHG concentration

The concentration of the GHG under consideration in the flue gas shall be determined by continuous measurement at a representative point through one of the following:

– direct measurement;

– indirect measurement: in the case of high concentration in the flue gas, the concentration of the GHG may be calculated using an indirect concentration measurement taking into account the measured concentration values of all other components *i* of the gas stream, using the following formula:

$$GHG\ conc\ [\%] = 100\% - \sum_i Conc_i[\%] \qquad \text{(Equation 17)}$$

Where $conc_i$ is the concentration of gas component *i*.

B.6.2.3 CO_2 emissions from biomass

Where relevant, any CO_2 amount stemming from biomass which complies with the criteria given in Section B.3.3 of this Annex may be subtracted from the total measured CO_2 emissions, provided one of the following methods is used for the amount of biomass CO_2 emissions:

– a calculation based approach, including approaches using analyses and sampling based on ISO 13833 (Stationary source emissions — Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide — Radiocarbon sampling and determination);

– another method based on a relevant standard, including ISO 18466 (Stationary source emissions — Determination of the biogenic fraction in CO_2 in stack gas using the balance method);

– another method allowed by an eligible monitoring, reporting and verification system.

B.6.2.4 Determining $CO_{2(e)}$ emissions from N_2O

In case of N_2O measurement, the total annual N_2O emissions from all emissions sources, measured in tonnes to three decimal places, are be converted to annual $CO_{2(e)}$ in rounded tonnes, using the following formula and the GWP values given in Annex VIII:

$$CO_{2(e)}\ [t] = N_2O_{annual}[t] \times GWP_{N2O} \qquad \text{(Equation 18)}$$

Where:

N_2O_{annual} … total annual N_2O emissions, calculated in accordance with Section B.6.2.1 of this Annex.

B.6.2.5 Determination of flue gas flow

The flue gas flow maybe determined by one of the following methods:

– calculation by means of a suitable mass balance, taking into account all significant parameters on the input side, including for CO_2 emissions at least input material loads, input airflow and process efficiency, and on the output side, including at least the product output and the concentration of oxygen (O_2), sulphur dioxide (SO_2) and nitrogen oxides (NO_x);

– determination by continuous flow measurement at a representative point.

B.6.2.6 Treatment of measurement gaps

Where the continuous measurement equipment for a parameter is out of control, out of range or out of operation for part of the hour or reference period, the related hourly average is calculated pro rata to the remaining data points for that specific hour or shorter reference period, provided that at least 80 % of the maximum number of data points for a parameter are available.

Where fewer than 80 % of the maximum number of data points for a parameter are available, the following approaches is used:

– For a parameter directly measured as concentration, a substitution value as the sum of an average concentration and twice the standard deviation associated with that average is used, applying the following equation:

$$C^*_{subst} = \bar{C} + 2\,\sigma_c \qquad \text{(Equation 19)}$$

Where:

$\bar{C}$ … the arithmetic mean 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;

σ_c … the best estimate of the standard deviation of the concentration of the specific parameter over the whole reporting or, where specific circumstances applied when data loss occurred, an appropriate period reflecting the specific circumstances.

Where the reporting period is not applicable for determining such substitution values due to significant technical changes at the installation, another sufficiently representative timeframe shall be chosen for determining the average and standard deviation, where possible with the duration of at least 6 months.

– For a parameter other than concentration, substitute values shall be determined through a suitable mass balance model or an energy balance of the process. This model shall be validated by using the remaining measured parameters of the measurement-based methodology and data at regular working conditions, considering a time period of the same duration as the data gap.

B.6.3 Quality requirements

All measurements shall be carried out applying methods based on:

– 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

– ISO 14385-1:2014 Stationary source emissions — Greenhouse gases — Part 1: Calibration of automated measuring systems

– ISO 14385-2:2014 Stationary source emissions — Greenhouse gases — Part 2: Ongoing quality control of automated measuring systems

– other relevant ISO standards, in particular ISO 16911-2 (Stationary source emissions — Manual and automatic determination of velocity and volume flow rate in ducts).

Where no applicable published standards exist, suitable draft standards, industry best practice guidelines or other scientifically proven methodologies shall be used, limiting sampling and measurement bias.

All relevant aspects of the continuous measurement system shall be considered, including the location of the equipment, calibration, measurement, quality assurance and quality control.

Laboratories carrying out measurements, calibrations and relevant equipment assessments for continuous measurement systems shall be accredited in accordance with ISO/IEC 17025 for the relevant analytical methods or calibration activities. Where the laboratory does not have such accreditation, sufficient competence in line with Section B.5.4.3 of this Annex shall be ensured.

B.6.4 Corroborating calculations

CO_2 emissions determined by a measurement-based methodology shall be corroborated by calculating the annual emissions of each greenhouse gas in question for the same emission sources and source streams. For this purpose, the requirements laid down in Sections B.4 to B.6 of this Annex may be simplified as appropriate.

B.6.5 Minimum requirements for continuous emissions measurements

As a minimum requirement, an uncertainty 7,5 % of the GHG emissions of an emission source over the full reporting period shall be achieved. For minor emission sources, or under exceptional circumstances 10 % uncertainty may be allowed. It is a recommended improvement to achieve an uncertainty of 2,5 % at least for emission sources emitting more than 100 000 tonnes of fossil $CO_{2(e)}$ per reporting period.

B.7 Requirements for determining perfluorocarbon emissions

Monitoring shall cover emissions of perfluorocarbons (PFCs) resulting from anode effects including fugitive emissions of perfluorocarbons s. Perfluorocarbons emissions not related to anode effects shall be determined based on estimation methods in accordance with industry best practice, in particular guidelines provided by the International Aluminium Institute.

PFC emissions shall be calculated from the emissions measurable in a duct or stack ('point source emissions') as well as fugitive emissions using the collection efficiency of the duct:

$$PFC\ emissions\ (total) = PFC\ emissions\ (duct) / collection\ efficiency \quad \text{(Equation 20)}$$

The collection efficiency shall be measured when the installation-specific emission factors are determined.

The emissions of CF_4 and C_2F_6 emitted through a duct or stack shall be calculated by using one of the following methods:

- Method A where the anode effect minutes per cell-day are recorded;
- Method B where the anode effect overvoltage is recorded.

B.7.1 Calculation Method A – Slope Method

The following equations for determining PFC emissions are used:

$$CF_4\ emissions\ [t] = AEM \times (SEF_{CF4}/1\ 000) \times Pr_{Al} \quad \text{(Equation 21)}$$

$$C_2F_6\ emissions\ [t] = CF_4\ emissions \times F_{C2F6} \quad \text{(Equation 22)}$$

Where:

AEM … Anode effect minutes / cell-day;

SEF_{CF4} … Slope emission factor expressed in (kg CF_4 / t Al produced) / (anode effect minutes / cell-day)]. Where different cell-types are used, different *SEF* may be applied as appropriate;

Pr_{Al} … Production of primary Aluminium [t] during the reporting period;

F_{C2F6} … Weight fraction of C_2F_6 [t 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):

$$\text{AEM} = \text{frequency} \times \text{average duration} \qquad \text{(Equation 23)}$$

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.

Minimum requirement: Technology-specific emission factors from Table 3 are used.

Recommended improvement: Installation-specific emission factors for CF_4 and C_2F_6 are established through continuous or intermittent field measurements. For the determination of those emission factors industry best practice shall be applied, in particular the most recent guidelines provided by the International Aluminium Institute. The emission factor shall also take into account emissions related to non-anode effects. Each emission factor shall be determined with a maximum uncertainty of ±15%. The emission factors shall be determined at least every three years or earlier where necessary due to relevant changes at the installation. Relevant changes shall include a change in the distribution of anode effect duration, or a change in the control algorithm affecting the mix of the types of anode effects or the nature of the anode effect termination routine.

Table 2: 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-Mins/cell-day)]**	**Emission factor for C_2F_6 (F_{C2F6}) [t C_2F_6/ t CF_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 (VSS)	0,058	0,086
Horizontal Stud Søderberg (HSS)	0,165	0,077

(*) 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.

B.7.2 Calculation Method B – Overvoltage Method

For the overvoltage method, the following equations are used:

$$CF_4 \text{ emissions [t]} = OVC \times (AEO/CE) \times Pr_{Al} \times 0{,}001 \qquad \text{(Equation 24)}$$

$$C_2F_6 \text{ emissions [t]} = CF_4 \text{ emissions} \times F_{C2F6} \qquad \text{(Equation 25)}$$

Where:

OVC … Overvoltage coefficient ('emission factor') expressed in kg CF_4 per tonne of aluminium produced per mV overvoltage;

AEO … 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 … Average current efficiency of aluminium production [%];

Pr_{Al} … Annual production of primary Aluminium [t];

F_{C2F6} … 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 [%].

Minimum requirement: Technology-specific emission factors from Table 4 are used.

Recommended improvement: Installation-specific emission factors are used for CF_4 [(kg CF_4 / t Al) / (mV)] and C_2F_6 [t C_2F_6/ t CF_4] established through continuous or intermittent field measurements. For the determination of those emission factors industry best practice shall be applied, in particular the most recent guidelines provided by the International Aluminium Institute. The emission factors shall be determined with a maximum uncertainty of ±15% each. The emission factors shall be determined at least every three years or earlier where necessary due to relevant changes at the installation. Relevant changes shall include a change in the distribution of anode effect duration, or a change in the control algorithm affecting the mix of the types of anode effects or the nature of the anode effect termination routine

Table 3: Technology-specific emission factors related to overvoltage activity data.

Technology	**Emission factor for CF_4 [(kg CF_4/t Al) / mV]**	**Emission factor for C_2F_6 [t C_2F_6/ t CF_4]**
Centre Worked Prebake (CWPB)	1,16	0,121
Side Worked Prebake (SWPB)	3,65	0,252

B.7.3 Determination of $CO_{2(e)}$ emissions

$CO_{2(e)}$ emissions are calculated from CF_4 and C_2F_6 emissions as follows, using the global warming potentials listed in Annex VIII.

$$\text{PFC emissions [t } CO_{2(e)}\text{]} = CF_4 \text{ emissions [t]} \times GWP_{CF4} + C_2F_6 \text{ emissions [t]} \times GWP_{C2F6} \quad \text{(Equation 26)}$$

B.8 Requirements for CO_2 transfers between installations

B.8.1 CO_2 contained in gases ("inherent CO_2")

Inherent CO_2 that is transferred into an installation, including that contained in natural gas, a waste gas (including blast furnace or coke oven gas) or in process inputs (including synthesis gas), is included in the emission factor for that source stream.

Where inherent CO_2 transferred out of the installation as part of a source stream to another installation, it is not counted as emissions of the installation where it originates. However, where inherent CO_2 is emitted (e.g., vented or flared) or transferred to entities which do not themselves monitor emissions for the purpose of this Regulation or an eligible monitoring, reporting and verification system, it is counted as emissions of the installation where it originates.

B.8.2 Eligibility to deduct stored or used CO_2

In the following cases CO_2 originating from fossil carbon and originating from combustion or processes leading to process emissions, or which is imported from other installations, including in the form of inherent CO_2, may be accounted for as not emitted:

(a) if the CO_2 is used within the installation or transferred out of the installation to any of the following:

(i) an installation for the purpose of CO_2 capture which monitors emissions for the purpose of this Regulation or an eligible monitoring, reporting and verification system;

(ii) an installation or transport network with the purpose of long-term geological storage of CO_2 which monitors emissions for the purpose of this Regulation or an eligible monitoring, reporting and verification system;

(iii) a storage site for the purpose of long-term geological storage which monitors emissions for the purpose of this Regulation or an eligible monitoring, reporting and verification system;

(b) if the CO_2 is used within the installation or transferred out of the installation to an entity which monitors emissions for the purpose of this Regulation or an eligible monitoring, reporting and verification system, in order to produce products in which the carbon stemming from CO_2 is permanently chemically bound so that it does not enter the atmosphere under normal use, including any normal activity taking place after the end of the life of the product, as defined in the delegated act adopted pursuant to Article 1(21)(f) of Directive (EU) 2023/959[2].

CO_2 transferred to another installation for the purposes given in points (a) and (b) may be accounted for as not emitted only to the extent evidence is provided across the whole chain of custody to the storage site or installation of CO_2 use and including any transport operators, of the fraction of CO_2 actually stored or used for the production of chemically stable products compared to the total amount of CO_2 transferred out of the originating installation.

If CO_2 is used within the same installation for the purposes in points (a) and (b), the monitoring approaches given in Sections 21 to 23 of Annex IV to Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of

greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012 ([5]) shall be applied.

B.8.3 Monitoring rules for CO_2 transfers

The identity and contact data of a responsible person of the receiving installations or entities shall be clearly laid down in the monitoring methodology documentation. The amount of CO_2 considered not emitted shall be reported as memo item in the report pursuant to Section I of this Annex.

The identity and contact data of a responsible person of the installations or entities from which CO_2 was received shall be clearly laid down in the monitoring methodology documentation. The amount of CO_2 received shall be reported as memo item in the report pursuant to Section I of this Annex.

For the determination of the quantity of CO_2 transferred from one installation to another, a measurement-based methodology shall be used. For the amount of CO_2 permanently chemically bound in products, a calculation-based methodology shall be used, preferably using a mass balance. The chemical reactions applied, and all relevant stoichiometric factors shall be laid down in the monitoring methodology documentation.

B.9 Sector specific requirements

B.9.1 Additional rules for combustion units

Combustion emissions shall cover all CO_2 emissions from the combustion of carbon-containing fuels, including wastes, independent of any other classification of such emissions or fuels. Where it is unclear if a material acts as fuel or as process input, e.g., for reducing metal ores, that material's emissions shall be monitored the same way as combustion emissions. All stationary combustion units shall be considered, including boilers, burners, turbines, heaters, furnaces, incinerators, calciners, kilns, ovens, dryers, engines, fuel cells, chemical looping combustion units, flares, thermal or catalytic post-combustion units.

Monitoring shall furthermore include CO_2 process emissions from flue gas scrubbing, in particular CO_2 from limestone or other carbonates for desulphurisation and similar scrubbing, and from urea used in de-NO_x units.

B.9.1.1 Desulphurisation and other acid gas scrubbing

Process CO_2 emissions from the use of carbonates for acid gas scrubbing from the flue gas stream shall be calculated on the basis of carbonate consumed (Method A). In case of desulphurisation, calculation may be based alternatively on the quantity of gypsum produced (Method B). In the latter case, the emission factor shall be the stoichiometric ratio of dry gypsum ($CaSO_4 \times 2H_2O$) to CO_2 emitted: 0,2558 t CO_2/t gypsum.

B.9.1.2 De-NO_x

If urea is used as reduction agent in a de-NO_x unit, process CO_2 emissions from its use shall be calculated using method A, applying an emission factor based on the stoichiometric ratio of 0,7328 t CO_2/t urea.

B.9.1.3 Monitoring of flares

([5]) OJ L334, 31.12.2018, p.1.

When calculating emissions from flares, routine flaring as well as operational flaring (trips, start-up and shutdown as well as emergency relieves) shall be covered. Inherent CO_2 in in the flared gases is to be included.

If more accurate monitoring is technically not feasible or would lead to unreasonable costs, a reference emission factor of 0,00393 t CO_2/Nm^3 shall be used, derived from the combustion of pure ethane used as a conservative proxy for flare gases.

It is a recommended improvement to determine installation-specific emission factors derived from an estimate of the molecular weight of the flare stream, using process modelling based on industry standard models. By considering the relative proportions and the molecular weights of each of the contributing streams, a weighted annual average figure shall be derived for the molecular weight of the flare gas.

For activity data, higher measurement uncertainty than for other fuels combusted is acceptable.

B.9.2 Additional rules for emissions from cement clinker production

B.9.2.1 Additional rules for Method A (input based)

Where method A (kiln input based) is used for determining process emissions, the following special rules apply:

- Where cement kiln dust (CKD) or bypass dust leave the kiln system, the related quantities of raw material are not considered as process input. Emissions from CKD are calculated separately in accordance with Section B.9.2.3 of this Annex.

- Either raw meal as a whole, or separate input materials may be characterised, avoiding double counting or omissions from returned or by-passed materials. Where activity data is determined based on the clinker produced, the net amount of raw meal may be determined by means of a site-specific empirical raw meal/clinker ratio. That ratio shall be updated at least once per year applying industry best practice guidelines.

B.9.2.2 Additional rules for Method B (output based)

Where method B (clinker output based) is used for determining process emissions, the following special rules apply:

- Activity data shall be determined as the clinker production [t] over the reporting period in one of the following ways:
  - by direct weighing of clinker;
  - based on cement deliveries, by material balance taking into account dispatch of clinker, clinker supplies as well as clinker stock variation, using the following formula:

$$Cli_{prod} = (Cem_{deliv} - Cem_{SV}) \cdot CCR - Cli_s + Cli_d - Cli_{SV} \qquad \text{(Equation 27)}$$

Where

Cli_{prod} is the amount of clinker produced expressed in tonnes,

Cem_{deliv} the amount of cement deliveries expressed in tonnes,

Cem_{SV} the cement stock variations expressed in tonnes,

CCR the clinker to cement ratio (tonnes clinker per tonne cement),

Cli_s the amount of clinker supplied expressed in tonnes,

Cli_d the amount of clinker dispatched, and

Cli_{SV} the amount of clinker stock variations expressed in tonnes.

- The the clinker to cement ratio is either derived separately for each of the different cement products based on laboratory analyses in line with the provisions of Section B.5.4, or calculated 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.
- As minimum requirement to determine the emission factor, a standard value of 0,525 t CO_2/t clinker is applied.

B.9.2.3 Emissions related to discarded dust

CO_2 process emissions from bypass dust or cement kiln dust (CKD) leaving the kiln system, shall be added to the emissions, corrected for a partial calcination ratio of CKD.

Minimum requirement: An emission factor of 0,525 t CO_2/t dust is applied.

Recommended improvement: The emission factor (EF) is determined at least once annually in line with the provisions of Section B.5.4 of this Annex and using the following formula:

$$EF_{CKD} = \left(\frac{EF_{Cli}}{1+EF_{Cli}} \cdot d\right) / \left(1 - \frac{EF_{Cli}}{1+EF_{Cli}} \cdot d\right) \quad \text{(Equation 28)}$$

Where:

EF_{CKD} … Emission factor of partially calcined cement kiln dust [t CO_2/t CKD];

EF_{Cli} … Installation-specific emission factor of clinker [t CO_2/t clinker];

d … Degree of CKD calcination (released CO_2 as % of total carbonate CO_2 in the raw mix).

B.9.3 Additional rules for emissions from nitric acid production

B.9.3.1 General rules for N_2O measurement

N_2O emissions shall be determined using a measurement-based approach. N_2O concentrations in the flue gas from each emission source shall be measured at a representative point, after the NO_x/N_2O abatement equipment, where abatement is used. Techniques capable of measuring N_2O concentrations of all emission sources during both abated and unabated conditions shall be applied. All measurements shall be adjusted to a dry gas basis where required and consistently reported.

B.9.3.2 Determination of flue gas flow

For monitoring flue gas flow the mass balance method set out in Section B.6.2.5 of this Annex shall be used, unless it is technically not feasible. In that case an alternative method may be used, including by a mass balance methodology based on significant parameters such as ammonia input load, or determination of flow by continuous emissions flow measurement.

The flue gas flow shall be calculated in accordance with the following formula:

$$V_{flue\ gas\ flow}\ [Nm^3/h] = V_{air} \times (1 - O_{2,air}) / (1 - O_{2,flue\ gas}) \quad \text{(Equation 29)}$$

Where:

V_{air} … Total input air flow in Nm^3/h at standard conditions;

$O_{2,air}$ … Volume fraction of O_2 in dry air [= 0,2095];

$O_{2,flue\ gas}$ … Volume fraction of O_2 in the flue gas.

V_{air} shall be calculated as the sum of all air flows entering the nitric acid production unit, in particular primary and secondary input air, and seal input air, where applicable.

All measurements shall be adjusted to a dry gas basis and reported consistently.

B.9.3.3 Oxygen (O_2) concentrations

Where necessary for calculating the flue gas flow in accordance with Section B.9.3.2 of this Annex, the oxygen concentrations in the flue gas shall be measured, applying the requirements laid down in Section B.6.2.2 of this Annex. All measurements shall be adjusted to a dry gas basis and reported consistently.

C. HEAT FLOWS

C.1 Rules for determining net measurable heat

C.1.1 Principles

All specified amounts of measurable heat shall always refer to net amount of measurable heat, determined as the heat content (enthalpy) of the heat flow transmitted to the heat consuming process or external user minus the heat content of the return flow.

Heat consuming processes necessary for operating the heat production and distribution, such as deaerators, make-up water preparation, and regular blow offs, shall be taken into account in the efficiency of the heat system and need therefore be accounted for in the embedded emissions of goods.

Where the same heat medium is used by several consecutive processes and its heat is consumed starting from different temperature levels, the quantity of heat consumed by each heat consuming process shall be determined separately, unless the processes are part of the overall production process of the same good. Re-heating of the transfer medium between consecutive heat consuming processes shall be treated like additional heat production.

Where heat is used to provide cooling via an absorption cooling process, that cooling process shall be considered as the heat consuming process.

C.1.2 Methodologies for determining net amounts of measurable heat

For the purpose of selecting data sources for quantification of energy flows in accordance with Section A.4 of this Annex, the following methodologies for determining net amounts of measurable heat shall be considered:

C.1.2.1 Method 1: Using measurements

Under this method, all relevant parameters are measured, in particular temperature, pressure, state of the transmitted as well as the returned heat medium. The state of the medium in case of steam shall refer to its saturation or degree of superheating. Furthermore the (volumetric) flow rate of the heat transfer medium is measured. Based on the measured values, the enthalpy and the specific volume of the heat transfer medium are determined using suitable steam tables or engineering software.

The mass flow rate of the medium is calculated as

$$\dot{m} = \dot{V}/v \qquad \text{(Equation 30)}$$

Where $\dot{m}$ is the mass flow rate in kg/s, $\dot{V}$ is the volumetric flow rate in m^3/s and v is the specific volume in m^3/kg.

As the mass flow rate is considered the same for transmitted and returned medium, the heat flow rate is calculated using the difference in enthalpy between the transmitted flow and the return, as follows:

$$\dot{Q} = (h_{flow} - h_{return}) \cdot \dot{m} \quad \text{(Equation 31)}$$

Where $\dot{Q}$ is the heat flow rate in kJ/s, h_{flow} is the enthalpy of the transmitted flow in kJ/kg, h_{return} is the enthalpy of the return flow in kJ/kg, and $\dot{m}$ is the mass flow rate in kg/s.

In case of steam or hot water used as heat transfer medium, where the condensate is not returned, or where it is not feasible to estimate the enthalpy of the returned condensate, h_{return} is determined based on a temperature of 90°C.

If the mass flow rates are known to be not identical, the following shall apply:

1. Where evidence is available that condensate remains in the product (e.g., in 'life steam injection' processes), the respective amount of condensate enthalpy is not deducted;
2. Where heat transfer medium is known to be lost (e.g., due to leakages or sewering), an estimate for the respective mass flow is deducted from the mass flow of the transmitted heat transfer medium.

For determining the annual net heat flow from the above data, one of the following methods is used, subject to the measurement equipment and data processing available:

3. Determine annual average values for the parameters determining the annual average enthalpy of the transmitted and returned heat medium, and multiply with the total annual mass flow, using equation 31;
4. Determine 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 may be substituted by other time intervals as appropriate.

C.1.2.2 Method 2: Calculation of a proxy based on measured efficiency

The amounts of net measurable heat are determined based on the fuel input and the measured efficiency related to the heat production:

$$Q = \eta_H \cdot E_{In} \quad \text{(Equation 32)}$$

$$E_{In} = \sum_i AD_i \cdot NCV_i \quad \text{(Equation 33)}$$

Where Q is the amount of heat expressed in TJ, η_H is the measured efficiency of heat production, E_{In} is the energy input from fuels, AD_i are the annual activity data (i.e., quantities consumed) of fuels i, and NCV_i the net calorific values of fuels i.

The value of η_H is either measured over a reasonably long period, which sufficiently takes into account different load states of the installation or taken from the manufacturer's documentation. In that regard the specific part load curve is to be taken into account by using an annual load factor, as follows:

$$L_F = \frac{E_{In}}{E_{Max}} \quad \text{(Equation 34)}$$

Where L_F is the load factor, E_{In} the energy input as determined using Equation 33 over the reporting period, and E_{Max} the maximum fuel input if the heat producing unit had been running at 100 % nominal load for the full calendar year. The efficiency shall be based on a situation in which all condensate is returned. A temperature of 90 °C shall be assumed for the returned condensate.

C.1.2.3 Method 3: Calculating a proxy based on the reference efficiency

This method is identical to method 3, but using a reference efficiency of 70 % ($\eta_{Ref,H}$ = 0,7) in Equation 32.

C.1.3 Special rules

Where an installation *consumes* measurable heat produced from exothermic chemical processes other than combustion, such as in ammonia or nitric acid production, that amount of heat consumed is determined separately from other measurable heat and that heat consumption is be assigned zero CO_2 emissions.

Where measurable heat is recovered from non-measurable heat generated from fuels and used in production processes after that use, e.g., from exhaust gases, for avoiding double counting, the relevant amount of net measurable heat divided by a reference efficiency of 90 % is subtracted from the fuel input.

C.2 Determining the fuel mix emission factor of measurable heat

Where a production process consumes measurable heat produced within the installation, the heat-related emissions is determined using one of the following methods.

C.2.1 Emission factor of non-measurable heat from combined heat and power production (CPH) produced in the installation

For measurable heat produced from the combustion of fuels within the installation except heat produced by cogeneration, the emission factor of the relevant fuel mix is determined and the emissions attributable to the production process are calculated as:

$$Em_{Heat} = EF_{mix} \cdot Q_{consumed} / \eta \qquad \text{(Equation 35)}$$

Where Em_{Heat} is the heat-related emissions of the production process in t CO_2, EF_{mix} is the emission factor of the respective fuel mix expressed in t CO_2/TJ including emissions from flue gas cleaning, where applicable, $Q_{consumed}$ is the amount of measurable heat consumed in the production process expressed in TJ, and η is the efficiency of the heat production process.

EF_{mix} is calculated as:

$$EF_{mix} = (\Sigma\ AD_i \cdot NCV_i \cdot EF_i + Em_{FGC}) / (\Sigma\ AD_i \cdot NCV_i) \qquad \text{(Equation 36)}$$

Where AD_i are the annual activity data (i.e., quantities consumed) of fuels *i* used for the measurable heat production expressed in tonnes or Nm^3, NCV_i the net calorific values of fuels *i* expressed in TJ/t or TJ/Nm^3, and EF_i the emission factors of fuels *i* expressed in t CO_2/TJ. Em_{FGC} are process emissions from flue gas cleaning expressed in t CO_2.

Where a waste gas is part of the fuel mix used, and where the emission factor of the waste gas is higher than the standard emission factor of natural gas given in Table 1 of Annex VIII, that standard emission factor is used to calculate EF_{mix} instead of the emission factor of the waste gas.

C.2.2 Emission factor of measurable heat from combined heat and power production (CHP) produced in the installation

Where measurable heat and electricity are produced by cogeneration, the relevant emissions attributed to measurable heat and electricity are determined as required by this section. The rules regarding electricity apply also to the production of mechanical energy, if relevant.

The emissions of a cogeneration unit are determined as follows:

$$Em_{CHP} = \sum_i AD_i \cdot NCV_i \cdot EF_i + Em_{FCG} \quad \text{(Equation 37)}$$

Where Em_{CHP} are the emissions of the cogeneration unit during the reporting period expressed in t CO_2, AD_i are the annual activity data (i.e. quantities consumed) of fuels *i* used for the CHP unit expressed in tonnes or Nm^3, NCV_i the net calorific values of fuels *i* expressed in TJ/t or TJ/Nm^3, and EF_i the emission factors of fuels *i* expressed in t CO_2/TJ. Em_{FGC} are process emissions from flue gas cleaning expressed in t CO_2.

The energy input to the CHP unit is calculated in accordance with Equation 33. The respective average efficiencies over the reporting period of heat production and electricity (or mechanical energy, if applicable) production are calculated as follows:

$$\eta_{heat} = \frac{Q_{net}}{E_{In}} \quad \text{(Equation 38)}$$

$$\eta_{el} = \frac{E_{El}}{E_{In}} \quad \text{(Equation 39)}$$

Where η_{heat} (dimensionless) is the average efficiency of heat production during the reporting period, Q_{net} is the net amount of heat produced during the reporting period by the cogeneration unit expressed in TJ as determined in accordance with Section C.1.2, E_{In} the energy input as determined using Equation 33 expressed in TJ, η_{el} (dimensionless) is the average efficiency of electricity production during the reporting period, and E_{el} the net electricity production of the cogeneration unit during the reporting period, expressed in TJ.

Where the determination of the efficiencies η_{heat} and η_{el} is technically not feasible or would incur unreasonable costs, values based on technical documentation (design values) of the installation shall be used. If no such values are available, conservative standard values of η_{heat} = 0,55 and η_{el} = 0,25 shall be used.

The attribution factors for heat and electricity from CHP are calculated as follows:

$$F_{CHP,heat} = \frac{\frac{\eta_{heat}}{\eta_{ref,heat}}}{\frac{\eta_{heat}}{\eta_{ref,heat}} + \frac{\eta_{el}}{\eta_{ref,el}}} \quad \text{(Equation 40)}$$

$$F_{CHP,el} = \frac{\frac{\eta_{el}}{\eta_{ref,el}}}{\frac{\eta_{heat}}{\eta_{ref,heat}} + \frac{\eta_{el}}{\eta_{ref,el}}} \quad \text{(Equation 41)}$$

Where $F_{CHP,Heat}$ is the attribution factor for heat and $F_{CHP,El}$ is the attribution factor for electricity (or mechanical energy, if applicable), both expressed without dimension. $\eta_{ref,\ heat}$ is the reference efficiency for heat production in a stand-alone boiler, and $\eta_{ref,el}$ the reference efficiency of electricity production without cogeneration. The appropriate fuel-specific reference efficiencies given in Annex IX.

The specific emission factor of the CHP-related measurable heat to be used for the attribution of heat-related emissions to production processes is calculated as

$$EF_{CHP,Heat} = Em_{CHP} \cdot F_{CHP,Heat} / Q_{net} \quad \text{(Equation 42)}$$

Where $EF_{CHP,\ heat}$ is the emission factor for the production of measurable heat in the cogeneration unit expressed in t CO_2/TJ, and Q_{net} is the net heat produced by the cogeneration unit expressed in TJ.

The specific emission factor of the CHP-related electricity to be used for the attribution of indirect emissions to production processes is calculated as

$$EF_{CHP,El} = Em_{CHP} \cdot F_{CHP,El} / E_{El,cons} \quad \text{(Equation 43)}$$

Where $E_{El,cons}$ is the electricity consumed in the production process.

Where a waste gas is part of the fuel mix used, and where the emission factor of the waste gas is higher than the standard emission factor of natural gas given in Table 1 of Annex VIII, that standard emission factor is used to calculate EF_{mix} instead of the emission factor of the waste gas.

C.2.3 Emission factor of measurable heat produced outside the installation

Where a production process consumes measurable heat produced outside the installation, the heat-related emissions are determined using one of the following methods.

1. Where the installation producing the measurable heat is subject to an eligible monitoring, reporting and verification system, or where the operator of the installation consuming the measurable heat ensures by the means of relevant provisions of the heat delivery contract that the installation producing the heat carries out emission monitoring in line with this Annex, the emission factor of measurable heat is determined using relevant equations of Section C.2.1 or C.2.2, based on emission data provided by the operator of the installation producing the measurable heat.

2. Where the method pursuant to point 1 is not available, a standard value is used, based on the standard emission factor of the fuel most commonly used in the country and industrial sector, assuming a boiler efficiency of 90%.

D. ELECTRICITY

D.1 Calculating the emissions related to electricity

The emissions relating to electricity production or consumption for the purpose of calculating embedded emissions in accordance with section F.1 are calculated using the following equation:

$$Em_{el} = E_{el} \cdot EF_{el} \qquad \text{(Equation 44)}$$

Where:

Em_{el}	Emissions related to electricity produced or consumed, expressed in t CO_2
E_{el}	Electrical energy produced or consumed expressed in MWh or TJ
EF_{el}	Emission factor for electricity applied, expressed in t CO_2/MWh or t CO_2/TJ

Where actual CO_2 emissions are claimed, based on conditions under point D.2.4 of this Annex, or for the production of renewable hydrogen then those emissions shall be subtracted from the calculation of the region's emission intensity.

When declaring actual emissions pursuant to Article 4(3) point a, the information declared shall be determined in accordance with point 5 of Annex IV of Regulation (EU) 2023/956, whereby the actual emissions shall be excluded from the calculation of the respective country factor for indirect emissions.

D.2 Rules for determining the emission factor of electricity as an imported good

For determining the specific actual embedded emissions of electricity imported as a good, only direct emissions are applicable in accordance with Section 2 of Annex IV of Regulation (EU) 2023/956.

The emission factor for calculating the specific actual embedded emissions of electricity shall be established as follows:

(a) Generally, the Commission will apply the specific default value for a third country, group of third countries or region within a third country as the relevant CO2 emission factor as set out in point D.2.1 of this Annex.

(b) Where no specific default value is available under point (a), the Commission will apply the CO2 emission factor in the EU as set out in point D.2.2 of this Annex.
(c) Where an importer submits sufficient evidence to demonstrate that the CO_2 emission factor in the third country, group of third countries or region within a third country from where electricity is imported is lower than the values, in accordance with points (a) and (b), and where the conditions given in point D.2.3 of this Annex are fulfilled. The claimed lower values shall be determined on the basis of available and reliable data
(d) An importer may apply actual embedded emissions instead of default values for the calculation of embedded emissions of the imported electricity, provided the cumulative criteria in given in Section 5 (a) to (d) of Annex IV to Regulation (EU) 2023/956 are met, and the calculation is based on data determined in line with provisions of this Annex by the producer of the electricity, calculated using equation 50, given in Section F.1 of this Annex.

D.2.1 CO_2 emission factor based on specific default values

In accordance with Section 4.2.1 of Annex IV to Regulation (EU) 2023/956 CO_2 emission factors in the third country, group of third countries or region within a third country, shall be based on data from the International Energy Agency (IEA) provided by the Commission.

D.2.2 CO_2 emission factor based on alternative default value

Pursuant to Section 4.2.2 of Annex IV to Regulation (EU) 2023/956, the following CO_2 emission factor for the Union shall apply: […] (t CO_2/MWh).

D.2.3 CO_2 emission factor based on reliable data demonstrated by the importer

For the purpose of point (c) of section D.2 of this Annex,, the importer shall provide the latest available datasets from alternative official sources, including national statistics, for the past five years, considering the starting year of the dataset, two years before the current year.

In order to reflect the impact of decarbonisation policies, such as the increase in renewable energy production, as well as climatic conditions, such as particularly cold years, on the yearly electricity supply in the countries concerned, the importer shall calculate the CO_2 emission factor on the basis of the weighted average of the CO_2 emission factor for the past five years, starting with the current year minus two.

For this purpose, the importer shall calculate the yearly CO_2 emission factors per fossil fuel technology and its respective gross electricity generation in the third country capable of exporting electricity to the EU, based on the following equation:

$$Em_{el,y} = \frac{\sum_i^n EF_i \times E_{el,i,y}}{E_{el,y}} \qquad \text{(Equation 45)}$$

Where $Em_{el,y}$ is the yearly CO_2 emission factor for all fossil fuel technologies in the given year in the third country capable of exporting electricity to the EU, $E_{el,y}$ is the total gross electricity generation from all fossil fuel technologies in that year. EF_i is the CO_2 emission factor for each fossil fuel technology 'i' and $E_{el,i,y}$ represents the yearly gross electricity generation for each fossil fuel technology 'i'.

The importer shall calculate the CO_2 emission factor as a moving average of those years starting with the current year minus two, based on the following equation:

$$Em_{el} = \frac{\sum_{y-6}^{y-2} Em_{el,y}}{5} \qquad \text{(Equation 46)}$$

Where Em_{el} is the CO_2 emission factor resulting from the moving average of the CO2 emission factors of the 5 previous years, starting from the current year, minus two years, until the current year, minus 6 years. $Em_{el,y}$ is the CO2 emission factor for each year, and 'y' is the variable index which stands for the current year.

D.2.4 CO2 emission factor based on actual CO2 emissions of the installation

Pursuant Point 5 (a) to (d) of Annex IV Regulation (EU) 2023/956 a reporting declarant may apply actual embedded emissions instead of default values for the calculation of embedded emissions of the imported electricity if the following cumulative criteria are met:

(a) the amount of electricity for which the use of actual embedded emissions is claimed is covered by a power purchase agreement between the importer and a producer of electricity located in a third country;

(b) the installation producing electricity is either directly connected to the EU transmission system or it can be demonstrated that at the time of export, there was no physical network congestion at any point in the network between the installation and the EU transmission system;

(c) the installation producing electricity does not emit more than 550 grammes of CO_2 of fossil fuel origin per kilowatt-hour of electricity;

(d) the amount of electricity for which the use of actual embedded emissions is claimed has been firmly nominated to the allocated interconnection capacity by all responsible transmission system operators in the country of origin, the country of destination and, if relevant, each country of transit, and the nominated capacity and the production of electricity by the installation refer to the same period of time which shall not be longer than one hour;

D.3 Rules for determining electricity quantities used for the production of goods other than electricity

For the purpose of determining embedded emissions, metering of electricity quantities shall apply to real power, not apparent power (complex power), i.e. only the active power component shalöl be metered, and the reactive power shall be disregarded.

For production of electricity, the activity level refers to net electricity leaving the system boundaries of the power plant or CHP unit, after subtraction of internally consumed electricity.

D.4 Rules for determining the embedded indirect emissions of electricity as an input for other goods

An objective of the transitional period is to collect data for the purpose of further specifying the methodology for the calculation of embedded indirect emissions for the definitive period, in the implementing act referred to in Section 4.3 of Annex IV to Regulation (EU)2023/956.

Accordingly, reporting of indirect emission during the transitional period is open and designed to select the most appropriate value of those listed in section 4.3 of Annex IV to Regulation (EU)2023/956.For the purpose, the commission will base itself on the most up-to-date and reliable data, including on data gathered during the tranistional period.

During the transitional period default values for indirect emissions embedded in a good produced in a third country, shall be determined on a default value calculated on the average, of either:

- the average emission factor of the country of origin electricity grid, based on data from the International Energy Agency (IEA) provided by the Commission; or

- any other emission factor of the country of origin electricity grid based on publicly available data in the country of origin representing either the average or the CO_2 emission factor as defined in Section 1 of Annex IV of Regulation (EU) 2023/956 in the country of origin. .

Reporting requirements for embedded indirect emissions during the transitional period will not include reporting based on the average emissions factor of the Union electricity grid, as this value is already known to the European Commission.

D.4.1 Emission factor of non-CHP electricity produced in the installation

For electricity produced from the combustion of fuels within the installation except electricity produced by cogeneration, the operator determines the emission factor of electricity EF_{El} based on the relevant fuel mix and calculates emissions attributable to the electricity production as:

$$EF_{El} = (\Sigma\, AD_i \cdot NCV_i \cdot EF_i + Em_{FGC}) / El_{prod}$$

(Equation 47)

Where:

AD_i are the annual activity data (i.e., quantities consumed) of fuels *i* used for the electricity production expressed in tonnes or Nm^3,

NCV_i is the net calorific values of fuels *i* expressed in TJ/t or TJ/Nm^3,

EF_i is the emission factors of fuels *i* expressed in t CO_2/TJ,

Em_{FGC} are process emissions from flue gas cleaning expressed in t CO_2,

El_{prod} is the net amount of electricity produced expressed in MWh. It may include quantities of electricity produced from other sources than by combustion of fuels.

Where a waste gas is part of the fuel mix used, and where the emission factor of the waste gas is higher than the standard emission factor of natural gas given in Table 1 of Annex VIII, that standard emission factor shall be used to calculate EF_{El} instead of the emission factor of the waste gas.

D.4.2 Emission factor of electricity produced by CHP in the installation

The emission factor of electricity production from CHP is determined accrding to Section C.2.2 of this Annex.

D.4.3 Emission factor of electricity produced outside the installation

1. Where electricity is received from a directly connected installation [at the same site | operated by the same operator], and where all the relevant data is available to the operator, the emission factor of that electricity is determined applying sections D.4.1 or D.4.2 as appropriate.
2. Where the electricity is received from a power plant specified in a power purchase agreement concluded between the operator and the power plant's operator, the operator may use the emission factor for electricity determined in accordance with sections D.4.1 or D.4.2, as appropriate, and communicated by the power plant's operator, provided the operator makes evidence regarding the power purchase agreement available together with the communication pursuant to section I of this Annex.

E. MONITORING OF PRECURSORS

Where the description of production routes for the production processes defined for the installation indicates relevant precursors, the quantity of each precursor consumed within the installation's production processes shall be determined in order to calculate the total embedded emissions of the complex goods produced in accordance with Section G of this Annex.

By way of derogation from the previous paragraph, where the production and use of a precursor are covered by the same production process, only the quantity of additional precursor used and obtained from other installations or from other production processes shall be determined.

The quantity used and emission properties shall be determined separately for each installation from which the precursor is sourced. The approaches used for determining the required data shall be laid down in the monitoring methodology documentation of the installation, applying the following provisions:

(1) Where the precursor is produced within the installation, but in a different production process as assigned by applying the rules of Section A.5 of this Annex, data sets to be determined shall include:

(a) specific embedded direct and indirect emissions of the precursor as average over the reporting period, expressed in tonnes $CO_{2(e)}$ per tonne of precursor;

(b) quantity of the precursor consumed in each production process of the installation for which it is a relevant precursor.

(2) Where the precursor is obtained from another installation, data sets to be determined shall include:

(a) the country of origin of the imported good;

(b) the installation where it was produced, identified by

– the unique installation identifier, if available;

– the applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;

– an exact address and its English transcript; and

– the geographical coordinates of the installation.

(c) the production route used as defined in Section 2 of Annex II;

(d) the values of applicable specific parameters required for determining the embedded emissions, as listed in Section 2 of Annex III;

(e) specific embedded direct and indirect emissions of the precursor as average over the most recent available reporting period, expressed in tonnes $CO_{2(e)}$ per tonne of precursor;

(f) the start and end date of the reporting period used by the installation from which the precursor was obtained;

(g) the information the carbon price paid for the precursor, if relevant.

The installation producing the precursor shall provide the relevant information, preferably by means of the electronic template mentioned in Section I of this Annex.

(3) For each quantity of precursor for which incomplete or inconclusive data under point (2) was received, the applicable preliminary default values made available by the Commission shall be used.

F. RULES FOR ATTRIBUTING EMISSIONS OF AN INSTALLATION TO GOODS

F.1 Calculation approach

For the purpose of assigning the installation's emissions to goods, the emissions, inputs and outputs are attributed to production processes defined in accordance with Section A.5 of this Annex using Equation 48 for direct emissions and equation 49 for indirect emissions, using total figures over the whole reporting period for the parameters given in the equation. The attributed direct and indirect emissions are then converted into specific embedded direct and indirect emissions of the goods resulting from the production process using equations 50 and 51.

$$AttrEm_{Dir} = DirEm^{*} + Em_{H,imp} - Em_{H,exp} + WG_{corr,imp} - WG_{corr,exp} - Em_{el,prod} \quad \text{(Equation 48)}$$

Where $AttrEm_{Dir}$ is calculated to have a negative value, it shall be set to zero.

$$AttrEm_{indir} = Em_{el,cons} \quad \text{(Equation 49)}$$

$$SEE_{g,Dir} = \frac{AttrEm_{g,Dir}}{AL_g} \quad \text{(Equation 50)}$$

$$SEE_{g,Indir} = \frac{AttrEm_{g,Indir}}{AL_g} \quad \text{(Equation 51)}$$

Where the parameters have the following meanings and rules for their determination:

$\boldsymbol{AttrEm_{Dir}}$	Attributed direct emission of the production process over the whole reporting period, expressed in t $CO_{2(e)}$
$AttrEm_{indir}$	Attributed indirect emission of the production process over the whole reporting period, expressed in t $CO_{2(e)}$
$DirEm^{*}$	Directly attributable emissions from the production process, determined for the reporting period using the rules provided in Section B of this Annex, and the following rules: Measurable heat: Where fuels are consumed for the production of measurable heat which is consumed outside the production process under consideration, or which is used in more than one production process (which includes situations with imports from and exports to other installations), the fuels' emissions are not included in the directly attributable emissions of the sub-installation, but added under the parameter $Em_{H,import}$ in order to avoid double counting. Waste gases: The emissions caused by waste gases produced and fully consumed within the same production process are included in DirEm*. The emissions from the combustion of waste gases exported from the production process are fully included in DirEm* irrespective of where they are consumed. However, for exports of waste gases the term $WG_{corr,export}$ shall be calculated. Emissions from the combustion of waste gases imported from other production processes are not taken into account in DirEm*. Instead the term $WG_{corr,import}$ is calculated.
$Em_{H,imp}$	Emissions equivalent to the quantity of measurable heat imported to the production process, determined for the reporting period using the rules provided in Section C of this Annex, and the following rules: Emissions related to measurable heat imported to the production process include imports from other installations, other production processes within the same installation, as well as heat received from a technical unit (e.g. a central power

house at the installation, or a more complex steam network with several heat producing units) that supplies heat to more than one production process.
Emissions from measurable heat are calculated using the following formula:

$$Em_{H,imp} = Q_{imp} \cdot EF_{heat} \quad \text{(Equation 52)}$$

Where EF_{heat} is the emission factor for the production of measurable heat determined in accordance with Section C.2 of this Annex, expressed in t CO_2/TJ, and Q_{imp} is the net heat imported to and consumed in the production process expressed in TJ.

$Em_{H,exp}$ Emissions equivalent to the quantity of measurable heat exported from the production process, determined for the reporting period using the rules provided in Section C of this Annex. For the exported heat either the emissions of the actually known fuel mix in accordance with Section C.2 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, assuming a boiler efficiency of 90%.
Heat recovered from electricity-driven processes and from nitric acid production shall be accounted using an emission factor of zero.

$WG_{corr,imp}$ Attributed direct emissions of a production process consuming waste gases imported from other production processes are corrected for the reporting period using the following formula:

$$WG_{corr,imp} = V_{WG} \cdot NCV_{WG} \cdot EF_{NG} \quad \text{(Equation 53)}$$

Where V_{WG} is the volume of the waste gas imported, NCV_{WG} its net calorific value, and EF_{NG} the standard emission factor of natural gas as given in Annex VIII.

$WG_{corr,exp}$ Emissions equivalent to the quantity of waste gases exported from the production process, determined for the reporting period using the rules provided in Section B of this Annex, and the following formula:

$$WG_{corr,exp} = V_{WG,exp} \cdot NCV_{WG} \cdot EF_{NG} \cdot Corr_{\eta} \quad \text{(Equation 54)}$$

Where $V_{WG,exported}$ is the volume of waste gas exported from the sub-installation, NCV_{WG} is the net calorific value of the waste gas, EF_{NG} is the standard emission factor of natural gas as given in Annex VIII, and $Corr_{\eta}$ is a factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel natural gas. The standard value is $Corr_{\eta}$ = 0,667.

$Em_{el,prod}$ Emissions equivalent to the quantity of electricity produced within the boundaries of the production process, determined for the reporting period using the rules provided in Section D of this Annex.

$Em_{el,cons}$ Emissions equivalent to the quantity of electricity consumed within the boundaries of the production process, determined for the reporting period using the rules provided in Section D of this Annex.

$SEE_{g,Dir}$ Specific direct embedded emissions of goods g, in $CO_{2(e)}$ per tonne, valid for the reporting period.

$SEE_{g,Indir}$ Specific indirect embedded emissions of goods g, in $CO_{2(e)}$ per tonne, valid for the reporting period.

AL_g The activity level of the goods g, i.e. the amount of the goods g produced in the reporting period in that installation, determined in accordance with Section F.2 of this Annex, expressed in tonnes.

F.2 Monitoring rules for activity levels

The activity level of a production process during a reporting period is calculated as the total mass of all goods leaving the production process during the reporting period which are conform with the CN codes covered by the aggregated goods category according to Section 1 of Annex II to which the production process relates. Where production processes are defined such that also the production of precursors is included, double counting shall be avoided by counting only the final products leaving the system boundaries of the production process. Any special provisions laid down for the production process or production route in Section 2 of Annex II shall be taken into account. Where several production routes are used at the same installation for producing goods falling under the same CN code, the embedded emissions of the good are calculated as weighted average across all used production routes.

Only goods which can be sold or directly used as precursor in another production process shall be taken into account. Off-spec products, by-products, waste and scrap produced in a production process, irrespective of whether they are returned to production processes, delivered to other installations or disposed of, shall not be included in the determination of the activity level. They are therefore assigned zero embedded emissions when entering another production process.

For determining activity levels, the metering requirements laid down in Section B.4 of this Annex apply.

F.3 Monitoring rules required for attributing emissions to production processes

F.3.1 Principles for attributing data to production processes

1. The methods chosen for attributing data sets to production processes shall be laid down in the monitoring methodology documentation. They shall be regularly reviewed in order to improve the data quality, where possible, in line with Section A of this Annex.

2. Where data for a specific data set are not available for each production process, an appropriate method for determining the required data for each individual production process need to be chosen. For this purpose, either of the following principles is applied depending on which principle yields more accurate results:

   (a) where different goods are produced one after the other in the same production line, inputs, outputs and corresponding emissions are attributed sequentially based on the usage time per year for each production process;

   (b) inputs, outputs and corresponding emissions are attributed based on the mass or volume of individual goods produced or estimates based on the ratio of free reaction enthalpies of the chemical reactions involved or based on another suitable distribution key that is corroborated by a sound scientific methodology.

3. Where several measurement instruments of different quality are contributing to measurement results, either of the following methods may be used for splitting installation-level data on quantities of materials, fuels, measurable heat or electricity to production processes:

   (a) Determination of the split based on a determination method, such as sub-metering, estimate, correlation, used equally for each production process. Where the sum of the production process data is different from the data determined separately for the installation, a uniform ‘reconciliation factor’ is applied for uniform correction to meet the total figure of the installation as follows:

   $$RecF = D_{Inst} / \Sigma D_{PP} \qquad \text{(Equation 55)}$$

   where $RecF$ is the reconciliation factor, D_{Inst} is the data value determined for the installation as a whole, and D_{PP} are the data values for the different production processes. The data for each production process are then corrected as follows, with $D_{PP,corr}$ being the corrected value of D_{PP}:

   $$D_{PP,corr} = D_{PP} \times RecF \qquad \text{(Equation 56)}$$

   (b) If only one production process’ data are unknown or of lower quality than the data of other production processes, known production process data may be subtracted from the total installation data.

This method is preferred only for production processes which contribute smaller quantities to the installation's allocation.

F.3.2 Procedure for tracking CN codes of goods and precursors

For the purpose of correct attribution of data to production processes, the installation shall maintain a list of all goods and precursors produced at the installation as well as of precursors obtained from outside the installation, and their applicable CN codes. Based on this list:

- products and their annual production figures are attributed to production processes in accordance with the aggregated goods categories provided in Section 1 of Annex II;
- this information is taken into account for attributing inputs, outputs and emissions separately to production processes.

To this end a procedure shall be established, documented, implemented and maintained for regular checking whether the goods and precursors produced in the installation confirm with the CN codes applied when setting up the monitoring methodology documentation. This procedure shall furthermore contain provisions to identify if the installation produces a new good for the first time, and to ensure that the applicable CN code for the new product is determined, and added it to the list of goods for attributing related inputs, outputs and emissions to the appropriate production process.

F.4 Further rules for the attribution of direct emissions

1. Emissions of source streams or emission sources serving only one production process are attributed to that production process in full. Where a mass balance is used, outgoing source streams shall be subtracted in accordance with Section B.3.2 of this Annex. For avoiding double counting, source streams which are converted into waste gases, with the exception of waste gases produced and fully consumed within the same production process, are attributed using equations 53 and 54. The necessary monitoring of the NCV and volume of the respective waste gas is done by applying the rules given in Sections B.4 and B.5 of this Annex.
2. Only where source streams or emission sources serve more than one production process, the following approaches for attribution of direct emissions apply:
   - Emissions from source streams or emission sources used for the production of measurable heat are attributed to production processes in accordance with Section F.5 of this Annex;
   - Where waste gases are not used within the same production process in which they are produced, the emissions stemming from waste gases are attributed in accordance with rules and equations given in Section F.1 of this Annex;
   - Where the amounts of source streams attributable to production processes are determined by metering before the use in the production process, the appropriate methodology is applied in accordance with Section F.3.1 of this Annex.
   - Where emissions from source streams or emission sources cannot be attributed in accordance with other approaches, they shall be attributed using correlated parameters, which have already been attributed to production processes in accordance with Section F.3.1 of this Annex. For that purpose, source stream amounts and their respective emissions shall be attributed proportionally to the ratio in which those parameters are attributed to production processes. Appropriate parameters include the mass of goods produced, mass or volume of fuel or material consumed, amount of non-measurable heat produced, operating hours, or known equipment efficiencies.

F.5 Further rules for the attribution of emissions from measurable heat

The general calculation principles given in Section F.1 of this Annex apply. The relevant heat flows are determined in line with Section C.1 of this Annex and the emission factor of measurable heat by applying Section C.2 of this Annex.

Where losses of measurable heat are determined separately from the amounts used in production processes, emissions related to these heat losses are added proportionally to the emissions of all production processes in which measurable heat produced in the installation is used, in order to ensure that 100 % of the quantity of net measurable heat produced within the installation, or imported or exported by the installation, as well as quantities transferred between production processes, are attributed to production processes without any omission or double counting.

G. CALCULATION OF SPECIFIC EMBEDDED EMISSIONS OF COMPLEX GOODS

In accordance with Annex IV of Regulation (EU) 2023/956, the specific embedded emissions SEE_g of a complex good *g* are calculated as follows:

$$SEE_g = \frac{AttrEm_g + EE_{InpMat}}{AL_g} \quad \text{(Equation 57)}$$

$$EE_{InpMat} = \sum_{i=1}^{n} M_i \cdot SEE_i \quad \text{(Equation 58)}$$

Where:

SEE_g	Specific direct or indirect embedded emissions of a (complex) good g expressed in t $CO_{2(e)}$ per tonne of good g
$AttrEm_g$	Attributed direct or indirect emissions of the production process yielding good *g* determined in accordance with Section F.1 of this Annex for the reporting period, expressed in t $CO_{2(e)}$
AL_g	Activity level of the production process yielding good *g* determined in accordance with Section F.2 of this Annex for the reporting period, expressed in tonnes
EE_{InpMat}	Embedded direct or indirect emissions of all precursors consumed during the reporting period which are defined as relevant for the production process of good *g* in Section 2 of Annex II, expressed in t $CO_{2(e)}$.
M_i	Mass of precursor *i* used in the production process yielding *g* during the reporting period, expressed in tonnes of precursor *i*.
SEE_i	Specific direct or indirect embedded emissions of precursor *i* expressed in t $CO_{2(e)}$ per tonne of precursor *i*.

In this calculation, only precursors not covered by the same production process as good *g* are taken into account. Where the same precursor is obtained from different installations, the precursor from each installation shall be treated separately.

Where a precursor *i* itself has precursors, those precursors are first taken into account using the same calculation approach in order to calculate the embedded emissions of the precursor *i* before they are used for calculating the embedded emissions of good *g*. This approach is used recursively to all precursors which are complex goods.

The parameter M_i refers to the total mass of precursor required to produce the amount AL_g. It includes also quantities of the precursor which do not end up in the complex good but may be spilt, cut off, combusted, chemically modified, etc. in the production process and leave the process as by-products, scrap, residues, wastes, or emissions.

In order to provide data which can be used independently of activity levels, the specific mass consumption m_i for each precursor *i* shall be determined and included in the report mentioned in Section I of this Annex:

$$m_i = \mathrm{M_i}/AL_g \qquad \text{(Equation 59)}$$

Thereby the specific embedded emissions of a complex good *g* may be expressed as:

$$SEE_g = \mathrm{ae_g} + \sum_{i=1}^{n}(m_i \cdot SEE_i) \qquad \text{(Equation 60)}$$

Where

$\boldsymbol{ae_g}$	Specific attributed direct or indirect emissions of the production process yielding good *g*, expressed in t $CO_{2(e)}$ per tonne of *g*, being equivalent to specific embedded emissions without precursors' embedded emissions: $\boldsymbol{ae_g = AttrEm_g/AL_g}$ (Equation 61)
$\boldsymbol{m_i}$	Specific mass consumption of precursor *i* used in the production process yielding one tonne of *g*, expressed in tonnes of precursor *i* per tonne of good *g* (i.e., dimensionless).
$\boldsymbol{SEE_i}$	Specific direct or indirect embedded emissions of precursor *i* expressed in t $CO_{2(e)}$ per tonne of precursor *i*.

H. OPTIONAL MEASURES TO INCREASE QUALITY OF DATA

(1) Sources of risks of errors are identified in the data flow from primary data to final data in the data communication outlined in Section I of this Annex. An effective control system is established, documented, implemented and maintained to ensure that the communications resulting from data flow activities do not contain misstatements and are in conformity with the monitoring methodology documentation and in compliance with this Annex.

The risk assessment pursuant to the first subparagraph is made available to the Commission and the competent authority upon request. If the operator chooses to use verification in line with recommended improvements, the operator also makes it available for the purposes of verification.

(2) For the purpose of the risk assessment, written procedures are established, documented, implemented and maintained for data flow activities as well as for control activities, and references to those procedures are included in the monitoring methodology documentation.

(3) Control activities referred to in paragraph 2 shall include, where applicable:

(a) quality assurance of the relevant measurement equipment;

(b) quality assurance of information technology systems ensuring that the relevant systems are designed, documented, tested, implemented, controlled and maintained in a way that ensures processing reliable, accurate and timely data in accordance with the risks identified in the risk assessment;

(c) segregation of duties in the data flow activities and control activities, as well as management of necessary competencies;

(d) internal reviews and validation of data;

(e) corrections and corrective action;

(f) control of out-sourced processes;

(g) keeping records and documentation including the management of document versions.

(4) For the purposes of paragraph 3(a), it shall be ensured that all relevant measuring equipment is calibrated, adjusted and checked at regular intervals including prior to use, and checked against measurement standards traceable to international measurement standards, where available, and proportionate to the risks identified.

Where components of the measuring systems cannot be calibrated, those components shall be identified in the monitoring methodology documentation and alternative control activities shall be established.

When the equipment is found not to comply with required performance, necessary corrective action shall be promptly taken.

(5) For the purposes of paragraph 3(d), data resulting from the data flow activities referred to in paragraph 2 shall be regularly reviewed and validated. Such review and validation of the data shall include:

(a) a check as to whether the data are complete;

(b) a comparison of the data determined over the preceding reporting period and, in particular, consistency checks based on time series of greenhouse gas efficiency of the relevant production processes;

(c) a comparison of data and values resulting from different operational data collection systems, in particular for production protocols, sales figures and stock figures of relevant goods;

(d) comparisons and completeness checks of data at the level of the installation and production process of relevant goods.

(6) For the purposes of paragraph 3(e), it shall be ensured that, where data flow activities or control activities are found not to function effectively, or not to respect the rules set in the documentation of procedures for those activities, corrective action is taken and affected data is corrected without undue delay.

(7) For the purposes of paragraph 3(f), where one or more data flow activities or control activities referred to in paragraph 1 are outsourced from the installation, to all of the following shall be performed:

(a) checking the quality of the outsourced data flow activities and control activities in accordance with this Annex;

(b) defining appropriate requirements for the outputs of the outsourced processes as well as the methods used in those processes;

(c) checking the quality of the outputs and methods referred to in point (b) of this paragraph;

(d) ensuring that outsourced activities are carried out such that those are responsive to the inherent risks and control risks identified in the risk assessment.

(8) The effectiveness of the control system shall be monitored, including by carrying out internal reviews and taking into account the findings of the verifier, if verification is applied.

When the control system is found ineffective or not commensurate with the risks identified, the control system shall be improved and the monitoring methodology documentation updated accordingly, including the underlying written procedures for data flow activities, risk assessments and control activities, as appropriate.

(9) Recommended improvement: the operator may voluntarily have the installation's emissions data and specific embedded emissions data of goods as compiled in accordance with Section I of this Annex verified by an independent verifier accredited to ISO 14065, or according to the rules of the eligible monitoring, reporting and verification system relevant to the installation.

I. COMMUNICATION TO THE OPERATOR OF THE DATA FOR THE USE BY THE REPORTING DECLARANT IN THE CBAM REPORT

Within three months after the end of each reporting period or, if applicable, within the relevant interval required by an eligible monitoring, reporting and verification system relevant at the installation, the emissions data determined for the reporting period shall be compiled by the operator in an emission communication suitable for making it available to reporting declarants upon their request, containing at least all information required by the reporting declarant to compile the CBAM report.

It is recommended to use the electronic template elaborated by the Commission, containing as a minimum the information listed in Section 1 of Annex III. That section also indicates which information shall be considered as mandatory input, and what information is considered to be communicated on a voluntary basis as means of recommended improvements for allowing plausibility checks on the data.

Annex IV

Content of the communication from operators of installations to reporting declarants

1. CONTENT OF THE EMISSIONS DATA COMMUNICATION TEMPLATE

1.1 Mandatory general information

(1) Information on the installation:

- The name and contact details of the operator;
- The name of the installation;
- Contact details for the installation;
- The unique installation identifier, if available;
- the applicable United Nations Code for Trade and Transport Location (UN/LOCODE) of the location;
- An exact address and its English transcript;
- Geographical coordinates of the installation's main emission source.

(2) For each aggregated goods category, the production processes and routes used as listed in Table 1 of Annex II;

(3) For each good, listed either for each CN code separately, or aggregated by aggregated goods category in accordance with Section 1 of Annex II:

- the specific direct embedded emissions of each good;
- information on the data quality and determination approaches used, in particular if the embedded emissions have been completely determined based on monitoring, or whether any of the preliminary default values made available and published by the Commission have been used;
- the specific indirect embedded emissions of each good, and the method how the emission factor was determined, and the information source used;
- Where preliminary default made available and published by the Commission published by the Commission are reported instead of actual data of specific embedded emissions, a short description for the reasons shall be added;
- the sector-specific information in accordance with Section 2 of this Annex, if relevant;
- if applicable, the information on carbon price paid. Where a carbon price was paid for precursors obtained from other installations, any carbon price paid for those precursors shall be listed separately per country of origin.

1.2 Optional general information (recommended improvement)

(1) Total emissions of the installation, including:

(a) Activity data and calculation factors for each source stream used;

(b) Emissions of each emission source monitored using a measurement-based approach;

(c) Emissions determined by other approaches;

(d) Quantities of CO_2 received from other installations or exported to other installations, for the purpose of geological storage or as input to products in which the CO_2 is permanently chemically bound;

(2) A balance of imported, produced, consumed and exported measurable heat, waste gases and electricity;

(3) The quantity of all precursors received from other installations, and their specific direct and indirect embedded emissions;

(4) The quantity of precursor used in each production process, excluding precursors produced in the same installation;

(5) Information on how the attributed direct and indirect emissions of each production process were calculated;

(6) The activity level and attributed emissions of each production process;

(7) A list of all relevant goods produced by CN code, including precursors not covered by separate production processes;

(8) A short description of the installation, its main production processes, any production processes not covered for CBAM purposes, main elements of the monitoring methodology used, whether rules of an eligible monitoring, reporting and verification system have been applied, and which measures for improvement of the data quality have been taken, in particular whether any form of verification was applied.

2. SECTOR-SPECIFIC PARAMETERS TO BE INCLUDED IN THE COMMUNICATION

Aggregated goods category	**Reporting requirement in the CBAM report**
Calcined clay	– Whether or not the clay is calcined
Cement clinker	– N.a.
Cement	– Mass ratio of tonnes cement clinker consumed per produced tonne of cement (clinker to cement ratio expressed in per cent)
Aluminous cement	– N.a.
Hydrogen	– N.a.
Urea	– Purity (mass % urea contained, % N contained)
Nitric acid	– Concentration (mass %)
Ammonia	– Concentration, if hydrous solution

Aggregated goods category	Reporting requirement in the CBAM report
Mixed fertilizers	– information required anyway under Regulation (EU) 2019/1009: – 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
Sintered Ore	– N.a.
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, total of other alloy elements
Crude steel	– The main reducing agent of the precursor, if known; – Mass % of Mn, Cr, Ni, total of other alloy elements; – Tonnes scrap used for producing 1 t crude steel
Iron and steel products	– The main reducing agent used in precursor production, if known; – Mass % of Mn, Cr, Ni, total of other alloy elements; – Mass % of materials contained which are not iron or steel, if their mass is more than [1-5%] of the total good's mass; – Tonnes scrap used for producing 1 t of the product
Unwrought aluminium	– Tonnes scrap used for producing 1 t of the product – If the total content of elements other than aluminium exceeds [1%], the total percentage of such elements
Aluminium products	– Tonnes scrap used for producing 1 t of the product – If the total content of elements other than aluminium exceeds [1%], the total percentage of such elements

ANNEX V

Data Requirements complement for Inward Processing

The reporting declarant shall include the information and follow the CBAM report structure listed in table 1, when submitting the CBAM report for inward processing.

The reporting declarant shall fill in fill-in the fields marked as mandatory, when submitting the CBAM report.

Optional fields can be filled in by the reporting declarant to ensure greater transparency of the data reported. Conditional required fields must be filled in by the reporting declarant if certain conditions are met.

Table 1: Mandatory, optional and conditional fields in the CBAM report for inward processing

Data requirement from Customs after IP bill of discharge	Mandatory (M), Optional (O), or Conditional (C)
Issuing country	M
Data record reference	M
Data record version number	M
Data record version status	M
Reporting Period Start Date	M
Reporting Period End Date	M
SCO (for IP)	C
Authorization for IP reference number	M
Importer identification number/Authorization Holder for IP	M
Importer country	M
Goods item identifier (seq. no)	M
Harmonised system sub-heading code	M
Combined nomenclature code	M
Description of goods	M
Requested procedure code	M
Previous procedure code	M
Country of origin code	M
Country of destination code	M
Country of dispatch	M
Net mass	M

Statistical value	M
Net mass of the actual product used in processed products released for free circulation	C
Net mass as actual products released on the same commodity code for free circulation	C
Supplementary units	C
Representative identification number and status – Optional	O
Mode of transport at the border - Optional	O

ANNEX VI
EORI DATA

The table contains the information on the economic operators as found in EOS, which shall be interoperable with the CBAM Transitional Registry.

Economic Operator System (EOS) EORI
Customer Identification
EORI country + EORI national Number
EORI country
EORI start date
EORI expiry date
Customs Customer Information
EORI short name
EORI full name
EORI language
EORI establishment date
EORI person type
EORI economic activity
List of EORI establishment addresses
Establishment addresses
EORI Address
EORI language
EORI name
Establishment in union
EORI address start date
EORI address end date
VAT or TIN numbers
"VAT" or "TIN"
National identifier + VAT or TIN number Concatenate country with national identifier
EORI legal status
EORI legal status language
EORI legal status
EORI legal status begin date & end date
Contact list
Contact
EORI contact address
EORI contact language
EORI contact full name
EORI contact name
Publication agreement flag
Address fields description
Street and Number
Postcode
City

Country code
List of communication details
Communication type

ANNEX VII

National Import System Data

The table contains the information from the National Import System, which shall be interoperable with the CBAM Transitional Registry.

National Import System	Mandatory (M), Optional (O), or Conditional (C)
Issuer	M
Data record reference	M
Data record version number	M
Data record version status	M
Import declaration number	M
Declaration goods item number	M
Declaration acceptance date	M
Requested procedure code	M
Previous procedure code	M
Country of origin code	C
Country of preferential origin code	C
Country of destination code	M
Country of dispatch	M
Quota order number	O
Description of goods	M
Harmonised system sub-heading code	M
Combined nomenclature code	M
TARIC code	C
Net mass	M
Statistical value	M
Supplementary units	C
Declaration type	M
Additional declaration type	M
Format	O
Importer identification number	M
Importer country	M
Consignee identification number	M
Declarant identification number	M
Holder of authorization identification number	C
Holder authorization type	C
Authorization reference number	C
Representative identification number	C
Mode of transport at the border	M
Inland mode of transport	O

Annex VIII

Standard factors used in the monitoring of direct emissions at installation level

1. FUEL EMISSION FACTORS RELATED TO NET CALORIFIC VALUES (NCV)

Table 1: Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of fuel.

Fuel type description	Emission factor (t CO_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

Fuel type description	Emission factor (t CO_2/TJ)	Net calorific value (TJ/Gg)	Source
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 ([6])	n.a.	WBCSD CSI
Carbon monoxide	155,2 ([7])	10,1	J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995
Methane	54,9 ([8])	50,0	J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995

Table 2: Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of biomass material.

Biomass material	Preliminary EF [t CO_2 / TJ]	NCV [GJ/t]
Wood / Wood waste (air dry ([9]))	112	15,6
Sulphite lyes (black liquor)	95,3	11,8
Other primary solid biomass	100	11,6
Charcoal	112	29,5
Biogasoline	70,8	27,0
Biodiesels ([10])	70,8	37,0
Other liquid biofuels	79,6	27,4

([6]) This value is the preliminary emission factor, i.e., before application of a biomass fraction, if applicable.

([7]) Based on NCV of 10,12 TJ/t

([8]) Based on NCV of 50,01 TJ/t

([9]) The given emission factor assumes around 15% water content of the wood. Fresh wood can have water content of up to 50%. For determining the NCV of completely dry wood, the following equation shall be used:

$$NCV = NCV_{dry} \cdot (1 - w) - \Delta H_v \cdot w$$

Where NCV_{dry} is the NCV of the absolute dry material, w is the water content (mass fraction) and $\Delta H_v = 2{,}4 GJ/t\ H_2O$ is the evaporation enthalpy of water. Using the same equation, the NCV for a given water content can be back-calculated from the dry NCV.

([10]) The NCV value is taken from Annex III of the RED II.

Biomass material	Preliminary EF [t CO_2 / TJ]	NCV [GJ/t]
Landfill gas ([11])	54,6	50,4
Sludge gas ([10])	54,6	50,4
Other biogas ([10])	54,6	50,4
Municipal waste (biomass fraction) ([12])	100	11,6

2. EMISSION FACTORS RELATED TO PROCESS EMISSIONS

Table 3: Stoichiometric emission factor for process emissions from carbonate decomposition (Method A)

Carbonate	Emission factor [t CO_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 = $[M(CO_2)] / \{Y * [M(x)] + Z * [M(CO_3^{2-})]\}$ X = metal M(x) = molecular weight of X in [g/mol] $M(CO_2)$ = molecular weight of CO_2 in [g/mol] $M(CO_3^{2-})$ = molecular weight of CO_3^{2-} in [g/mol] Y = stoichiometric number of X Z = stoichiometric number of CO_3^{2-}

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

([11]) For landfill gas, sludge gas and other biogas: Standard values refer to pure Biomethane. For arriving at the correct standard values, a correction is required for the methane content of the gas.

([12]) The IPCC guidelines also give values for the fossil fraction of municipal waste: EF = 91,7 t CO_2/TJ; NCV = 10 GJ/t

Oxide	Emission factor [t CO_2/ t Oxide]
BaO	0,287
general: X_YO_Z	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 and steel, and processing of ferrous metals) ([13])

Input or output material	Carbon content (t C/t)	Emission factor (t CO_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

3. GLOBAL WARMING POTENTIALS FOR NON-CO_2 GREENHOUSE GASES

Table 6: Global warming potentials

Gas	Global warming potential
N_2O	265 t $CO_{2(e)}$ / t N_2O
CF_4	6 630 t $CO_{2(e)}$ / t CF_4
C_2F_6	11 100 t $CO_{2(e)}$ / t C_2F_6

([13]) IPCC 2006 Guidelines for National Greenhouse Gas Inventories

ANNEX IX

Harmonised efficiency reference values for separate production of electricity and heat

In the tables below the harmonised efficiency reference values for separate production of electricity and heat are based on net calorific value and standard atmospheric ISO conditions (15 °C ambient temperature, 1,013 bar, 60 % relative humidity).

Table 1: Reference efficiency factors for electricity production

Category		Type of fuel	Year of construction		
			Before 2012	2012-2015	From 2016
Solids	S1	Hard coal including anthracite, bituminous coal, sub-bituminous coal, coke, semi-coke, pet coke	44,2	44,2	44,2
	S2	Lignite, lignite briquettes, shale oil	41,8	41,8	41,8
	S3	Peat, peat briquettes	39,0	39,0	39,0
	S4	Dry biomass including wood and other solid biomass including wood pellets and briquettes, dried woodchips, clean and dry waste wood, nut shells and olive and other stones	33,0	33,0	37,0
	S5	Other solid biomass including all wood not included under S4 and black and brown liquor.	25,0	25,0	30,0
	S6	Municipal and industrial waste (non-renewable) and renewable/bio-degradable waste	25,0	25,0	25,0
Liquids	L7	Heavy fuel oil, gas/diesel oil, other oil products	44,2	44,2	44,2
	L8	Bio-liquids including bio-methanol, bioethanol, bio-butanol, biodiesel and other bio-liquids	44,2	44,2	44,2
	L9	Waste liquids including biodegradable and non-renewable waste (including tallow, fat and spent grain).	25,0	25,0	29,0
Gaseous	G10	Natural gas, LPG, LNG and biomethane	52,5	52,5	53,0
	G11	Refinery gases hydrogen and synthesis gas	44,2	44,2	44,2
	G12	Biogas produced from anaerobic digestion, landfill, and sewage treatment	42,0	42,0	42,0
	G13	Coke oven gas, blast furnace gas, mining gas, and other recovered gases (excluding refinery gas)	35,0	35,0	35,0
Other	O14	Waste heat (including high temperature process exhaust gases, product from exothermic chemical reactions)			30,0

Table 2: Reference efficiency factors for heat production

Category		Type of fuel	Year of construction					
			Before 2016			From 2016		
			Hot water	Steam ([14])	Direct use of exhaust gases ([15])	Hot water	Steam ([13])	Direct use of exhaust gases ([14])
Solids	S1	Hard coal including anthracite, bituminous coal, sub-bituminous coal, coke, semi-coke, pet coke	88	83	80	88	83	80
	S2	Lignite, lignite briquettes, shale oil	86	81	78	86	81	78
	S3	Peat, peat briquettes	86	81	78	86	81	78
	S4	Dry biomass including wood and other solid biomass including wood pellets and briquettes, dried woodchips, clean and dry waste wood, nut shells and olive and other stones	86	81	78	86	81	78
	S5	Other solid biomass including all wood not included under S4 and black and brown liquor.	80	75	72	80	75	72

([14]) If steam plants do not account for the condensate return in their calculation of CHP heat efficiencies, the steam efficiencies shown in the table above shall be increased by 5 percentage points.

([15]) Values for direct use of exhaust gases shall be used if the temperature is 250 °C or higher.

	S6	Municipal and industrial waste (non-renewable) and renewable/bio-degradable waste	80	75	72	80	75	72
Liquids	L7	Heavy fuel oil, gas/diesel oil, other oil products	89	84	81	85	80	77
	L8	Bio-liquids including bio-methanol, bioethanol, bio-butanol, biodiesel and other bio-liquids	89	84	81	85	80	77
	L9	Waste liquids including biodegradable and non-renewable waste (including tallow, fat and spent grain).	80	75	72	75	70	67
Gaseous	G10	Natural gas, LPG, LNG and biomethane	90	85	82	92	87	84
	G11	Refinery gases hydrogen and synthesis gas	89	84	81	90	85	82
	G12	Biogas produced from anaerobic digestion, landfill, and sewage treatment	70	65	62	80	75	72
	G13	Coke oven gas, blast furnace gas, mining gas, and other recovered gases (excluding refinery gas)	80	75	72	80	75	72

Other	O14	Waste heat (including high temperature process exhaust gases, product from exothermic chemical reactions)	—	—	—	92	87	—