

Working Paper

on

“Review of the EU-Monitoring and Reporting Guidelines: First Order Draft of Annexes I to XII”

Prepared under the project:

Support to the Commission’s Work Related to the Review, Implementation and Further Development of the Commission Decision 2004/156/EC Establishing Guidelines for the Monitoring and Reporting of Greenhouse Gas Emissions Pursuant to Directive 2003/87/EC

Version B: “Tracked Changes”

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Prepared on behalf of the

European Commission (DG ENV)

by

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All views expressed in this report are those of the authors and do not necessarily represent the views of European Commission.

Introduction

This document comprises a “first-order-draft” with Annexes I to XII of the EU Monitoring and Reporting Guidelines designed for application in the EU-Emissions Trading Scheme as of 1.1.2008.

For informative purposes the authors are circulating a Version B “Tracked Changes” marking proposed changes against the original text of the Guidelines from 2004 in parallel to the main Version A “Consolidated” on which further work within the review process will be based.

The draft is addressing most of the issues identified as part of the stakeholder consultation involving affected industries and Member States.

The document was prepared by Ecofys and its partners on behalf of DG Environment. The sole purpose of this document is to facilitate an informed discussion with Member States and Stakeholders.

The authors would like to acknowledge the contributions to this draft by Member States, DG Environment, representatives of several industry associations, individual experts as well as the project partners PwC, TÜV Rheinland, KPMG and the World Resources Institute in the two projects preparing and supporting the review of EU Monitoring and Reporting Guidelines.

In particular we would like to emphasize the draft text provided for section 14 of Annex I by the IMPEL EU ETS Support Group and the draft text of section 11 as provided by Jeroen Kruijd and Jean-Yves Saliez from PwC.

Member States and Stakeholders are invited to submit comments referring to the page and line numbers of the Version A “Consolidated” to

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by 24 February 2006 the latest.

Comments received after this date cannot be taken into account in the compilation of the final draft prepared by Ecofys for DG Environment which is due in early March 2006.

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Revised Numbering

During the review process, the numbering of sections in Annex I has partly changed. In order to allow for a clear overview on the changes in numbering, Table A displays the the numbering in the recent MRG as well as in the revised version.

Table A Numbering of Annex I in recent and revised draft MRG versions

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	17.EXEMPTIONS FROM REQUIREMENTS FOR SMALL INSTALLATIONS

EN



Brussels, xx.xx.20064
COM(xxx)

COMMISSION DECISION

of xx/xx/20064

establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council

(Text with EEA relevance)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, and in particular Article 14(1) thereof,

Whereas:

- (1) The complete, consistent, transparent and accurate monitoring and reporting of greenhouse gas emissions in accordance with these guidelines is fundamental for the operation of the greenhouse gas emission allowance trading scheme established in Directive 2003/87/EC.
- (2) The guidelines contained in this Decision set out detailed criteria for the monitoring and reporting of greenhouse gas emissions resulting from the activities listed in Annex I of Directive 2003/87/EC of greenhouse gases specified in relation to those activities, based on the principles for monitoring and reporting set out in Annex IV of that Directive.
- (3) Article 15 of Directive 2003/87/EC requires Member States to ensure that reports submitted by operators are verified in accordance with the criteria set out in Annex V of that Directive.

- (4) The measures provided for in this Decision are in accordance with the opinion of the Committee established by Article 8 of Decision 93/389/EEC,

HAS ADOPTED THIS DECISION:

Article 1

The guidelines for the monitoring and reporting of greenhouse gas emissions from the activities listed in Annex I to Directive 2003/87/EC, referred to in Article 14 thereof, are set out in the Annexes to this Decision.

These guidelines are based on the principles set out in Annex IV to that Directive.

Article 2

This Decision is addressed to the Member States.

Article 3

[This Decision enters into force on 1 January 2008 replacing Decision 2004/156/EC of 29 January 2004.](#)

Done at Brussels, xx / xx / 2006⁴

For the Commission

~~*Margot Wallström*~~ *Stavros Dimas*

Member of the Commission

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1. Introduction

This Annex contains the general guidelines for the monitoring and reporting of emissions from the activities listed in Annex I to Directive 2003/87/EC, hereinafter “the Directive”, of greenhouse gases specified in relation to those activities. Additional guidelines on activity-specific emissions are set out in Annexes II-XI.

The Commission will review this Annex and Annexes II-XI by 31 December ~~2006,2010,~~ taking into account experiences with the application of these Annexes and any revisions to Directive 2003/87/EC, with a view to any revised Annexes taking effect from 1 January ~~2008,2013.~~

2. Definitions and Responsibilities

2.1 Definitions

For the purposes of this Annex and Annexes II to XI the following definitions shall apply:

a) “accreditation” means the issuing of a statement by an accreditation body based on its decision following a review related to a verifier conveying formal demonstration of its competence to carry out verification in accordance with specified requirements;

b) “arithmetic mean” means the sum of all the members of a set of value divided by the number of items in the set;

c) “accuracy” means the closeness of the agreement between the result of a measurement and the true value of the particular quantity. Accuracy takes into account both, random and systematic factors. In these guidelines the term is used conceptually and quantitatively exchangeable to the term “uncertainty” (see below);

~~e)d)~~ a) “activities” means the activities listed in Annex I to the Directive;

~~d)e)~~ b) “activity specific” means specific to an activity as carried out at one specific installation;

~~e)f)e)~~ “batch” means an amount of fuel or material transferred as one shipment or continuously over a specific period of time. It shall be representatively sampled and characterised as laid down in section 4014 in respect of its average energy and carbon content and other relevant aspects of its chemical composition;

~~f)g)d)~~ “biomass” means non-fossilised and biodegradable organic material originating from plants, animals and micro-organisms. This shall also include products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilised and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gases and liquids recovered from the decomposition of non-fossilised and biodegradable organic material. When burned for energy purposes biomass is referred to as biomass fuel;

- ~~h) e)~~ “combustion emissions” means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen;
- ~~ì)~~ “calibration” means the set of operations, which establish, 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 realized by a reference standard;
- i) “commercial standard fuel” means the following standardized commercial fuels: gas oil, light fuel oil, gasoline, kerosene, ethane, propane and butane;
- j) ~~ñ)~~ “competent authority” means the appropriate competent authority or authorities for the implementation of the provisions set out in this Decision, designated in accordance with Article 18 of the Directive;
- k) “continuous measurement” means a set of operations having the objective of determining the value of a quantity, with two values being determined maximum 180 seconds apart from each other;
- l) “control risks” means the susceptibility of a parameter in the Annual Emissions Report to material misstatements that will not be prevented or detected and corrected on a timely basis by the control system;
- m) “detection risk” means the risk that the verifier will not detect a material misstatement or a material nonconformity;
- n) “Directive” means Directive 2003/87/EC;
- o) “emission source” means a separately identifiable point or process in an installation from which greenhouse gases are emitted;
- p) “energy balance method” means a method to estimate the amount of one fuel used in a boiler based on the amount of generated electricity and utilisable heat as well all relevant losses of energy by radiation, transmission and via the flue gas;
- ~~m)q) ð)~~ “emissions” means the release of greenhouse gases into the atmosphere from emission sources in an installation, as defined in the Directive;
- ~~n)r)h)~~ “greenhouse gases” means the gases listed in Annex II to the Directive;
- s) ~~ì)ø)~~ “greenhouse gas emissions permit” or “permit” means a permit as referred to in Article 4 of the Directive and issued in accordance with Articles 5 and 6 of the Directive;
- t) ~~p)~~ “inherent risk” means the susceptibility of a parameter in the Annual Emissions Report to material misstatements, assuming that there were no related control activities;
- ~~ø)u) ÿ)~~ “installation” means a stationary technical unit where one or more activities listed in Annex I to the Directive are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution, as defined in the Directive;

~~r)v)k)~~ “level of assurance” means the degree to which the verifier is confident in the verification conclusions that it has been proved whether or not the information reported for an installation taken as a whole is free from material misstatement;

w) “lower tiers” means a range of tiers below the highest tier from which one can be chosen by the operator;

x) “major source stream” means any source stream in relation to an installations which does not fall under the definition “minor source stream” as defined in section 5.2;

~~l) “materiality” means the professional judgment of the verifier as to whether an individual or aggregation of omissions, misrepresentations or errors that affects the information reported for an installation will reasonably influence the intended users decisions. As a broad guide, a verifier will tend to class a misstatement in the total emissions figure as being material if it leads to aggregate omissions, misrepresentations or errors in the total emissions figure being greater than 5 percent;~~

y) “materiality level” means the quantitative threshold or cutoff point to be used to determine the appropriate verification opinion on the emission data reported. The materiality level is to be set by the competent authority or the verifier if the competent authority has not set such a level;

z) “material misstatement” means that, to the professional judgment of the verifier, an Annual Emissions Report contains misstatements (omissions, misrepresentations and errors, not considering the permissible uncertainty), that could affect the treatment of the Annual Emissions Report by the competent authority. This is the case when the misstatement exceeds the materiality level;

aa) “material non-conformity” means that a nonconformity to the requirements in these guidelines or in the approved monitoring plan could lead to different a treatment of the installation by the competent authority or other regulator of the EU ETS;

bb) “measurement” means a set of operations having the object of determining a value of a quantity;

cc) “measurement instrument” means a device intended to be used to make measurements, alone or in conjunction with supplementary device(s);

dd) “measurement system” means a complete set of measurement instruments and other equipment assembled to carry out specified measurements;

~~“metrological confirmation” means a set of operations required to ensure that a measurement instrument is in a state of compliance with requirements for its intended use. Metrological confirmation normally includes, inter alia, calibration and necessary adjustment or repair and subsequent recalibration as well as any required sealing and labelling.~~

~~w)ee) m)~~ “monitoring methodology” means the ~~methodology~~sum of approaches used by an operator used for the determination of to determine the emissions, including the choice between calculation or measurement and the choice of tiers;emissions of a given installation;

- ff) “monitoring plan” means a detailed, complete and transparent documentation of the monitoring methodology of a specific installation, including documentation of quality assurance and control procedures and data management;
- gg) “non-conformity” means any act or omission of an act by the installation being under verification, either intentional or unintentional, that is contrary to the prevailing requirements;
- hh) ~~h)~~ “operator” means any person who operates or controls an installation or, where this is provided for in national legislation, to whom decisive economic power over the technical functioning of the installation has been delegated, as defined in the Directive;
- ~~bb)ii) e)~~ “process emissions” means greenhouse gas emissions other than “combustion emissions” occurring as a result of intentional and unintentional reactions between substances or their transformation, including the chemical or electrolytic reduction of metal ores, the thermal decomposition of substances, and the formation of substances for use as product or feedstock;
- jj) “pure” relating to a substance means that a material or fuel consists of at least 97% (related to mass) of the specified substance - corresponding to the commercial classification of “purum”; For biomass this relates to the origin of carbon in the fuel or material;
- kk) “reasonable assurance” means a high but not absolute level of assurance, expressed positively in the verification opinion, whether the emissions report subject to verification is free from material misstatement and whether the installation does not have material non-conformities with respect to compliance with these guidelines and the approved Monitoring Plan;
- ~~ee)ll) p)~~ “reporting period” means the time period for which emissions have to be monitored and reported as set out in Article 14(3) of the Directive, being a calendar year;
- ~~ff)q) “source” “emission source” means a separately identifiable point or process in an installation from which greenhouse gases are emitted;~~
- mm) “standard conditions” means temperature and pressure conditions of 273 K and 1013 hPA, which all measured values must relate to. Measurement in parts of the process carried out under differing temperature and pressure conditions therefore needs to include temperature and pressure adjustment.
- nn) “standard deviation” means the positive square root of the mean square deviation from the arithmetic mean divided by the number of degrees of freedom (number of measurements minus one);
- oo) “source stream” means the annual net consumption of a specific fuel, raw material or the net production of any product in an installation if it bears direct relevance for the calculation of greenhouse gas emissions;
- pp) “technical feasible” means that technical resources capable of meeting the needs of a proposed system can be acquired or developed by the operator in the required time;

~~jj)qq) r)~~ “tier” means a specific methodology for determining activity data, emission factors and oxidation or conversion factors. Several tiers form a hierarchy of methodologies from which a selection shall be made in accordance with these guidelines;

rr) “uncertainty” means a parameter, associated with the result of the determination of a quantity, that characterizes the dispersion of the values that could reasonably be attributed to the particular quantity . The parameter includes the effects of systematic as well as of random factors. The uncertainty is 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;

~~uu)ss)~~ “unreasonable costs” means costs disproportionate relative to the average value over the previous trading period of the allowances allocated to the installation for that period. For installations without this ~~history~~history, data from representative installations carrying out the same or ~~similar~~comparable activities shall be used as reference and scaled according to their capacity;

tt) "verification" means the activities carried out by a verifier to be able to provide a verification opinion;

uu) "verification opinion" means a clear written expression of opinion on the annual emissions report and compliance with these guidelines the approved monitoring plan. (see further section 7.311.4)s);

vv) “verification risk” means the risk that the verifier expresses an inappropriate verification opinion. Verification risk is a function of inherent risks, control risks, and detection risk;

ww) "verifier" means a competent, independent, accredited verification body with responsibility for performing and reporting on the verification process, in accordance with the detailed requirements established by the Member State pursuant to Annex V of the Directive;

2.2. Responsibilities within the monitoring and reporting process

The following list summarises the main responsibilities of Member States, competent authorities, operators and verifiers in application of these guidelines.

The Member States

- ensure that emissions are monitored in accordance with these guidelines for each reporting period;
- ensure that each operator of an installation reports the verified emissions from each installation during each calendar year to the competent authority by 31 March after the end of that year in accordance with these guidelines;
- make the appropriate administrative arrangements, including the designation of the appropriate competent authority or authorities, for the implementation of these guidelines ahead of the start of the reporting period;

- ensure that the reports submitted by operators are verified in accordance with the criteria set out in Annex V of the Directive and the detailed requirements established pursuant to Annex V by the Member State and that the competent authority is informed thereof;
- establish detailed competence requirements and verification methodology requirements for verifiers, and an accreditation process for ensuring verifiers meet these requirements when verifying emissions reports;
- consider publishing a list of representative national emission factors and net calorific values for relevant fuel types as used in the latest common reporting framework submitted to the Secretariat of the United Nations Framework Convention on Climate Change.
- shall notify the Commission by 30 September of each year if the application of the most accurate tier approach, including when used to corroborate measurement, is found to be technically not feasible or is expected to lead to unreasonably high costs for major source streams within installations classified as Category C according to Table 1 (see section 5.23.2.2.1.3).

The Competent Authority:

- approves the monitoring ~~methodology~~ plan and the monitoring methodology therein as part of an installation's permitting procedure;
- agrees or rejects the procedures proposed by the operator to develop an activity specific emission factor and oxidation/conversion factor, or determine a biomass fraction;
- approves changes of the monitoring methodology proposed by the operator ahead or after the start of the reporting period;
- may require an operator to change his monitoring plan ~~monitoring methodology~~ as part of an annual review;
- approves methodologies to account for "transferred CO₂".

The Operator

- proposes the monitoring plan ~~monitoring methodology~~ for each Annex I activity carried by an installation, and the selection of tiers in the permit application ahead of the start of the reporting period;
- proposes a measurement methodology to the competent authority if appropriate as part of the monitoring methodology ahead of the start of the reporting period;
- seeks approval for changes of the monitoring methodology from the competent authority ahead of the start of the reporting period;

- immediately seeks approval, notifies the competent authority within five days in case of for temporary changes of the monitoring methodology after the start of the reporting period from the competent authority and retains information providing proof of its necessity;
- selects and contracts a verifier for each reporting period;
- agrees with the competent authority procedures for the development of activity specific emission factors and, oxidation and conversion factors or for the determination of biomass fractions in mixed fuels or materials ahead of the start of the reporting period as part of the monitoring plan;
- submits the verified emissions report to the competent authority by March 31 of the year following the reporting period.

The Verifier

- verifies emissions reports submitted by operators in accordance with the detailed requirements established by the Member State pursuant to Annex V of the Directive;
- upon consideration of compliance of the applied monitoring methodology with the monitoring methodology approved by the competent authority under the installation's permit, the principles for monitoring and reporting presented in section 2.13 above and the guidelines laid down in this and subsequent annexes, will conclude on the materiality of any omissions, misrepresentations or errors which could lead to a rejection of the emissions report;

3. Monitoring and reporting principles

To ensure the accurate and verifiable monitoring and reporting of greenhouse gas emissions under the Directive, monitoring and reporting shall be based on the following principles:

Completeness. Monitoring and reporting for an installation shall cover all process and combustion emissions from all emission sources and source streams belonging to activities listed in Annex I to the Directive and of all greenhouse gases specified in relation to those activities: while avoiding double-counting.

Consistency. Monitored and reported emissions shall be comparable over time, using the same monitoring methodologies and data sets. Monitoring methodologies can be changed in accordance with the provisions of these guidelines if the accuracy of the reported data is improved. Changes in monitoring methodologies shall be subject to approval from the competent authority and shall be fully documented.

Transparency. Monitoring data, including assumptions, references, activity data, emission factors, oxidation factors and conversion factors shall be obtained, recorded, compiled, analysed and documented in a manner that enables the reproduction of the determination of emissions by the verifier and the competent authority.

Accuracy/Trueness. It shall be ensured that the emission determination is systematically neither over nor under true emissions, as far as can be judged; Source of uncertainties shall

~~be identified and and that uncertainties are~~ reduced as far as practicable ~~and quantified where required under these guidelines~~. Due diligence shall be exercised to ensure that the calculation and measurement of emissions exhibit highest achievable accuracy. The operator shall provide reasonable assurance of the integrity of reported emissions. Emissions shall be determined using the appropriate monitoring methodologies set out in these guidelines. All metering or other testing equipment used to report monitoring data shall be appropriately applied, maintained and calibrated, and checked. Spreadsheets and other tools used to store and manipulate monitoring data shall be free from error.

Cost effectiveness. In selecting a monitoring methodology, the improvements from greater accuracy shall be balanced against the additional costs. Hence, monitoring and reporting of emissions shall aim for the highest achievable accuracy, unless this is technically not feasible or will lead to unreasonably high costs. ~~The monitoring methodology itself shall describe the instructions to the operator in a logical and simple manner, avoiding duplication of effort and taking into account the existing systems in place at the installation.~~

~~*Materiality.* An emission report and related disclosures shall be free from material misstatement, avoid bias in the selection and presentation of information, and provide a credible and balanced account of an installation's emissions.~~

Faithfulness. A verified emissions report shall be capable of being depended upon by users to represent faithfully that which it either purports to represent or could reasonably be expected to represent.

Improvement of performance in monitoring and reporting emissions. The process of verifying the emission reports shall be an effective and reliable tool in its support of quality assurance and quality control procedures, providing information upon which an operator can act to improve its performance in monitoring and reporting emissions.

4. Monitoring of Greenhouse Gas Emissions

4.1 Boundaries

The monitoring and reporting process for an installation shall include all emissions from all emission sources and/or source streams belonging to activities listed in Annex I to the Directive, carried out at the installation, of greenhouse gases specified in relation to those activities.

Article 6(2)(b) of the Directive requires that greenhouse gas emissions permits shall contain a description of the activities and emission from the installation. Therefore, all ~~sources of greenhouse gas emission~~emission sources and/or source streams from activities listed in Annex I to the Directive that are to be monitored and reported shall be listed in the permit. Article 6(2)(c) of the Directive requires that greenhouse gas emissions permits shall contain monitoring requirements, specifying monitoring methodology and frequency.

Emissions from internal combustion engines for transportation purposes shall be excluded from the emission estimates.

The monitoring of emissions shall include emissions from regular operations and abnormal events including start-up and shut-down and emergency situations over the reporting period.

If the separate or combined production capacities or outputs of one or several activities belonging to the same activity subheading in Annex I to the Directive exceed the respective threshold defined in Annex I to the Directive in one installation or on one site, all emissions from all [emission sources](#) [and/or source streams](#) of all activities listed in Annex I to the Directive in the respective installation or site shall be monitored and reported.

Whether an additional combustion installation, such as a combined heat and power installation, is regarded as part of an installation carrying out another Annex I activity or as a separate installation depends on local circumstances and shall be established in the installation's greenhouse gas emission permit.

All emissions from an installation shall be assigned to that installation, regardless of exports of heat or electricity to other installations. Emissions associated with the production of heat or electricity imported from other installations shall not be assigned to the importing installation.

4.2 Calculation and measurement [based methodologies](#)

Annex IV to the Directive permits a determination of emissions using either:

- a calculation based methodology (~~“calculation”~~), determining emissions [from source streams](#) based on activity data obtained by means of measurement devices or systems and additional parameters from laboratory analyses or standard factors
- a measurement based methodology (~~“measurement”~~), determining emissions from an emission source by means of continuous measurement of the concentration of the relevant greenhouse gas in the exhaust flow and of the exhaust gas flow.

The operator may propose to [use a measurement based methodology](#) ~~measure emissions~~ if he can demonstrate that:

- it reliably gives higher accuracy than the relevant calculation [based methodology](#) applying a combination of the highest tiers; and
- the comparison between measurement and calculation [based methodology](#) is based on an identical sets of emission sources and source streams.

The use of [a measurement based methodology](#) shall be subject to the approval of the competent authority. For each reporting period the operator shall corroborate the measured emissions by means of calculation [based methodology](#) in accordance with [these guidelines](#) ~~the provisions of section 7. The rules for the selection of the tiers of the corroborating calculation shall be the same as those applied for a calculation approach, set out in paragraph 4.2.2.1.4.~~

The operator may, with the approval of the competent authority, combine measurement and calculation [based methodologies](#) for different emission sources and source streams belonging to one installation. The operator shall ensure and demonstrate that neither gaps nor double counting concerning emissions occur.

4.3 ~~Determination of greenhouse gas emissions~~ The Monitoring Methodology

The complete, transparent and accurate monitoring of greenhouse gas emissions requires decisions to be taken when determining appropriate monitoring methodologies. This includes deciding between measurement and calculation as well as selecting specific tiers for the determination of activity data, emission factors and oxidation or conversion factors. The sum of approaches used by an operator for an installation for the determination of its emissions is referred to as a monitoring methodology.

Article 6(2)(c) of the Directive requires that greenhouse gas emissions permits shall contain monitoring requirements, specifying monitoring methodology and frequency. Each monitoring methodology shall be approved by the competent authority in accordance with the criteria set out in this section and its subsections. The Member State or its competent authorities shall ensure that the monitoring methodology to be applied by installations shall be specified either under the conditions of the permit or, where consistent with the Directive, in general binding rules.

The competent authority shall approve a detailed description of the monitoring methodology ~~- called the monitoring plan -~~ prepared by the operator before the start of the reporting period, and again after any change to the monitoring methodology applied to an installation.

~~This description~~ The monitoring plan shall contain:

- the ~~exact definition~~ description of the installation and activities carried out by the installation to be monitored;
- information on responsibilities for monitoring and reporting within the installation;
- a list of emission sources for each activity carried out within the installation;
- a list of ~~fuel and material~~ emissions sources and/or source streams to be monitored for each activity;
- a list of tiers to be applied for activity data, emission factors, oxidation and conversion factors for each of the ~~activities and fuels types / materials;~~ source streams.;
- a description of the ~~typetiers,~~ type of measurement systems, and the specification and exact location of the ~~metering devices~~ measurement instruments to be used for each of the ~~sources and fuels types / materials;~~ source streams and/or emission sources to be monitored;
- a description of the approach to be used for the sampling of fuel and materials for the determination of net calorific value, carbon content, emission factors, and biomass content for each of the ~~sources and fuel types / materials;~~ and source streams ;
- a description of the intended sources or analytical approaches for the determination of the net calorific values, carbon content, emission factor or

biomass fraction for each of the ~~sources and fuels types / materials;~~source streams;

- ~~– if applicable, a list and description of non-accredited laboratories and relevant analytical procedures,~~
- a description of continuous emission measurement systems to be used for the monitoring of an emission source, i.e. the points of measurement, frequency of measurements, equipment used, calibration procedures and data collection and storage procedures (if applicable);
- a description of the quality assurance and quality control procedures for data management;
- where applicable, information on relevant links with activities undertaken under the Community eco-management and audit scheme (EMAS) and other environmental management systems (e.g. ISO14001).

The monitoring methodology shall be changed if this improves the accuracy of the reported data, unless this is technically not feasible or will lead to unreasonably high costs. All proposed changes in monitoring methodologies or the underlying data sets shall be clearly stated, justified, fully documented and submitted to the competent authority. All changes in methodologies or the underlying data sets shall be subject to approval from the competent authority.

The operator shall without undue delay propose changes to the monitoring methodology when:

- accessible data has changed, allowing for higher accuracy in the determination of emissions;
- a previously non-existent emission has started;
- errors were detected in data resulting from the monitoring methodology;
- the competent authority has requested a change.

A competent authority may require the operator to change its monitoring methodology for the next reporting period if the reporting installation's monitoring methodologies are no longer in conformity with the rules laid down in these guidelines. A competent authority may also require the operator to change its monitoring methodology for the next reporting period if the monitoring methodology under the permit has been updated in accordance with a review to be undertaken before each period referred to in Article 11(2) of the Directive.

4.2.2 Calculation

4.2.2.15: Calculation based methodologies for ~~of~~ CO₂-emissions

4.2.2.1.5.1 Calculation formulae

Calculation of CO₂ emissions shall be based either on the following formula:

$$\text{CO}_2\text{-emissions} = \text{activity data} * \text{emission factor} * \text{oxidation factor}$$

or on an alternative approach if defined in the activity-specific guidelines.

The expressions within this formula are specified for combustion emission and process emissions as follows:

Combustion emissions:

Activity data shall be based on fuel consumption. The quantity of fuel used shall be expressed in terms of energy content as TJ. The emission factor shall be expressed as tCO₂/TJ. When energy is consumed not all of the carbon in the fuel oxidises to CO₂. Incomplete oxidation occurs due to inefficiencies in the combustion process that leave some of the carbon unburned or partly oxidised as soot or ash. Un-oxidised carbon is taken into account in the oxidation factor which shall be expressed as a fraction. In the event that the oxidation factor is taken into account in the emission factor, a separate oxidation factor shall not be applied. The oxidation factor shall be expressed as a percentage. The resulting calculation formula is:

$$\text{CO}_2 \text{ emissions} = \text{fuel consumption [t or Nm}^3] * \text{Net calorific value [TJ/t or TJ/Nm}^3] * \text{emission factor [tCO}_2\text{/TJ]} * \text{oxidation factor}$$

The calculation of combustion emissions is further specified in Annex II.

Process emissions:

Activity data shall be based on material consumption, throughput or production output and expressed in t or Nm³. The emission factor shall be expressed in [t CO₂/ t or t CO₂/ Nm³]. Carbon contained in input materials which is not converted to CO₂ during the process, is taken into account in the conversion factor which shall be expressed as a fraction. In the event that a conversion factor is taken into account in the emission factor, a separate conversion factor shall not be applied. The quantity of input material used shall be expressed in terms of mass or volume [t or Nm³]. The resulting calculation formula is:

$$\text{CO}_2 \text{ emissions} = \text{activity data [t or Nm}^3] * \text{emission factor [t CO}_2\text{/ t o Nm}^3] * \text{conversion factor}$$

~~Where conversion is accounted for in the emission factor, no conversion factor shall be used.~~

The calculation of process emissions is further specified in the activity-specific guidelines in the Annexes II-XI.

4.2.2.1.45.2 Tiers of approaches

Section 173 of this annex contains exemptions from the requirements of this section for installations with average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period.

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The activity-specific guidelines set out in Annexes II to XI contain specific methodologies for determining the following variables: activity data (consisting of the two variables fuel/material flow and net calorific value), emission factors, composition data, oxidation and conversion factors. These different approaches are referred to as tiers. The increasing

numbering of tiers from 1 upwards reflects increasing levels of accuracy, with the highest numbered tier as the preferred tier. Equivalent tiers are referred to with the same tier number and a specific alphabetic character (e.g.: Tier 2a and 2b). For those activities where alternative calculation methods are provided within these Guidelines (e.g. in Annex VII: “Method A – Carbonates” and “Method B - Clinker Production”) an operator may only change from one method to the other if he can demonstrate to the satisfaction of the competent authority that such change will lead to a more accurate monitoring and reporting of the emissions of the relevant activity.

The highest tier approach shall be used by all operators to determine all variables for all emission sources and/or source streams within the installation with the following exceptions of:

- of what these guidelines define as commercial standard fuels
- minor source streams and de-minimis source streams,
- pure biomass,
- what these guidelines define as commercial standard fuel,
- additional exceptions specified in Annex II to XII.

Only if it is shown to the satisfaction of the competent authority that the highest tier approach is technically not feasible or will lead to unreasonably high costs, may a next lower tier be used for that variable within a monitoring methodology. Where exceptions from the obligation to apply the highest tier approach provisions can be made, this is indicated in the in the respective sections of Annex II XI

Therefore, the selected tier shall reflect the highest level of accuracy that is technically feasible and does not lead to unreasonably high costs. The operator may apply different approved tier levels to the different variables fuel/material flow, net calorific value, emission factors, composition data, oxidation or conversion factors used within a single calculation. The choice of tiers shall be subject to approval by the competent authority (see section 4.32).

Member States ~~shall~~ apply as a minimum the tiers as set out in table 1 below unless this technically not feasible or the installation had average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period. Columns A contain tier values for all “major source streams” from installations with total annual emissions equal to or less than 50 ktonnes. Columns B contains tier values for all “major source streams” from installations with total annual emissions of more than 50 ktonnes but less than and including 500 ktonnes. Columns C contains tier values for all “major source streams” from installations with total annual emissions of more than 500 ktonnes.

The size thresholds contained in the table refers to total annual emissions from the entire installation:

With the approval of the competent authority, tThe operator may apply lower tiers for the variables used to calculate emissions from minor source streams, including minor streams of fuels or materials than the tiers applied for the variables used to calculate emissions from major source streams within an installation. Major source streams, are those which, if ranked

~~in order of their decreasing magnitude, cumulatively contribute at least 90% to the total annual emissions of the installation.~~ Minor source streams are those selected by the operator to jointly emitting 2 up to 5 ktonnes CO₂ or less per year or that to contribute less than 10+0% (up to a total maximum contribution of 100 ktonnes CO₂ per year), or less to the total annual emissions of an installation, whichever is the highest in terms of absolute emissions. For those minor source streams jointly emitting 1 ktonnes CO₂ or less per year or that contribute less than 2% (up to a total maximum contribution of 20 ktonnes CO₂ per year) of total annual emissions of that installation, whichever is the highest in terms of absolute emissions, the operator of an installation may apply a “de minimis” approach for monitoring and reporting using his own no-tier estimation method, subject to the approval of the competent authority. Such source streams are referred to as “de-minimis source streams”.

The thresholds given in table 1 and in the definition of minor sources and de-minimis sources refer to total annual emissions of CO₂ from the entire installation before subtraction of transferred CO₂ and excluding biogenic CO₂.

The activity data of pure biomass fuel and materials may be determined using no-tier approaches, including the energy balance method for installations deriving more than 97% of their energy input from pure biomass, may be applied unless the respective calculated emissions are to be used for the subtraction of biomass carbon from carbon dioxide emissions derived by means of continuous emission measurement. Potential fossil contaminants to a source stream qualifying as pure biomass as defined by these guidelines are to be determined estimated applying no-tier approaches and reported as a separate and additional source stream.

The operator shall without undue delay propose changes to the tiers applied when:

- accessible data has changed, allowing for higher accuracy in the determination of emissions;
- errors were detected in data resulting from the monitoring methodology;
- the competent authority has requested a change.

For installations with ~~emissions of a total~~ of more than 500 ktonnes of ~~annual fossil CO₂ annually equivalent emissions~~ the competent authority shall notify the Commission by 30 September of each year, if the application of a combination of highest tier approaches for major sources streams within that installation for the forthcoming reporting period is found to be technically not feasible or is expected to lead to unreasonably high costs. On the basis of this information received from competent authorities, the Commission will consider whether a revision of the rules on the selection of tiers is appropriate.

If the highest tier methodology, or the variable-specific agreed tier is temporarily not feasible for technical reasons an operator may apply the highest achievable tier until such time as the conditions for application of the former tier have been restored. The operator shall without undue delay provide proof of the necessity for a change of tiers to the competent authority and details of the interim monitoring methodology. The operator shall take all necessary action to allow the prompt restoration of the original tier for monitoring and reporting purposes.

Changes of tiers shall be fully documented. The treatment of minor data gaps which result from downtimes of metering equipment shall follow good professional practice and the provisions of the Integrated Pollution Prevention and Control (IPPC) Reference Document on

the General Principles of Monitoring of July 2003.¹ When tiers are changed within a reporting period the results for the affected activity shall be calculated and reported as separate sections of the annual report to the competent authority for the respective parts of the reporting period.

¹ Available through: <http://eippcb.jrc.es/>

Table 1: Minimum Requirements

Column A: total annual emissions of the installation <=50 ktonnes of fossil CO₂

Column B: 50 ktonnes<total annual emissions of the installation <=500 ktonnes of fossil CO₂

Column C: total annual emissions of the installation >500 ktonnes of fossil CO₂

Annex/Activity	<u>FlowActivityFuel/Material Flow-Data</u>			Net Calorific Value			Emission Factor			Composition Data			Oxidation-Factor			Conversion-Factor		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
II: Combustion														-	-	-	-	-
<u>Commercial standard fuelsCommercial-fuels</u>	<u>2a/2b</u>	<u>3</u>	<u>4a/4b</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>						
<u>Other gaseous and liquid fuels</u>				<u>2a/2b²</u>	<u>2a/2b²</u>											<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>
<u>Combustion (gaseous, liquid)</u>	<u>2a/2b</u>	<u>3a/3b</u>	<u>4a/4b</u>			<u>3</u>	<u>2a/2b</u>	<u>2a/2b</u>	<u>3</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>+</u>	<u>+</u>	<u>+</u>			
<u>Other solid fuels Combustion (solid)</u>	<u>1</u>	<u>2a/2b</u>	<u>3a/3b</u>	<u>2a/2b²</u>	<u>3</u>	<u>3</u>	<u>2a/2b</u>	<u>3</u>	<u>3</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>+</u>	<u>2₁</u>	<u>2₁</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>
Flares	<u>1₂</u>	<u>2₃</u>	<u>3₃</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>2a/b</u>	<u>2a/b²</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>+</u>	<u>+</u>	<u>+</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>
Scrubbing Carbonate	<u>1</u>	<u>1</u>	<u>1</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>+</u>	<u>+</u>	<u>+</u>
Gypsum	<u>1</u>	<u>1</u>	<u>1</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>+</u>	<u>+</u>	<u>+</u>

	<u>Material Flow</u> Activity Data			Net Calorific Value			Emission Factor			Composition Data			<u>Conversion Factor</u>		
	A	B	C	A	B	C	A	B	C	A	B	C			
III: Refineries															
Mass balance	4	4	4	†	†	†	n.a.	n.a.	n.a.	†	†	†	n.a.	n.a.	n.a.
Catalytic Cracker Regen.	†	2	2	n.a.	n.a.	n.a.	†	†	†	n.a.	n.a.	n.a.	†	†	†
Cokers	†	2	2	n.a.	n.a.	n.a.	†	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hydrogen Production	1	2	2	n.a.	n.a.	n.a.	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IV: Coke Ovens															
Mass balance	<u>13</u>	<u>32</u>	3	1	<u>12</u>	<u>31</u>	n.a.	n.a.	n.a.	1	<u>2†</u>	<u>2†</u>	n.a.	n.a.	n.a.
Fuel as process input	<u>12</u>	2	3	2	2	3	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
V: MO Roasting & Sintering															
Mass balance	<u>12</u>	<u>22</u>	3	1	<u>12</u>	<u>31</u>	n.a.	n.a.	n.a.	1	<u>2†</u>	<u>2†</u>	n.a.	n.a.	n.a.
Carbonate Input	1	1	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	1	1	1
VI: Iron & Steel															
Mass balance	<u>21</u>	2	3	1	<u>2†</u>	<u>3†</u>	n.a.	n.a.	n.a.	1	<u>2†</u>	<u>2†</u>	n.a.	n.a.	n.a.
Fuel as process input	<u>12</u>	2	3	2	2	3	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

	<u>Material Flow Activity Data</u>			Net Calorific Value			Emission Factor			Composition Data			<u>Conversion Factor</u>		
	A	B	C	A	B	C	A	B	C	A	B	C			
VII: Cement															
Carbonates Kiln Input Based	1	<u>12</u>	<u>22</u>	n.a.	n.a.	n.a.	1	<u>21</u>	<u>21</u>	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
Clinker Output	1	<u>2a/21b</u>	<u>2a/2b</u>	n.a.	n.a.	n.a.	1	2	2	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
CKD	1	<u>12</u>	2	n.a.	n.a.	n.a.	1	2	2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Non-Carbonate Carbon	<u>1</u>	<u>1</u>	<u>2</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>1</u>
VIII: Lime															
Carbonates	1	1	2	n.a.	n.a.	n.a.	1	<u>11</u>	<u>12</u>	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
Alkali Earth Oxide	1	1	2	n.a.	n.a.	n.a.	1	<u>14</u>	<u>21</u>	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
IX: Glass															
Carbonates	1	<u>12</u>	2	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
Alkali Oxide	<u>1</u>	<u>2</u>	<u>2</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>n.a.</u>	<u>n.a.</u>	<u>n.a.</u>	<u>1</u>	<u>1</u>	<u>1</u>
X: Ceramic															
Carbon Inputsates	1	<u>12</u>	2	n.a.	n.a.	n.a.	1	1	<u>21</u>	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
Alkali Oxide	1	<u>12</u>	2	n.a.	n.a.	n.a.	1	1	<u>12</u>	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
Scrubbing	1	<u>12</u>	<u>12</u>	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	<u>n.a.†</u>	<u>n.a.†</u>	<u>n.a.†</u>
XI: Pulp & Paper															
Standard Method	1	<u>12</u>	<u>12</u>	n.a.	n.a.	n.a.	1	1	1	n.a.	n.a.	n.a.	<u>1</u>	<u>1</u>	<u>1</u>

In cases in which after application of the de-minimis approach based on estimation source streams remain for which it is technically not feasible to apply even the lowest tier, the operator shall demonstrate to the competent authority that by applying an alternative monitoring methodology for the whole installation which is to be documented in detail and to be approved by the competent authority, the overall uncertainty thresholds given in Table 2 for the annual level of greenhouse gas emissions for the whole installation are met. Table 2 does not apply for installations determining their greenhouse gas emissions using continuous emission monitoring systems applying Annex XII.

Table 2 - Fall-Back Overall Uncertainty Thresholds

<u>Total annual emissions (E) of fossil CO₂ from the installation</u>	<u>Uncertainty threshold to be met for total annual emission value</u>
<u>E <=50 ktonnes</u>	<u>± 7.5 %</u>
<u>50 ktonnes < E <=500 ktonnes</u>	<u>± 5.0 %</u>
<u>E > 500 ktonnes</u>	<u>± 2.5 %</u>

4.2.2.1.55.3 Activity data

Activity data represents information on material flow, consumption of fuel, input material or production output expressed as energy content [TJ] (in exceptional cases also as mass or volume [t or Nm³], see section 5.4)~~determined as net calorific value for in the case of~~ fuels and mass or volume ~~for in the case of~~ input or output materials [t or Nm³Nm³].

Where activity data for the calculation of process emissions cannot be measured directly before entering the process and no specific requirements are listed in any of the tiers of the respective activity specific guidelines (Annex II-XI), activity data shall be determined via an assessment of stock changes:

$$\text{Material C} = \text{Material P} + (\text{Material S} - \text{Material E}) - \text{Material O}$$

where:

- Material C: Material processed during the reporting period
- Material P: Material purchased during the reporting period
- Material S: Material stock at the beginning of the reporting period
- Material E: Material stock at the end of the reporting period
- Material O: Material used for other purposes (transportation or re-sold)

In cases in which it is technically not feasible or would lead to unreasonably high costs to determine “Material S” and “Material E” by measurement e.g. metering, the operator may estimate these two quantities based on data from previous years and correlation with output for the reporting period. The operator shall then corroborate these estimates with supporting

documented calculations and respective financial statements. All other requirements on tier selection shall remain unaffected by this provision, e.g. “Material P” and “Material O” and respective emission or oxidation factors shall be determined according to the activity specific guidelines in Annex II-XI.

To assist the selection of appropriate tiers for activity data table 32 below gives an overview of ranges of typical uncertainties found for different types of [measurement instruments devices](#) used to determine mass fluxes of fuels, material flow, input materials or production output. The table may be used to inform competent authorities and operators about the possibilities and limitations for applying appropriate tiers for the determination of activity data.

Table 32 Informative table with the uncertainty ranges typically found for different [measurement instruments metering devices](#) under stable operating conditions

Measurement instruments Metering Device	Media	Field of application	Range of typical uncertainties
Orifice meter	gas	various gases	± 1-3 %
Venturi tube meter	gas	various gases	± 1-3 %
Ultra sonic flow meter	gas	natural gas / miscellaneous gases	± 0.5 – 1.5 %
Rotary meter	gas	natural gas / miscellaneous gases	± 1-3 %
Turbine meter	gas	natural gas / miscellaneous gases	± 1-3 %
Ultra sonic flow meter	liquid	liquid fuels	± 1-2 %
Magnetic inductive meter	liquid	conductive fluids	± 0.5-2 %
Turbine meter	liquid	liquid fuels	± 0.5-2 %
Truck scale	solid	miscellaneous raw materials	± 2-7 %
Rail scale (trains - moving)	solid	coal	± 1-3 %
Rail scale (single car)	solid	coal	± 0.5-1.0 %
Ship – river (displacement)	solid	coal	± 0.5-1.0 %
Ship – ocean (displacement)	solid	coal	± 0.5-1.5 %
Belt scale with integrator	solid	miscellaneous raw materials	± 1-4 %

Emission factors are based on the carbon content of fuels or input materials and expressed as tCO₂/TJ (combustion emissions), or tCO₂/t or tCO₂/Nm³ (process emissions). Emission factors and provisions for the development of activity-specific emission factors are given in section ~~8-12~~ and ~~4014~~ of this Annex. An operator may use an emission factor for a fuel expressed as ~~carbon content (tCO₂/t)~~ rather than tCO₂/TJ for combustion emissions if he demonstrates to the competent authority that this leads to a permanently higher accuracy. In this case the operator shall nevertheless periodically - minimum 6 times a year - determine the energy content to meet his reporting requirements as specified in section ~~105~~ of this Annex.

For the conversion of carbon into the respective value for CO₂ the factor² of 3.667 [t CO₂/t C] shall be used.

CO₂ being moved into an installation under the EU-ETS as part of a fuel (e.g. blast furnace gas, coke oven gas or natural gas) shall be included in the emission factor for that fuel. Thereby, it shall be added to the emissions of the installation where the fuel is combusted and deducted from the installation of origin.

Accordingly, CO₂ moved out of an installation under the EU-ETS as part of a fuel (e.g. blast furnace gas, coke oven gas, natural gas or refinery gas) shall not be added to the emissions of that installation - independently of whether it is supplied to another EU-ETS installation or not. In any case, it shall be reported as a memo-item "admixed exported CO₂".

The more accurate tiers require the development of activity specific factors in accordance with the requirements contained in section ~~4014~~ of this Annex. The tier 1 approaches require the use of reference emission factors, which are listed in section ~~8-12~~ of this Annex.

Biomass is considered as CO₂-neutral. An emission factor of 0 [t CO₂/TJ or t or Nm³] shall be applied to biomass. An exemplary list of different types of materials accepted as biomass is given in section ~~9-13~~ of this Annex.

For fossil waste fuels no reference emission factors are provided in these guidelines, therefore specific emission factors shall be derived according to the provisions of section ~~4014~~ of this Annex.

For fuels or materials containing both fossil and biomass carbon, a weighted emission factor shall be applied, based on the proportion of the fossil carbon in the fuel's overall carbon content. This calculation shall be transparent and documented in accordance with the rules and procedures of section ~~4014~~ of this Annex.

All relevant information regarding the emission factors used, including information sources and results of analyses of fuel, input and output material shall be clearly recorded. More detailed requirements are set out in the activity-specific guidelines.

4.2.2.1.75.5 Oxidation and conversion factors

If an emission factor does not reflect the proportion of the carbon that is not oxidised or converted in the process, then an additional oxidation factor (for combustion emissions) respectively conversion factor (for process emissions) shall be used. ~~Annexes II-XI do not contain conversion factors, as conversion factors were equal to 1 or were reflected by the emission factor and are thus left out for practical reasons.~~

² Based on the ratio of atomic masses of carbon (12) and oxygen (16) as used in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, 1.13.

For oxidation factors the use of the highest tier-level is optional, only use of the lowest tier level is required. ~~These more accurate tiers require the development of activity specific factors, therefore provisions for deriving these factors are set out in section 10 of this Annex.~~

If different fuels or material are used within an installation and activity specific oxidation factors are calculated, the operator may determine one aggregate oxidation factor for the activity and apply it to all fuels or material, or attribute incomplete oxidation to one major stream of fuel or material and use a value of 1 for the others.

All relevant information regarding the oxidation/conversion factors used, including information sources and results of analyses of fuel, input and output material, shall be clearly recorded.

4.2.2.1.2-5.6 Transferred CO₂

Subject to approval by the competent authority, the operator may subtract from the calculated level of emissions of the installation any CO₂ which is not emitted from the installation but transferred out of the installation as a pure substance, as a component of fuels or and directly used in products or as a feedstock in the chemical or paper industry, shall be subtracted from the calculated level of emissions provided this is mirrored by a respective reduction for the activity and installation which the respective Member State will report in its next national inventory submission to the Secretariat of the United Nations Framework Convention on Climate Change. The respective amount of CO₂ shall be reported as a memo item.

CO₂ that is transferred out of the installation for the following uses may be considered as transferred CO₂:

- pure CO₂ used for the carbonation of beverages;
- pure CO₂ used as dry ice for cooling purposes;
- pure CO₂ used as fire extinguishing agent, refrigerant or as laboratory gas;
- pure CO₂ used for grains disinfestations;
- pure CO₂ used as solvent into the food or chemical industry,
- pure CO₂ used as feedstock in the chemical and pulp industry (e.g. for urea or carbonates);

~~–CO₂ which is part of a fuel being exported from that installation.~~

~~CO₂ being transferred to an installation as part of a mixed fuel (such as blast furnace gas or coke oven gas) shall be included in the emission factor for that fuel. Thereby, it shall be added to the emissions of the installation where the fuel is combusted and deducted from the installation of origin.~~

The monitoring requirements for transferred CO₂ shall be those of the highest tier given for fuels used in combustion installations as laid out in section 2.1.1.1 of Annex II of these Guidelines. ~~The respective provisions for the oxidation factor do not apply.~~

4.2.2.1.35.7 CO₂ capture and storage

The Commission is stimulating research into the capture and storage of CO₂. This research will be important for the development and adoption of guidelines on the monitoring and reporting of CO₂ capture and storage, where covered under the Directive, in accordance with the procedure referred to in Article 23(2) of the Directive. Such guidelines will take into account the methodologies developed under the UNFCCC. Member States interested in the development of such guidelines are invited to submit their research findings to the Commission in order to promote the timely adoption of such guidelines.

Before such guidelines are adopted, Member States may submit to the Commission interim guidelines for the monitoring and reporting of the capture and storage of CO₂ where covered under the Directive. Subject to the approval of the Commission, in accordance with the procedures referred to in Article 23(2) of the Directive, the capture and storage of CO₂ may be subtracted from the calculated level of emissions from installations covered under the Directive in accordance with those interim guidelines.

4.2.2.26. Calculation of non-CO₂ greenhouse gas emissions

General guidelines for the calculation of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

4.2.37. Measurement based methodologies for Greenhouse-Gas Emissions

4.2.3.1 Measurement of CO₂ emissions

As set out in section 4.2.1, greenhouse gas emissions may be determined by a measurement based methodology using continuous emission measurement systems (CEMS) from all or selected emission sources using standardized or accepted methods once the operator has received approval from the competent authority before the reporting period that using a CEMS achieves greater accuracy than the calculation of emissions using the most accurate tier approach.

~~Specific approaches for measurement based methodologies are laid down in Annex XII of these guidelines. For each reporting period thereafter, emissions determined using CEMS shall be corroborated by a supporting calculation of emissions, with the rules for the selection of the tiers being the same as those applied for a calculation approach, set out in paragraph 4.2.2.1.4.~~

Measurement of CO₂-concentrations, as well as for the mass or volume flow of off-gases through each stack, shall be according to a standardized method that limits sampling and measurement bias and has a known measurement uncertainty. CEN standards shall be used where available. If CEN standards are not available the following ISO standards shall apply:

- ISO12039:2001 Stationary source emissions – Determination of carbon monoxide, carbon dioxide and oxygen - Performance characteristics and calibration of an automated measuring method.

~~- ISO 10396:2006 ‘Stationary source emission – Sampling for the automated determination of gas concentrations’.~~

~~- ISO 14164: 1999 Stationary source emissions. Determination of the volume flow rate of gas streams in ducts - automated method.~~

~~Measurement procedures for CO₂ concentrations as well as for the mass or volume flow of off-gases through each stack shall use relevant CEN standards as soon as they are available. If CEN standards are not available, ISO standards or national standards shall apply. Where no applicable standards exist, procedures can be carried out where possible in accordance with draft standards or industry best practice guidelines.~~

~~Examples for relevant ISO standards are the following:~~

~~–ISO 10396:1993 “Stationary source emissions—Sampling for the automated determination of gas concentrations”;~~

~~–ISO 10012:2003 “Measurement management systems—Requirements for measurement processes and measuring equipment”.~~

~~–ISO 14181~~

~~–ISO 14956 (oder so..)~~

~~Once the CEMS has been installed it shall be periodically checked for functionality and performance, including:~~

~~–response time;~~

~~–linearity;~~

~~–interference;~~

~~–zero and span drift;~~

~~–its overall uncertainty against a reference method.~~

The biomass fraction of measured CO₂ emissions shall be subtracted based on the calculation approach and shall be reported as a memo item (see section [12-15](#) of this Annex).

Continuous measurement approaches

The following continuous measurement approaches are considered in the provisions of these guidelines:

- In-situ measurement in the stack

- extractive sampling with a measurement instrument located close to the stack.

Non-continuous (“periodic”) measurement approaches based on the collection of samples from the stack shall not be used for the measurement activities required under these guidelines.

Tiers

For the reporting periods 2008-2012 at least Tier 2 in the respective Annexes covering measurement based methodologies shall be applied.

Sampling rates

Hourly averages shall be computed for all elements of the emission determination (as applicable) - as laid out in the respective Annexes to these guidelines - as follows: A valid hour of data shall be computed with all data points available for that specific hour. In case of equipment being out of control or out of operation for part of the hour, the hourly average shall be calculated with the remaining data points for that specific hour. In case a valid hour of data cannot be computed for an element of emission determination, as no data points are available, the hour is lost. For each instance where a valid hour of data cannot be computed, values for substitution according to the provisions of section 7 shall be calculated.

Missing data

Where a valid hour of data cannot be provided for one or more elements of emission calculation due to the equipment being out of control (e.g. in case of calibration or interference errors) or out of operation, the operator shall determine values for substitution for each missing hour of data as shown below.

Concentrations

In case a valid hour of data cannot be provided for a parameter directly measured as concentration (e.g. GHGs, O₂), a substitution value C^*_{subst} [mg/Nm^3] for that hour shall be calculated as follows:

$$C^*_{subst} = \bar{C}_{subst} + \sigma_{C_{subst}}$$

with

\bar{C}_{subst} the arithmetic mean of the concentration of the specific parameter,

$\sigma_{C_{subst}}$ the standard deviation of the concentration of the specific parameter.

Arithmetic mean and standard deviation are to be calculated at the end of the reporting period from the whole set of emission data measured during the reporting period. If such a period is not applicable due to essential technical changes at the installation, an representative timeframe, if possible with a duration of 1 year, shall be agreed with the competent authority.

The calculation of arithmetic mean and standard deviation shall be presented to the verifier.

Other parameters

In case a valid hour of data cannot be provided for the parameters not directly measured as concentrations, substitute values of these parameters shall be obtained through a mass balance model of the production process. The remaining measured elements of emission calculation shall be used to validate the results.

The mass balance model and underlying assumptions shall be clearly documented and presented to the verifier together with the calculated results.

Corroborating Calculation of emissions

Parallel to emission determination by a measurement based methodology, annual emissions of each considered GHG shall be determined by calculation based on one of the following options:

- a) Calculation of emissions as laid down in the respective Annexes for the respective activities. For the calculation of emissions, lower tiers can generally be applied or
- b) Calculation of emission as laid down in the 2006 IPCC Guidelines, e.g. Tier 1 methods may be used.

Deviations between the results from the measurement and the calculation approach can occur. The operator shall explore the correlation between results from the measurement and the calculation approach, taking into account that a generic deviation resulting from the two different approaches might exist. Taking this correlation into account, the operator shall use the results of the calculation approach to cross-check results from the measurement approach.

Where comparison with results of the calculation approach indicates that results of the measurement approach are not valid, the operator shall use substitution values as described under this section.

4.2.3.2 Measurement of non-CO₂ emissions

~~General guidelines for the measurement of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.~~

4.38 Uncertainty Assessment

~~“Permissible uncertainty” within these Guidelines shall be expressed as the 95% confidence interval around the measured value, e.g. when characterising metering equipment for the tier system or the accuracy of a continuous measurement system.~~

8.14.3.1 Calculation

Section 173 of this annex contains exemptions from the requirements of this section for installations with average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period.

The operator shall have an understanding of ~~the impact~~main sources of uncertainty when calculating emissions. ~~on the overall accuracy of his reported emission data.~~

Under the calculation based methodology, the competent authority will have approved the combination of tiers for each source stream in an installation plus approved all other details of the monitoring methodology for that installation as contained within the installation's permit. In doing so, the competent authority has authorised the uncertainty directly resulting from correct application of the approved monitoring methodology, and the evidence of that approval is the content of the permit.

~~The operator shall state the approved combination of tiers for each source stream in an installation in his annual emissions report to the competent authority for each activity and relevant stream of fuel or material.~~ Stating the combination of tiers in the emissions report shall constitute reporting uncertainty for the purposes of the Directive. Hence there is no further requirement to report on uncertainty if the calculation based methodology is applied.

The ~~permissible~~ uncertainty determined for metering equipment within the tier system shall comprise the specified uncertainty of the applied measurement instruments ~~metering equipment~~, uncertainty associated to the calibration and any additional uncertainty connected to how the metering equipment is used in practice. The stated threshold values within the tier system refer to the uncertainty associated to the value for one reporting period.

Competent authorities may permit in specific situations the determination of the annual fuel/material flow (expressed in tons) by the operator based solely on the invoiced amount of fuel or material without further individual proof of associated uncertainties. This shall be restricted to those fuels and materials of specified composition which are frequently and freely traded between several different, and commonly economically independent suppliers and consumers including inter alia natural gas, light and heavy fuel oil, coal, petroleum coke, lime, cement clinker and excludes, inter alia, unprocessed lime stone, dolomite or clay as well as coke oven gas and blast furnace gas;

If this provision is not met, and for all other fuels and materials the operator shall estimate the uncertainty of the annual activity data for each source stream in order to demonstrate compliance with the uncertainty thresholds defined in Annexes II-XI of these guidelines. The calculation of uncertainty shall be documented and be made available on request to the verifier or the competent authority. The operator shall base the calculation on the specifications as provided by the supplier of the measurement instruments. He shall take into account necessary corrections of these specifications from effects resulting from the actual use conditions like ageing, conditions of the physical environment, calibration and maintenance. These corrections may involve conservative expert judgement.

If measurement systems are applied, the operator shall take into account the cumulative effect of all components of the measurement system on the uncertainty of the annual activity data using the error propagation law³ which yields two convenient rules for combining uncorrelated uncertainties under addition and multiplication:

a) Uncertainty of a sum (e.g. of individual contributions to an annual value):

$$U_{\text{total}} = \frac{\sqrt{(U_1 \cdot x_1)^2 + (U_2 \cdot x_2)^2 + \dots + (U_n \cdot x_n)^2}}{|x_1 + x_2 + \dots + x_n|}$$

³ As discussed more extensively in Annex 1 of the 2000 Good Practice Guidance, and in Annex I of the Revised 1996 IPCC Guidelines (Reporting Instructions)-: <http://www.ipcc-nggip.iges.or.jp/public/public.htm>

Where:

U_{total} is the percentage uncertainty in the sum of the

x_i and U_i are the uncertain quantities and the percentage uncertainties associated with them, respectively.

b) Uncertainty of a product (e.g. of different parameters used to convert a meter reading into mass flow data):

$$U_{\text{total}} = \sqrt{U_1^2 + U_2^2 + \dots + U_n^2}$$

Where:

U_{total} is the percentage uncertainty in the product of the quantities divided by the total and expressed as a percentage);

U_i are the percentage uncertainties associated with each of the quantities.

The operator, via the quality assurance and control process, shall manage and reduce the remaining uncertainties of the emissions data in his emissions report. During the verification process, the verifier shall check the correct application of the approved monitoring methodology, and shall assess the management and reduction of remaining uncertainties via the operator's quality assurance and control procedures.

4.38.2 Measurement

As set out in section 4.2.1, an operator can justify the use of a measurement based methodology if it reliably results in gives higher accuracy a lower uncertainty than the relevant calculation based methodology applying a combination of the highest tiers. In order to provide this justification to the competent authority, the operator shall report the quantitative results of a more comprehensive uncertainty analysis considering the following sources of uncertainty.

Concentration measurements for the continuous emission measurement:

- the specified uncertainty of continuous measurement equipment;
- uncertainties associated to the calibration;
- additional uncertainty connected to how the monitoring equipment is used in practice.

In mass and volume metering for the determination of the waste gas stream for the continuous emission monitoring and the corroborating calculation:

- ~~–the specified uncertainty of metering equipment;~~
- ~~–uncertainties associated to the calibration;~~

- ~~additional uncertainty connected to how the metering equipment is used in practice.~~

~~In the determination of the calorific values, emission and oxidation factors or composition data for the corroborating calculation:~~

- ~~the specified uncertainty from the applied calculation method or system;~~
- ~~additional uncertainty connected to how the calculation method is used in practice.~~

On the basis of the operator's justification, the competent authority may approve the operator's use of a continuous emission measurement system for selected or all certain emission sources, in an installation plus approve all other details of the monitoring methodology for those emission sources, as to be contained within the installation's permit. In doing so, the competent authority has authorised the uncertainty directly resulting from correct application of the approved monitoring methodology, and the evidence of that approval is the content of the permit.

The operator shall state the uncertainty figure resulting from this initial comprehensive uncertainty analysis in his annual emissions report to the competent authority for the relevant sources and source streams, until such point that the competent authority reviews the choice of measurement over calculation and requests that the uncertainty figure be re-calculated. Stating this uncertainty figure in the emissions report shall constitute reporting uncertainty for the purposes of the Directive.

The operator, via the quality assurance and control process, shall manage and reduce the remaining uncertainties of the emissions data in his emissions report. During the verification process, the verifier shall check the correct application of the approved monitoring methodology, and shall assess the management and reduction of remaining uncertainties via the operator's quality assurance and control procedures.

~~4.3.3 Illustrative uncertainty figures~~

~~Table 3 gives an indicative overview of overall uncertainty typically achievable with respect to determination of CO₂ emissions from installations of different magnitudes of emissions levels. The information in this table should be considered by the competent authority when evaluating or approving the monitoring methodology of a given installation using calculation methods or using continuous emissions measurement systems.~~

~~**Table 3: Informative table with typical overall uncertainties associated to the determination of CO₂ emissions from an installation or activity in an installation for individual fuel or material streams of different magnitudes**~~

Description	Examples	E : CO ₂ -emission in ktonnes per year		
		E > 500	100 < E < 500	E < 100
gaseous and liquid fuels with constant quality	natural gas	2.5%	3.5%	5%
liquid fuels and gaseous fuels with varying	Gas oil; blast furnace gas	3.5%	5%	10%

composition				
solid fuels with varying composition	coal	3%	5%	10%
solid fuels with strongly varying composition	waste	5%	10%	12.5%
process emissions from solid raw materials	limestone, dolomite	5%	7.5%	10%

59. Reporting

Annex IV to the Directive sets out the reporting requirements for installations. The reporting format set out in section 4.15 of this Annex [and the information required therein](#) shall be used as a basis for reporting of the quantitative data. The report shall be verified in accordance with the detailed requirements established by the Member State pursuant to Annex V to the Directive. The operator shall submit the verified report to the competent authority by 31 March each year for emissions during the preceding year.

Emission reports held by the competent authority shall be made available to the public by that authority subject to the rules laid down in Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC.⁴ With regards to the application of the exception laid down in Article 4 (2) (d) of that Directive, operators may indicate in their report which information they consider commercially sensitive.

Each operator shall include the following information in the report for an installation:

- (1) Data identifying the installation, as specified in Annex IV to the Directive, and its unique permit number;
- (2) For all emissions sources [and/or](#) source streams the emission totals, chosen approach (measurement or calculation), chosen tiers and method (if applicable), activity data⁵, emission factors⁶, and oxidation/conversion factors⁷. If a mass balance is applied operators shall report the mass flow, carbon and energy content for each fuel and material stream into and out of the installation and their stocks;
- (3) Temporal or permanent changes of tiers, reasons for these changes, starting date for changes, and starting and ending dates of temporal changes;
- (4) Any other changes in the installation during the reporting period that may be relevant for the emissions report.

Information to be provided under (3) and (4) and supplementary information regarding (2) is not suitable for presentation in the tabulated form of the reporting format and shall therefore be included in the annual emission report as plain text.

The following items, which are not accounted for in terms of emissions, shall be reported as memo items:

- amounts of biomass combusted [TJ] or employed in processes [t or Nm³];
- CO₂ emissions [t CO₂] from biomass where measurement is used to determine emissions;
- CO₂ transferred from an installation [t CO₂] , and in what type of compounds it was transferred.

⁴ OJ L 041 of 14.02.2003, p. 26.

⁵ Activity data for combustion activities shall be reported as energy (net calorific value) and mass. Biomass fuels or input materials also have to be reported as activity data.

⁶ Emission factors for combustion activities shall be reported as CO₂ emission per energy content.

⁷ Conversion and oxidation factors shall be reported as dimensionless fractions.

Fuels and resulting emissions shall be reported using the IPCC standard fuel categories (see section [8-12](#) of this Annex) which are based on the definitions of the International Energy Agency

(<http://www.iea.org/stats/defs/defs.htm>http://www.iea.org/textbase/nppdf/free/2005/statistics_manual.pdf). In the event that the Member State relevant to the operator has published a list of fuel categories including definitions and emission factors consistent with its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change these categories and their emissions factors shall be used if approved under the relevant monitoring methodology.

In addition, waste types and emissions resulting from their use as fuels or input materials shall be reported. The waste types shall be reported using the classification of the "European List of Wastes" (Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste,⁸: (<http://europa.eu.int/comm/environment/waste/legislation/a.htm>). The respective six digit codes shall be added to the names of the relevant waste types used in the installation.

Emissions occurring from different [emission](#) sources or source streams of a single installation belonging to the same type of activity may be reported in an aggregate manner for the type of activity.

Emissions shall be reported as rounded tonnes of CO₂ (for example 1,245,978 tons). Activity data, emission factors and oxidation or conversion factors shall be rounded to include only significant digits both for emission calculations and reporting purposes, for example only a total of five digits (for example 1.2369) for a value which exhibits an uncertainty of $\pm 0.01\%$.

In order to achieve consistency between data reported under the Directive and data reported by Member States under the UN Framework Convention on Climate Change and other emission data reported for the European Pollutant Emission Register (EPER), each activity carried out by an installation shall be labelled applying the codes from the following two reporting schemes:

- (a) the Common Reporting Format for national greenhouse gas inventory systems as approved by the respective bodies of the United Nations Framework Convention on Climate Change (see section [162.1](#) of this Annex);
- (b) the IPCC code of Annex A3 of the European Pollutant Emission Register (EPER) (see section [162.2 of this Annex below](#)).

⁸ OJ L 226 of 06.09.2000, p.3. Most recently amended by Council Decision 2001/573/EC (OJ L 203 of 28.07.2001, p.18).

106. Retention of information

An operator of an installation shall document and archive monitoring data for the installation's emissions from all emission sources and/or source streams belonging to activities listed in Annex I to the Directive of greenhouse gases specified in relation to those activities.

The documented and archived monitoring data shall be sufficient to allow for the verification of the annual emissions report of an installation's emissions submitted by the operator pursuant to Article 14(3) to the Directive, in accordance with the criteria set out in Annex V to the Directive.

Data that are not part of the annual emissions report shall not be required to be reported or made public otherwise.

To allow reproducibility of the determination of emissions by the verifier or another third party, an operator of an installation shall retain for at least ten years after the submission of the report pursuant to Article 14(3) of the Directive for each reporting year:

For ~~the~~ calculation based methodologies: approach:

- the list of all emission source and/or source streams monitored;
- the activity data used for any calculation of the emissions for each source stream, categorised by process and fuel or material type;
- documents justifying the selection of the monitoring methodology and the documents justifying temporal or non-temporal changes of monitoring methodologies and tiers approved by the competent authority;
- documentation of the monitoring methodology and results from the development of activity specific emission factors and biomass fractions for specific fuels, and oxidation or conversion factors, and respective proofs of approval from the competent authority;
- documentation of the process of collection of activity data for the installation and its source streams;
- the activity data, emission, oxidation or conversion factors submitted to the competent authority for the national allocation plan for years preceding the time period covered by the trading scheme;
- documentation of the responsibilities in connection to the emissions monitoring;
- the annual emissions report; and
- any other information that is identified as required for the verification of the annual emissions report.

The following additional information shall be retained ~~if the~~for measurement based approach ~~is applied~~methodologies:

- documentation justifying the selection of a measurement based methodology as a monitoring methodology;
- the data used for the uncertainty analysis of emissions from each emission source of greenhouse gases, categorised by process;
- a detailed technical description of the continuous measurement system including the documentation of the approval from the competent authority;
- raw and aggregated data from the continuous measurement system, including documentation of changes over time, the log-book on tests, down-times, calibrations, servicing and maintenance;
- documentation of any changes of the continuous measuring system.

711. Quality assurance and control**Control and verification**

711.1 Data acquisition and handling

The operator shall establish, document, implement and maintain effective data acquisition and handling activities for the monitoring and reporting of greenhouse gas emissions in accordance with these guidelines. The data acquisition and handling activities include measuring, monitoring, analyzing, recording, processing and calculating parameters in order to be able to report on the GHG emissions.

117.2 Control system

The operator shall establish, document, implement and maintain an effective control system to ensure that the annual emissions report, as produced by the data acquisition and handling activities, does not contain errors, misrepresentations or omissions and complies with these guidelines as well as the approved monitoring plan.

The operator's control system is made up of the processes aimed at effective reporting as designed and implemented by those in charge of annual emissions reporting. The control system consists of the following components:

(a) The control environment, which includes the governance and management functions, and the attitudes, awareness and actions of those charged with governance and management concerning the operator's internal control

(b) The operator's own assessment process of inherent and control risks to errors, misrepresentations or omissions in the annual emissions report, and non compliance with these guidelines, and the monitoring plan

(c) Control activities that help to mitigate the identified risks.

(d) Evaluation and improvement of controls, assessing the effectiveness of the control system over time

The control system shall be described completely and transparently in the monitoring plan.

The operator shall, considering the general control environment of the installation, assess the inherent risks in the data handling and acquisition activities to be able to define adequate control activities and to be able to define adequate evaluation and improvement of the control activities.

The control system may make reference to other procedures and documents, including those in management systems EU Eco-Management and Audit Scheme (EMAS), ISO 14001:2004 ("Environmental management systems - Specification with guidance for use"), ISO 9001:2000, and financial control systems. When such a reference has been made, the operator shall ensure that the requirements in these guidelines are arranged for in the applicable system.

117.3 Control activities

The operator shall identify and implement control activities as described in this section in order to mitigate the inherent and control risks.

The operator shall assign responsibilities to all data acquisition and handling activities and to all control activities. Conflicting duties shall be segregated, including handling and control activities.

The operator shall assign sufficient competent staff to the data acquisitions and handling activities as well as to the control activities. The operator shall instruct and train this staff timely.

The operator shall document the data acquisition and handling activities and control activities in written procedures. The procedure shall include for each activity:

- o responsibilities
- o records (IT or physical)
- o information systems used
- o input and output, and clear linkage with previous and next activity
- o frequency

The remainder of this section provides a minimum of control activities that shall be identified by the operator as a response to his risk assessment as described above.

Quality Assurance of measuring techniques and devices and IT

The operator shall ensure that 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. In addition, the operator shall assess and record the validity of the previous measuring results when the equipment is found not to conform to requirements. When the equipment is found not to conform to requirements, the operator shall promptly take necessary remedial action. Records of the results of calibration and authentication shall be retained.

If the operator is working with a continuous emission measurement system, the operator shall comply with the orders of the EN 14181 (“Stationary source emissions – Quality assurance of automated measuring systems”) and of the EN ISO 14956:2002 (“Air quality – Evaluation of the suitability of a measurement procedure by comparison with a required uncertainty”) for the instruments and the operator.

Alternatively, independent and accredited test laboratories may be entrusted with the measurements, evaluation of data, monitoring and reporting. In this case the test laboratories shall in addition be accredited against the EN ISO 17025:2000 (“General requirements for the competence of testing and calibration laboratories”).

If the operator uses IT, the IT shall be designed, tested, implemented, controlled and maintained in order to ensure reliable, accurate and timely data being processed. This includes the proper use of calculation formulas in the monitoring methodology. The control of IT should include access control, back up, recovery, continuity planning and security.

Reviews and validation of data

For all data acquisition and handling activities, the operator shall design and implement appropriate reviews and validation of data. These validations may be either manual or electronically. They should be designed such that boundaries for rejecting the data are clear upfront where possible.

Simple and effective data reviews can be performed at the operational level by comparisons of monitored values using vertical and horizontal approaches.

A vertical approach compares emissions data monitored for the same installation in different years. A monitoring error is likely if differences between annual data cannot be explained by:

- changes in activity levels;
- changes concerning fuels or input material;
- changes concerning the emitting processes (e.g. energy efficiency improvements).

A horizontal approach compares values resulting from different operational data collection systems, including:

- comparison of data on source streams with fuel or material purchasing data and data on stock changes;
- comparison of total data on fuel or input material consumption data with fuel purchasing data and data on stock changes;
- comparison of emission factors that have been calculated or obtained from the fuel supplier, to national or international reference emission factors of comparable fuels;
- comparison of emission factors based on fuel analyses to national or international reference emission factors of comparable fuels;
- comparison of measured and calculated emissions.

Out-sourced processes

Where an operator chooses to out-source any process that may lead to misstatements in data reported, the operator shall control the quality of these processes. The operator shall define appropriate requirements for outputs and methods and review the quality delivered.

Corrections and corrective action

When any device or equipment, staff member, supplier, procedure is found not to function effectively or to function outside set boundaries, the operator shall promptly take necessary remedial action. Rejected data shall be corrected. The operator shall assess the validity of the outputs of the applicable steps, determine the root cause of the malfunctioning or error and take appropriate corrective action.

Records and documentation

The operator shall keep records of all control activities (including responsibilities and competences, QA/QC of equipment and IT, review of data and corrections) and all information listed under section 106 of this annex. These records shall be such that they provide useful input to the evaluation and improvement of the data acquisition and handling as well as the control system.

The operator shall ensure that relevant documents are available when and where they are needed to perform the data acquisition and handling activities as well as the control activities. The operator shall have a procedure to identify, produce, distribute and control the version of these documents.

Evaluation and improvement of the control system

The operator shall evaluate and improve his control system to be in compliance constantly and to ensure the Annual Emissions Report is not material misstated. Therefore, the operator shall design and implement effective procedures for:

- assessment of the performance of the control system on a timely basis, including by
 - internal audits of the control system and on the data reported;
 - assessing records of corrections made;
 - signaling of deviations in execution of the control activities;
 - communicating with the Competent Authority on reported deviations to the approved Monitoring Plan, possibly requesting changes in legal requirements and enforcements
 - signaling other changes relevant to the effective operation of the control system, including changes in the installations, staffing and information systems
 - analysis of all nonconformities and misstatements as reported in no matter what form or time by the verifier
- management evaluations on the assessments
- preventive action to improve the control system.

117.4. Verification

Section 173 of this annex contains exemptions from the requirements of this section for installations with average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period.

711.4.1. General Principles

Pursuant to the Directive, the objective of the verification is to provide a verification opinion with reasonable assurance whether the data in the emissions report is free from uncorrected omissions, misrepresentations or errors that lead to material misstatement of the reported information and whether there are no material non-conformities.

The scope of the verification is defined by the tasks the verifier needs to perform to achieve the above objective. The verifier shall at least perform the activities as outlined in this section 117.4.

The operator shall submit the emissions report, a copy of its approved Monitoring Plan for each of its installation, and any other relevant information to the verifier.

7.11.4.2. Verification methodology

The verifier shall plan and perform verification with an attitude of professional skepticism recognizing that circumstances may exist that cause the information contained in the Annual Emissions Report to be materially misstated.

As part of the verification process, the verifier shall carry out the following steps:

i Conduct a Strategic analysis, under which he shall :

- o understand each activity undertaken by the installation, the sources, source streams within the installation, the metering equipment used to monitor or measure activity data, the origin and application of emission factors and oxidation/conversion factors, any other data used to calculate or measure the emissions, and the environment in which the installation operates;
- o understand the operator's monitoring methodology, data acquisition and data handling activities as well as its control system, including the overall organisation with respect to monitoring and reporting;
- o establish an acceptable materiality level in the context of the nature and complexity of the installation's activities and sources, source streams. The verifier checks with the Competent Authority whether requirements have been set to materiality levels. If not, the verifier sets the level to his own professional judgement.
- o verify whether the monitoring plan has been approved by the competent authority. The verifier should not continue the verification if this is not the case and advise the operator to first have the monitoring plan approved.

ii Conduct a Risk Analysis, under which he shall :

- o analyse the inherent risks and control risks related to the scope and complexity of the operator's activities and emission sources and source streams, and which could lead to a material misstatement within the Annual Emissions Report and non-conformities with requirements in the GHG permit, monitoring methodology and requirements in these Guidelines. The analysis is performed on the basis of the verifier's professional knowledge and the information submitted by the operator, including the approved Monitoring Plan and the GHG permit.
- o draw up a verification plan which is commensurate with this risk analysis . The *verification plan* describes the way in which the verification activities are to be carried out. *Its* contains a verification programme and a data sampling plan. *The verification programme* describes the nature of the activities, at what times they must be carried out and their scope in order for the verification plan to be completed. *The data sampling plan* sets out the what the data is to be tested in order to reach a verification opinion.

iii Carry out the verification

In carrying the verification, the verifier shall conduct a site visit, in order to inspect the operation of meters and monitoring systems, conduct interviews, and collect sufficient information and evidence.

Moreover, he shall:

- o carry out the verification plan by gathering data in accordance with the defined sampling methods, walkthrough tests, document reviews, site visits, analytical

procedures and data review procedures, including any relevant additional evidence, upon which the verifier's verification opinion will be based;

- verify that the application of the monitoring methodology defined in the approved Monitoring Plan has delivered an uncertainty level consistent with the defined tiers in the permit;
- verify that the approved Monitoring Plan is implemented;
- request the operator to provide any missing data or complete missing sections of audit trails, explain variations in the emissions data, or revise calculations, or adjust reported data, before reaching a final verification opinion. The verifier should, in any form, report all nonconformities and misstatements identified to the operator.

In case part of the data cannot be verified due to any circumstances, the operator may propose to the Competent Authority to report an alternative verifiable overestimation of the applicable emissions (conserative approach). The verifier shall conclude on his verification without official consent of the Competent Authority.

Throughout the verification process, the verifier shall determine misstatements by assessing whether:

- the Monitoring Plan including the requirements described in 7.1, 7.2 and 7.3 has been implemented and is effective;
- there is clear and objective evidence obtained through the gathering of data to support the determination of misstatements.

The verifier shall determine whether any individual misstatement or the aggregate of misstatements lead to a material misstatement of the Annual Emissions Report or to material nonconformities.

iv Prepare an Internal Verification Report

At the end of the verification process, the verifier shall prepare an internal verification report. The verification report shall record evidence showing that the strategic analysis, the risk analysis and the verification plan has been performed in full, and provide sufficient information to support verification opinions. The internal verification report" should as well facilitate a potential evaluation of the audit by the competent authority, and accreditation body.

Based on the findings contained in the internal verification report, the verifier shall make a judgment with respect to whether the annual emissions report contains any material misstatement as compared to the materiality threshold, and whether there are material non-conformities or other issues relevant for the verification opinion.

While the function of the internal verification report is primarily internal, it should as well be suitable to facilitate evaluation of the conducted verification activities by the accreditation body.

v Issue a Verification Report

The verifier shall present the verification methodology, his findings and verification opinion in a verification report, addressed to the operator.

The verification report shall include at least the following basic elements:

- (a) Title that clearly indicates the report is an independent Verification Report
- (b) Identification of the operator and installation
- (c) Identification of the exact version of the Annual Emissions Report that has been verified, accompanied by the aggregated total amount of reported annual emissions in ktCO₂.
- (d) Identification of the criteria: at a minimum the Monitoring Plan and these guidelines.
- (e) Where appropriate, a description of any significant, inherent limitation associated with the evaluation or measurement of the subject matter against the criteria
- (f) A statement to describe the respective roles and responsibilities of the operator and the verifier.
- (g) A summary of the work performed, including an explanation which site visits were performed.
- (h) The verification opinion, and relevant supporting explanation in case it is qualified, including material non-conformities and material misstatements
- (j) Date of issuance
- (k) Authorised signature of the verifier, specifying clearly its name, specific location and accreditation reference.
- (l) The applied materiality level.

The verification report may address non-material non-conformities and recommendations for improvements as well. These could also be reported in a separate management letter.

The verification opinion of the verifier shall be either “unqualified”, “unqualified with an emphasis of matter”, “qualified”, “adverse” or “disclaimer of verification opinion”.

If the verifier concludes that the Annual Emissions Report is free from any material misstatement, it shall issue an unqualified (*satisfactory*) verification opinion. In case of non-conformities which have no material impact to the professional judgment of the verifier, he should describe these as an "emphasis of matter".

The verifier shall express a qualified verification opinion when he concludes that an unqualified verification opinion cannot be expressed, but that the effect of aggregated uncorrected omissions, misrepresentations or errors is not such that an adverse verification opinion, or a disclaimer of verification opinion is required.

A qualified verification opinion shall be expressed in case of material misstatements and material uncertainties (like material nonconformities, weaknesses or failures in the control system that could lead to material misstatements and in case other information materially contradicts information contained in the annual emissions report). A qualified verification opinion is expressed as being “except for” the effects of the matter to which the qualification relates.

The verifier shall express an adverse verification opinion if the emissions stated in the Annual Emissions Report are significantly materially misstated. This is the case when a qualified verification statement is insufficient to express the extent to which the annual emissions report is misleading or incomplete to the professional judgement of the verifier.

When there is a limitation on the scope of the verifier's work, that is, circumstances prevent, or a restriction was imposed, that prevents the verifier from obtaining evidence required to

reduce the engagement risk to the reasonable level, he shall express a disclaimer of verification opinion.

A disclaimer of verification opinion is expressed when the possible effect of a limitation on scope is so material and pervasive that the verifier has not been able to obtain sufficient appropriate evidence and accordingly is unable to express a verification opinion on the Annual Emissions Report. In such a situation, the operator shall contact the Competent Authority in order to define additional criteria in the Monitoring Plan, allowing to resolve this situation.

Where the verifier expresses a verification opinion that is other than unqualified, the verification report shall contain a clear description of all the reasons.

711.4.3 Consequences

In case of an unqualified verification opinion, the operator shall submit the emission report to the competent authority in accordance with Article 14 (3) and 15 of the Directive. In case of a qualified verification opinion, the Competent Authority may not change the data verified, due to the definition of material misstatements, unless enforcement activities lead to other conclusions.

When there is an “emphasis of matter”, the operator shall address these after consultation of the Competent Authority in a timeframe set by the Competent Authority. The management of the operator provide its response to the matter within 6 months to the verifier.

In case of a qualified verification opinion, the operator shall submit the emission report to the competent authority in accordance with Article 14 (3) and 15 of the Directive. The competent authority shall consider the material misstatements and material nonconformities reported. The competent authority shall require conservative re-reporting and corrective actions as appropriate. The operator shall adjust its report and control system accordingly and have them re-verified, if possible.

In case of an adverse verification opinion or a disclaimer of verification opinion, the annual emissions report was not satisfactorily verified, and the operator may not submit the annual emissions report to the competent authority in accordance with Article 14 (3) and 15 of the Directive.

Member States shall ensure that divergences of opinion between operators, verifiers and competent authorities do not affect proper reporting and are settled in accordance with the Directive, these guidelines, the detailed requirements established by the Member States pursuant to Annex V to the Directive and relevant national procedures.

711.4.4. Competences of verifiers

Member States shall determine and approve the accreditation rules and criteria against which for the competence of verifier, so that an adequate assessment of the verifier's competence can be performed by the accreditation body, on the basis of relevant European and international standards and guidance documents. As a minimum, criteria shall comply with the requirements in Annex V to the Directive. Member States shall strive to a harmonized set of competence criteria considering guidance issued by the European Cooperation for Accreditation (EA).

Member States shall ensure that the designated accreditation body is technically competent, is independent and impartial, operates in the public interest, meets the obligations set out in the decision giving it formal recognition, and operates freely from political pressures.

Member States shall establish a distinct acceptance procedure, independent from the accreditation procedure, specifying among others to what conditions foreign accredited verifiers have to comply in order to be authorised to perform on their territory.

Member States shall establish and operate an efficient control mechanism on the work performed by the accreditation body.

In order to be accredited, the verifier shall comply with the accreditation rules and procedures.

~~an devices and devices orders the 6 Data management fuel or input material consumed by specific sources and materiality~~

~~The operator shall submit the emissions report, a copy of its permit for each of its installations, plus any other relevant information to the verifier. The verifier shall assess whether the monitoring methodology applied by the operator complies with the installation's monitoring methodology as approved by the competent authority, the principles for monitoring and reporting presented in section 3, and the guidelines laid down in this and subsequent Annexes. On the basis of this assessment the verifier shall conclude as to whether the data within the emissions report contains omissions, misrepresentations or errors that lead to material misstatement of the reported information.~~

~~As part of the verification process, the verifier shall in particular:~~

- ~~– understand each activity undertaken by the installation, the source source of emissions within the installation, the metering equipment used to monitor or measure activity data, the origin and application of emission factors and oxidation/conversion factors, and the environment in which the installation operates;~~
- ~~– understand the operator's data management system and overall organisation with respect to monitoring and reporting, and obtain, analyse and check the data contained within the data management system;~~
- ~~– establish an acceptable materiality level in the context of the nature and complexity of the installation's activities and source source;~~
- ~~– analyse the data risks which could lead to a material misstatement within the emissions report, based on the verifier's professional knowledge and the information submitted by the operator;~~
- ~~– draw up a verification plan which is commensurate with this risk analysis and the scope and complexity of the operator's activities and emission sources and source, and which defines the sampling methods to be used with respect to that operator's installations;~~
- ~~– carry out the verification plan by gathering data in accordance with the defined sampling methods, plus all relevant additional evidence, upon which the verifier's verification conclusion will be based;~~

- ~~–check that the application of the monitoring methodology specified in the permit has delivered an uncertainty accuracy level consistent with the defined tiers;~~
- ~~–request the operator to provide any missing data or complete missing sections of audit trails, explain variations in the emissions data, or revise calculations, before reaching a final verification conclusion.~~

~~Throughout the verification process, the verifier shall determine misstatements by assessing whether:~~

- ~~–the quality assurance and control processes described in 7.1, 7.2 and 7.3 have been implemented;~~
- ~~–there is clear and objective evidence obtained through the gathering of data to support the determination of misstatements.~~

~~The verifier shall assess the materiality both of any individual misstatement and of the aggregate of uncorrected misstatements, taking into account any omission, misrepresentation or error that that could lead to misstatement, for example a data management system that produces non transparent, biased or inconsistent figures. The level of assurance shall be commensurate with the materiality threshold determined for that installation.~~

~~At the end of the verification process, the verifier shall make a judgment with respect to whether the emissions report contains any material misstatement. If the verifier concludes that the emissions report does not contain any material misstatement, the operator can submit the emissions report to the competent authority in accordance with Article 14 (3) to the Directive. If the verifier concludes that the emissions report contains a material misstatement, the operator's report has not been verified as satisfactory. In accordance with Article 15 to the Directive, Member States shall ensure that an operator whose report has not been verified as satisfactory by 31 March each year for emissions during the preceding year cannot make further transfers of allowances until a report from that operator has been verified as satisfactory. Member States shall lay down applicable penalties in accordance with Article 16 to the Directive.~~

~~The total emissions figure for an installation in an emissions report that has been verified as satisfactory shall be used by the competent authority to check whether a sufficient number of allowances have been surrendered by the operator in respect of that same installation.~~

~~Member States shall ensure that divergences of opinion between operators, verifiers and competent authorities do not affect proper reporting and are settled in accordance with the Directive, these guidelines, the detailed requirements established by the Member States pursuant to Annex V to the Directive and relevant national procedures.~~

812. Emission factors

This section contains reference emission factors for the tier 1 level that permit the use of non-activity-specific emission factors for the combustion of fuel. If a fuel does not belong to an existing fuel category the operator shall use his expert judgement to assign the fuel used to a related fuel category, subject to the approval of the competent authority.

Table 34: Fossil fuel emission factors – related to net calorific value (NCV), excluding oxidation factors

Fuel	CO ₂ emission factor (tCO ₂ /TJ)	Source of emission factor
A) Liquid Fossil		
Primary Fuels		
Crude Oil	73.3	IPCC, 1996 ⁹
Orimulsion	80.7	IPCC, 1996
Natural Gas Liquids	63.1	IPCC, 1996
Secondary Fuels/Products		
Gasoline	69.3	IPCC, 1996
Kerosene ¹⁰	71.9	IPCC, 1996
Shale Oil	77.4	National Communication Estonia, 2002
Gas / Diesel Oil	74.1	IPCC, 1996
Residual Fuel Oil	77.4	IPCC, 1996
Liquid Petroleum Gas	63.1	IPCC, 1996
Ethane	61.6	IPCC, 1996
Naphta	73.3	IPCC, 1996
Bitumen	80.7	IPCC, 1996
Lubricants	73.3	IPCC, 1996
Petroleum Coke	100.8	IPCC, 1996
Refinery Feedstocks	73.3	IPCC, 1996
Other Oil	73.3	IPCC, 1996
B) Solid Fossil		
Primary Fuels		
Anthracite	98.3	IPCC, 1996
Coking Coal	94.6	IPCC, 1996
Other bitumen Coal	94.6	IPCC, 1996
Sub-bitumen Coal	96.1	IPCC, 1996
Lignite	101.2	IPCC, 1996
Oil Shale	106.7	IPCC, 1996
Peat	106.0	IPCC, 1996
Secondary Fuels		
BKB & Patent Fuel	94.6	IPCC, 1996
Coke Oven / Gas Coke	108.2	IPCC, 1996
C) Gaseous Fossil		
Carbon Monoxide	155.2	Based on NCV of 10.12 TJ/ t ¹¹)

⁹ Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, 1.13.

¹⁰ Kerosene, other than Jet Kerosene.

¹¹ J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995.

Natural Gas (Dry)	56.1	IPCC, 1996
Methane	54.9	Based on NCV of 50.01 TJ/ t ¹²
Hydrogen	0	Carbon free substance

¹² J. Falbe and M. Regitz, Römpp Chemie Lexikon, Stuttgart, 1995.

913. List of CO₂-neutral biomass

This exemplary but not exhaustive list contains a number of materials, which are considered biomass for the application of these guidelines and shall be weighted with an emission factor of 0 [t CO₂/TJ or t or Nm³]. Peat and fossil fractions of the materials listed below, shall not be considered biomass.

1. Plants and parts of plants, inter alia:

- straw;
- hay and grass;
- leaves, wood, roots, stumps, bark;
- crops, e.g. maize and triticale.

2. Biomass wastes, products and by-products, inter alia:

- industrial waste wood (waste wood from woodworking and wood processing operations and waste wood from operations in the wood materials industry);
- used wood (used products made from wood, wood materials) and products and by-products from wood processing operations
- wood-based waste from the pulp and paper industries, e.g. black liquor;
- [crude tall oil, tall oil and pitch oil from the production of pulp;](#)
- forestry residues;
- [lignin from the processing of plants containing ligno-cellulose,](#)
- animal, fish and food meal, fat, oil and tallow;
- primary residues from the food and beverage production;
- manure;
- agricultural plant residues;
- sewage sludge;
- biogas produced by digestion, fermentation or gasification of biomass;
- harbour sludge and other waterbody sludges and sediments;
- landfill gas.

3. Biomass fractions of mixed materials, inter alia:

- the biomass fraction of flotsam from waterbody management;
- the biomass fraction of mixed residues from food and beverage production;

- the biomass fraction of composites containing wood;
- the biomass fraction of textile wastes;
- the biomass fraction of paper, cardboard, pasteboard;
- the biomass fraction of municipal and industrial waste;
- the biomass fraction of processed municipal and industrial wastes.

4. Fuels whose components and intermediate products have all been produced from biomass, inter alia:

- bioethanol;
- biodiesel;
- etherised bioethanol;
- biomethanol;
- biodimethylether;
- bio-oil (a pyrolysis oil fuel) and bio-gas.

1014. Determination of activity-specific data and factors

1014.1 Determination of net calorific values and emission factors for fuels

The specific procedure to determine the activity specific emission factor including the sampling procedure for a specific fuel type shall be agreed with the competent authority before the start of respective reporting period in which it will be applied.

The procedures applied to sample the fuel and to determine its net calorific value, carbon content and emission factor should be according to a standardized method that limits sampling and measurement bias and has a known measurement uncertainty. CEN standards shall be used if available.~~shall be based on relevant CEN standards (such as on the sample frequency, sampling procedures, determination of gross and net calorific value, and carbon contents for the different fuel types) as soon as they are available.~~ If CEN standards are not available, suitable ISO standards or national standards shall apply. Where no applicable standards exist, procedures can be carried out where possible in accordance with suitable draft standards or industry best practice guidelines.

Examples for relevant CEN standards are as follows:

- EN ISO 4259:1996 “Petroleum products - Determination and application of precision data in relation to methods of test”.

Examples for relevant ISO standards are as follows:

- ISO 13909-1,2,3,4: 2001 Hard coal and coke - Mechanical sampling;
- ISO 5069-1,2: 1983: Brown coals and lignites; Principles of sampling;
- ISO 625:1996 Solid mineral fuels - Determination of carbon and hydrogen - Liebig method;
- ISO 925:1997 Solid mineral fuels - Determination of carbonate carbon content - Gravimetric method;
- ISO 9300-1990: Measurement of gas flow by means of critical flow Venturi nozzles;
- ISO 9951-1993/94: Measurement of gas flow in closed conduits - Turbine meters.

Supplemental national standards for the characterization of fuels are as follows:

- DIN 51900-1:2000 “Testing of solid and liquid fuels – Determination of gross calorific value by the bomb calorimeter and calculation of net calorific value – Part 1: Principles, apparatus, methods”;
- DIN 51857:1997 Gaseous fuels and other gases - Calculation of calorific value, density, relative density and Wobbe index of pure gases and gas mixtures”;
- DIN 51612:1980 Testing of liquefied petroleum gases; calculation of net calorific value;

- DIN 51721:2001 “Testing of solid fuels - Determination of carbon and hydrogen content” (also applicable for liquid fuels).

The laboratory used to determine the emission factor, carbon content and net calorific value shall comply with requirements laid down in section 4014.5 of this Annex. be accredited according to EN ISO 17025 (“General requirements for the competence of testing and calibration laboratories”).

It is important to note that to achieve appropriate accuracy of the activity specific emission factor (in addition to the precision of the analytical procedure for the determination of the carbon content and the net calorific value) the sampling frequency, the sampling procedure and the sample preparation are critical. They depend greatly on the state and homogeneity of the fuel/material. The required number of samples will be larger for very heterogeneous materials such as municipal solid waste and be much smaller for most commercial gaseous or liquid fuels.

The determination sampling procedure and frequency for the determination of the carbon content, net calorific values and emission factors for batches shall comply with the requirements of section 4014.6.

of fuel shall follow generally accepted practice for representative sampling. The operator shall provide evidence that the derived carbon content, calorific values and emission factors are representative and free of bias.

The respective emission factor shall be used only for the batch of fuel for which it was intended to be representative.

The full documentation of the procedures used in the respective laboratory for the determination of the emission factor and the full set of results shall be retained and made available to the verifier of the emissions report.

4014.2 Determination of activity specific oxidation factors

The specific procedure to determine the activity specific oxidation factor including the sampling procedure for a specific fuel type and installation shall be agreed with the competent authority before the start of respective reporting period in which it will be applied.

The procedures applied to determine a representative activity-specific oxidation factors (e.g. via the carbon content of soot, ashes, effluents and other wastes or by-products) for a specific activity should be according to a standardized method that limits sampling and measurement bias and has a known measurement uncertainty. CEN standards shall be used if available. shall be based on relevant CEN standards as soon as they are available. If CEN standards are not available, suitable ISO standards or national standards shall apply. Where no applicable standards exist, procedures can be carried out where possible in accordance with suitable draft standards or industry best practice guidelines.

The laboratory used to determine the oxidation factor or the underlying data shall comply with requirements laid down in section 4014.5 of this Annex. be accredited according to EN ISO 17025 (“General requirements for the competence of testing and calibration laboratories”).

The sampling procedure and frequency for the determination of parameters used for the calculation of oxidation factors shall comply with the requirements of section 4014.6.

~~The determination of activity specific oxidation factors from batches of material shall follow generally accepted practice for representative sampling. The operator shall provide evidence that the derived oxidation factors are representative and free of bias.~~

The full documentation of the procedures used by the organisation for the determination of the oxidations factor and the full set of results shall be retained and made available to the verifier of the emissions report.

1014.3 Determination of process emission factors and composition data

The specific procedure to determine the activity specific emission factor including the sampling procedure for a specific material shall be agreed with the competent authority before the start of respective reporting period in which it will be applied.

The procedures applied to sample and determine the composition of the relevant material or derive a process emission factor should be according to a standardized method that limits sampling and measurement bias and has a known measurement uncertainty. CEN standards shall be used if available.~~shall be based on relevant CEN standards as soon as they are available.~~ If CEN standards are not available suitable ISO standards or national standards shall apply. Where no applicable standards exist, procedures can be carried out where possible in accordance with suitable draft standards or industry best practice guidelines.

The laboratory used to determine the composition or emission factor shall comply with requirements laid down in section 1014.5 of this Annex.~~be accredited according to EN ISO 17025 (“General requirements for the competence of testing and calibration laboratories”).~~

The sampling procedure and frequency for the determination of the process emission factors and composition data shall comply with the requirements of section 1014.6.

~~The determination of the process emission factors and composition data for batches of materials shall follow generally accepted practice for representative sampling. The operator shall provide evidence that the derived process emission factor or composition data are representative and free of bias.~~

~~The respective value shall be used only for the batch of material for which it was intended to be representative.~~

The full documentation of the procedures used by the organisation for the determination of the emission factor or composition data and the full set of results shall be retained and made available to the verifier of the emissions report.

1014.4 Determination of a biomass fraction

The term “biomass fraction” for the purpose of these guidelines refers to the mass percentage of ~~mass combustible~~ biomass carbon according to the biomass definition (see sections 2 and 9 13 of this Annex) out of the total mass of carbon in a fuel mixture.

The specific procedure to determine the biomass fraction of a specific fuel type including the sampling procedure shall be agreed with the competent authority before the start of the reporting period in which it will be applied.

The procedures applied to sample the fuel and to determine the biomass fraction should be according to a standardized method that limits sampling and measurement bias and has a known measurement uncertainty. CEN standards shall be used if available.~~shall be based on~~

~~relevant CEN standards as soon as they are available.~~ If CEN standards are not available ~~suitable~~ ISO standards or national shall apply. Where no applicable standards exist, procedures can be carried out where possible in accordance with ~~suitable~~ draft standards or industry best practice guidelines.¹³

Methods applicable to determine the biomass fraction in a fuel could range from the manual sorting of components of mixed materials, to differential methods determining heating values of a binary mixture and its two pure components to an isotopic analysis of carbon-14 – depending on the specific nature of the respective fuel mixture. For fuels or materials originating from a production process with defined and traceable input streams, the operator may alternatively base the determination of the biomass fraction on a mass-balance of fossil and biogenic carbon entering and leaving the process. The respective methods are to be approved by the competent authority.

The laboratory used to determine the biomass fraction shall comply with requirements laid down in section 4014.5 of this Annex. ~~be accredited according to EN ISO 17025 (“General requirements for the competence of testing and calibration laboratories”).~~

The sampling procedure and frequency for the determination of the biomass fraction of fuels and material shall comply with the requirements of section 4014.6.

~~The determination of the biomass fraction in batches of materials shall follow generally accepted practice for representative sampling. The operator shall provide evidence that the derived values are representative and free of bias.~~

~~The respective value shall be used only for the batch of material for which it was intended to be representative.~~

The full documentation of the procedures used in the respective laboratory for the determination of the biomass fraction and the full set of results shall be retained and made available to the verifier of the emissions report.

If the determination of the biomass fraction in a mixed fuel is technically not feasible or would lead to unreasonably high costs the operator shall either assume a 0% biomass share (i.e. complete fossil origin of all carbon in that particular fuel) or propose an estimation method for approval by the competent authority.

14.5 Requirements for laboratory analyses

Section 173 of this annex contains exemptions from the requirements of this section for installations with average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period.

14.5.1 Use of accredited laboratories

The laboratory used to determine the emission factor, net calorific value, oxidation factor, carbon content, the biomass fraction or composition data should be accredited according to EN ISO 17025:2000 (“General requirements for the competence of testing and calibration laboratories”).

¹³ An example is the Dutch BRL-K 10016 (“The share of biomass in secondary fuels”) developed by KIWA.

14.5.2 Use of non-accredited laboratories

The use of non-accredited laboratories shall be limited to situations in which the operator can demonstrate to the competent authority that the laboratory meets equivalent requirements to those laid out in EN ISO 17025:2000. The respective laboratories and relevant analytical procedures shall be listed in the monitoring plan for the installation. Equivalence in respect to quality management this should be demonstrated by a certification of the laboratory against EN ISO 9001 or EN ISO 9002, depending on whether the laboratory is engaged in the development and application of non-standard methods or not. Additional evidence shall be provided that the laboratory is technically competent and able to generate technically valid results using the relevant analytical procedures. Under the responsibility of the operator, each non-accredited laboratory used by the operator to determine results used for the calculation of emissions shall take the following measures:

- a validation of each relevant analytical method against the reference method shall be carried out by a laboratory accredited according to EN ISO 17025: 2000. The validation procedure is carried out at the start of the assignment by the operator and shall be repeated every five years and is based on at least 15 parallel measurements for each relevant parameter and fuel or material;
- a comparison of the results of analytical methods shall be executed once a year by a laboratory accredited according to EN ISO 17025: 2000 applying a fivefold parallel measurement using the reference method for each relevant parameter and fuel or material;

The operator shall apply conservative adjustments to all relevant data of the respective year in cases in which a difference is observed between the results derived by the non-accredited and the accredited laboratory which might lead to an over-estimation of emissions. Any significant differences between the results derived by the non-accredited and the accredited laboratory shall be notified to the competent authority and be immediately resolved under supervision of a laboratory accredited according to EN ISO 17025: 2000.

14.6 Sampling methods and frequency

The determination of the relevant parameter shall follow generally accepted practice for representative sampling. The operator shall provide evidence that the derived values are representative and free of ~~known~~ bias. The respective value shall be used only for the delivery period or batch of fuel or material for which it was intended to be representative.

The relevant parameter shall be determined for the annual value by means of measurement systems with a maximum uncertainty of less than 1/3 of the maximum uncertainty which is required for the activity data for the same source stream.

If the operator is not able to meet the maximum uncertainty for the annual value or unable to demonstrate compliance with the thresholds, he shall determine the sampling for representative sampling laid down in table 5 - where applicable. In all other cases the competent authority shall define the sampling frequency.

Table 5 Indicative minimum sampling frequencies

<u>Fuel/material</u>	<u>Sampling frequency</u>
-----------------------------	----------------------------------

<u>Natural gas</u>	<u>At least monthly</u>
<u>Process gas (refinery mixed gas, cokes oven/gas coke, blast-furnace gas and convertor gas)</u>	<u>At least daily - using random procedures at different types of the day</u>
<u>Fuel oil</u>	<u>Every 40,000 ton and at least six times a year</u>
<u>Coal, coking coal, petroleum coke</u>	<u>Every 20,000 ton and at least six times a year</u>
<u>Solid waste (pure fossil or mixed biogenous fossil)</u>	<u>Every 3,000 ton and at least four times a year</u>
<u>Liquid waste</u>	<u>Every 4,000 tons and at least four times a year</u>
<u>Pure biogenic fuel and waste (solid, liquid, gaseous)</u>	<u>Every 4,000 tons and at least four times a year</u>
<u>Sulphate caustic waste</u>	<u>Every 4,000 tons and at least four times a year</u>
<u>Carbonates in mineral process industries (process emissions)</u>	<u>Every 50,000 tons and at least once per year</u>
<u>Other input and output streams in the mass balance (with the exemption of fuels)</u>	<u>Every 20,000 ton and at least once every month.</u>
<u>Other materials that are used as process input</u>	<u>Every 3,000 ton at least once per year</u>

151. Reporting Format

The following tables shall be used as a basis for reporting and may be adapted corresponding to the number of activities, type of installation, fuels and processes monitored.

151.1. Identification of Installation

Identification of installation	Response
1. Name of parent company	
23 . Operator of installation	
34 . Installation:	
34.1 Name	
34.2 Permit number ¹⁴	
34.3 Reporting under EPER required?	Yes/No
34.4 EPER- identification number ¹⁵	
34.5 Address/city of the installation	
34.6 Postcode/country	
34.7 Coordinates of the location	
45 . Contact Person:	
45.1 Name	
45.2 Address/city/postcode/country	
45.3 Telephone	
45.4 Fax	
45.5 email	
56 . Reporting year	
67 . Type of Annex I activities carried out ¹⁶	
Activity 1	
Activity 2	
Activity N	

¹⁴ The identification number will be provided by the competent authority in the permitting process.

¹⁵ Only to be filled in if installation is required to report under EPER and there is not more than one EPER-activity under the installation's permit. The information is not obligatory and used for additional identification purposes beyond the name and address data given.

¹⁶ E.g. "Mineral oil refineries".

15.2. Overview Activities and Emissions within an Installation

Emissions of Annex I activities						
Categories	IPCC CRF-Category ¹⁷	IPPC code of EPER Category	Approach used? Calculation/Measurement	Uncertainty (Measurement approach) ¹⁸	Tiers changed? Yes/No	Emissions t/CO ₂
Activities						
Activity 1						
Activity 2						
Activity N						
Total						

Memo Items					
	Transferred <u>or</u> <u>Admixed</u> CO ₂		Biomass employed for combustion	Biomass employed in processes	Biomass emissions ¹⁹
	Amount transferred <u>or</u> <u>admixed</u>	Transferred material <u>or</u> <u>fuel</u>			
Unit	[tCO ₂]		[TJ]	[t or Nm ³]	[tCO ₂]
Activity 1					
Activity 2					
Activity N					

¹⁷ E.g. "1.Industrial Processes, A Mineral Products, 1. Lime Production".

¹⁸ Only to be filled in if emissions have been determined by measurement.

¹⁹ Only to be filled in if emissions have been determined by measurement.

151.3. Combustion emissions (Calculation)

Activity N				
Type of Annex I activity:				
Description of activity:				
Fossil fuels				
Fuel 1				
Fossil fuel				
Type of fuel:				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
		TJ		
	Emission factor	tCO ₂ / TJ		
	Oxidation factor	%		
	Total emissions	tCO ₂		
Fuel N				
Fossil fuel				
Type of fuel:				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
		TJ		
	Emission factor	tCO ₂ / TJ		
	Oxidation factor	%		
	Total emissions	tCO ₂		
Biomass and mixed fuels				
Fuel M				
Biomass/mixed fuels				
Type of fuel:				
Fraction of biomass (0-100% of carbon content):				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
		TJ		
	Emission factor	tCO ₂ / TJ		
	Oxidation factor	%		
	Total emissions	tCO ₂		
Activity total				
Total emissions (tCO₂)²⁰				
Total biomass used (TJ)²¹				

²⁰ Equals the sum of emissions from fossil fuels and the fossil fraction of mixed fuels.

²¹ Equals the energy content of the pure biomass and the biomass fraction of mixed fuels.

151.4. Process Emissions (Calculation)

Activity N				
Type of Annex I activity:				
Description of activity:				
Processes using only fossil input material				
Process 1				
Type of process:				
Description of activity data:				
Calculation method applied (only if specified in guidelines):				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
	Emission factor	tCO ₂ / t or tCO ₂ /Nm ³		
	Conversion factor	%		
	Total emissions	tCO ₂		
Process N				
Type of process:				
Description of activity data:				
Calculation method applied (only if specified in guidelines):				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
	Emission factor	tCO ₂ / t or tCO ₂ /Nm ³		
	Conversion factor	%		
	Total emissions	tCO ₂		
Processes using biomass/mixed input material				
Process M				
Description of process:				
Description of input material:				
Fraction of biomass (% of carbon content):				
Calculation method applied (only if specified in guidelines):				
		Unit	Data	Tier applied
	Activity data	t or Nm ³		
	Emission factor	tCO ₂ / t or tCO ₂ /Nm ³		
	Conversion factor	%		
	Total emissions	tCO ₂		
Activity total				
Total emissions	(tCO₂)			
Total biomass used	(t or Nm³)			

162. Reporting Categories

Emissions shall be reported according to the categories of the IPCC Reporting Format and the IPPC code of Annex A3 of the EPER Decision (see section 162.2 of this Annex). The specific categories of both reporting formats are shown below. Where an activity could be classified under two or more categories the selected classification shall reflect the primary purpose of the activity.

126.1. IPCC Reporting Format

The table below is an excerpt of the Common Reporting Format (CRF) part of the UNFCCC reporting guidelines on annual inventories²². In the CRF emissions are attributed to seven major categories:

- 1. energy;
- 2. industrial processes;
- 3. solvent and other products use;
- 4. agriculture;
- 5. land-use change and forestry;
- 6. waste;
- 7. other.

Categories 1 and 2 and 6 of the following table of the CRF, which are the categories relevant for the Directive, are reproduced below together with their relevant subcategories. ~~are reproduced below: Categories 1, 2 and 6 of the following table with their relevant subcategories are reproduced below:~~

1. SECTORAL REPORT FOR ENERGY
A. Fuel Combustion Activities (Sectoral Approach)
1. Energy Industries
a. Public Electricity and Heat Production
b. Petroleum Refining
c. Manufacture of Solid Fuels and Other Energy Industries
2. Manufacturing Industries and Construction
a. Iron and Steel
b. Non-Ferrous Metals
c. Chemicals
d. Pulp, Paper and Print
e. Food Processing, Beverages and Tobacco
f. Other (<i>please specify</i>)
4. Other Sectors
a. Commercial/Institutional
b. Residential
c. Agriculture/Forestry/Fisheries

22 UNFCCC (1999): FCCC/CP/1999/7.

5. Other (please specify)⁽¹⁾
a. Stationary
b. Mobile
B. Fugitive Emissions from Fuels
1. Solid Fuels
a. Coal Mining
b. Solid Fuel Transformation
c. Other (please specify)
2. Oil and Natural Gas
a. Oil
b. Natural Gas
c. Venting and Flaring
Venting
Flaring
d. Other (please specify)
2. SECTORAL REPORT FOR INDUSTRIAL PROCESSES
A. Mineral Products
1. Cement Production
2. Lime Production
3. Limestone and Dolomite Use
4. Soda Ash Production and Use
5. Asphalt Roofing
6. Road Paving with Asphalt
7. Other (please specify)
B. Chemical Industry
1. Ammonia Production
2. Nitric Acid Production
3. Adipic Acid Production
4. Carbide Production
5. Other (please specify)
C. Metal Production
1. Iron and Steel Production
2. Ferroalloys Production
3. Aluminium Production
4. SF ₆ Used in Aluminium and Magnesium Foundries
5. Other (please specify)
SECTORAL REPORT FOR WASTE
mo Items
C Waste Incineration
CO₂ emissions from biomass
mo Items
CO₂ emissions from biomass

²³ Not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under the Energy Module, 1A. See Intergovernmental Panel on Climate Change; Greenhouse Gas Inventory Reporting Instructions. Revised 1996 IPCC Guidelines for national greenhouse gas inventories; 1997.

162.2 IPPC source category code of EPER Decision

The table below is an excerpt of Annex A3 to Commission Decision 2000/479/EC of 17 July 2000 on the implementation of a European pollutant emission register (EPER) according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control.²⁴

Excerpt of Annex A3 of the EPER Decision	
1.	Energy Industries
1.1.	Combustion installations > 50 MW
1.2.	Mineral oil and gas refineries
1.3.	Coke ovens
1.4.	Coal gasification and liquefaction plants
2	Production and processing of metals
2.1./2.2./2.3./ 2.4./2.5./2.6.	Metal industry and metal ore roasting or sintering installations; Installations for the production of ferrous and non-ferrous metals
3.	Mineral industry
3.1./3.3./3.4./ 3.5.	Installations for the production of cement clinker (> 500 t/day), lime (> 50 t/day), glass (> 20 t/day), mineral substances (> 20 t/day) of ceramic products (> 75 t/day)
3.2.	Installations for the production of asbestos or asbestos-based products
4.	Chemical industry and chemical installations for the production of:
4.1.	Basic organic chemicals
4.2./4.3.	Basic inorganic chemicals or fertilisers
4.4./4.6	Biocides and explosives
4.5.	Pharmaceutical products
5.	Waste management
5.1./5.2.	Installations for the disposal or recovery of hazardous waste (> 10 t/day) or municipal waste (> 3 t/hour)

²⁴ OJ L 192, 28.07.2000, p.36.

5.3./5.4.	Installations for the disposal of non-hazardous waste (> 50 t/day) and landfills (> 10 t/day)
6.	Other Annex I activities
6.1.	Industrial plants for pulp from timber or other fibrous materials and paper or board production (> 20 t/day)
6.2.	Plants for the pre-treatment of fibres or textiles (> 10 t/day)
6.3.	Plants for tanning of hides and skins (> 12 t/day)
6.4.	Slaughterhouses (> 50 t/day), plants for the production of milk (> 200 t/day), other animal raw materials (> 75 t/day) or vegetable raw materials (> 300 t/day)
6.5.	Installations for the disposal or recycling of animal carcasses and animal waste (> 10 t/day)
6.6.	Installations for poultry (> 40 000), pigs (> 2 000) or sows (> 750)
6.7.	Installations for surface treatment or products using organic solvents (> 200 t/year)
6.8.	Installations for the production of carbon or graphite

17. Exemptions From Requirements for Small Installations

For installations with average emissions of less than 25,000 tons of CO₂ equivalents per year during the previous trading period, the following exemptions from the requirements of this Annex shall apply:

- The Member State may waive the need for or reduce the frequency for site visits in the verification audit and permit that verification audits are based on evidence packs.
- Where necessary, the operator may use information as specified by the supplier of relevant measurement devices irrespective of specific use conditions to estimate the uncertainty of activity data.
- The need of proof of compliance with the requirements regarding calibration in paragraph one of section 11.3. of Annex I is waived.
- Lower tier approaches may be applied for all source streams.
- Requirements regarding the accreditation against EN ISO 17025 are waived if the laboratory in question is certified according to EN ISO 9001/2.
- Purchasing records for commercial fuels and materials are accepted as source of activity data without additional information on uncertainties.

Annex II: Guidelines for Combustion Emissions from activities as listed in Annex I to the Directive

1. Boundaries and completeness

The activity-specific guidelines contained in this Annex shall be used to monitor ~~greenhouse gas emissions~~ from combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations) as listed in Annex I to the Directive and to monitor combustion emissions from other activities as listed in Annex I to the Directive where referred to in Annexes III to XI to these guidelines. For relevant processes of the petrochemical industry - if covered by Annex I of the Directive - Annex III may also apply.

The monitoring of ~~greenhouse gas emissions~~ from combustion processes shall include emissions from the combustion of all fuels at the installation as well as emissions from scrubbing processes for example to remove SO₂ from exhaust gas. Emissions from internal combustion engines for transportation purposes shall not be monitored and reported. All ~~greenhouse gas emissions~~ from the combustion of fuels at the installation shall be assigned to the installation, regardless of exports of heat or electricity to other installations. Emissions associated with the production of heat or electricity that is imported from other installations shall not be assigned to the importing installation.

Emissions of a combustion installation which is part adjacent and drawing its main fuel from of an integrated steel plant but operated under a separate greenhouse gas emission permit might be calculated as part of the mass balance consideration of this steel plant if the operator can prove to the competent authority that such an approach will reduce overall uncertainty of the emission determination.

2. Determination of CO₂ emissions

Emission s Sources of CO₂ emissions from combustion installations and processes include:

- boilers
- burners
- turbines
- heaters
- furnaces
- incinerators
- kilns
- ovens
- dryers
- engines

- flares
- scrubbers (process emissions)
- any other equipment or machinery that uses fuel, excluding equipment or machinery with combustion engines that is used for transportation purposes.

2.1 Calculation of CO₂ emissions

2.1.1 Combustion emissions

2.1.1.1 General combustion activities

CO₂ emissions from combustion ~~sources~~ installations shall be calculated by multiplying the energy content of each fuel used by an emission factor and an oxidation factor. For each fuel the following calculation shall be carried out for each activity:

$$\text{CO}_2 \text{ emissions} = \text{Activity data} * \text{Emission factor} * \text{Oxidation factor}$$

With:

a) Activity data:

Activity data is generally expressed as the net energy content of the fuel consumed [TJ] during the reporting period. The energy content of the fuel consumption shall be calculated by means of the following formula:

$$\text{Energy content of fuel consumption [TJ]} = \text{fuel consumed [t or Nm}^3\text{]} * \text{net calorific value of fuel [TJ/t or TJ/Nm}^3\text{]}^{25}$$

In case a mass related emission factor [t CO₂/t] is used, activity data is expressed as the amount of fuel consumed [t or Nm³].

With

a1) Fuel consumed:

Tier 1:

The ~~annual~~ fuel consumption over the reporting period is determined by the operator or fuel supplier within a maximum uncertainty of less than ±7.5 % for the annual value taking into account the effect of stock changes where applicable.

Tier 1:

Fuel consumption is metered without intermediate storage before combustion in the installation resulting in a maximum permissible uncertainty of less than ±7.5 % for the metering process.

²⁵ In case volume units are used the operator shall consider any conversion that may be required to account for differences in pressure and temperature of the metering device and the standard conditions for which the net calorific value was derived for the respective fuel type.

Tier 2:

The annual fuel consumption over the reporting period is determined by the operator or fuel supplier within a maximum uncertainty of less than $\pm 5\%$ for the annual value taking into account the effect of stock changes where applicable.

Tier 2a:

~~Fuel consumption is metered without intermediate storage before combustion in the installation applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 5.0\%$ for the metering process~~

Tier 2b:

~~Fuel purchase metered applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 4.5\%$ for the metering process. Fuel consumption is calculated using a mass balance approach based on the quantity of fuel purchased and the difference in the quantity held in stock over a period of time using the following formula:~~

$$\text{Fuel C} = \text{Fuel P} + (\text{Fuel S} - \text{Fuel E}) - \text{Fuel O}$$

where:

Fuel C: Fuel combusted during the reporting period

Fuel P: Fuel purchased during the reporting period

Fuel S: Fuel stock at the beginning of the reporting period

Fuel E: Fuel stock at the end of the reporting period

Fuel O: Fuel used for other purposes (transportation or re-sold)

Tier 3:

The annual fuel consumption over the reporting period is determined by the operator or fuel supplier within a maximum uncertainty of less than $\pm 2.5\%$ for the annual value taking into account the effect of stock changes where applicable.

Tier 3a:

~~Fuel consumption is metered without intermediate storage before combustion in the installation applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.5\%$ for the metering process.~~

Tier 3b:

~~Fuel purchase metered applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.0\%$ for the metering process. Fuel consumption is calculated using a mass balance approach based on the quantity of fuel purchased and the difference in the quantity held in stock over a period of time using the following formula:~~

$$\text{Fuel C} = \text{Fuel P} + (\text{Fuel S} - \text{Fuel E}) - \text{Fuel O}$$

where:

Fuel C: Fuel combusted during the reporting period

Fuel P: Fuel purchased during the reporting period
Fuel S: Fuel stock at the beginning of the reporting period
Fuel E: Fuel stock at the end of the reporting period
Fuel O: Fuel used for other purposes (transportation or re-sold)

Tier 4:

The annual fuel consumption over the reporting period is determined by the operator or fuel supplier within a maximum uncertainty of less than $\pm 1.5\%$ for the annual value taking into account the effect of stock changes where applicable.

Tier 4a:

~~Fuel consumption is metered without intermediate storage before combustion in the installation applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 1.5\%$ for the metering process.~~

Tier 4b:

~~Fuel purchase metered applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 1.0\%$ for the metering process. Fuel consumption is calculated using a mass balance approach based on the quantity of fuel purchased and the difference in the quantity held in stock over a period of time using the following formula:~~

$$\text{Fuel C} = \text{Fuel P} + (\text{Fuel S} - \text{Fuel E}) - \text{Fuel O}$$

where:

Fuel C: Fuel combusted during the reporting period
Fuel P: Fuel purchased during the reporting period
Fuel S: Fuel stock at the beginning of the reporting period
Fuel E: Fuel stock at the end of the reporting period
Fuel O: Fuel used for other purposes (transportation or re-sold)

~~It should be noted that different fuel types will result in significantly different permissible uncertainties for the metering process with gaseous and liquid fuels generally being metered more accurately than solid fuels. There are however many exceptions within each of the classes (depending on the type and properties of the fuel, the delivery path (ship, rail, truck, conveyor belt, pipeline) and circumstances specific to the installation) which preclude a simple attribution of fuels to tiers.~~

a2) Net calorific value:

Tier 1:

The operator applies country specific net calorific values for the respective fuel as listed in Appendix 2.1 A.3 “1990 country specific net calorific values” of the 2000 IPCC “Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (<http://www.ipcc.ch/pub/guide.htm>).

Tier 2a:

The operator applies country specific net calorific values for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 2b:

For commercial fuels traded between economically independent organisations the net calorific value as stated reported by the fuel supplier on their purchasing records for the respective fuel are used.

Tier 3:

The net calorific value representative for ~~the each batch of~~ fuel in an installation is measured by the operator, a contracted laboratory or the fuel supplier in accordance with the provisions of section ~~1014~~ of Annex I.

b) Emission Factor:

Tier 1:

Reference factors for each fuel are used as specified in section ~~8-12~~ of Annex I

Tier 2a:

The operator applies country specific emission factors for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 2b:

The operator derives emission factors for ~~each batch of the~~ fuel based on one of the following established proxies:

- density measurement of specific oils or gases common e.g. to the refinery or steel industry, and
- net calorific value for specific coals types,

in combination with an empirical correlation as determined by an external laboratory according to the provisions of section ~~1014~~ of Annex I. The operator shall ensure that the correlation satisfies the requirements of good engineering practice and that it is applied only to values of the proxy which fall into the range for which it was established.

Tier 3:

Activity specific emission factors ~~representative for the respective batches for the fuel~~ are determined by the operator, an external laboratory or the fuel supplier according to the provisions of section ~~4014~~ of Annex I.

c) Oxidation Factor:

The Application of tier 2 is optional.

Tier 1:

A reference oxidation / reference value of 0.99 (corresponding to a 99% conversion of carbon to CO₂) is assumed for all solid fuels and of 0.995 for all other fuels. The operator applies oxidation factors for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change. Where a national inventory does not supply an oxidation factor for a specific fuel, the following IPCC²⁶ values value shall be used.

<u>Fuels</u>	<u>Oxidation Factor</u>
<u>Solid fuels</u>	<u>0.98</u>
<u>Liquid fuels</u>	<u>0.99</u>
<u>Gaseous fuels</u>	<u>0.995</u>

Tier 2:

For solid fuels activity-specific factors are derived by the operator based on carbon contents of ashes, effluents and other wastes and by-products and other non fully oxidised emissions of carbon according to the provisions specified in section ~~4014~~ of Annex I.

2.1.1.2 Flares

Emissions from flares shall include routine flaring and operational flaring (trips, start-up and shutdown as well as emergency relieves).

CO₂ emissions shall be calculated from the amount of gas flared [Nm³] and the carbon content of the flared gas [t CO₂/ Nm³] (including any inorganic carbon).

CO₂ emissions = activity data * emission factor * oxidation factor

With:

²⁶ See IPCC 2000 “Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (<http://www.ipcc.ch/pub/guide.htm>).
Good Practice Guidance,

a) Activity data

Tier 1:

Amount of flare gas [m^3] used ~~during over the~~ reporting period, ~~derived by volume metering~~ with a maximum ~~permissible uncertainty~~ of ~~± 12.5~~ ~~17.5%~~ ~~for the annual value, for the metering process.~~

Tier 2:

Amount of flare gas [m^3] used ~~during over the~~ reporting period, ~~derived by volume metering~~ with a maximum ~~permissible~~ uncertainty of ~~± 7.5~~ ~~12.5%~~ ~~for the annual value, the metering process.~~

Tier 3:

Amount of flare gas [m^3] used during reporting period, ~~derived by volume metering~~ with a maximum ~~permissible~~ uncertainty of ~~± 7.5~~ ~~12.5%~~ ~~for the metering process.~~

b) Emission factor:

Tier 1:

Using a reference emission factor of ~~0.00393785~~ t CO₂/ m³ (~~at standard conditions at 298 K temperature, 1013 hPa~~) derived from the combustion of pure ~~butane-ethane~~ used as a conservative proxy for flare gases.

Tier 2a:

The operator applies country specific emission factors for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 2b:

Installation specific emission factors are 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 is derived for the molecular weight of the flare gas.

Tier 23:

Emission factor [t CO₂/Nm³_{flare gas}] calculated from the carbon content of the flared gas applying the provisions of section ~~4014~~ of Annex I.

c) ~~e~~ Oxidation factor:

Tier 1:

The operator applies an oxidation factors as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change. Where a national inventory does not supply a suitable

oxidation factor, the IPCC²⁷ 2000 Guidelines' value of 0.995 shall be used. ~~Oxidation rate of 0.995.~~

2.1.2 Process emissions

Process CO₂ emissions from the use of carbonate for SO₂ scrubbing from the waste gas stream shall be calculated on the basis of carbonate purchased (Calculation method tier 1a) or gypsum produced (Calculation method tier 1b). These two calculation methods are equivalent. Calculation shall be as follows:

$$\text{CO}_2\text{-emissions [t]} = \text{Activity data} * \text{emission factor} * \del{\text{conversion factor}}$$

With

Calculation method A “Carbonate based”

Calculation of emissions is based on the amount of carbonate employed:

a) Activity data:

Tier 1:

Tons[t] of dry carbonate as process input consumed over the reporting period per year metered-determined by the operator or supplier with a maximum permissible-uncertainty of less than $\pm 7.5\%$ for the annual value metering process.

b) Emission factor:

Tier 1:

Use of stoichiometric ratios of conversions of carbonates [t CO₂/t dry carbonate] as shown in table 1. This value shall be adjusted for the respective moisture and gangue content of the applied carbonate material.

Table 1: Stoichiometric emission factors

Carbonate	Emission factor [t CO ₂ /t Ca-, Mg- or other Carbonate]	Remarks
CaCO ₃	0.440	
MgCO ₃	0.522	
general: X _Y (CO ₃) _Z	Emission factor = $[M_{\text{CO}_2}] / \{ Y * [M_x] + Z * [M_{\text{CO}_3^{2-}}] \}$	X = alkali earth or alkali metal M _x = molecular weight of X in [g/mol] M _{CO₂} = molecular weight of CO ₂ = 44 [g/mol] M _{CO₃} = molecular weight of CO ₃ ²⁻ = 60

²⁷ See IPCC 2000 “Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (<http://www.ipcc.ch/pub/guide.htm>).

		[g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of CO ₃ ²⁻ = 1
--	--	---

e) Conversion factor:

Tier 1:

~~Conversion factor: 1.0~~

Calculation method B “Gypsum based”

Calculation of emissions is based on the amount of gypsum produced:

a) Activity data:

Tier 1:

~~{t} Tons~~ of dry gypsum (CaSO₄ · 2H₂O) as process output per year ~~determined~~ ~~metered~~ by ~~the~~ operator or processor of gypsum with a maximum ~~permissible~~-uncertainty of less than ±7.5% for the ~~metering process annual value~~.

d) b) B) emission factor:

Tier 1:

Stoichiometric ratio of dehydrated gypsum (CaSO₄ · 2H₂O) and CO₂ in the process: 0.2558 t CO₂/ t gypsum

e) Conversion factor:

Tier 1:

~~Conversion factor: 1.0~~

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex ~~XIII~~ shall be applied.

3. Determination of emissions of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex III: Activity-Specific Guidelines for Mineral Oil Refineries as Listed in Annex I to the Directive

e) 1. Boundaries

The monitoring of ~~greenhouse gas emissions~~ from an installation shall include all emissions from combustion and production processes as occurring in refineries. Emissions from processes carried out in adjacent installations of the chemical industry not included in Annex I to the Directive, which are not part of the refining production chain shall not be accounted for.

2. Determination of CO₂ emissions

Potential emission sources for CO₂-~~emissions sources~~ include:

f) a) Energy related combustion:

- Boilers
- Process heaters / treaters
- Internal combustion engines / turbines
- Catalytic and thermal oxidizers
- Coke calcining kilns
- Firewater pumps
- Emergency/standby generators
- Flares
- Incinerators
- Crackers

g) b) Process

- Hydrogen production installations
- Catalytic regeneration (from catalytic cracking and other catalytic processes)
- Cokers (flexi-coking, delayed coking)

2.1 Calculation of CO₂ emissions

~~Operator may calculate emissions:~~

- a) for every fuel type and process of the installation, or
- b) using the mass balance approach if the operator can demonstrate that it is more accurate for the installation as a whole than a calculation for each fuel type or process, or
- c) using the mass balance approach on a well defined subset of fuel types or processes and individual calculations for the remaining fuel types and processes of the installation if the operator can demonstrate that it is more accurate for the whole installation than a calculation for each fuel type or process.

2.1.1 Mass Balance Approach

The mass balance approach shall analyse all carbon in inputs, accumulations, inclusion in products and exports to account for the installation's emissions of greenhouse gases, using the following equation:

$$\text{CO}_2\text{-emissions [t-CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With

- **Input [tC]:** all carbon entering the boundaries of the installation
- **Products [tC]:** all carbon in products and materials, including by products, leaving the boundaries of the mass balance
- **Export [tC]:** carbon exported from the boundaries of the mass balance, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases into the atmosphere.
- **Stock changes [tC]:** Stock increases of carbon within the boundaries of the installation.

The calculation shall then be as follows:

$$\text{CO}_2\text{-emissions [t-CO}_2\text{]} =$$

$$\left(\sum (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \sum (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \sum (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \sum (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}}) \right) * 3.664$$

With

Activity data

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately.

Tier 1

For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 7.5\%$ for the metering process. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.5\%$ for the metering process.

Tier 2

~~For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 5.0\%$ for the metering process. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.5\%$ for the metering process.~~

Tier 3

~~Mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.5\%$ for the metering process.~~

Tier 4

~~Mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 1.0\%$ for the metering process.~~

Carbon content

Tier 1

~~When calculating the mass balance the operator shall follow the provisions of section 10 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.~~

Energy content

Tier 1

~~For the purpose of consistent reporting, the energy content of each of the fuel and material streams (expressed as net calorific value of the respective streams) shall be calculated.~~

2.1.2 Combustion emissions

~~Combustion emissions shall be monitored in accordance with Annex II.~~

2.1.3 Process Emissions

Specific processes leading to CO₂-emissions include:

h) 1. Catalytic Cracker Regeneration, and other catalyst regeneration and flexi-cokers

The coke deposited on the catalyst as a by-product of the cracking process is burned in the regenerator in order to restore the activity of the catalyst. Further refinery processes employ a catalyst which needs to be regenerated, e.g. catalytic reforming.

~~The amount of CO₂ emitted in this process shall be calculated in accordance with Annex II, with the amount of coke combusted as activity data and the carbon content of the coke as basis for the calculation of the emission factor.~~

~~CO₂-emissions = activity data * emission factor * conversion factor~~

$$\underline{CO_2\text{-tot ann. [t]} = \left(\sum_{i=1}^{\text{operating_hours_p.a.}} (\text{Con}_{CO_2\ i} + (\text{Con}_{CO\ i} * 1.5714)) * \text{exhaust air flow}_i \right) * 10^{-9}}$$

With:

Exhaust air flow_i: The air flow [Nm³/h] leaving the process at point of time i.

Con_{CO₂ i}: CO₂-concentration in the exhaust gas at point of time i. In case the measurement equipment provides the CO₂-concentration as volume concentration in [ppmv], conversion to mass concentration [mg/ Nm³] shall be calculated by the following equation valid under standard conditions:

$$\underline{CO_2\text{-concentration [mg/ Nm}^3] = CO_2\text{-concentration [ppmv]} * \frac{44.01[g / mol]}{22.41[l / mol]}}$$

Con_{CO i}: CO-concentration in the exhaust gas at point of time i. In case the measurement equipment provides the CO-concentration as volume concentration in [ppmv], conversion to mass concentration [mg/ Nm³] shall be calculated by the following equation valid under standard conditions:

$$\underline{CO\text{-concentration [mg/ Nm}^3] = CO\text{-concentration [ppmv]} * \frac{28.01[g / mol]}{22.41[l / mol]}}$$

CO₂ and CO-concentration as well as the exhaust air flow are determined by continuous measurement according to the provision of section 7 of this Annex I and Annex XII.

Tier 1:

A total uncertainty of the annual emission level of less than ± 7.5 % shall be achieved.

Tier 2:

A total uncertainty of the annual emission level of less than ± 5.0% shall be achieved.

Tier 3:

A total uncertainty of the annual emission level of less than ± 2.5 % shall be achieved.

Tier 4:

A total uncertainty of the annual emission level of less than ± 1.5 % shall be achieved.

a) Activity data:

Tier 1:

~~Amount of coke [t] burned from catalyst during reporting period, based on industry best practice guidelines for the specific process.~~

Tier 2:

~~Amount of coke [t] burned from catalyst during reporting period, as calculated from the heat and material balance over the catalytic cracker.~~

b) Emission factor:**Tier 1:**

~~Activity specific emission factor [t CO₂/t coke] based on the carbon content of the coke derived in accordance with the provisions of section 10 in Annex I.~~

c) Conversion factor:**Tier 1:**

~~Conversion factor: 1.0~~

2. Cokers

~~CO₂ vents from the coke burners of fluid cokers and flexi cokers shall be calculated as follows:~~

$$\text{CO}_2 \text{ emissions} = \text{activity data} * \text{emission factor}$$

~~With:~~

a) Activity data:**Tier 1:**

~~Amount of coke [t] produced during reporting period, derived by weighing with a maximum permissible uncertainty of $\pm 5.0\%$ for the metering process.~~

Tier 2:

~~Amount of coke [t] produced during reporting period, derived by weighing with a maximum permissible uncertainty of $\pm 2.5\%$ for the metering process.~~

b) Emission factor:**Tier 1:**

~~Specific emission factor [t CO₂/t coke] based on industry best practice guidelines for the specific process.~~

Tier 2:

~~Specific emission factor [t CO₂/t coke] derived based on the measured CO₂ content in off-gases with the provisions of section 10 of Annex I.~~

3.2. Refinery Hydrogen Production

The CO₂-emitted stems from the carbon content of the feed gas. An input-based calculation of CO₂-emissions shall be carried out.

$$\text{CO}_2 \text{ emissions} = \text{activity data}_{\text{input}} * \text{emission factor}$$

With:

a) Activity data:

Tier 1:

Amount of hydrocarbon feed [t feed] processed during the reporting period, derived ~~by volume metering~~ with a maximum ~~permissible~~ uncertainty of $\pm 7.5\%$ ~~for the metering process~~.

Tier 2:

Amount of hydrocarbon feed [t feed] processed during the reporting period, derived ~~by volume metering~~ with a maximum ~~permissible~~ uncertainty of $\pm 2.5\%$ ~~for the metering process~~.

i) ~~b)~~ B) emission factor:

Tier 1:

Use a reference value of 2.9 t CO₂ per t feed processed conservatively based on ethane.

Tier 2:

Use of an activity-specific emission factor [CO₂/ t feed] calculated from the carbon content of the feed gas, determined according to section ~~4014~~ of Annex I.

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of emissions of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex IV: Activity-Specific Guidelines for Coke Ovens as Listed in Annex I to the Directive

j) 1. Boundaries and completeness

Coke ovens can be part of steel works with a direct technical connection to sintering installations and installations for the production of pig iron and steel including continuous casting, causing an intensive energy and material exchange (for example blast furnace gas, coke oven gas, coke) to take place in regular operation. If the installation's permit according to Article 4, 5 and 6 of the Directive encompasses the entire steel works and not solely the coke oven, the CO₂-emissions may also be monitored for the integrated steel works as a whole, using the mass balance approach specified in section 2.1.1 of this Annex.

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In coke ovens, CO₂ emissions result from the following [emission sources and source streams](#):

- raw materials (coal or petrol coke)
- conventional fuels (e.g. natural gas)
- process gases (e.g. blast furnace gas (BFG))
- other fuels
- waste gas scrubbing

2.1 Calculation of CO₂ Emissions

In case the coke oven is part of an integrated steelworks, the operator may calculate emissions:

[k\) a\)](#) for the integrated steelworks as a whole, using the mass balance approach, or

[l\) b\)](#) for the coke oven as individual activity of the integrated steelworks.

2.1.1 Mass Balance Approach

The mass balance approach shall analyse all carbon in inputs, accumulations, inclusion in products and exports to account for the [installation's](#) emissions of greenhouse gases, using the following equation:

CO₂-emissions [t CO₂] = (input – products – export – stock changes) * conversion factor CO₂/C

With

- **Input [tC]:** all carbon entering the boundaries of the installation
- **Products [tC]:** all carbon in products and materials, including by-products, leaving the boundaries of the mass balance
- **Export [tC]:** carbon exported from the boundaries of the mass balance, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases into the atmosphere.
- **Stock changes [tC]:** Stock increases of carbon within the boundaries of the installation.

The calculation shall then be as follows:

CO₂-emissions [t CO₂] =

$$\begin{aligned}
 & (\Sigma (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \Sigma (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \Sigma \\
 & (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \Sigma (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) \\
 & \quad * 3.6674
 \end{aligned}$$

With

m) a) Activity data

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the the energy content [t C/TJ] of the respective mass flow for the calculation of the mass balance.

Tier 1

Annual activity data ~~For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±7.5% annually for the metering process measurement of activity data. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5% for the metering process.~~

Tier 2

Annual activity data ~~For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±5% annually for the metering process measurement of activity data. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5% for the metering process.~~

Tier 3

~~Annual activity data For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±2.5% annually for the metering process measurement of activity data.~~

Tier 4

~~Annual activity data For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±1.5% annually for the metering process measurement of activity data.~~

n) b) Carbon content

Tier 1

The carbon content of input or output streams shall be derived from standard emission factors for fuels or materials named in Section 12 of Annex I or the Annexes II-XI. The carbon content is derived as follows:

$$\text{C-Cont [t / t or TJ]} = \frac{\text{Emission factor [t CO}_2 \text{ / t or TJ]}}{3.667 \text{ [t C / t CO}_2 \text{]}}$$

Tier 2

The carbon content of input or output stream shall be derived following ~~When calculating the mass balance the operator shall follow~~ the provisions of section 4014 of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

The carbon content of products or semi-finished products may be determined based on annual analyses following the provisions of section 4014 of Annex I or be derived from mid-range composition values as specified by relevant international or national standards.

e) Energy content

Tier 1

~~For the purpose of consistent reporting the energy content of each of the fuel and material streams (expressed as net calorific value of the respective streams) shall be calculated.~~

2.1.2 Combustion emissions

Combustion processes taking place at coke ovens where fuels (e.g. coke, coal, and natural gas) are not used as reducing agents or do not stem from metallurgical reactions shall be monitored and reported in accordance with Annex II.

2.1.3 Process emissions

During carbonisation in the coke chamber of the coke oven, coal is converted under the exclusion of air to coke and crude coke oven gas (crude COG). The main carbon containing input material/input streams is coal, but may also be coke slack, petrol coke, oil and process

gases such as blast furnace gas. The crude coke oven gas, as part of the process output, contains many carbon containing components, amongst other carbon dioxide (CO₂), carbon monoxide (CO), methane (CH₄), hydrocarbons (C_xH_y).

Total CO₂ emission from coke ovens shall be calculated as follows:

$$\text{CO}_2\text{-emission [t CO}_2\text{]} = \Sigma (\text{activity data}_{\text{INPUT}} * \text{emission factor}_{\text{INPUT}}) - \Sigma (\text{activity data}_{\text{OUTPUT}} * \text{emission factor}_{\text{OUTPUT}})$$

With:

o) a)—Activity data

Activity data_{INPUT} can comprise coal as raw material, coke slack, petrol coke, oil, blast furnace gas, coke oven gas and alike. Activity data_{OUTPUT} can comprise: coke, tar, light oil, coke oven gas and alike.

A1) Fuel employed as process input

Tier 1:

The mass flow of fuels into and from the installation over a reporting period is determined ~~applying metering devices resulting in a~~ with a maximum ~~permissible~~ uncertainty of less than $\pm 7.5\%$ ~~for the metering process~~.

Tier 2:

The mass flow of fuels into and from the installation over a reporting period is determined ~~applying metering devices resulting in~~ with a maximum ~~permissible~~ uncertainty of less than $\pm 5.0\%$ ~~for the metering process~~.

Tier 3:

The mass flow of the fuel into and from the installation over a reporting period is determined ~~applying metering devices resulting in~~ with a maximum ~~permissible~~ uncertainty of less than $\pm 2.5\%$ ~~for the metering process~~.

Tier 4 :

The mass flow of the fuel into and from the installation over a reporting period is determined ~~applying metering devices resulting in~~ with a maximum ~~permissible~~ uncertainty of less than $\pm 1.0\%$ 1.5 % ~~for the metering process~~.

A2) Net calorific value

Tier 1:

The operator applies country specific net calorific values for the respective fuel as listed in Appendix 2.1 A.3 “1990 country specific net calorific values” of the 2000 IPCC “Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (<http://www.ipcc.ch/pub/guide.htm>).

Tier 2:

The operator applies country specific net calorific values for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 3:

The net calorific value representative for each batch of fuel in an installation is measured by the operator, a contracted laboratory or the fuel supplier in accordance with the provisions of section ~~4014~~ of Annex I.

~~p) b)~~ B) emission factor

Tier 1:

Use of reference factors from the below table or section ~~8-12~~ of Annex I:

Table 1: Emission factors for process gases (including CO₂ component in fuel)²⁸

	emission factor [t CO ₂ /TJ]	source of data
coke oven gas (COG)	47.7	IPCC 1996 GL
blast furnace Gas (BFG)	241.82	IPCC 1996 GL

Tier 2:

Specific emission factors are determined in accordance with the provisions of section ~~4014~~ of Annex I.

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

²⁸ Values are based on IPCC factors expressed in tC/TJ, multiplied with a CO₂/C-conversion factor of 3.6674. See IPCC, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2; 1997.

Annex V: Activity-Specific Guidelines for Metal Ore Roasting and Sintering Installations as Listed in Annex I to the Directive

g) 1. Boundaries and completeness

Metal ore roasting ~~and~~ sintering or pelletisation installations can form an integral part of steel works with a direct technical connection to coke ovens and installations for the production of pig iron and steel including continuous casting. Thus an intensive energy and material exchange (e.g. blast furnace gas, coke oven gas, coke, limestone) takes place in regular operation. If the installation's permit according to Article 4, 5 and 6 of the Directive encompasses the entire steel works and not solely the roasting or sintering installation, the CO₂-emissions may also be monitored for the integrated steel works as a whole. In such cases the mass balance approach (section 2.1.1 of this Annex) may be used.

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In metal ore roasting and sintering installations, CO₂ emissions result from the following emission sources and source streams:

- raw materials (calcination of limestone and dolomite)
- conventional fuels (natural gas and coke/coke breeze)
- process gases (e.g. coke oven gas(COG) and blast furnace gas(BFG))
- process residues used as input material including filtered dust from the sintering plant, the converter and the blast furnace.
- other fuels
- waste gas scrubbing

2.1 Calculation of CO₂ Emissions

Operator may calculate emissions using either the mass balance approach or for every source stream source of the installation.

2.1.1 Mass Balance Approach

The mass balance approach shall analyse all carbon in inputs, accumulations, inclusion in products and exports to account for the installation's emissions of greenhouse gases, using the following equation:

CO₂-emissions [t CO₂] = (input – products – export – stock changes) * conversion factor CO₂/C

With

- **Input [tC]:** all carbon entering the boundaries of the installation

- **Products [tC]:** all carbon in products and materials, including by-products, leaving the boundaries of the mass balance
- **Export [tC]:** carbon exported from the boundaries of the mass balance , e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases into the atmosphere.
- **Stock changes [tC]:** Stock increases of carbon within the boundaries of the installation. [Definition wie oben](#)

The calculation shall then be as follows:

CO₂-emissions [t CO₂] =

$$(\Sigma (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \Sigma (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \Sigma (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \Sigma (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) * 3.6674$$

With

r) a) Activity data

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. [Where the carbon content of a mass flow is usually related to energy content \(fuels\), the operator may determine and use the carbon content related to the energy content \[t C/TJ\] of the respective mass flow for the calculation of the mass balance.](#)

Tier 1

~~Activity data over the reporting period For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±7.5% annually for the metering process measurement of activity data. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5% for the metering process.~~

Tier 2

~~Activity data over the reporting period For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±5% annually for the metering process measurement of activity data. All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5% for the metering process.~~

Tier 3

~~Activity data over the reporting period~~For a sub-set of fuels and materials mass flows into and from the installation are determined ~~applying metering devices~~~~measurement systems~~ resulting ~~in with~~ a maximum ~~permissible~~ uncertainty of less than $\pm 2.5\%$ ~~annually for the metering process~~~~measurement of activity data~~.

Tier 4

~~Activity data over the reporting period~~For a sub-set of fuels and materials mass flows into and from the installation are determined ~~applying metering devices~~~~measurement systems~~ resulting ~~in with~~ a maximum ~~permissible~~ uncertainty of less than $\pm 1.5\%$ ~~annually for the metering process~~~~measurement of activity data~~.

s) b) Carbon content

Tier 1

The carbon content of input or output streams is derived from standard emission factors for fuels or materials named in Section 12 of Annex I or the Annexes II-XI. The carbon content is derived as follows:

$$\text{C-Cont [t / t or TJ]} = \frac{\text{Emission factor [t CO}_2 \text{ / t or TJ]}}{3.667 \text{ [t C / t CO}_2 \text{]}}$$

Tier 2

When calculating the mass-balance the operator shall follow the provisions of section ~~4014~~ of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

The carbon content of products or semi-finished products may be determined based on annual analyses following the provisions of section ~~4014~~ of Annex I or be derived from mid-range composition values as specified by relevant international or national standards.

e) Energy content

~~For the purpose of consistent reporting, the energy content of each of the fuel and material streams (expressed as net calorific value of the respective streams) shall be calculated.~~

2.1.2 Combustion emissions

Combustion processes that take place at metal ore roasting and sintering installations shall be monitored and reported in accordance with Annex II.

2.1.3 Process emissions

During calcination on the grate CO₂ is released from the input materials, i.e. the raw mix (commonly from calcium carbonate) and from reemployed process residues. For each type of input material used the amount of CO₂ shall be calculated as follows:

$$\text{CO}_2\text{-emissions} = \Sigma \{ \text{activity data}_{\text{process input}} * \text{emission factor} * \text{conversion factor} \}$$

t) a) Activity data

Tier 1:

Amounts [t] of carbonate input material [t_{CaCO_3} , t_{MgCO_3} or $t_{\text{CaCO}_3\text{-MgCO}_3}$] and process residues used as input material ~~employed~~ in the process ~~over a reporting period as weighed~~ by ~~the~~ operator or ~~his~~ suppliers with a maximum ~~permissible~~ uncertainty of less than $\pm 5.0\%$ ~~for the metering process~~.

Tier 2:

Amounts [t] of carbonate input material [t_{CaCO_3} , t_{MgCO_3} or $t_{\text{CaCO}_3\text{-MgCO}_3}$] and process residues used as input material employed in the process ~~over a reporting period as weighed~~ by ~~the~~ operator or ~~his~~ suppliers with a maximum ~~permissible~~ uncertainty of less than $\pm 2.5\%$ ~~for the metering process~~.

~~u) b)~~ — B) emission factor

Tier 1:

For carbonates: use of stoichiometric ratios given in the following table 1:

Table 1: Stoichiometric emission factors

emission factor	
CaCO ₃	0.440 t CO ₂ /t CaCO ₃
MgCO ₃	0.522 t CO ₂ /t MgCO ₃

These values shall be adjusted for the respective moisture and gangue content of the applied carbonate material.

For process residues: activity-specific factors shall be determined according to the provisions of section ~~4014~~ of Annex I.

~~v) e)~~ — Conversion factor

Tier 1:

Conversion factor: 1.0

Tier 2:

Activity specific factors determined according to the provisions of section ~~4014~~ of Annex I, determining the amount of carbon in the sinter produced and in filtered dust. In case filtered dust is reemployed in the process, the amount of carbon [t] contained shall not be accounted for in order to avoid double counting.

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex VI: Activity-Specific Guidelines for Installation for the Production of Pig Iron and Steel including Continuous Casting as Listed in Annex I to the Directive

w) 1. Boundaries and completeness

The guidelines in this Annex encompass emissions from installations for the production of pig iron, ~~and~~ steel and ferroalloys, including continuous casting. They refer in particular to primary (~~blast furnace (BF) and basic oxygen furnace (BOF)~~) and secondary (~~electric arc furnace (EAF)~~) steel production.

Installations for the production of pig iron and steel including continuous casting are generally integral parts of steel works with a technical connection to coke ovens and sinter installations. Thus an intensive energy and material exchange (e.g. blast furnace gas, coke oven gas, coke, limestone) takes place in regular operation. If the installation's permit according to Article 4, 5 and 6 of the Directive encompasses the entire steel works and not solely the blast furnace, the CO₂-emissions may also be monitored for the integrated steel works as a whole. In such cases the mass balance approach as presented in section 2.1.1 of this Annex may be used.

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In installations for the production of pig iron and steel including continuous casting, CO₂-emissions result from the following emission sources and source streams:

- raw materials (calcination of limestone or dolomite)
- conventional fuels (natural gas, coal and coke)
- reducing agents (coke, coal, plastics, etc.)
- process gases (coke oven gas/COG, blast furnace gas/BFG and basic oxygen furnace gas/BOFG)
- consumption of graphite electrodes
- other fuels
- waste gas scrubbing

2.1 Calculation of CO₂ Emissions

Operator may calculate emissions using either the mass balance approach or for every source stream of the installation.

2.1.1 Mass Balance Approach

The mass balance approach shall analyse all carbon in inputs, accumulations, inclusion in products and exports to account for the installation's emissions of greenhouse gases, using the following equation:

$$\text{CO}_2\text{-emissions [t CO}_2\text{]} = (\text{input} - \text{products} - \text{export} - \text{stock changes}) * \text{conversion factor CO}_2\text{/C}$$

With

- **Input [tC]:** all carbon entering the boundaries of the installation
- **Products [tC]:** all carbon in products and materials, including by-products, leaving the boundaries of the mass balance
- **Export [tC]:** carbon exported from the boundaries of the mass balance, e.g. discharged to sewer, deposited into landfill or through losses. Export does not include the release of greenhouse gases into the atmosphere.
- **Stock changes [tC]:** Stock increases of carbon within the boundaries of the installation.

The calculation shall then be as follows:

$$\text{CO}_2\text{-emissions [t CO}_2\text{]} =$$

$$\begin{aligned} & (\Sigma (\text{activity data}_{\text{input}} * \text{carbon content}_{\text{input}}) - \Sigma (\text{activity data}_{\text{products}} * \text{carbon content}_{\text{products}}) - \Sigma \\ & (\text{activity data}_{\text{export}} * \text{carbon content}_{\text{export}}) - \Sigma (\text{activity data}_{\text{stock changes}} * \text{carbon content}_{\text{stock changes}})) \\ & * 3.667 \end{aligned}$$

With

x) a) Activity data

The operator shall analyse and report the mass flows into and from the installation and respective stock changes for all relevant fuels and materials separately. Where the carbon content of a mass flow is usually related to energy content (fuels), the operator may determine and use the carbon content related to the the energy content [t C/TJ] of the respective mass flow for the calculation of the mass balance.

Tier 1

Activity data over the reporting period ~~For a sub-set of fuels and materials mass flows into and from the installation~~ are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±7.5%% annually for the metering process measurement of activity data. ~~All other fuel and material mass flows into and from the installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than ±2.5% for the metering process.~~

Tier 2

Activity data over the reporting period ~~For a sub-set of fuels and materials mass flows into and from the installation~~ are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than ±5%% annually for the metering process measurement of activity data. ~~All other fuel and material mass flows into and from the~~

~~installation are determined applying metering devices resulting in a maximum permissible uncertainty of less than $\pm 2.5\%$ for the metering process.~~

Tier 3

~~Activity data over the reporting period For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than $\pm 2.5\%$ annually for the metering process measurement of activity data.~~

Tier 4

~~Activity data over the reporting period For a sub-set of fuels and materials mass flows into and from the installation are determined applying metering devices measurement systems resulting in with a maximum permissible uncertainty of less than $\pm 1.5\%$ annually for the metering process measurement of activity data.~~

y) ~~b)~~ Carbon content

Tier 1

The carbon content of input or output streams is derived from standard emission factors for fuels or materials named in Section 12 of Annex I or the Annexes II-XI. The carbon content is derived as follows:

$$\text{C-Cont [t / t or TJ]} = \frac{\text{Emission factor [t CO}_2 \text{ / t or TJ]}}{3.667 \text{ [t CO}_2 \text{/t C]}}$$

Tier 2

When calculating the mass-balance the operator shall follow the provisions of section ~~4014~~ of Annex I in respect to representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction.

The carbon content of products or semi-finished products may be determined based on annual analyses following the provisions of section ~~4014~~ of Annex I or be derived from mid-range composition values as specified by relevant international or national standards.

~~e)~~ Energy content

Tier 1

~~For the purpose of consistent reporting, the energy content of each of the fuel and material streams (expressed as net calorific value of the respective streams) shall be calculated.~~

2.1.2 Combustion emissions

Combustion processes taking place at installations for the production of pig iron and steel including continuous casting where fuels (e.g. coke, coal, and natural gas) are not used as reducing agents or do not stem from metallurgical reactions shall be monitored and reported in accordance with Annex II.

2.1.3 Process emissions

Installations for the production of pig iron and steel including continuous casting are normally characterized by a sequence of facilities (e.g. blast furnace, basic oxygen furnace, ~~hot rolling mill~~) and these facilities frequently have technical connections to other installations (e.g. coke oven, sinter installation, power installation). Within such installations a number of different fuels are used as reducing agents. Generally these installations also produce process gases of different compositions, e.g. coke oven gas/COG, blast furnace gas/BFG, basic oxygen furnace gas/BOFG).

Total CO₂-emissions from pig iron and steel installations including continuous casting shall be calculated as follows:

$$\text{CO}_2\text{-emission [t CO}_2\text{]} = \Sigma (\text{activity data}_{\text{INPUT}} * \text{emission factor}_{\text{INPUT}}) - \Sigma (\text{activity data}_{\text{OUTPUT}} * \text{emission factor}_{\text{OUTPUT}})$$

With:

~~z) a)~~ — Activity data

a1) Fuel employed

Tier 1:

The annual mass flow of the fuel into and from the installation is determined applying metering devices resulting in with a maximum permissible uncertainty of less than $\pm 7.5\%$ ~~for the metering process~~.

Tier 2:

The annual mass flow of the fuel into and from the installation is determined applying metering devices resulting in with a maximum permissible uncertainty of less than $\pm 5.0\%$ ~~for the metering process~~.

Tier 3:

The annual mass flow of the fuel into and from the installation is determined applying metering devices resulting in with a maximum permissible uncertainty of less than $\pm 2.5\%$ ~~for the metering process~~.

Tier 4:

The annual mass flow of the fuel into and from the installation is determined applying metering devices resulting in with a maximum permissible uncertainty of less than $\pm 1.0\%$ 1.5% ~~for the metering process~~.

A2) Net calorific value (if applicable)

Tier 1:

The operator applies country specific net calorific values for the respective fuel as listed in Appendix 2.1 A.3 “1990 country specific net calorific values” of the 2000 IPCC “Good

Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (<http://www.ipcc.ch/pub/guide.htm>).

Tier 2:

The operator applies country specific net calorific values for the respective fuel as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 3:

The net calorific value representative for each batch of fuel in an installation is measured by the operator, a contracted laboratory or the fuel supplier in accordance with the provisions of section ~~40~~14 of Annex I.

b) Emission factor

The emission factor for the activity data_{OUTPUT} refers to the amount of non-CO₂-carbon in process output, which is expressed as tCO₂/t output to enhance comparability.

Tier 1:

Reference factors for input and output material from see Tables 1 and 2 below and section ~~8~~ 12 of Annex I).

Table 1: Reference emission factors for input material²⁹

emission factor		Source of emission factor
Coke Oven Gas	47.7 t CO ₂ /TJ	IPCC 1996 GL
Blast Furnace Gas	241.8 2 t CO ₂ /TJ	IPCC 1996 GL
basic oxygen furnace gas (BOFG)	186.6 t CO ₂ /TJ	WBCSD/WRI
graphite electrodes	3.60 t CO ₂ /t electrode	WBCSD/WRI IPCC
steel scrap, steel products	0.0147 [t CO₂/t]	WBCSD/WRI
PET	2.24 t CO ₂ /t PET	WBCSD/WRI
PE	2.85 t CO ₂ /t PE	WBCSD/WRI
CaCO ₃	0.440 t CO ₂ /t CaCO ₃	Stoichiometric ratio
CaCO ₃ -MgCO ₃	0.477 t CO ₂ /t CaCO ₃ -MgCO ₃	Stoichiometric ratio

²⁹ ~~Values are based on IPCC~~IPCC based values stem from factors expressed in tC/TJ, multiplied with a CO₂/C-conversion factor of 3.6674. See IPCC, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2; 1997. For WBCSD/WRI based values see WBCSD/WRI; Calculating Direct GHG Emissions from the Production of Iron & Steel. Calculation Worksheets. June 2002. Version 1.0; 2002.

Table 2: Reference emission factor for output material (based on carbon content)

emission factor [t CO ₂ /t]		Source of emission factor
Ore	0	WBCSD/WRI/PC
pig iron, pig iron scrap, iron products	0.1467	WBCSD/WRI/PC
steel scrap, steel products	0.0147	WBCSD/WRI/PC

Tier 2:

Specific emission factors (t CO₂/t_{INPUT} or t_{OUTPUT}) for input and output materials, developed in accordance with the provisions of section [4014](#) of Annex I.

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ emissions

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex VII: Activity-Specific guidelines for Installations for the Production of Cement Clinker as Listed in Annex I to the Directive

aa) 1. Boundaries and completeness

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In cement installations, CO₂ emissions result from the following [emission sources and source streams](#):

- calcination of limestone in the raw materials
- conventional fossil kiln fuels
- alternative fossil-based kiln fuels and raw materials
- biomass kiln fuels (biomass wastes)
- non kiln fuels
- [organic carbon content of limestone and shales](#)
- [raw materials used for](#) waste gas scrubbing

2.1 Calculation of CO₂ Emissions

2.1.1 Combustion emissions

Combustion processes involving different types of fuels (e.g. coal, petcoke, fuel oil, natural gas and the broad range of waste fuels) that take place at installations for the production of cement clinker shall be monitored and reported in accordance with Annex II. ~~Emissions from the combustion of the organic content of (alternative) raw materials shall also be calculated according to Annex II.~~

In cement kilns the incomplete combustion of fossil fuels is negligible, due to the very high combustion temperatures, long residence time in kilns and minimal residual carbon found in clinker. Carbon in all kiln fuels shall therefore be accounted for as fully oxidized (oxidation factor = 1.0).

2.1.2 Process emissions

~~During calcination in the kiln, CO₂ from carbonates is released from the raw mix. Calcination CO₂ is directly linked with clinker production.~~ Process related CO₂ emissions occur from the calcination of carbonates in the raw materials used to produce the clinker (2.1.2.1), from the partial or full calcination of cement kiln dust or bypass dust removed from the process (2.1.2.2) and in some instances in significant quantities from the ~~organic~~ non-carbonate carbon content of raw materials (2.1.2.3).

2.1.2.1 CO₂ from Clinker Production

~~Calcination CO₂ shall be calculated based on the amounts of clinker produced and the CaO and MgO contents of clinker. The emission factor shall be corrected for already calcined Ca and Mg entering the kiln, for instance through fly ash or alternative fuels and raw materials with a relevant CaO content (e.g. sewage sludge).~~

Emissions shall be calculated based on the carbonate content of the process input (calculation method A) or on the amount of clinker produced (calculation method B). These approaches are considered equivalent and should can be mutually used by the operator to validate the results of the respective other method. -

Calculation method A: Carbonates Kiln input based

Calculation shall be based on the carbonate content of process inputs (including fly-ash or blast furnace slag) with cement kiln dust (CKD) and bypass dust deducted from raw material consumption and respective emissions calculated according to section 2.1.2.2., in the case CKD is discarded. Non-carbonate carbon is captured by this method thus 2.1.2.3. does not apply.-

CO₂ shall be calculated with the following formula:

$$\text{CO}_2\text{-emissions}_{\text{clinker}} = \text{Activity data} * \text{Emission factor} * \del{\text{Conversion factor}}$$

With

bb) a) Activity data

These requirements apply separately to each of the relevant carbon-bearing kiln inputs (other than fuels) e.g. limestone or shale, avoiding double counting or omissions from returned or by-passed materials.

Tier 1:

The net amount of relevant kiln input [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±7.5 %.

Tier 2:

The net amount of relevant kiln input [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±5.0 %.

~~Amount of pure carbonates (e.g. limestone) contained in the raw meal [t] as process input employed during the reporting period, determined by weighing the raw meal with a maximum permissible uncertainty of less than ±5.0%. The determination of the amount of carbonates from the composition of relevant raw material is characterised by industry best practice guidelines.~~

Tier 3:

The net amount of relevant kiln input [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±2.5 %.

~~Amount of pure carbonates (e.g. limestone) contained in the raw meal [t] as process input employed during the reporting period, determined by weighing the raw meal with a maximum permissible uncertainty of less than ±2.5%. The determination of the amount of carbonates~~

~~from the composition of relevant raw material is determined by the operator according to section 10 of Annex I.c~~

b) Emission factor

Tier 1:

The determination of the amount of carbonates and other relevant sources of CO₂ in the kiln (other than fuels) in each relevant input material is carried out according to section 4.14 of Annex I. Stoichiometric ratios shall be applied for carbonates in process input kiln inputs as shown in table 1 below.

Table 1: Stoichiometric emission factors

Carbonates	Emission factor
CaCO ₃	0.440 [t CO ₂ / CaCO ₃]
MgCO ₃	0.522 [t CO ₂ / MgCO ₃]

Tier 1:

Carbonates and other carbon leaving the kiln in the clinker are conservatively set to zero i.e. assuming full calcination and oxidation.

Tier 2:

Carbonates and other carbon leaving the kiln in the clinker are considered appropriately in a modified emission factor leading to a closed carbon balance for the kiln.

~~e) Conversion factor:~~

Tier 1:

~~Conversion factor: 1.0~~

Calculation method B: ~~Clinker production~~ Clinker output based

This calculation method is based on the amount of clinker produced. CO₂ shall be calculated with the following formula:

$$\text{CO}_2\text{-emissions}_{\text{clinker}} = \text{Activity data} * \text{Emission factor} * \text{Conversion factor}$$

If emission estimates are based on clinker output, CO₂ released from the calcination of cement kiln dust (~~CKD~~) and bypass dust need to be considered for installations where such dust is discarded (see 2.1.2.2) along with potential emissions from non-carbonate carbon in the raw materials (see 2.1.2.3). Emissions from clinker production and from cement kiln dust and bypass dust shall be calculated separately and added up to the emission total:

$$\text{CO}_2\text{-emissions}_{\text{process_total}} [t] = \text{CO}_2\text{-emissions}_{\text{clinker}} [t] + \text{CO}_2\text{-emissions}_{\text{dust}} [t] + \text{CO}_2\text{-emissions}_{\text{non-carbonate carbon}}$$

Emissions related to clinker output

a) Activity data:

~~Amount of clinker [t] produced in the reporting period. The clinker production [t] over the reporting period is calculated from cement deliveries using the following formula (material balance taking into account dispatch of clinker, clinker supplies as well as clinker stock variation):~~

~~clinker produced [t] =~~

$$\begin{aligned} & \text{(cement deliveries [t] * clinker/cement ratio [t clinker/t cement]) - (clinker supplied [t]) +} \\ & \text{(clinker dispatched [t]) - (clinker stock variation [t])} \end{aligned}$$

~~The cement/clinker ratio shall either be derived for each of the different cement products based on the provisions of section 4014 of Annex I or be calculated from the difference of cement deliveries and all materials used as additives to the cement including an appropriate consideration of by-pass dust and cement kiln dust.~~

Tier 1:

~~The Amount of clinker produced [t] over a reporting period [t] is derived by weighing with an permissible uncertainty of less than ±5.0 5 % for the metering process.~~

Tier 2a:

~~The amount of clinker produced [t] over a reporting period is derived with an uncertainty of less than ±2.5 %.~~

~~Amount of clinker produced [t] derived by weighing with a permissible uncertainty of less than ±2.5 % for the metering process.~~ **Tier 2b:**

b) Emission factor:

Tier 1:

Emission factor: 0.525 t CO₂/t clinker

Tier 2:

The operator applies a country specific emission factor as reported by the respective Member State in its latest national inventory submitted to the Secretariat of the United Nations Framework Convention on Climate Change.

Tier 3:

The emission factor is calculated from a CaO- and MgO-balance, assuming that part of these were not derived from conversion of carbonates but were already contained in the process input. CaO- and MgO originating from carbonates in fuels shall not be considered as a source streams leading to process emissions but be included in the emission factor for the fuel.

The composition of the clinker and the relevant raw materials is to be determined following the provisions of section 4.14 on Annex I.

The emission factor shall be calculated with the following equation:

Emission factor [t CO₂/t clinker] =

$$0.785 \left[\frac{\text{t CO}_2}{\text{t CaO}} \right] * (\text{Output}_{\text{CaO}} [\text{t CaO} / \text{t clinker}] - \text{Input}_{\text{CaO}} [\text{t CaO} / \text{t input material}] * \text{Rel}_{\text{IO}} [\text{t input material} / \text{t clinker}]) + 1.092 \left[\frac{\text{t CO}_2}{\text{t MgO}} \right] * (\text{Output}_{\text{MgO}} [\text{t MgO} / \text{t clinker}] - \text{Input}_{\text{MgO}} [\text{t MgO} / \text{t input material}] * \text{Rel}_{\text{IO}} [\text{t input material} / \text{t clinker}])$$

with

Output_{CaO}: –CaO fraction contained in clinker

Input_{CaO}: –CaO fraction contained in input materials

Output_{MgO}: –MgO fraction contained in clinker

Input_{MgO}: –MgO fraction contained in input materials

Rel_{IO}: – Amount of input material used per t clinker produced.

This equation uses the stoichiometric fraction of CO₂ for CaO and CO₂ for MgO shown in table 2 below.

Table 2: Stoichiometric emission factors for CaO and MgO (net production)

Oxides	Emission factor
CaO	0.785 [t CO ₂ /CaO]
MgO	1.092 [t CO ₂ /MgO]

e) Conversion factor:

Tier 1:

~~Conversion factor: 1.0~~

2.1.2.2 Emissions related to discarded dust

CO₂ from discarded bypass dust or cement kiln dust (CKD) shall be calculated based on discarded amounts of dust and the emission factor for clinker, corrected for partial calcination of CKD. Discarded bypass dust, as opposed to CKD, is considered fully calcined. Emissions shall be calculated as follows:

CO₂-emissions_{dust} = Activity data * Emission factor * ~~Conversion factor~~

With

a) Activity data:

Tier 1:

Amount [t] of CKD or bypass dust ~~(if relevant) [t]~~ discarded ~~during over a~~ reporting period estimated using industry best practice guidelines.

~~Derived by weighing with a permissible uncertainty of less than ±10% for the metering process.~~

Tier 2:

Amount [t] of CKD or bypass dust ~~(if relevant) [t]~~ discarded during ~~reporting over a~~ period derived ~~by weighing~~ with an permissible uncertainty of less than ~~±7.55.0% for the metering process.~~

b) Emission factor:

Tier 1:

Use of the reference value of 0.525 t CO₂ per ton clinker also for CKD.

Tier 2:

An emission factor [t CO₂ / t CKD] shall be calculated based on the degree of CKD calcination. The degree of calcination shall be determined at least annually following the provisions of section 140 of Annex I, where applicable. The relation between the degree of CKD calcination and the CO₂ emissions per ton of CKD is non-linear. It shall be approximated with the following formula:

$$EF_{CKD} = \frac{\frac{EF_{Cli} * d}{1 + EF_{Cli}}}{1 - \frac{EF_{Cli} * d}{1 + EF_{Cli}}}$$

where

EF_{CKD}

= emission factor of partially calcined cement kiln dust [t CO₂/t CKD]

EF_{cli}

= installation specific emission factor of clinker ([CO₂/t clinker]

DD

= degree of CKD calcination (released CO₂ as % of total carbonate CO₂ in the raw mix)

e) Conversion factor:

Tier 1:

Conversion factor: 1.0

2.1.2.3 Emissions connected from non-carbonate carbon in raw materials

Emissions from a potential significant content of organic non-carbonate carbon matter in limestone or shale shall be determined using the following expression:

CO₂-emissions_{organic raw} = Activity data * Emission factor*Conversion factor

With

a) Activity data:

Tier 1:

Amount of relevant raw material [t] consumed over a reporting period derived with an uncertainty of less than ±15%.

Tier 2:

Amount of relevant raw material [t] consumed over a reporting period derived with an uncertainty of less than ±7.5%.

b) Emission factor:

Tier 1:

The content of non-carbonate carbon in the relevant raw material shall be estimated using industry best practice guidelines.

Tier 2:

The content of organic non-carbonate carbon in the relevant raw material shall be determined at least annually following the provisions of section 1014 of Annex I.

c) Conversion factor

Tier 1: 1.0

Tier 2: At conversion factor shall be determined following the provisions of section 14 of Annex I.

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex VIII: Activity-Specific Guidelines for Installations for the Production of Lime as Listed in Annex I to the Directive

cc) 1. Boundaries and completeness

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In installations for the production of lime, CO₂ emissions result from the following [emission sources and source streams](#):

- calcination of limestone and dolomite in the raw materials
- conventional fossil kiln fuels
- alternative fossil-based kiln fuels and raw materials
- biomass kiln fuels (biomass wastes)
- other fuels
- [raw materials used for waste gas scrubbing](#)~~waste gas scrubbing~~

2.1 Calculation of CO₂ Emissions

2.1.1 Combustion emissions

Combustion processes involving different types of fuels (e.g. coal, petcoke, fuel oil, natural gas and the broad range of waste fuels) that take place at installations for the production of lime shall be monitored and reported in accordance with Annex II. Emissions from the combustion of the organic content of (alternative) raw materials shall also be calculated according to Annex II.

2.1.2. Process emissions

During calcination in the kiln, CO₂ from carbonates is released from the raw materials. Calcination CO₂ is directly linked with the lime production. On installation level, calcination CO₂ can be calculated in two ways: based on the amount of ~~carbonates~~ [calcium and magnesium carbonate](#) from the raw material (mainly limestone ~~and~~, dolomite) converted in the process (**calculation method A**), or based on the amount of ~~earth-alkali~~ [calcium and magnesium](#) oxides in the lime produced (**calculation method B**). The two approaches are considered to be equivalent [and can be mutually used by the operator to validate the results of the respective other method](#).

·

Calculation method A: Carbonates

~~Calculation shall be based on the amount of carbonates (calcium carbonate, magnesium carbonate) consumed. The following formula shall be used:~~

$$\text{CO}_2\text{-emission [t CO}_2\text{]} = \sum \{(\text{Activity data}_{\text{Carbonate-INPUT}} - \text{Activity data}_{\text{Carbonate-OUTPUT}}) * \text{emission factor x conversion factor}\}$$

with

dd) a) Activity data

~~Activity data_{Carbonate-INPUT} and activity data_{Carbonate-OUTPUT} are the amounts [t] of CaCO₃, and MgCO₃ or other alkali earth or earth alkali carbonates employed during the reporting period.~~

These requirements apply separately to each of the relevant carbon-bearing kiln inputs (other than fuels) e.g. limestone, avoiding double counting or omissions from returned or by-passed materials.

Tier 1:

The amount of relevant kiln input [t] consumed during the reporting period is determined by the operator with a maximum uncertainty of less than ±7.5%.

Tier 2:

The amount of relevant kiln input [t] consumed during the reporting period is determined by the operator with a maximum uncertainty of less than ±5.0%.

~~Amount of pure CaCO₃ and MgCO₃ earth alkali carbonates (e.g. limestone) [t] in process input and the product during the reporting period, determined by weighing with maximum permissible uncertainty of less than ±5.0% for the metering process of the raw material. The composition of relevant raw material and the product is characterised by industry best practice guidelines.~~

Tier 3:

The amount of relevant kiln input [t] consumed during the reporting period is determined by the operator with a maximum uncertainty of less than ±2.5%.

Tier 2:

~~Amount of pure CaCO₃ and MgCO₃ earth alkali carbonates (e.g. limestone) [t] in process input and the product during the reporting period, determined by weighing with maximum permissible uncertainty of less than ±2.5% for the metering process of the raw material. The composition of relevant raw material and the product is determined by the operator according to section 10 of Annex I.~~

b) Emission factor

The determination of the amount of CaCO₃ and MgCO₃ in each relevant kiln input material is carried out according to section 10 of Annex I.

Stoichiometric ratios shall be applied for carbonates in kiln inputs as shown in table 1 below.

Table 1: Stoichiometric emission factors

<u>Carbonates</u>	<u>Emission factor</u>
<u>CaCO₃</u>	<u>0.440 [t CO₂/ CaCO₃]</u>
<u>MgCO₃</u>	<u>0.522 [t CO₂/ MgCO₃]</u>

Tier 1:

Carbonates leaving the kiln are conservatively assumed to be zero i.e. assuming full calcination.

Tier 2:

Carbonates leaving the kiln are considered appropriately in a modified emission factor leading to a closed carbon balance for the kiln.

.

b) Emission factor

Tier 1:

Stoichiometric ratios of carbonates in process input and output as shown in table 1.

Table 1: Stoichiometric emission factors

<u>Carbonate</u>	<u>Emission factor</u> <u>[t CO₂/t Ca-, Mg- or other Carbonate]</u>	<u>Remarks</u>
<u>CaCO₃</u>	<u>0.440</u>	
<u>MgCO₃</u>	<u>0.522</u>	

e) Conversion factor

Tier 1:

Conversion factor: 1.0

Calculation method B: Alkali Earth Oxides

CO₂ shall be calculated based on the amounts of CaO ~~and~~, MgO ~~and other earth alkali earth /alkali oxide~~ contents in the lime produced. Already calcined Ca and Mg entering the kiln, for instance through fly ash or ~~alternative~~ fuels and raw materials with a relevant CaO or MgO content shall be considered appropriately.

The following calculation formula shall be used:

$$\text{CO}_2\text{-emission [t CO}_2\text{]} = \sum \{((\text{activity data}_{\text{Alkali-oxides-OUTPUT}} - \text{activity data}_{\text{Alkali-oxides-INPUT}}) * \text{emission factor} * \text{conversion factor})\}$$

with

Tier 1:

Amount of lime [t] produced during the reporting period is determined by the operator with a maximum uncertainty of less than ±5.0%

Tier 2:

Amount of lime [t] produced during the reporting period is determined by the operator with a maximum uncertainty of less than ±2.5%

Emission factors:

The determination of the amount of CaO and MgO in the product is carried out according to section 4014 of Annex I.

Stoichiometric ratios of oxides shall be used as shown in table 2.

Table 2: Stoichiometric emission factors

<u>Carbonate</u>	<u>Emission factor</u> <u>[t CO₂] / [t Earth Alkali Oxide]</u>
<u>CaO</u>	<u>0.785</u>
<u>MgO</u>	<u>1.092</u>

Tier 1:

CaO and MgO in the raw materials are conservatively assumed to be zero i.e. all Ca and Mg in the product is assumed to have originated from carbonate raw materials.

Tier 2:

The amount of CaO and MgO in the raw materials is considered appropriately in a modified emission factor.**a) Activity data**

The term “activity data_{OUTPUT}—activity data_{INPUT}” is the total amount [t] of CaO and MgO or other alkali earth or earth alkali oxides converted from respective carbonates during the reporting period.

Tier 1:

Mass of CaO, MgO or other alkali earth or earth alkali oxides [t] in the product and the process input during the reporting period derived by weighing by the operator with a

~~maximum permissible uncertainty of ± 5.0 % for the metering process and industry best practice guidelines on the composition of the respective product types and raw materials.~~

~~Tier 2:~~

~~Mass of CaO, MgO or other alkali earth or earth alkali oxides [t] in the product and in the process input during the reporting period derived by weighing by the operator with a maximum permissible uncertainty of ± 2.5 % for the metering process and composition analyses following the provisions of section 10 of Annex I.~~

~~b) Emission factor~~

~~Tier 1:~~

~~Stoichiometric ratios of oxides in process input and output as shown in table 2.~~

Table 2: Stoichiometric emission factors

Carbonate	Emission factor <i>[t CO₂] / [t Ca-, Mg- or other Oxide]</i>	Remarks
CaO	0.785	
MgO	1.092	

e) Conversion factor

Tier 1:

~~Conversion factor: 1.0~~

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex IX: Activity-Specific Guidelines for Installations for the Manufacture of Glass as Listed in Annex I to the Directive

ee) 1. Boundaries and completeness

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

In glass production installations, CO₂ emissions result from the following emission sources and source streams:

- Decomposition of melting of alkali- and ~~alkali~~-earth alkali metal-carbonates during melting of the raw material
- conventional fossil kiln-fuels
- alternative fossil-based kiln-fuels and raw materials
- biomass kiln-fuels (biomass wastes)
- other fuels
- carbon containing additives including coke and coal dust
- waste gas scrubbing

This annex is also applicable to installations for the production of water glass and stone wool.

2.1 Calculation of CO₂ Emissions

2.1.1 Combustion emissions

Combustion processes that take place in installations for the manufacture of glass shall be monitored and reported in accordance with Annex II.

2.1.2 Process emissions

CO₂ is released during melting in the kiln~~furnace~~, from carbonates contained in the raw materials, and from the neutralization of HF, HCl and SO₂ in the exhaust gases with limestone or other carbonates. Emissions from the decomposition of carbonates in the melting process and from scrubbing shall both be part of the installation's emissions. They shall be added up to the emission total but be reported separately if possible.

CO₂ from carbonates in the raw materials released during melting in the furnace~~kiln~~, is directly linked with the glass production and shall~~can~~ be calculated ~~in two ways:~~ based on the converted quantity of carbonates from raw material ~~— mainly soda, lime/limestone, dolomite and other alkali and alkali earth carbonates supplemented by carbonate free recycled glass (cullet). — (calculation method A), or based on the amount of alkali oxides in the glass produced (calculation method B). The two calculation methods are considered equivalent.~~

Calculation method A: Carbonates

Calculation shall be based on the amount of carbonates consumed. The following formula shall be used:

$$\text{CO}_2 \text{ emissions [t CO}_2\text{]} = \left(\sum \{ \text{activity data}_{\text{Carbonate}} * \text{emission factor} \} + \sum \{ \text{additive} * \text{emission factor} \} \right) * \text{conversion factor}$$

With

ff) a) Activity data

Activity data_{Carbonate} is the amount [t] of CaCO₃, MgCO₃, Na₂CO₃, BaCO₃ or other alkali earth or alkali carbonates in raw materials (soda, lime/limestone, dolomite) processed during the reporting period as well as the amount of carbon containing additives.

Tier 1:

The mass of CaCO₃, MgCO₃, Na₂CO₃, BaCO₃ or other alkali earth or alkali carbonates and the mass of carbon containing additives [t] in the raw materials consumed process input during over the reporting period derived by weighing of the respective raw materials by the operator or the his suppliers with a maximum permissible uncertainty of ± 2.5 % for the metering process and composition data from industry best practice guidelines for the specific product category.

Tier 2:

The mass of CaCO₃, MgCO₃, Na₂CO₃, BaCO₃ or other alkali earth or alkali carbonates and the mass of carbon containing additives [t] in the sum of all raw materials consumed process input during over the reporting period derived by weighing of the respective raw material by the operator or the his suppliers with a maximum permissible uncertainty of ± 1.0 % 1.5 % for the metering process and composition analyses following the provision of section 1014 of Annex I.

b) Emission factor

Carbonates:

Tier 1:

Stoichiometric ratios of carbonates in process input and output as in table 1.

Table 1: Stoichiometric emission factors

Carbonate	Emission factor [t CO ₂ /t Ca, Mg, Na, Ba or other Carbonate]	Remarks
CaCO ₃	0.440	
MgCO ₃	0.522	
Na ₂ CO ₃	0.415	
BaCO ₃	0.223	
Li₂CO₃	0.596	
K₂CO₃	0.318	
general: X _Y (CO ₃) _Z	Emission factor = $\frac{[M_{CO_2}]}{[M_{CO_3^{2-}}]} / \{Y * [M_x] + Z * [M_{CO_3^{2-}}]\}$	X = alkali earth or alkali metal M _x = molecular weight of X in [g/mol] M _{CO₂} = molecular weight of CO ₂ = 44 [g/mol] M _{CO₃} = molecular weight of CO ₃ ²⁻ = 60 [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of CO ₃ ²⁻ = 1

These values shall be adjusted according to moisture and gangue content of the applied carbonate materials.

Additives:

Specific emission factor derived following the provisions of section [4014](#) of Annex I.

e) Conversion factor

Tier 1:

~~Conversion factor: 1.0~~

Calculation method B: Alkali Oxides

~~CO₂ emissions shall be calculated based on the amounts of glass produced and the CaO, MgO, Na₂O, BaO and other alkali earth /alkali contents of the glass (activity data_{O OUTPUT}). The emission factor shall be corrected for Ca, Mg, Na and Ba and other alkali earth /alkali entering the kiln not as carbonates, for instance through recycling glass or alternative fuels~~

and raw materials with a relevant CaO, MgO, Na₂O or BaO and other alkali earth /alkali oxides content (activity data_{O-INPUT}).

The following calculation formula shall be used:

$$\text{CO}_2\text{-emission [t-CO}_2\text{]} = (\sum \{ (\text{activity data}_{\text{O-OUTPUT}} - \text{activity data}_{\text{O-INPUT}}) * \text{emission factor} \} + \sum \{ \text{additive} * \text{emission factor} \}) * \text{conversion factor}$$

with

a) Activity data

The term “Activity data_{O-OUTPUT}—activity data_{O-INPUT}” is the mass [t] of CaO, MgO, Na₂O, BaO or other alkali earth or alkali oxides converted from carbonates during the reporting period.

Tier 1:

Amount [t] of CaO, MgO, Na₂O, BaO or other alkali earth or alkali oxides employed during the reporting period in the process input and in the products as well as the amount of carbon containing additives derived by metering of input materials and products at installation level with a permissible uncertainty of less than ±2.5% for the metering process and composition data from industry best practice guidelines for the specific product category and raw materials.

Tier 2:

Amount [t] of CaO, MgO, Na₂O, BaO or other alkali earth or alkali oxides employed during the reporting period in the process input and in the products as well as the amount of carbon containing additives derived by metering of input materials and products at installation level with a permissible uncertainty of less than ±1.0% for the metering process and composition analyses following the provision of section 10 of Annex I.

b) Emission factor

Tier 1:

Carbonates:Stoichiometric ratios of oxides in process input and output as shown in table 2.

Table 2: Stoichiometric emission factors

Oxide	Emission factor [t CO ₂ / t Ca-, Mg-, Na-, Ba- or other Oxide]	Remarks
CaO	0.785	
MgO	1.092	
Na ₂ O	0.710	
BaO	0.287	

<p>general:</p> <p>$X_Y(O)_Z$</p>	<p>Emission factor =</p> $\frac{[M_{CO_2}]}{\{Y * [M_X] + Z * [M_O]\}}$	<p>X = alkali earth or alkali metal</p> <p>M_X = molecular weight of X in [g/mol]</p> <p>M_{CO_2} = molecular weight of CO_2 = 44 [g/mol]</p> <p>M_O = molecular weight of O = 16 [g/mol]</p> <p>Y = stoichiometric number of X</p> <p>= 1 (for alkali earth metals)</p> <p>= 2 (for alkali metals)</p> <p>Z = stoichiometric number of O = 1</p>
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Additives:

Specific emission factors derived following the provisions of section 10 of Annex I.

e) Conversion factor

Tier 1:

Conversion factor: 1.0

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex X: Activity-specific Guidelines for Installations for the Manufacture of Ceramic Products as listed in Annex I to the Directive

gg) 1. Boundaries and completeness

No specific boundary issues.

2. Determination of CO₂ emissions

In installations for the manufacture of ceramic products, CO₂ emissions result from the following [emission sources](#) [and source streams](#):

- calcination of limestone/dolomite in the raw material
- limestone for reducing air pollutants [and other flue gas cleaning](#)
- conventional fossil kiln fuels
- alternative fossil-based kiln fuels and raw materials
- biomass kiln fuels (~~biomass wastes~~)
- other fuels
- organic material in the clay raw material
- additives used to induce porosity, e.g. sawdust or, polystyrol

~~–waste gas scrubbing~~

2.1 Calculation of CO₂ Emissions

2.1.1 Combustion emissions

Combustion processes that take place at installations for the manufacture of ceramic products shall be monitored and reported in accordance with Annex II.

2.1.2 Process emissions

CO₂ is released during calcinations of the raw materials in the kiln [and the oxidation of organic material of the clay and additives](#), and from the neutralization of HF, HCl and SO₂ in the exhaust gases with limestone or other carbonates [and from other flue gas cleaning processes](#). Emissions from the decomposition of carbonates ~~in the calcination process~~ [and the oxidation of organic material in the kiln](#) and from ~~scrubbing~~ [flue gas cleaning](#) shall ~~both all~~ be ~~part of the~~ [included in the](#) installation's emissions. They shall be added up to the emission total but reported separately if possible. Calculation shall be as follows:

$$\text{CO}_2\text{-emissions}_{\text{total}} [\text{t}] = \text{CO}_2\text{-emissions}_{\text{e}_{\text{input material}}} [\text{t}] + \text{CO}_2\text{-emissions}_{\text{flue gas cleaning} \text{scrubbing}} [\text{t}]$$

2.1.2.1 CO₂ from input material

CO₂ from carbonates and from carbon contained in other input materials shall be calculated using either a calculation method based on the amount of carbonates from raw material

(mainly e.g. limestone, dolomite, organic content of the clay and of additives) converted in the process (**calculation method A**), or a methodology based on the alkali oxides in ceramics produced (**calculation method B**). The two approaches are considered equivalent for ceramics based on purified or synthetic clays. Calculation method A shall be applied for ceramic products based on unprocessed clays and whenever clays or additives with significant organic content are used.

Calculation method A: CarbonatesCarbon Inputs

Calculation is based on the carbonate input (carbonate or non-carbonate) in each of the relevant raw materials e.g. different types of clays or additives. ~~including the amount of limestone employed consumed to neutralize HF, HCl and SO₂ in the exhaust gases as well as from carbon contained in the clay and in the amount of additives. Double counting through the internal recycling of dust shall be avoided.~~

The following calculation formula shall be used:

CO₂ emission [t CO₂] =

$$\left(\sum \{ \text{Activity data}_{\text{Carbonate}} * \text{emission factor} \} + \sum \{ \text{Activity data}_{\text{additives}} * \text{emission factor} \} \right) * \text{conversion factor}$$

with

a) Activity data

These requirements apply separately to each of the relevant carbon-bearing raw materials (other than fuels) e.g. clay or additives, avoiding double counting or omissions from returned or by-passed materials.

Tier 1:

The net amount of relevant raw material or additive [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±7.5 %.

Tier 2:

The net amount of relevant raw material or additive [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±5.0 %.

Tier 3:

The net amount of relevant raw material or additive [t] consumed during the reporting period, is determined with a maximum uncertainty of less than ±2.5 %.

b)-Emission factor

The determination of the amount of carbonates and other relevant sources of CO₂ in each of the relevant raw materials or additives is carried out according to section 4014 of Annex I.

The content of total carbon may be determined as standard parameter “total carbon (TC)” in the dry raw material and additives consumed. The content of carbonates may be determined as parameter “total inorganic carbon (TIC)” in each of the dry raw materials consumed. Alternatively, where appropriate, the content of carbonates in the input materials can be deduced from the content of respective earth alkali oxides in the products. The content of organic carbon and additive carbon may be determined as parameter “total organic carbon (TOC)” in each of the dry raw materials or additives consumed.

The determination of biomass carbon consumed as additive shall follow the provisions of section 4014.4 of Annex I.

Stoichiometric ratios shall be applied for carbonates in kiln inputs as shown in table 1 below.

Table 1: Stoichiometric emission factors

<u>Carbonates</u>	<u>Emission factor</u>	
<u>CaCO₃</u>	<u>0.440 [t CO₂/ CaCO₃]</u>	
<u>MgCO₃</u>	<u>0.522 [t CO₂/ MgCO₃]</u>	
<u>BaCO₃</u>	<u>0.223 [t CO₂/ BaCO₃]</u>	
<u>General:</u> <u>X_Y(CO₃)_Z</u>	<u>Emission factor =</u> <u>$\frac{[M_{CO_2}]}{\{Y \times [M_x] + Z \times [M_{CO_3^{2-}}]\}}$</u>	<u>X = alkali earth or alkali metal</u> <u>M_x = molecular weight of X in [g/mol]</u> <u>M_{CO₂} = molecular weight of CO₂ = 44 [g/mol]</u> <u>M_{CO₃²⁻} = molecular weight of CO₃²⁻ = 60 [g/mol]</u> <u>Y = stoichiometric number of X</u> <u>= 1 (for alkali earth metals)</u> <u>= 2 (for alkali metals)</u> <u>Z = stoichiometric number of CO₃²⁻ = 1</u>

Tier 1:

Carbonates and other carbon leaving the kiln in the products are conservatively assumed to be zero i.e. assuming full calcination and oxidation.

Tier 2:

Carbonates and other carbon leaving the kiln in the products are considered appropriately in a modified emission factor leading to a closed carbon balance for the kiln.

a) Activity data

Activity data_{Carbonate} is the amount [t] of CaCO₃, MgCO₃ or other alkali earth or alkali carbonates employed during the reporting period through the raw materials (limestone, dolomite) and their CO₃²⁻ concentration as well as the amount [t] of carbon containing additives.

Tier 1:

The mass of CaCO₃, MgCO₃ or other alkali earth or alkali carbonates [t] as well as the amount [t] of carbon containing additives in the process input during the reporting period derived by weighing by the operator or the supplier with a maximum permissible uncertainty of ± 2.5 % for the metering process and composition data from industry best practice guidelines for the specific product category, or additives

Tier 2:

The mass of CaCO₃, MgCO₃ or other alkali earth or alkali carbonates [t] as well as the amount [t] of carbon containing additives in the process input during the reporting period derived by weighing by the operator or the supplier with a maximum permissible uncertainty of ± 1.0 % for the metering process and composition analyses following the provision of section 10 of Annex I, or additives

b) Emission factor

Tier 1: Carbonates:

Stoichiometric ratios of carbonates in process input.

and output as shown in table 1.

Table 1: Stoichiometric emission factors

Carbonate	Emission factor [t CO ₂ /t Ca, Mg or other Carbonate]	Remarks
CaCO ₃	0.440	
MgCO ₃	0.522	
general: X _Y (CO ₃) _Z	Emission factor = $\frac{[M_{CO_2}]}{\{Y \times [M_x] + Z \times [M_{CO_3^{2-}}]\}}$	X = alkali earth or alkali metal M _x = molecular weight of X in [g/mol] M _{CO₂} = molecular weight of CO ₂ = 44 [g/mol] M _{CO₃²⁻} = molecular weight of CO ₃ ²⁻ = 60 [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of CO ₃ ²⁻ = 1

~~These values shall be adjusted according to moisture and gangue content of the applied carbonate materials.~~

Additives:

~~Specific emission factors derived following the provisions of section 10 of Annex I.~~

e) Conversion factor

Tier 1:

~~Conversion factor: 1.0~~

Calculation method B: Alkali oxides

Calcination CO₂ is calculated based on the amounts of ceramics produced and the CaO, MgO and other (earth) alkali oxide contents of the ceramics (activity data_{O OUTPUT}). The emission factor is corrected for already calcined Ca, Mg and for other alkali earth/alkali contents entering the kiln (activity data_{O INPUT}), for instance alternative fuels and raw materials with a relevant CaO or MgO content. ~~Emissions from HF, HCl or SO₂ reduction shall be calculated based on the carbonate input according to the procedures laid out in 2.1.2.2 of this Annex, calculation method A.~~

~~The following calculation formula shall be used:~~

$$\text{CO}_2 \text{ emission [t CO}_2\text{]} = \sum \{((\text{activity data}_{\text{O OUTPUT}} - \text{activity data}_{\text{O INPUT}}) * \text{emission factor} * \text{conversion factor})\} + (\text{CO}_2 \text{ emissions from HF, HCl or SO}_2 \text{ reduction})$$

~~With:~~

a) Activity data

~~The term “activity data_{O OUTPUT} - activity data_{O INPUT}” is the amounts [t] of CaO, MgO or other alkali earth or alkali oxides converted from carbonates during the reporting period.~~

Tier 1:

~~The M_{mass of} of CaO, MgO or other alkali earth or alkali oxides [t] in the process input and in the products during the reporting period is derived derived by weighing by the operator with a maximum permissible uncertainty of ± 2.5% for the metering process and industry best practice guidelines on the composition of the respective product types and raw materials.~~

Tier 2:

~~Mass The mass of of CaO, MgO or other alkali earth or alkali oxides [t] in the process input and in the products during the reporting period is derived by weighing by the operator with a maximum permissible uncertainty of ± 1.0% for the metering process and composition analyses following the provision of section 10 of Annex I.~~

Tier 3:

~~The mass of the products during the reporting period is derived with a maximum uncertainty of ± 2.5%.~~

b) Emission factor

The emission factor shall be calculated based on the content of the relevant metal oxides i.e. MgO and CaO in the product using the stoichiometric ratios in Table 2.

The determination of composition of the products is carried out according to section 4014 of Annex I.

Table 2: Stoichiometric emission factors

<u>Carbonate</u>	<u>Emission factors</u> <u>[t CO₂ / t Ca-, Mg- or other Oxide]</u>	<u>Remarks</u>
<u>CaO</u>	<u>0.785</u>	
<u>MgO</u>	<u>1.092</u>	
<u>BaO</u>	<u>0.287</u>	
<u>general:</u> <u>X_Y(O)_Z</u>	<u>Emission factor =</u> <u>[M_{CO2}] / {Y x [M_X] + Z x [M_O]}</u>	<u>X = alkali earth or alkali metal</u> <u>M_X = molecular weight of X in [g/mol]</u> <u>M_{CO2} = molecular weight of CO₂ = 44 [g/mol]</u> <u>M_O = molecular weight of O = 16 [g/mol]</u> <u>Y = stoichiometric number of X</u> <u>= 1 (for alkali earth metals)</u> <u>= 2 (for alkali metals)</u> <u>Z = stoichiometric number of O = 1</u>

Tier 1:

The amount of relevant oxides in the relevant raw materials are conservatively assumed to be zero i.e. all relevant oxides are assumed to have originated from carbonate.

Tier 2:

The amount of relevant oxides in the relevant raw materials is considered appropriately in a modified emission factor. **Tier 1:**

Stoichiometric ratios of oxides in process input and output shall be used (see Table 2).

Table 2: Stoichiometric emission factors

Carbonate	Emission factors	Remarks
	[t CO₂ / t Ca, Mg or other Oxide]	
CaO	0.785	
MgO	1.092	
general: X _Y (O) _Z	Emission factor = $\frac{[M_{CO_2}]}{\{Y \cdot X [M_X] + Z \cdot X [M_O]\}}$	X = alkali earth or alkali metal M _x = molecular weight of X in [g/mol] M_{CO₂} = molecular weight of CO₂ = 44 [g/mol] M _O = molecular weight of O = 16 [g/mol] Y = stoichiometric number of X = 1 (for alkali earth metals) = 2 (for alkali metals) Z = stoichiometric number of O = 1

e) Conversion factor

Tier 1:

Conversion factor: 1.0

2.1.2.2 CO₂ from limestone for reducing air pollutants and other flue gas cleaning exhaust gas scrubbing

CO₂ from limestone for reducing air pollutants and other flue gas cleaning exhaust gas scrubbing shall be calculated based on the amount of CaCO₃ input. Double counting from used limestone recycled as raw material in the same installation shall be avoided.

The following calculation formula shall be used:

CO₂ emission [t CO₂] = Activity data * emission factor * conversion factor

with

a) Activity data

Tier 1:

The amount [t] of dry CaCO₃ employed/consumed during the reporting period determined by weighing by operator or the his suppliers with permissible uncertainty of less than ±72.5% for the metering process.

Tier 2:

~~The amount [t] of dry CaCO₃ employed during the reporting period determined by weighing by operator or the supplier with permissible uncertainty of less than ±1.0 % for the metering process.~~

b) Emission factor

Tier 1:

Stoichiometric ratios of CaCO₃ as shown in table 1.

~~**c) Conversion factor**~~

~~**Tier 1:**~~

~~Conversion factor: 1.0~~

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex XI: Activity-specific Guidelines for Pulp and Paper Producing Installations as Listed in Annex I to the Directive

1. Boundaries and completeness

If the installation exports fossil fuel-derived CO₂, for instance to an adjacent precipitated calcium carbonate (PCC) installation, these exports shall not be included in the installation's emissions.

If waste gas scrubbing is carried out at the installation and the resulting emissions are not calculated as part of the installation's process emissions, they shall be calculated in accordance with Annex II.

2. Determination of CO₂ emissions

Pulp and paper mill processes with the potential to emit CO₂ emissions include:

- power boilers, gas turbines, and other combustion devices producing steam or power for the mill
- recovery boilers and other devices burning spent pulping liquors
- incinerators
- lime kilns and calciners
- waste gas scrubbing
- gas-or other fossil fuel-fired dryers (such as infrared dryers)

Wastewater treatment and landfills, including anaerobic wastewater treatment or sludge digestion operations and landfills used to dispose of mill wastes, are not listed in Annex I to the Directive. Consequently their emissions fall outside the scope of the Directive.

2.1 Calculation of CO₂ Emissions

2.1.1 Combustion emissions

Emissions from combustion processes that take place at pulp and paper installations shall be monitored in accordance with Annex II.

2.1.2 Process emissions

Emissions are caused by the use of carbonates as make-up chemicals in pulp mills. Although losses of sodium and calcium from the recovery system and causticising area are usually made up using non-carbonate chemicals, small amounts of Calcium Carbonate (CaCO₃) and Sodium Carbonate (Na₂CO₃), which do result in CO₂ emissions are sometimes used. The carbon contained in these chemicals is usually of fossil origin, although in some cases (e.g., Na₂CO₃ purchased from soda-based semi-chem mills) it can be derived from biomass.

It is assumed that the carbon in these chemicals is emitted as CO₂ from the lime kiln or recovery furnace. These emissions are determined by assuming that all of the carbon in CaCO₃ and Na₂CO₃ used in the recovery and causticising areas is released to the atmosphere.

Calcium make-up is required because of losses from the causticising area, most of which are in the form of calcium carbonate.

CO₂-emissions shall be calculated as follows:

$$\text{CO}_2 \text{ emissions} = \sum \{(\text{Activity data}_{\text{Carbonate}} * \text{Emission factor} - * \text{Conversion factor})\}$$

With:

a) Activity data:

Activity data_{Carbon} are the amounts of CaCO₃ and Na₂CO₃ ~~employed~~consumed in the process.

Tier 1:

Amounts [t] of CaCO₃ and Na₂CO₃ ~~employed~~consumed in the process ~~as weighed as determined~~ by the operator or his suppliers with a maximum ~~permissible~~ uncertainty of less than ±2.5 % ~~for the metering process~~.

Tier 2:

Amounts [t] of CaCO₃ and Na₂CO₃ ~~employed~~consumed in the process ~~as weighed as determined~~ by the operator or his suppliers with a maximum ~~permissible~~ uncertainty of less than ±~~1.0 %~~ 1.5 % ~~for the metering process~~.

b) Emission factor:

Tier 1:

Stoichiometric ratios [t_{CO2}/t_{CaCO3}] and [t_{CO2}/t_{Na2CO3}] for non-biomass carbonates as indicated in Table 1. Biomass carbonates are weighted with an emission factor of 0 [t CO₂ / t Carbonate].

Table 1: Stoichiometric emission factors

Carbonate type and origin	Emission factor [t CO ₂ / t Carbonate]
Pulp mill make-up CaCO ₃	0.440
Pulp mill make-up Na ₂ CO ₃	0.415
CaCO ₃ biomass origin	0.0
Na ₂ CO ₃ biomass origin	0.0

These values shall be adjusted according to moisture and gangue content of the applied carbonate materials.

e) Conversion factor:

Tier 1:

~~Conversion factor: 1.0~~

2.2 Measurement of CO₂ emissions

The measurement guidelines contained in Annex I shall be applied.

3. Determination of non-CO₂ greenhouse gases

Specific guidelines for the determination of emissions of non-CO₂ greenhouse gas emissions may be elaborated at a later stage, in accordance with the relevant provisions of the Directive.

Annex XII: Guidelines for Determination of Greenhouse-Gas-emissions by Continuous Emission Measurement Systems

1. Boundaries and completeness

The provision in this Annex address emissions of CO₂, CH₄, N₂O, SF₆, HFC and PFC (in the following referred to as “greenhouse gases”) from activities under the EU-ETS. CO₂-emissions might occur at several instances in an installation. All greenhouse emissions from activities under the EU-ETS can be covered in principle. In accordance with the relevant provisions of the Directive, the Commission may elaborate at a later stage guidelines for emissions of specific gases from specific activities.

2. Determination of Greenhouse-gas Emissions

Tier 1:

A total uncertainty of the overall emissions over the reporting period of less than $\pm 10\%$ shall be achieved.

Tier 2:

A total uncertainty of the overall emissions over the reporting period of less than $\pm 7.5\%$ shall be achieved.

Tier 3:

A total uncertainty of the overall emissions over the reporting period of less than $\pm 5\%$ shall be achieved.

Tier 4:

A total uncertainty of the overall emissions over the reporting period of less than $\pm 2.5\%$ shall be achieved.

Overall approach:

Total annual emissions of a greenhouse gas (GHG) from an emission source shall be determined by using the below formula. In case several emission sources exist in one installation and cannot be measured as one, emissions from these emission sources shall be measured separately and summed up to the total annual emissions of the specific gas in the whole installation.

$$\underline{GHG_{-tot\ ann.} [t]} = \frac{\sum_{i=1}^{operating_hours_p.a.} \underline{GHG-concentration_i [mg/Nm^3]} * \underline{exhaust\ air\ flow_i [Nm^3/h]} * 10^{-9}}{}$$

With:

GHG-concentration

The GHG-concentration [mg/ Nm³] in the exhaust air is determined by continuous measurement at a representative point. In case the measurement equipment provides the GHG-concentration as volume concentration in [ppmv], conversion to mass concentration [mg/ Nm³] shall be calculated by the following equation valid under standard conditions:

$$\underline{GHG-concentration [mg/ Nm^3]} = \underline{GHG-concentration_i [ppmv]} * \frac{\underline{molar\ mass_{GHG} [g / mol]}}{\underline{22.41 [l / mol]}}$$

The molar masses of relevant GHGs are listed in table 1.

Table 1 Molar mass of GHG molecules

<u>Greenhouse Gas</u>	<u>Molar mass [g/mol]</u>
<u>CO₂</u>	<u>44.01</u>
<u>CH₄</u>	<u>16.04</u>
<u>N₂O</u>	<u>44.01</u>
<u>SF₆</u>	<u>146.06</u>
<u>HFCs</u>	<u>Depending on spec. gas</u>
<u>PFCs</u>	<u>Depending on spec. gas</u>

Exhaust air flow

The exhaust gas flow [Nm³/h] can be determined using one of the following methods.

Method A

The exhaust gas flow Q_e [Nm^3/h] is calculated by means of a mass balance approach, taking into account all significant parameters such as input material loads, input air flow, process efficiency, etc. and on the output side the product output, the O_2 -concentration, SO_2 and NO_x concentrations, etc.

The specific calculation approach shall be approved by the competent authority as part of evaluation of the monitoring methodology.

Method B:

The exhaust gas flow Q_e [Nm^3/h] is determined by continuous emission flow measurement at a representative point in the installation.