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**COMMISSION IMPLEMENTING REGULATION (EU) 2018/2066
of 19 December 2018**

**on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC
of the European Parliament and of the Council and amending Commission Regulation (EU) No
601/2012**

(Text with EEA relevance)

(OJ L 334, 31.12.2018, p. 1)

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CHAPTER I**GENERAL PROVISIONS****SECTION 1*****Subject matter and definitions******Article 1*****Subject matter**

This Regulation lays down rules for the monitoring and reporting of greenhouse gas emissions and activity data pursuant to Directive 2003/87/EC in the trading period of the Union emissions trading system commencing on 1 January 2021 and subsequent trading periods.

Article 2**Scope**

This Regulation shall apply to the monitoring and reporting of greenhouse gas emissions specified in relation to the activities listed in Annex I to Directive 2003/87/EC and activity data from stationary installations, from aviation activities and to the monitoring and reporting of tonne-kilometre data from aviation activities.

It shall apply to emissions and activity data occurring from 1 January 2021.

Article 3**Definitions**

For the purposes of this Regulation, the following definitions shall apply:

- (1) ‘activity data’ means data on the amount of fuels or materials consumed or produced by a process relevant for the calculation-based monitoring methodology, expressed in terajoules, mass in tonnes or (for gases) volume in normal cubic metres, as appropriate;
- (2) ‘trading period’ means a period as referred to in Article 13 of Directive 2003/87/EC;
- (3) ‘tonne-kilometre’ means a tonne of payload carried a distance of one kilometre;

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- (4) ‘source stream’ means any of the following:
- (a) a specific fuel type, raw material or product giving rise to emissions of relevant greenhouse gases at one or more emission sources as a result of its consumption or production;
 - (b) a specific fuel type, raw material or product containing carbon and included in the calculation of greenhouse gas emissions using a mass-balance methodology;
- (5) ‘emission source’ means a separately identifiable part of an installation or a process within an installation, from which relevant greenhouse gases are emitted or, for aviation activities, an individual aircraft;
- (6) ‘uncertainty’ means a parameter, associated with the result of the determination of a quantity, that characterises the dispersion of the values that could reasonably be attributed to the particular quantity, including the effects of systematic as well as of random factors, expressed in per cent, and describes a confidence interval around the mean value comprising 95 % of inferred values taking into account any asymmetry of the distribution of values;
- (7) ‘calculation factors’ means net calorific value, emission factor, preliminary emission factor, oxidation factor, conversion factor, carbon content or biomass fraction;
- (8) ‘tier’ means a set requirement used for determining activity data, calculation factors, annual emission and annual average hourly emission, and payload;
- (9) ‘inherent risk’ means the susceptibility of a parameter in the annual emissions report or tonne-kilometre report to misstatements that could be material, individually or when aggregated with other misstatements, before taking into consideration the effect of any related control activities;
- (10) ‘control risk’ means the susceptibility of a parameter in the annual emissions report or tonne-kilometre report to misstatements that could be material, individually or when aggregated with other misstatements, and not prevented or detected and corrected on a timely basis by the control system;
- (11) ‘combustion emissions’ means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen;
- (12) ‘reporting period’ means a calendar year during which emissions have to be monitored and reported or, for tonne-kilometre data, the monitoring year as referred to in Articles 3e and 3f of Directive 2003/87/EC;
- (13) ‘emission factor’ means the average emission rate of a greenhouse gas relative to the activity data of a source stream assuming complete oxidation for combustion and complete conversion for all other chemical reactions;

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- (14) ‘oxidation factor’ means the ratio of carbon oxidised to CO₂ as a consequence of combustion to the total carbon contained in the fuel, expressed as a fraction, considering carbon monoxide (CO) emitted to the atmosphere as the molar equivalent amount of CO₂;
- (15) ‘conversion factor’ means the ratio of carbon emitted as CO₂ to the total carbon contained in the source stream before the emitting process takes place, expressed as a fraction, considering CO emitted to the atmosphere as the molar equivalent amount of CO₂;
- (16) ‘accuracy’ means the closeness of the agreement between the result of a measurement and the true value of the particular quantity or a reference value determined empirically using internationally accepted and traceable calibration materials and standard methods, taking into account both random and systematic factors;
- (17) ‘calibration’ means the set of operations, which establishes, under specified conditions, the relations between values indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values of a quantity realised by a reference standard;
- (18) ‘flight’ means flight as defined in point 1(1) of the Annex to Decision 2009/450/EC;
- (19) ‘passengers’ means the persons onboard the aircraft during a flight excluding its on duty crew members;
- (20) ‘conservative’ means that a set of assumptions is defined in order to ensure that no under-estimation of annual emissions or over-estimation of tonne-kilometres occurs;
- (21) ‘biomass’ means the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste; it includes bioliquids and biofuels;
- (22) ‘bioliquids’ means liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass;
- (23) ‘biofuels’ means liquid or gaseous fuel for transport produced from biomass;
- (24) ‘legal metrological control’ means the control of the measurement tasks intended for the field of application of a measuring instrument, for reasons of public interest, public health, public safety, public order, protection of the environment, the levying of taxes and duties, the protection of consumers and fair trading;

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- (25) ‘maximum permissible error’ means the error of measurement allowed as specified in Annex I and instrument-specific annexes to Directive 2014/32/EU of the European Parliament and of the Council (⁽¹⁾), or national rules on legal metrological control, as appropriate;
- (26) ‘data-flow activities’ mean activities related to the acquisition, processing and handling of data that are needed to draft an emissions report from primary source data;
- (27) ‘tonnes of CO_{2(e)}’ means metric tonnes of CO₂ or CO_{2(e)};
- (28) ‘CO_{2(e)}’ means any greenhouse gas, other than CO₂, listed in Annex II to Directive 2003/87/EC with an equivalent global-warming potential as CO₂;
- (29) ‘measurement system’ means a complete set of measuring instruments and other equipment, such as sampling and data-processing equipment, used to determine variables such as the activity data, the carbon content, the calorific value or the emission factor of the greenhouse gas emissions;
- (30) ‘net calorific value’ (NCV) means the specific amount of energy released as heat when a fuel or material undergoes complete combustion with oxygen under standard conditions, less the heat of vaporisation of any water formed;
- (31) ‘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;
- (32) ‘commercial standard fuel’ means the internationally standardised commercial fuels that exhibit a 95 % confidence interval of not more than 1 % for their specified calorific value, including gas oil, light fuel oil, gasoline, lamp oil, kerosene, ethane, propane, butane, jet kerosene (jet A1 or jet A), jet gasoline (jet B) and aviation gasoline (AvGas);
- (33) ‘batch’ means an amount of fuel or material representatively sampled and characterised, and transferred as one shipment or continuously over a specific period of time;
- (34) ‘mixed fuel’ means a fuel which contains both biomass and fossil carbon;
- (35) ‘mixed material’ means a material which contains both biomass and fossil carbon;
- (36) ‘preliminary emission factor’ means the assumed total emission factor of a fuel or material based on the carbon content of its biomass fraction and its fossil fraction before multiplying it by the fossil fraction to produce the emission factor;

⁽¹⁾ Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (OJ L 96, 29.3.2014, p. 149).

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- (37) ‘fossil fraction’ means the ratio of fossil carbon to the total carbon content of a fuel or material, expressed as a fraction;
- (38) ‘biomass fraction’ means the ratio of carbon stemming from biomass to the total carbon content of a fuel or material, expressed as a fraction;
- (39) ‘energy balance method’ means a method to estimate the amount of energy used as fuel in a boiler, calculated as the sum of utilisable heat and all relevant losses of energy by radiation, transmission and via the flue gas;
- (40) ‘continuous emission measurement’ means a set of operations having the objective of determining the value of a quantity by means of periodic measurements, applying either measurements in the stack or extractive procedures with a measuring instrument located close to the stack, whilst excluding measurement methodologies based on the collection of individual samples from the stack;
- (41) ‘inherent CO₂’ means CO₂ which is part of a source stream;
- (42) ‘fossil carbon’ means inorganic and organic carbon that is not biomass;
- (43) ‘measurement point’ means the emission source for which continuous emission measurement systems (CEMS) are used for emission measurement, or the cross-section of a pipeline system for which the CO₂ flow is determined using continuous measurement systems;
- (44) ‘mass and balance documentation’ means the documentation specified in international or national implementation of the standards and recommended practices (SARPs) laid down in Annex 6 to the Convention on International Civil Aviation, signed in Chicago on 7 December 1944 and specified in Section 3 of Subpart C of Annex IV to Commission Regulation (EU) No 965/2012 (¹), or equivalent applicable international rules;
- (45) ‘distance’ means the great-circle distance between the aerodrome of departure and the aerodrome of arrival, in addition to a fixed factor of 95 km;
- (46) ‘aerodrome of departure’ means the aerodrome at which a flight constituting an aviation activity listed in Annex I to Directive 2003/87/EC begins;
- (47) ‘aerodrome of arrival’ means the aerodrome at which a flight constituting an aviation activity listed in Annex I to Directive 2003/87/EC ends;
- (48) ‘payload’ means the total mass of freight, mail, passengers and baggage carried onboard an aircraft during a flight;

(¹) Commission Regulation (EU) No 965/2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1).

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- (49) ‘fugitive emissions’ means irregular or unintended emissions from sources that are not localised, or too diverse or too small to be monitored individually;
- (50) ‘aerodrome’ means aerodrome as defined in point 1(2) of the Annex to Decision 2009/450/EC;
- (51) ‘aerodrome pair’ means a pair constituted by the aerodrome of departure and the aerodrome of arrival;
- (52) ‘standard conditions’ means temperature of 273,15 K and pressure conditions of 101 325 Pa defining normal cubic metres (Nm³);
- (53) ‘storage site’ means storage site as defined in Article 3(3) of Directive 2009/31/EC;
- (54) ‘CO₂ capture’ means the activity of capturing from gas streams CO₂ that would otherwise be emitted, for the purposes of transport and geological storage in a storage site permitted under Directive 2009/31/EC;
- (55) ‘CO₂ transport’ means the transport of CO₂ by pipelines for geological storage in a storage site permitted under Directive 2009/31/EC;
- (56) ‘geological storage of CO₂’ means geological storage of CO₂ as defined in Article 3(1) of Directive 2009/31/EC;
- (57) ‘vented emissions’ means emissions deliberately released from an installation by provision of a defined point of emission;
- (58) ‘enhanced hydrocarbon recovery’ means the recovery of hydrocarbons in addition to those extracted by water injection or other means;
- (59) ‘proxy data’ means annual values which are empirically substantiated or derived from accepted sources and which an operator uses to substitute the activity data or the calculation factors for the purpose of ensuring complete reporting when it is not possible to generate all the required activity data or calculation factors in the applicable monitoring methodology;
- (60) ‘water column’ means water column as defined in Article 3(2) of Directive 2009/31/EC;
- (61) ‘leakage’ means leakage as defined in Article 3(5) of Directive 2009/31/EC;
- (62) ‘storage complex’ means storage complex as defined in Article 3(6) of Directive 2009/31/EC;
- (63) ‘transport network’ means transport network as defined in Article 3(22) of Directive 2009/31/EC.

▼B*SECTION 2****General principles****Article 4***General obligation**

Operators and aircraft operators shall carry out their obligations related to the monitoring and reporting of greenhouse gas emissions under Directive 2003/87/EC in accordance with the principles laid down in Articles 5 to 9.

*Article 5***Completeness**

Monitoring and reporting shall be complete and cover all process and combustion emissions from all emission sources and source streams belonging to activities listed in Annex I to Directive 2003/87/EC and other relevant activities included pursuant to Article 24 of that Directive, and of all greenhouse gases specified in relation to those activities, while avoiding double-counting.

Operators and aircraft operators shall take appropriate measures to prevent any data gaps within the reporting period.

*Article 6***Consistency, comparability and transparency**

1. Monitoring and reporting shall be consistent and comparable over time. To that end, operators and aircraft operators shall use the same monitoring methodologies and data sets, subject to changes and derogations approved by the competent authority.

2. Operators and aircraft operators shall obtain, record, compile, analyse and document monitoring data, including assumptions, references, activity data and calculation factors, in a transparent manner that enables the reproduction of the determination of emissions by the verifier and the competent authority.

*Article 7***Accuracy**

Operators and aircraft operators shall ensure that emission determination is neither systematically nor knowingly inaccurate.

They shall identify and reduce any source of inaccuracies as far as possible.

They shall exercise due diligence to ensure that the calculation and measurement of emissions exhibit the highest achievable accuracy.

▼B*Article 8***Integrity of the methodology and of the emissions report**

Operators and aircraft operators shall enable reasonable assurance of the integrity of emission data to be reported. They shall determine emissions using the appropriate monitoring methodologies set out in this Regulation.

Reported emission data and related disclosures shall be free from material misstatement as defined in Article 3(6) of Commission Implementing Regulation (EU) 2018/2067⁽¹⁾, avoid bias in the selection and presentation of information, and provide a credible and balanced account of an installation's or aircraft operator's emissions.

In selecting a monitoring methodology, the improvements from greater accuracy shall be balanced against additional costs. Monitoring and reporting of emissions shall aim for the highest achievable accuracy, unless this is technically not feasible or incurs unreasonable costs.

*Article 9***Continuous improvement**

Operators and aircraft operators shall take account of the recommendations included in the verification reports issued pursuant to Article 15 of Directive 2003/87/EC in their consequent monitoring and reporting.

*Article 10***Coordination**

Where a Member State designates more than one competent authority pursuant to Article 18 of Directive 2003/87/EC, it shall coordinate the work carried out by those authorities pursuant to this Regulation.

CHAPTER II**MONITORING PLAN***SECTION 1****General rules****Article 11****General obligation***

1. Each operator or aircraft operator shall monitor greenhouse gas emissions on the basis of a monitoring plan approved by the competent authority in accordance with Article 12, taking into account the nature and functioning of the installation or aviation activity to which it applies.

⁽¹⁾ Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council (see page 94 of this Official Journal).

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The monitoring plan shall be supplemented by written procedures which the operator or aircraft operator establishes, documents, implements and maintains for activities under the monitoring plan, as appropriate.

2. The monitoring plan referred to in paragraph 1 shall describe the instructions to the operator or aircraft operator in a logical and simple manner, avoiding duplication of effort and taking into account existing systems in place at the installation or used by the operator or aircraft operator.

*Article 12***Content and submission of the monitoring plan**

1. Each operator or aircraft operator shall submit a monitoring plan to the competent authority for approval.

The monitoring plan shall consist of a detailed, complete and transparent documentation of the monitoring methodology of a specific installation or aircraft operator and shall contain at least the elements laid down in Annex I.

Together with the monitoring plan, the operator or aircraft operator shall submit the following supporting documents:

- (a) for installations, evidence for each major and minor source stream demonstrating compliance with the uncertainty thresholds for activity data and calculation factors, where applicable, for the applied tiers as defined in Annexes II and IV, and for each emission source demonstrating compliance with the uncertainty thresholds for the applied tiers as defined in Annex VIII, where applicable;
- (b) the results of a risk assessment providing evidence that the proposed control activities and procedures for control activities are commensurate with the inherent risks and control risks identified.

2. Where Annex I refers to a procedure, an operator or aircraft operator shall establish, document, implement and maintain such a procedure separately from the monitoring plan.

The operator or aircraft operator shall summarise the procedures in the monitoring plan providing the following information:

- (a) the title of the procedure;
- (b) a traceable and verifiable reference for identification of the procedure;
- (c) identification of the post or department responsible for implementing the procedure and for the data generated from or managed by the procedure;
- (d) a brief description of the procedure, allowing the operator or aircraft operator, the competent authority and the verifier to understand the essential parameters and operations performed;

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- (e) the location of relevant records and information;
- (f) the name of the computerised system used, where applicable;
- (g) a list of EN standards or other standards applied, where relevant.

The operator or aircraft operator shall make any written documentation of the procedures available to the competent authority upon request. The operator or aircraft operator shall also make them available for the purposes of verification pursuant to Implementing Regulation (EU) 2018/2067.

▼M1**▼B***Article 13***Standardised and simplified monitoring plans**

1. Member States may allow operators and aircraft operators to use standardised or simplified monitoring plans, without prejudice to Article 12(3).

For that purpose, Member States may publish templates for those monitoring plans, including the description of data flow and control procedures referred to in Articles 58 and 59, based on the templates and guidelines published by the Commission.

2. Before the approval of any simplified monitoring plan, as referred to in paragraph 1, the competent authority shall carry out a simplified risk assessment as to whether the proposed control activities and procedures for control activities are commensurate with the inherent risks and control risks identified, and justify the use of such a simplified monitoring plan.

Member States may require the operator or aircraft operator to carry out the risk assessment pursuant to the previous subparagraph itself, where appropriate.

*Article 14***Modifications of the monitoring plan**

1. Each operator or aircraft operator shall regularly check whether the monitoring plan reflects the nature and functioning of the installation or aviation activity in accordance with Article 7 of Directive 2003/87/EC, and whether the monitoring methodology can be improved.
2. The operator or aircraft operator shall modify the monitoring plan, at least, in any of the following situations:

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- (a) new emissions occur due to new activities being carried out or due to the use of new fuels or materials not yet contained in the monitoring plan;
- (b) a change in the availability of data, due to the use of new types of measuring instrument, sampling methods or analysis methods, or for other reasons, leads to higher accuracy in the determination of emissions;
- (c) data resulting from the monitoring methodology applied previously has been found to be incorrect;
- (d) changing the monitoring plan improves the accuracy of the reported data, unless this is technically not feasible or incurs unreasonable costs;
- (e) the monitoring plan is not in conformity with the requirements of this Regulation and the competent authority requests the operator or aircraft operator to modify it;
- (f) it is necessary to respond to the suggestions for improvement of the monitoring plan contained in a verification report.

*Article 15***Approval of modifications of the monitoring plan**

1. The operator or aircraft operator shall notify the competent authority of any proposals for modification of the monitoring plan without undue delay.

However, the competent authority may allow the operator or aircraft operator to notify modifications of the monitoring plan that are not significant within the meaning of paragraphs 3 and 4 by 31 December of the same year.

2. Any significant modification of the monitoring plan within the meaning of paragraphs 3 and 4 shall be subject to approval by the competent authority.

Where the competent authority considers a modification not to be significant, it shall inform the operator or aircraft operator thereof without undue delay.

3. Significant modifications to the monitoring plan of an installation include:

- (a) changes to the category of the installation where such changes require a change to the monitoring methodology or lead to a change of the applicable materiality level pursuant to Article 23 of Implementing Regulation (EU) 2018/2067;
- (b) notwithstanding Article 47(8), changes regarding whether the installation is considered an ‘installation with low emissions’;
- (c) changes to emission sources;
- (d) a change from calculation-based to measurement-based methodologies, or *vice versa*, or from a fall-back methodology to a tier-based methodology for determining emissions or *vice versa*;

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- (e) a change in the tier applied;
- (f) the introduction of new source streams;
- (g) a change in the categorisation of source streams – between major, minor or *de-minimis* source streams where such a change requires a change to the monitoring methodology;
- (h) a change to the default value for a calculation factor, where the value is to be laid down in the monitoring plan;
- (i) the introduction of new methods or changes to existing methods related to sampling, analysis or calibration, where this has a direct impact on the accuracy of emissions data;
- (j) the implementation or adaption of a quantification methodology for emissions from leakage at storage sites.

4. Significant changes to the monitoring plans of an aircraft operator include:

- (a) with regard to the emission monitoring plan:
 - (i) a change of emission factor values laid down in the monitoring plan;
 - (ii) a change between calculation methods as laid down in Annex III, or a change from the use of a calculation method to the use of estimation methodology in accordance with Article 55(2) or *vice versa*;
 - (iii) the introduction of new source streams;
 - (iv) changes in the status of the aircraft operator as a small emitter within the meaning of Article 55(1) or with regard to one of the thresholds provided by Article 28a(6) of Directive 2003/87/EC;

(b) with regard to the tonne-kilometre data monitoring plan:

- (i) a change between a non-commercial and commercial status of the air transport service provided;
- (ii) a change in the object of the air transport service, the object being passengers, freight or mail.

Article 16

Implementation and record-keeping of modifications

1. Before receiving approval or information in accordance with Article 15(2), the operator or aircraft operator may carry out monitoring and reporting using the modified monitoring plan where it can reasonably assume that the proposed modifications are not significant, or where monitoring in accordance with the original monitoring plan would lead to incomplete emission data.

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In case of doubt, the operator or aircraft operator shall use in parallel both the modified and the original monitoring plan to carry out all monitoring and reporting in accordance with both plans, and it shall keep records of both monitoring results.

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2. Upon receipt of approval or information in accordance with Article 15(2), the operator or aircraft operator shall only use the data relating to the modified monitoring plan and carry out all monitoring and reporting using only the modified monitoring plan from the date from which that version of the monitoring plan is applicable.

3. The operator or aircraft operator shall keep records of all modifications of the monitoring plan. Each record shall contain:

- (a) a transparent description of the modification;
- (b) a justification for the modification;
- (c) the date of notification of the modification to the competent authority pursuant to Article 15(1);
- (d) the date on which the competent authority acknowledged receipt of the notification referred to in Article 15(1), where available, and the date of the approval or information referred to in Article 15(2);
- (e) the starting date of implementation of the modified monitoring plan in accordance with paragraph 2 of this Article.

SECTION 2

Technical feasibility and unreasonable costs

Article 17

Technical feasibility

Where an operator or aircraft operator claims that applying a specific monitoring methodology is technically not feasible, the competent authority shall assess the technical feasibility taking the operator's or aircraft operator's justification into account. That justification shall be based on the operator or aircraft operator having technical resources capable of meeting the needs of a proposed system or requirement that can be implemented in the required time for the purposes of this Regulation. Those technical resources shall include the availability of the requisite techniques and technology.

Article 18

Unreasonable costs

1. Where an operator or aircraft operator claims that applying a specific monitoring methodology would incur unreasonable costs, the competent authority shall assess whether the costs are unreasonable, taking into account the operator's justification.

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The competent authority shall consider costs unreasonable where the cost estimate exceeds the benefit. To that end, the benefit shall be calculated by multiplying an improvement factor by a reference price of EUR 20 per allowance and costs shall include an appropriate depreciation period based on the economic lifetime of the equipment.

2. When assessing the unreasonable nature of the costs with regard to the operator's choice of tier levels for activity data, the competent authority shall use as the improvement factor referred to in paragraph 1 the difference between the uncertainty currently achieved and the uncertainty threshold of the tier that would be achieved by the improvement multiplied by the average annual emissions caused by that source stream over the three most recent years.

In the absence of such data on the average annual emissions caused by that source stream over the three most recent years, the operator or aircraft operator shall provide a conservative estimate of the annual average emissions, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂. For measuring instruments under national legal metrological control, the uncertainty currently achieved may be substituted by the maximum permissible error in service allowed by the relevant national legislation.

3. When assessing the unreasonable nature of the costs with regard to measures increasing the quality of reported emissions but without direct impact on the accuracy of activity data, the competent authority shall use an improvement factor of 1 % of the average annual emissions of the respective source streams in the three most recent reporting periods. Those measures may include:

- (a) switching from default values to analyses to determine calculation factors;
- (b) an increase of the number of analyses per source stream;
- (c) where the specific measuring task does not fall under national legal metrological control, the substitution of measuring instruments with instruments complying with relevant requirements of legal metrological control of the Member State in similar applications, or to measuring instruments meeting national rules adopted pursuant to Directive 2014/31/EU of the European Parliament and of the Council (⁽¹⁾) or Directive 2014/32/EU;
- (d) shortening calibration and maintenance intervals of measuring instruments;
- (e) improvements to data-flow activities and control activities that significantly reduce the inherent or control risk.

4. Measures relating to the improvement of an installation's monitoring methodology shall not be deemed to incur unreasonable costs up to an accumulated amount of EUR 2 000 per reporting period. For installations with low emissions that threshold shall be EUR 500 per reporting period.

⁽¹⁾ Directive 2014/31/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of non-automatic weighing instruments (OJ L 96, 29.3.2014, p. 107).

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CHAPTER III

MONITORING OF EMISSIONS FROM STATIONARY INSTALLATIONS

SECTION I

*General provisions**Article 19***Categorisation of installations, source streams and emission sources**

1. For the purpose of monitoring emissions and determining the minimum requirements for tiers, each operator shall determine the category of its installation pursuant to paragraph 2, and, where relevant, of each source stream pursuant to paragraph 3 and of each emission source pursuant to paragraph 4.

2. The operator shall classify each installation in one of the following categories:

(a) a category A installation, where the average verified annual emissions in the trading period immediately preceding the current trading period, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, are equal to or less than 50 000 tonnes of CO_{2(e)};

(b) a category B installation, where the average verified annual emissions of the trading period immediately preceding the current trading period, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, are more than 50 000 tonnes of CO_{2(e)} and equal to or less than 500 000 tonnes of CO_{2(e)};

(c) a category C installation, where the average verified annual emissions of the trading period immediately preceding the current trading period, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, are more than 500 000 tonnes of CO_{2(e)}.

By way of derogation from Article 14(2), the competent authority may allow the operator not to modify the monitoring plan where, on the basis of verified emissions, the threshold for the classification of the installation referred to in the first subparagraph is exceeded, but the operator demonstrates to the satisfaction of the competent authority that this threshold has not already been exceeded within the past five reporting periods and will not be exceeded again in subsequent reporting periods.

3. The operator shall classify each source stream in one of the following categories, comparing it against the sum of all absolute values of fossil CO₂ and CO_{2(e)} corresponding to all source streams included in calculation-based methodologies and of all emissions of emission sources monitored using measurement-based methodologies, before subtraction of transferred CO₂:

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- (a) minor source streams, where the source streams selected by the operator jointly account for less than 5 000 tonnes of fossil CO₂ per year or less than 10 %, up to a total maximum of 100 000 tonnes of fossil CO₂ per year, whichever is greater in terms of absolute value;
- (b) *de minimis* source streams, where the source streams selected by the operator jointly account for less than 1 000 tonnes of fossil CO₂ per year or less than 2 %, up to a total maximum of 20 000 tonnes of fossil CO₂ per year, whichever is greater in terms of absolute value;
- (c) major source streams, where the source streams do not fall within the categories referred to in points (a) and (b).

By way of derogation from Article 14(2), the competent authority may allow the operator not to modify the monitoring plan where, on the basis of verified emissions, the threshold for the classification of a source stream as a minor source stream or a *de minimis* source stream referred to in the first subparagraph is exceeded, but the operator demonstrates to the satisfaction of the competent authority that this threshold has not already been exceeded within the past five reporting periods and will not be exceeded again in subsequent reporting periods.

4. The operator shall classify each emission source for which a measurement-based methodology is applied in one of the following categories:

- (a) minor emission sources, where the emission source emits less than 5 000 tonnes of fossil CO_{2(e)} per year or less than 10 % of the installation's total fossil emissions, up to a maximum of 100 000 tonnes of fossil CO_{2(e)} per year, whichever is greater in terms of absolute value;
- (b) major emission sources, where the emission source does not classify as a minor emission source.

By way of derogation from Article 14(2), the competent authority may allow the operator not to modify the monitoring plan where, on the basis of verified emissions, the threshold for the classification of an emission source as a minor emission source referred to in the first subparagraph is exceeded, but the operator demonstrates to the satisfaction of the competent authority that this threshold has not already been exceeded within the past five reporting periods and will not be exceeded again in subsequent reporting periods.

5. Where the average annual verified emissions in the trading period immediately preceding the current trading period for the installation are not available or no longer representative for the purpose of paragraph 2, the operator shall use a conservative estimate of annual average emissions, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, to determine the category of the installation.

Article 20

Monitoring boundaries

1. Operators shall define the monitoring boundaries for each installation.

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Within those boundaries, the operator shall include all relevant greenhouse gas emissions from all emission sources and source streams belonging to activities carried out at the installation and listed in Annex I to Directive 2003/87/EC, and from activities and greenhouse gases included by the Member State in which the installation is situated, pursuant to Article 24 of that Directive.

The operator shall also include emissions from regular operations and abnormal events, including start-up, shut-down and emergency situations, over the reporting period, with the exception of emissions from mobile machinery for transportation purposes.

2. When determining the monitoring and reporting process, the operator shall include the sector-specific requirements laid down in Annex IV.

3. Where leakages from a storage complex within the meaning of Directive 2009/31/EC are identified and lead to emissions or release of CO₂ to the water column, they shall be considered as emission sources for the installation in question and shall be monitored in accordance with section 23 of Annex IV to this Regulation.

The competent authority may allow the exclusion of a leakage emission source from the monitoring and reporting process, once corrective measures pursuant to Article 16 of Directive 2009/31/EC have been taken and emissions or release into the water column from that leakage can no longer be detected.

Article 21

Choice of the monitoring methodology

1. For the monitoring of the emissions of an installation, the operator shall choose to apply either a calculation-based methodology or a measurement-based methodology, subject to specific provisions of this Regulation.

A calculation-based methodology shall consist in determining emissions from source streams on the basis of activity data obtained by means of measurement systems and additional parameters from laboratory analyses or default values. The calculation-based methodology may be implemented according to the standard methodology set out in Article 24 or the mass-balance methodology set out in Article 25.

A measurement-based methodology shall consist in determining emissions from emission sources by means of continuous measurement of the concentration of the relevant greenhouse gas in the flue gas and of the flue-gas flow, including the monitoring of CO₂ transfers between installations where the CO₂ concentration and the flow of the transferred gas are measured.

Where the calculation-based methodology is applied, the operator shall determine for each source stream, in the monitoring plan, whether the standard methodology or the mass-balance methodology is used, including the relevant tiers in accordance with Annex II.

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2. Subject to approval by the competent authority, the operator may combine standard methodology, mass-balance and measurement-based methodologies for different emission sources and source streams belonging to one installation, provided that neither gaps nor double counting concerning emissions occur.

3. Where sector-specific requirements laid down in Annex IV require the use of a specific monitoring methodology, the operator shall use that methodology or a measurement-based methodology. The operator may choose a different methodology only if it provides the competent authority with evidence that the use of the required methodology is technically not feasible or incurs unreasonable costs, or that the alternative methodology leads to a higher overall accuracy of emissions data.

*Article 22***Monitoring methodology not based on tiers**

By way of derogation from Article 21(1), the operator may use a monitoring methodology that is not based on tiers (hereinafter ‘the fall-back methodology’) for selected source streams or emission sources, provided that all of the following conditions are met:

- (a) applying at least tier 1 under the calculation-based methodology for one or more major source streams or minor source streams and a measurement-based methodology for at least one emission source related to the same source streams is technically not feasible or would incur unreasonable costs;
- (b) the operator assesses and quantifies each year the uncertainties of all parameters used for the determination of the annual emissions in accordance with the *ISO guide to the expression of uncertainty in measurement* (JCGM 100:2008) or another equivalent internationally accepted standard, and includes the results in the annual emissions report;
- (c) the operator demonstrates to the satisfaction of the competent authority that by applying such a fall-back monitoring methodology, the overall uncertainty thresholds for the annual level of greenhouse gas emissions for the whole installation do not exceed 7,5 % for category A installations, 5,0 % for category B installations and 2,5 % for category C installations.

*Article 23***Temporary changes to the monitoring methodology**

1. Where it is for technical reasons temporarily not feasible to apply the monitoring plan as approved by the competent authority, the operator concerned shall apply the highest achievable tier, or a conservative no-tier approach if application of a tier is not achievable, until the conditions for application of the tier approved in the monitoring plan have been restored.

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The operator shall take all necessary measures to allow the prompt resumption of the application of the monitoring plan as approved by the competent authority.

2. The operator concerned shall notify the competent authority of the temporary change referred to in paragraph 1 to the monitoring methodology without undue delay to the competent authority, specifying:

- (a) the reasons for deviating from the monitoring plan as approved by the competent authority;
- (b) the details of the interim monitoring methodology that the operator is using to determine the emissions until the conditions for the application of the monitoring plan as approved by the competent authority have been restored;
- (c) the measures the operator is taking to restore the conditions for the application of the monitoring plan as approved by the competent authority;
- (d) the anticipated point in time when application of the monitoring plan as approved by the competent authority will be resumed.

SECTION 2

Calculation-based methodology

Subsection 1

General

Article 24

Calculation of emissions under the standard methodology

1. Under the standard methodology, the operator shall calculate combustion emissions source stream by multiplying the activity data related to the amount of fuel combusted, expressed as terajoules based on net calorific value (NCV), by the corresponding emission factor, expressed as tonnes of CO₂ per terajoule (t CO₂/TJ) consistent with the use of NCV, and the corresponding oxidation factor.

The competent authority may allow the use of emission factors for fuels expressed as t CO₂/t or t CO₂/Nm³. In such cases, the operator shall determine combustion emissions by multiplying the activity data related to the amount of fuel combusted, expressed as tonnes or normal cubic metres, by the corresponding emission factor and the corresponding oxidation factor.

2. The operator shall determine process emissions per source stream by multiplying the activity data related to the material consumption, throughput or production output, expressed in tonnes or normal cubic metres, by the corresponding emission factor, expressed in t CO₂/t or t CO₂/Nm³, and the corresponding conversion factor.

3. Where a tier 1 or tier 2 emission factor already includes the effect of incomplete chemical reactions, the oxidation factor or conversion factor shall be set to 1.

▼B*Article 25***Calculation of emissions under the mass balance methodology**

1. Under the mass balance methodology, the operator shall calculate the quantity of CO₂ corresponding to each source stream included in the mass balance by multiplying the activity data related to the amount of fuel or material entering or leaving the boundaries of the mass balance, with the fuel's or material's carbon content multiplied by 3,664 t CO₂/t C, applying section 3 of Annex II.

2. Notwithstanding Article 49, the emissions of the total process covered by the mass balance shall be the sum of the CO₂ quantities corresponding to all source streams covered by the mass balance. CO emitted to the atmosphere shall be calculated in the mass balance as emission of the molar equivalent amount of CO₂.

*Article 26***Applicable tiers**

1. When defining the relevant tiers for major and minor source streams in accordance with Article 21(1), to determine the activity data and each calculation factor, each operator shall apply the following:

- (a) at least the tiers listed in Annex V, in the case of a category A installation, or where a calculation factor is required for a source stream that is a commercial standard fuel;
- (b) in other cases than those referred to in point (a), the highest tier as defined in Annex II.

However, for major source streams the operator may apply a tier one level lower than required in accordance with the first subparagraph for category C installations and up to two levels lower for category A and B installations, with a minimum of tier 1, where it shows to the satisfaction of the competent authority that the tier required in accordance with the first subparagraph is technically not feasible or incurs unreasonable costs.

The competent authority may, for a transitional period agreed with the operator, allow an operator to apply tiers for major source streams that are lower than those referred to in the second subparagraph, with a minimum of tier 1, provided that:

- (a) the operator shows to the satisfaction of the competent authority that the tier required pursuant to the second subparagraph is technically not feasible or incurs unreasonable costs; and
- (b) the operator provides an improvement plan indicating how and by when at least the tier required pursuant to the second subparagraph will be reached.

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2. For minor source streams, the operator may apply a lower tier than required in accordance with the first subparagraph of paragraph 1, with a minimum of tier 1, where it shows to the satisfaction of the competent authority that the tier required in accordance with the first subparagraph of paragraph 1 is technically not feasible or incurs unreasonable costs.

3. For *de minimis* source streams, the operator may determine activity data and each calculation factor by using conservative estimates instead of using tiers, unless a defined tier is achievable without additional effort.

4. For the oxidation factor and conversion factor, the operator shall, as a minimum, apply the lowest tiers listed in Annex II.

5. Where the competent authority has allowed the use of emission factors expressed as t CO₂/t or t CO₂/Nm³ for fuels, and for fuels used as process input or in mass balances in accordance with Article 25, the net calorific value may be monitored using a conservative estimate instead of using tiers, unless a defined tier is achievable without additional effort.

Subsection 2**Activity data***Article 27***Determination of activity data**

1. The operator shall determine the activity data of a source stream in one of the following ways:

(a) on the basis of continual metering at the process which causes the emissions;

(b) on the basis of aggregation of metering of quantities delivered separately, taking into account relevant stock changes.

2. For the purposes of point (b) of paragraph 1, the quantity of fuel or material processed during the reporting period shall be calculated as the quantity of fuel or material received during the reporting period, minus the quantity of fuel or material moved out of the installation, plus the quantity of fuel or material in stock at the beginning of the reporting period, minus the quantity of fuel or material in stock at the end of the reporting period.

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

(a) data from previous years correlated with output for the reporting period;

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- (b) documented procedures and respective data in audited financial statements for the reporting period.

Where it is technically not feasible or would incur unreasonable costs to determine activity data for the entire calendar year, the operator may choose the next most appropriate day to separate one reporting year from the subsequent year, and reconcile accordingly to the calendar year required. The deviations involved for one or more source streams shall be clearly recorded, form the basis of a value representative for the calendar year, and be considered consistently in relation to the next year.

*Article 28***Measurement systems under the operator's control**

1. To determine activity data in accordance with Article 27, the operator shall use metering results based on measurement systems under its own control at the installation, provided that all of the following conditions are complied with:

- (a) the operator must carry out an uncertainty assessment and ensures that the uncertainty threshold of the relevant tier level is met;
- (b) the operator must ensure at least once a year and after each calibration of a measuring instrument that the calibration results multiplied by a conservative adjustment factor are compared with the relevant uncertainty thresholds. The conservative adjustment factor shall be based on an appropriate time series of previous calibrations of that or similar measuring instruments for taking into account the effect of uncertainty in service.

Where tier thresholds approved in accordance with Article 12 are exceeded or equipment found not to conform with other requirements, the operator shall take corrective action without undue delay and notify the competent authority thereof.

2. When notifying a new monitoring plan or when it is relevant for a change to the approved monitoring plan, the operator shall provide the competent authority with the uncertainty assessment referred to in point (a) of paragraph 1.

The assessment shall cover the specified uncertainty of the applied measuring instruments, uncertainty associated with the calibration, and any additional uncertainty connected to how the measuring instruments are used in practice. The uncertainty assessment shall cover uncertainty related to stock changes where the storage facilities are capable of containing at least 5 % of the annual used quantity of the fuel or material considered. When carrying out the assessment, the operator shall take into account the fact that the stated values used to define tier uncertainty thresholds in Annex II refer to the uncertainty over the full reporting period.

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The operator may simplify the uncertainty assessment by assuming that the maximum permissible errors specified for the measuring instrument in service or, where lower, the uncertainty obtained by calibration, multiplied by a conservative adjustment factor for taking into account the effect of uncertainty in service, are to be regarded as the uncertainty over the whole reporting period as required by the tier definitions in Annex II, provided that measuring instruments are installed in an environment appropriate for their use specifications.

3. Notwithstanding paragraph 2, the competent authority may allow the operator to use metering results based on measurement systems under its own control at the installation, where the operator provides evidence that the measuring instruments applied are subject to relevant national legal metrological control.

For that purpose, the maximum permissible error in service allowed by the relevant national legislation on legal metrological control for the relevant measuring task may be used as the uncertainty value without providing further evidence.

Article 29

Measurement systems outside the operator's own control

1. Where, based on a simplified uncertainty assessment, the use of measurement systems outside the operator's own control, as compared with the use of those within the operator's own control pursuant to Article 28, allows the operator to comply with at least as high a tier, gives more reliable results and is less prone to control risks, the operator shall determine the activity data from measurement systems outside its own control.

To that end, the operator may revert to one of the following data sources:

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

2. The operator shall ensure compliance with the applicable tier pursuant to Article 26.

To that end, the maximum permissible error in service allowed by relevant legislation for national legal metrological control for the relevant commercial transaction may be used as uncertainty without providing further evidence.

Where the applicable requirements under national legal metrological control are less stringent than the applicable tier pursuant to Article 26, the operator shall obtain evidence on the applicable uncertainty from the trade partner responsible for the measurement system.

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S u b s e c t i o n 3
C a l c u l a t i o n f a c t o r s

*Article 30***Determination of calculation factors**

1. The operator shall determine calculation factors either as default values or values based on analysis, depending on the applicable tier.

2. The operator shall determine and report calculation factors consistently with the state used for related activity data, referring to the fuel's or material's state in which the fuel or material is purchased or used in the emission-causing process, before it is dried or otherwise treated for laboratory analysis.

Where such an approach incurs unreasonable costs or where higher accuracy can be achieved, the operator may consistently report activity data and calculation factors referring to the state in which laboratory analyses are carried out.

The operator shall be required to determine the biomass fraction only for mixed fuels or materials. For other fuels or materials the default value of 0 % for the biomass fraction of fossil fuels or materials shall be used, and a default value of 100 % biomass fraction for biomass fuels or materials consisting exclusively of biomass.

*Article 31***Default values for calculation factors**

1. Where the operator determines calculation factors as default values, it shall use one of the following values, in accordance with the requirement of the applicable tier as set out in Annexes II and VI:

- (a) standard factors and stoichiometric factors listed in Annex VI;
- (b) standard factors used by the Member State for its national inventory submission to the Secretariat of the United Nations Framework Convention on Climate Change;
- (c) literature values agreed with the competent authority, including standard factors published by the competent authority, which are compatible with factors referred to in point (b), but representative of more disaggregated sources of fuel streams;
- (d) values specified and guaranteed by the supplier of a fuel or material where the operator can demonstrate to the satisfaction of the competent authority that the carbon content exhibits a 95 % confidence interval of not more than 1 %;

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- (e) values based on analyses carried out in the past, where the operator can demonstrate to the satisfaction of the competent authority that those values are representative for future batches of the same fuel or material.

2. The operator shall specify all default values used in the monitoring plan.

Where the default values change on an annual basis, the operator shall specify the authoritative applicable source of that value in the monitoring plan.

3. The competent authority may approve a change of default values for a calculation factor in the monitoring plan pursuant to Article 15(2) only where the operator provides evidence that the new default value leads to a more accurate determination of emissions.

4. Upon application by the operator, the competent authority may allow that the net calorific value and emission factors of fuels are determined using the same tiers as required for commercial standard fuels provided that the operator submits, at least every three years, evidence that the 1 % interval for the specified calorific value has been met during the last three years.

5. Upon application by the operator, the competent authority may accept that the stoichiometric carbon content of a pure chemical substance be considered as meeting a tier that would otherwise require analyses carried out in accordance with Articles 32 to 35, if the operator can demonstrate to the satisfaction of the competent authority that using analyses would lead to unreasonable costs and that using the stoichiometric value will not lead to under-estimation of the emissions.

Article 32

Calculation factors based on analyses

1. The operator shall ensure that any analyses, sampling, calibrations and validations for the determination of calculation factors are carried out by applying methods based on corresponding EN standards.

Where such standards are not available, the methods shall be based on suitable ISO standards or national standards. Where no applicable published standards exist, suitable draft standards, industry best-practice guidelines or other scientifically proven methodologies shall be used, limiting sampling and measurement bias.

2. Where online gas chromatographs or extractive or non-extractive gas analysers are used to determine emissions, the operator shall obtain the competent authority's approval for the use of such equipment. The equipment shall be used only with regard to composition data of gaseous fuels and materials. As minimum quality assurance measures, the operator shall ensure that an initial validation and annually repeated validations of the instrument are performed.

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3. The result of any analysis shall be used only for the delivery period or batch of fuel or material for which the samples have been taken, and for which the samples were intended to be representative.

When determining a specific parameter, the operator shall use the results of all analyses made with regard to that parameter.

*Article 33***Sampling plan**

1. Where calculation factors are determined by analyses, the operator shall submit to the competent authority for approval, for each fuel or material a sampling plan in the form of a written procedure, which contains information on methodologies for the preparation of samples, including information on responsibilities, locations, frequencies and quantities, and methodologies for the storage and transport of samples.

The operator shall ensure that the derived samples are representative for the relevant batch or delivery period and free of bias. Relevant elements of the sampling plan shall be agreed with the laboratory carrying out the analysis for the respective fuel or material, and evidence of that agreement shall be included in the plan. The operator shall make the plan available for the purposes of verification pursuant to Implementing Regulation (EU) 2018/2067.

2. The operator shall, in agreement with the laboratory carrying out the analysis for the respective fuel or material and subject to the approval of the competent authority, adapt the elements of the sampling plan where analytical results indicate that the heterogeneity of the fuel or material significantly differs from the information on heterogeneity on which the original sampling plan for that specific fuel or material was based.

*Article 34***Use of laboratories**

1. The operator shall ensure that laboratories used to carry out analyses for the determination of calculation factors are accredited in accordance with EN ISO/IEC 17025, for the relevant analytical methods.

2. Laboratories not accredited in accordance with EN ISO/IEC 17025 may be used for the determination of calculation factors only where the operator can demonstrate to the satisfaction of the competent authority that access to laboratories referred to in paragraph 1 is technically not feasible or would incur unreasonable costs, and that the non-accredited laboratory meets requirements equivalent to EN ISO/IEC 17025.

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3. The competent authority shall deem a laboratory to meet requirements equivalent to EN ISO/IEC 17025 within the meaning of paragraph 2 where the operator provides, to the extent feasible, in the form and to a similar level of detail required for procedures pursuant to Article 12(2), evidence in accordance with the second and the third subparagraph of this paragraph.

With respect to quality management, the operator shall produce an accredited certification of the laboratory in conformity with EN ISO/IEC 9001, or other certified quality management systems that cover the laboratory. In the absence of such certified quality management systems, the operator shall provide other appropriate evidence that the laboratory is capable of managing its personnel, procedures, documents and tasks in a reliable manner.

With respect to technical competence, the operator shall provide evidence that the laboratory is competent and able to generate technically valid results using the relevant analytical procedures. Such evidence shall cover at least the following elements:

- (a) management of the personnel's competence for the specific tasks assigned;
- (b) suitability of accommodation and environmental conditions;
- (c) selection of analytical methods and relevant standards;
- (d) where applicable, management of sampling and sample preparation, including control of sample integrity;
- (e) where applicable, development and validation of new analytical methods or application of methods not covered by international or national standards;
- (f) uncertainty estimation;
- (g) management of equipment, including procedures for calibration, adjustment, maintenance and repair of equipment, and record keeping thereof;
- (h) management and control of data, documents and software;
- (i) management of calibration items and reference materials;
- (j) quality assurance for calibration and test results, including regular participation in proficiency testing schemes, applying analytical methods to certified reference materials, or inter-comparison with an accredited laboratory;

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- (k) management of outsourced processes;
- (l) management of assignments, customer complaints, and ensuring timely corrective action.

*Article 35***Frequencies for analyses**

1. The operator shall apply the minimum frequencies for analyses for relevant fuels and materials listed in Annex VII.
2. The competent authority may allow the operator to use a frequency that differs from those referred to in paragraph 1, where minimum frequencies are not available or where the operator demonstrates one of the following:
 - (a) based on historical data, including analytical values for the respective fuels or materials in the reporting period immediately preceding the current reporting period, any variation in the analytical values for the respective fuel or material does not exceed 1/3 of the uncertainty value to which the operator has to adhere with regard to the activity data determination of the relevant fuel or material;
 - (b) using the required frequency would incur unreasonable costs.

Where an installation operates for part of the year only, or where fuels or materials are delivered in batches that are consumed over more than one calendar year, the competent authority may agree with the operator a more appropriate schedule for analyses, provided that it results in a comparable uncertainty as under point (a) of the first subparagraph.

Subsection 4**Specific calculation factors***Article 36***Emission factors for CO₂**

1. The operator shall determine activity-specific emission factors for CO₂ emissions.
2. Emission factors of fuels, including those used as process input, shall be expressed as t CO₂/TJ.

The competent authority may allow the operator to use an emission factor for a fuel expressed as t CO₂/t or t CO₂/Nm³ for combustion emissions,

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where the use of an emission factor expressed as t CO₂/TJ incurs unreasonable costs or where at least equivalent accuracy of the calculated emissions can be achieved by using such an emission factor.

3. For the conversion of the carbon content into the respective value of a CO₂ related emission factor or *vice versa*, the operator shall use the factor 3,664 t CO₂/t C.

*Article 37***Oxidation and conversion factors**

1. The operator shall use tier 1 as a minimum to determine oxidation or conversion factors. The operator shall use a value of 1 for oxidation or for a conversion factor where the emission factor includes the effect of incomplete oxidation or conversion.

However, the competent authority may require operators to always use tier 1.

2. Where several fuels are used within an installation and tier 3 is to be used for the specific oxidation factor, the operator may ask for the approval of the competent authority for one or both of the following:

- (a) the determination of one aggregate oxidation factor for the whole combustion process and to apply it to all fuels;
- (b) the attribution of the incomplete oxidation to one major source stream and use of a value of 1 for the oxidation factor of the other source streams.

Where biomass or mixed fuels are used, the operator shall provide evidence that application of points (a) or (b) of the first subparagraph does not lead to an under-estimation of emissions.

Subsection 5**Treatment of biomass***Article 38***Biomass source streams**

1. The operator may determine the activity data of a biomass source stream without using tiers and providing analytical evidence regarding the biomass content, where that source stream consists exclusively of biomass and the operator can ensure that it is not contaminated with other materials or fuels.

2. The emission factor of biomass shall be zero.

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The emission factor of each fuel or material shall be calculated and reported as the preliminary emission factor, determined in accordance with Article 30, multiplied by the fossil fraction of the fuel or material.

3. Peat, xylite and fossil fractions of mixed fuels or materials shall not be considered biomass.

4. Where the biomass fraction of mixed fuels or materials is equal or higher than 97 %, or where, due to the amount of the emissions associated with the fossil fraction of the fuel or material, it qualifies as a *de minimis* source stream, the competent authority may allow the operator to apply no-tier methodologies, including the energy balance method, for determining activity data and relevant calculation factors.

Article 39

Determination of biomass and fossil fraction

1. For mixed fuels or materials, the operator may either assume the absence of biomass and apply a default fossil fraction of 100 %, or determine a biomass fraction in accordance with paragraph 2, applying tiers as defined in section 2.4 of Annex II.

2. Where, subject to the tier level required, the operator has to carry out analyses to determine the biomass fraction, it shall do so on the basis of a relevant standard and the analytical methods therein, provided that the use of that standard and analytical method are approved by the competent authority.

Where, subject to the tier level required, the operator has to carry out analyses to determine the biomass fraction, but the application of the first subparagraph is technically not feasible or would incur unreasonable costs, the operator shall submit an alternative estimation method to determine the biomass fraction to the competent authority for approval. For fuels or materials originating from a production process with defined and traceable input streams, the operator may base the estimation on a mass balance of fossil and biomass carbon entering and leaving the process.

The Commission may provide guidelines on further applicable estimation methods.

3. By way of derogation from paragraphs 1 and 2 and Article 30, where the guarantee of origin has been established in accordance with Articles 2(j) and 15 of Directive 2009/28/EC for biogas injected into and subsequently removed from a gas network, the operator shall not use analyses to determine the biomass fraction.

▼B**SECTION 3*****Measurement-based methodology******Article 40*****Use of the measurement-based monitoring methodology**

The operator shall use measurement-based methodologies for all emissions of nitrous oxide (N_2O) as laid down in Annex IV, and to quantify CO_2 transferred pursuant to Article 49.

In addition, the operator may use measurement-based methodologies for CO_2 emission sources where it can provide evidence that for each emission source the tiers required in accordance with Article 41 are complied with.

Article 41**Tier requirements**

1. For each major emission source, the operator shall apply the following:

- (a) in the case of a category A installation, at least the tiers listed in section 2 of Annex VIII;
- (b) in other cases, the highest tier listed in section 1 of Annex VIII.

However, the operator may apply a tier one level lower than required in accordance with the first subparagraph for category C installations and up to two levels lower for category A and B installations, with a minimum of tier 1, where it shows to the satisfaction of the competent authority that the tier required in accordance with the first subparagraph is technically not feasible or incurs unreasonable costs.

2. For emissions from minor emission sources, the operator may apply a lower tier than required in accordance with the first subparagraph of paragraph 1, with a minimum of tier 1, where it shows to the satisfaction of the competent authority that the tier required in accordance with the first subparagraph of paragraph 1 is technically not feasible or incurs unreasonable costs.

Article 42**Measurement standards and laboratories**

1. All measurements shall be carried out applying methods based on:

- (a) EN 14181 (Stationary source emissions — Quality assurance of automated measuring systems);
- (b) EN 15259 (Air quality — Measurement of stationary source emissions — Requirements for measurement sections and sites and for the measurement objective, plan and report);

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

Where such standards are not available, the methods shall be based on suitable ISO standards, standards published by the Commission or national standards. Where no applicable published standards exist, suitable draft standards, industry best practice guidelines or other scientifically proven methodologies shall be used, limiting sampling and measurement bias.

The operator shall consider all relevant aspects of the continuous measurement system, including the location of the equipment, calibration, measurement, quality assurance and quality control.

2. The operator shall ensure that laboratories carrying out measurements, calibrations and relevant equipment assessments for CEMS are accredited in accordance with EN ISO/IEC 17025 for the relevant analytical methods or calibration activities.

Where the laboratory does not have such accreditation, the operator shall ensure that equivalent requirements of Article 34(2) and (3) are met.

Article 43

Determination of emissions

1. The operator shall determine the annual emissions from an emission source over the reporting period by summing up over the reporting period all hourly values of the measured greenhouse gas concentration multiplied by the hourly values of the flue gas flow, where the hourly values shall be averages over all individual measurement results of the respective operating hour.

In the case of CO₂ emissions, the operator shall determine annual emissions on the basis of equation 1 in Annex VIII. CO emitted to the atmosphere shall be treated as the molar equivalent amount of CO₂.

In the case of nitrous oxide (N₂O), the operator shall determine annual emissions on the basis of the equation in subsection B.1 of section 16 of Annex IV.

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

3. The operator shall determine the greenhouse gas concentration in the flue gas by continuous measurement at a representative point through one of the following:

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- (a) direct measurement;
- (b) in the case of high concentration in the flue gas, calculation of the concentration using an indirect concentration measurement applying equation 3 in Annex VIII and taking into account the measured concentration values of all other components of the gas stream as laid down in the operator's monitoring plan.

4. Where relevant, the operator shall determine separately any CO₂ amount stemming from biomass and subtract it from the total measured CO₂ emissions. For this purpose the operator may use:

- (a) a calculation based approach, including approaches using analyses and sampling based on EN ISO 13833 (Stationary source emissions — Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide — Radiocarbon sampling and determination);
- (b) another method based on a relevant standard, including ISO 18466 (Stationary source emissions — Determination of the biogenic fraction in CO₂ in stack gas using the balance method);
- (c) an estimation method published by the Commission.

Where the method proposed by the operator involves continuous sampling from the flue gas stream, EN 15259 (Air quality — Measurement of stationary source emissions — Requirements for measurement sections and sites and for the measurement objective, plan and report) shall be applied.

5. The operator shall determine the flue gas flow for the calculation in accordance with paragraph 1 by one of the following methods:

- (a) calculation by means of a suitable mass balance, taking into account all significant parameters on the input side, including for CO₂ emissions at least input material loads, input airflow and process efficiency, and on the output side, including at least the product output and the concentration of oxygen (O₂), sulphur dioxide (SO₂) and nitrogen oxides (NO_x);
- (b) determination by continuous flow measurement at a representative point.

Article 44

Data aggregation

1. The operator shall calculate hourly averages for each parameter, including concentrations and flue gas flow, relevant for determining emissions using a measurement-based methodology by using all data points available for that specific hour.

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Where an operator can generate data for shorter reference periods without additional cost, the operator shall use those periods for the determination of the annual emissions in accordance with Article 43(1).

2. Where the continuous measurement equipment for a parameter is out of control, out of range or out of operation for part of the hour or reference period referred to in paragraph 1, the operator shall calculate the related hourly average *pro rata* to the remaining data points for that specific hour or shorter reference period, provided that at least 80 % of the maximum number of data points for a parameter are available.

Article 45(2) to (4) shall apply where fewer than 80 % of the maximum number of data points for a parameter are available.

Article 45

Missing data

1. Where a piece of measurement equipment within a CEMS is out of operation for more than five consecutive days in any calendar year, the operator shall inform the competent authority without undue delay and propose adequate measures to improve the quality of the CEMS in question.

2. Where a valid hour or shorter reference period in accordance with Article 44(1) of data cannot be provided for one or more parameters of the measurement-based methodology due to the equipment being out of control, out of range or out of operation, the operator shall determine values for substituting each missing hour of data.

3. Where a valid hour or shorter reference period of data cannot be provided for a parameter directly measured as concentration, the operator shall calculate a substitution value as the sum of an average concentration and twice the standard deviation associated with that average, using equation 4 in Annex VIII.

Where the reporting period is not applicable for determining such substitution values due to significant technical changes at the installation, the operator shall agree with the competent authority a representative timeframe for determining the average and standard deviation, where possible with a duration of one year.

4. Where a valid hour of data cannot be provided for a parameter other than concentration, the operator shall obtain substitute values of that parameter through a suitable mass balance model or an energy balance of the process. The operator shall validate the results by using the remaining measured parameters of the measurement-based methodology and data at regular working conditions, considering a time period of the same duration as the data gap.

▼B*Article 46***Corroborating with calculation of emissions**

The operator shall corroborate emissions determined by a measurement-based methodology, with the exception of N₂O emissions from nitric acid production and greenhouse gases transferred to a transport network or a storage site, by calculating the annual emissions of each greenhouse gas in question for the same emission sources and source streams.

The use of tier methodologies shall not be required.

*SECTION 4****Special provisions****Article 47***Installations with low emissions**

1. The competent authority may allow the operator to submit a simplified monitoring plan in accordance with Article 13, provided that it operates an installation with low emissions.

The first subparagraph shall not apply to installations carrying out activities for which N₂O is included pursuant to Annex I to Directive 2003/87/EC.

2. For the purposes of the first subparagraph of paragraph 1, an installation shall be considered an installation with low emissions where at least one of the following conditions is met:

- (a) the average annual emissions of that installation reported in the verified emissions reports during the trading period immediately preceding the current trading period, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, were less than 25 000 tonnes of CO_{2(e)} per year;
- (b) the average annual emissions referred to in point (a) are not available or are no longer applicable because of changes to the installation's boundaries or changes to the operating conditions of the installation, but the annual emissions of that installation for the next five years, with the exclusion of CO₂ stemming from biomass and before subtraction of transferred CO₂, will be, based on a conservative estimation method, less than 25 000 tonnes of CO_{2(e)} per year.

3. The operator of an installation with low emissions shall not be required to submit the supporting documents referred to in the third subparagraph of Article 12(1), and shall be exempt from the requirement of submitting an improvement report as referred to in Article 69(4) in response to recommendations for improvement reported by the verifier in the verification report.

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4. By way of derogation from Article 27, the operator of an installation with low emissions may determine the amount of fuel or material by using available and documented purchasing records and estimated stock changes. The operator shall also be exempt from the requirement to provide the uncertainty assessment referred to in Article 28(2) to the competent authority.

5. The operator of an installation with low emissions shall be exempt from the requirement in Article 28(2) to include uncertainty related to stock changes in an uncertainty assessment.

6. By way of derogation from Articles 26(1) and 41(1), the operator of an installation with low emissions may apply as a minimum tier 1 for the purposes of determining activity data and calculation factors for all source streams and for determining emissions by measurement-based methodologies, unless higher accuracy is achievable without additional effort for the operator, without providing evidence that applying higher tiers is technically not feasible or would incur unreasonable costs.

7. For the purpose of determining calculation factors on the basis of analyses in accordance with Article 32, the operator of an installation with low emissions may use any laboratory that is technically competent and able to generate technically valid results using the relevant analytical procedures, and provides evidence for quality assurance measures as referred to in Article 34(3).

8. Where an installation with low emissions subject to simplified monitoring exceeds the threshold referred to in paragraph 2 in any calendar year, its operator shall notify the competent authority thereof without undue delay.

The operator shall, without undue delay, submit a significant modification of the monitoring plan within the meaning of point (b) of Article 15(3), to the competent authority for approval.

However, the competent authority shall allow that the operator continues simplified monitoring provided that that operator demonstrates to the satisfaction of the competent authority that the threshold referred to in paragraph 2 has not already been exceeded within the past five reporting periods and will not be exceeded again from the following reporting period onwards.

*Article 48***Inherent CO₂**

1. Inherent CO₂ that is transferred into an installation, including that contained in natural gas, a waste gas (including blast furnace or coke oven gas) or in process inputs (including synthesis gas), shall be included in the emission factor for that source stream.

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2. Where inherent CO₂ originates from activities covered by Annex I to Directive 2003/87/EC or included pursuant to Article 24 of that Directive and is subsequently transferred out of the installation as part of a source stream to another installation and activity covered by that Directive, it shall not be counted as emissions of the installation where it originates.

However, where inherent CO₂ is emitted, or transferred out of the installation to entities not covered by that Directive, it shall be counted as emissions of the installation where it originates.

3. The operators may determine quantities of inherent CO₂ transferred out of the installation both at the transferring and at the receiving installation. In that case, the quantities of respectively transferred and received inherent CO₂ shall be identical.

Where the quantities of transferred and received inherent CO₂ are not identical, the arithmetical average of both determined values shall be used in both the transferring and receiving installations' emissions reports, where the deviation between the values can be explained by the uncertainty of the measurement systems or the determination method. In such cases, the emissions report shall refer to the alignment of that value.

Where the deviation between the values cannot be explained by the approved uncertainty range of the measurement systems or the determination method, the operators of the transferring and receiving installations shall align the values by applying conservative adjustments approved by the competent authority.

*Article 49***Transferred CO₂**

1. The operator shall subtract from the emissions of the installation any amount of CO₂ originating from fossil carbon in activities covered by Annex I to Directive 2003/87/EC that is not emitted from the installation, but:

(a) transferred out of the installation to any of the following:

(i) a capture installation for the purpose of transport and long-term geological storage in a storage site permitted under Directive 2009/31/EC;

(ii) a transport network with the purpose of long-term geological storage in a storage site permitted under Directive 2009/31/EC;

(iii) a storage site permitted under Directive 2009/31/EC for the purpose of long-term geological storage;

(b) transferred out of the installation and used to produce precipitated calcium carbonate, in which the used CO₂ is chemically bound.

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2. In its annual emissions report, the operator of the transferring installation shall provide the receiving installation's installation identification code recognised in accordance with the acts adopted pursuant to Article 19(3) of Directive 2003/87/EC, if the receiving installation is covered by that Directive. In all other cases, the operator of the transferring installation shall provide the name, address and contact information of a contact person for the receiving installation.

The first subparagraph shall also apply to the receiving installation with respect to the transferring installation's installation identification code.

3. For the determination of the quantity of CO₂ transferred from one installation to another, the operator shall apply a measurement-based methodology, including in accordance with Articles 43, 44 and 45. The emission source shall correspond to the measurement point and the emissions shall be expressed as the quantity of CO₂ transferred.

For the purpose of point (b) of paragraph 1, the operator shall apply a calculation-based methodology.

4. For determining the quantity of CO₂ transferred from one installation to another, the operator shall apply the highest tier as defined in section 1 of Annex VIII.

However, the operator may apply the next lower tier provided that it establishes that applying the highest tier as defined in section 1 of Annex VIII is technically not feasible or incurs unreasonable costs.

For determining the quantity of CO₂ chemically bound in precipitated calcium carbonate, the operator shall use data sources representing highest achievable accuracy.

5. The operators may determine quantities of CO₂ transferred out of the installation both at the transferring and at the receiving installation. In such cases, Article 48(3) shall apply.

Article 50

Use or transfer of N₂O

1. Where N₂O originates from activities covered by Annex I to Directive 2003/87/EC for which that Annex specifies N₂O as relevant and an installation does not emit the N₂O but transfers it to another installation that monitors and reports emissions in accordance with this Regulation, it shall not be counted as emissions of the installation where it originates.

An installation that receives N₂O from an installation and activity in accordance with the first subparagraph shall monitor the relevant gas streams using the same methodologies, as required by this Regulation, as if the N₂O were generated within the receiving installation itself.

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However, where N₂O is bottled or used as a gas in products so that it is emitted outside the installation, or where it is transferred out of the installation to entities not covered by Directive 2003/87/EC, it shall be counted as emissions of the installation where it originates, except for quantities of N₂O in respect of which the operator of the installation where the N₂O originates can demonstrate to the competent authority that the N₂O is destroyed using suitable emissions abatement equipment.

2. In its annual emissions report, the operator of the transferring installation shall provide the receiving installation's installation identification code recognised in accordance with the acts adopted pursuant to Article 19(3) of Directive 2003/87/EC, if relevant.

The first subparagraph shall also apply to the receiving installation with respect to the transferring installation's installation identification code.

3. To determine the quantity of N₂O transferred from one installation to another, the operator shall apply a measurement-based methodology, including in accordance with Articles 43, 44 and 45. The emission source shall correspond to the measurement point and the emissions shall be expressed as the quantity of N₂O transferred.

4. To determine the quantity of N₂O transferred from one installation to another, the operator shall apply the highest tier as defined in section 1 of Annex VIII for emissions of N₂O.

However, the operator may apply the next lower tier provided that it establishes that applying the highest tier as defined in section 1 of Annex VIII is technically not feasible or incurs unreasonable costs.

5. The operators may determine quantities of N₂O transferred out of the installation both at the transferring and at the receiving installation. In such cases, Article 48(3) shall apply *mutatis mutandis*.

CHAPTER IV

MONITORING OF EMISSIONS AND TONNE-KILOMETRE DATA FROM AVIATION

Article 51

General provisions

1. Each aircraft operator shall monitor and report emissions from aviation activities for all flights included in Annex I to Directive 2003/87/EC that are performed by that aircraft operator during the reporting period and for which the aircraft operator is responsible.

To that end, the aircraft operator shall attribute all flights to the calendar year according to the time of departure measured in Coordinated Universal Time.

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2. The aircraft operator intending to apply for an allocation of allowances free of charge pursuant to Articles 3e or 3f of Directive 2003/87/EC shall also monitor tonne-kilometre data for the same flights during the respective monitoring years.

3. For the purpose of identifying the unique aircraft operator referred to in point (o) of Article 3 of Directive 2003/87/EC that is responsible for a flight, the call sign used for air traffic control purposes, shall be used. The call sign shall be one of the following:

- (a) the ICAO designator laid down in box 7 of the flight plan;
- (b) where the ICAO designator of the aircraft operator is not available, the registration markings of the aircraft.

4. Where the identity of the aircraft operator is not known, the competent authority shall consider the owner of the aircraft as aircraft operator unless it proves the identity the aircraft operator responsible.

Article 52

Submission of monitoring plans

1. At the latest four months before an aircraft operator commences aviation activities covered by Annex I to Directive 2003/87/EC, it shall submit to the competent authority a monitoring plan for the monitoring and reporting of emissions in accordance with Article 12.

By way of derogation from the first subparagraph, an aircraft operator that performs an aviation activity covered by Annex I to Directive 2003/87/EC for the first time that could not be foreseen four months in advance of the activity shall submit a monitoring plan to the competent authority without undue delay, but no later than six weeks after performance of that activity. The aircraft operator shall provide adequate justification to the competent authority why a monitoring plan could not be submitted four months in advance of the activity.

Where the administering Member State referred to in Article 18a of Directive 2003/87/EC is not known in advance, the aircraft operator shall without undue delay submit the monitoring plan when information on the competent authority of the administering Member State becomes available.

2. Where the aircraft operator is intending to apply for an allocation of allowances free of charge pursuant to Article 3e or 3f of Directive 2003/87/EC, it shall also submit a monitoring plan for the monitoring and reporting of tonne-kilometre data. That monitoring plan shall be submitted at the latest four months prior to the start of one of the following:

- (a) the monitoring year mentioned in Article 3e(1) of Directive 2003/87/EC for applications pursuant to that Article;

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- (b) the second calendar year of the period referred to in Article 3c(2) of Directive 2003/87/EC for applications pursuant to Article 3f of that Directive.

*Article 53***Monitoring methodology for emissions from aviation activities**

1. Each aircraft operator shall determine the annual CO₂ emissions from aviation activities by multiplying the annual consumption of each fuel (expressed in tonnes) by the respective emission factor.

2. Each aircraft operator shall determine the fuel consumption for each flight and for each fuel, including fuel consumed by the auxiliary power unit. For that purpose, the aircraft operator shall use one of the methods laid down in section 1 of Annex III. The aircraft operator shall choose the method that provides for the most complete and timely data combined with the lowest uncertainty without incurring unreasonable costs.

3. Each aircraft operator shall determine the fuel uplift referred to in section 1 of Annex III based on one of the following:

- (a) the measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight;
- (b) data from aircraft onboard measurement systems recorded in the mass and balance documentation, in the aircraft technical log or transmitted electronically from the aircraft to the aircraft operator.

4. The aircraft operator shall determine fuel contained in the tank using data from aircraft onboard measurement systems and recorded in the mass and balance documentation, in the aircraft technical log or transmitted electronically from the aircraft to the aircraft operator.

5. Where the amount of fuel uplift or the amount of fuel remaining in the tanks is determined in units of volume, expressed in litres, the aircraft operator shall convert that amount from volume to mass by using density values. The aircraft operator shall use the fuel density (which may be an actual or a standard value of 0,8 kg per litre) that is used for operational and safety reasons.

The procedure for informing the use of actual or standard density shall be described in the monitoring plan along with a reference to the relevant aircraft operator documentation.

6. For the purposes of the calculation referred to in paragraph 1, the aircraft operator shall use the default emission factors set out in table 1 in Annex III.

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For fuels not listed in that table, the aircraft operator shall determine the emission factor in accordance with Article 32. For such fuels, the net calorific value shall be determined and reported as a memo-item.

7. By way of derogation from paragraph 6, the aircraft operator may, upon approval by the competent authority, derive the emission factor or the carbon content, on which it is based, or the net calorific value for commercially traded fuels from the purchasing records for the fuel in question, as provided by the fuel supplier, provided that those have been derived on the basis of internationally accepted standards and the emission factors listed in table 1 of Annex III cannot be applied.

*Article 54***Specific provisions for biomass**

Article 39 shall apply accordingly to the determination of the biomass fraction of a mixed fuel.

Notwithstanding Article 39(2), the competent authority shall allow the use of a methodology uniformly applicable in all Member States for the determination of the biomass fraction, as appropriate.

Under that methodology, the biomass fraction, net calorific value and emission factor or carbon content of the fuel used in an EU ETS aviation activity listed in Annex I to Directive 2003/87/EC shall be determined using fuel purchase records.

The methodology shall be based on the guidelines provided by the Commission to facilitate its consistent application in all Member States.

The use of biofuels for aviation shall be assessed in accordance with Article 18 of Directive 2009/28/EC.

*Article 55***Small emitters**

1. Aircraft operators operating fewer than 243 flights per period for three consecutive four-month periods and aircraft operators operating flights with total annual emissions lower than 25 000 tonnes CO₂ per year shall be considered small emitters.
2. By way of derogation from Article 53, small emitters may estimate the fuel consumption using tools implemented by Eurocontrol or another relevant organisation, which can process all relevant air traffic information and avoid any underestimations of emissions.

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The applicable tools may only be used if they are approved by the Commission including the application of correction factors to compensate for any inaccuracies in the modelling methods.

3. By way of derogation from Article 12, a small emitter that intends to make use of any of the tools referred to in paragraph 2 of this Article may submit only the following information in the monitoring plan for emissions:

- (a) information required pursuant to point 1 of section 2 of Annex I;
- (b) evidence that the thresholds for small emitters set out in paragraph 1 of this Article are met;
- (c) the name of or reference to the tool as referred to in paragraph 2 of this Article that will be used for estimating the fuel consumption.

A small emitter shall be exempted from the requirement to submit the supporting documents referred to in the third subparagraph of Article 12(1).

4. Where an aircraft operator uses any of the tools referred to in paragraph 2 and exceeds the thresholds referred to in paragraph 1 during a reporting year, the aircraft operator shall notify the competent authority thereof without undue delay.

The aircraft operator shall, without undue delay, submit a significant modification of the monitoring plan within the meaning of point (iv) of Article 15(4)(a) to the competent authority for approval.

However, the competent authority shall allow that the aircraft operator continues to use a tool referred to in paragraph 2 provided that that aircraft operator demonstrates to the satisfaction of the competent authority that the thresholds referred to in paragraph 1 have not already been exceeded within the past five reporting periods and will not be exceeded again from the following reporting period onwards.

Article 56

Sources of uncertainty

1. The aircraft operator shall consider sources of uncertainty and their associated levels of uncertainty when selecting the monitoring methodology pursuant to Article 53(2).

2. The aircraft operator shall regularly perform suitable control activities, including cross-checks between the fuel uplift quantity as provided by invoices and the fuel uplift quantity indicated by on-board measurement, and take corrective action if notable deviations are observed.

▼B*Article 57***Determination of tonne-kilometre data**

1. Aircraft operators intending to apply for an allocation of allowances free of charge pursuant to Article 3e or 3f of Directive 2003/87/EC shall monitor tonne-kilometre data for all flights covered by Annex I to Directive 2003/87/EC in the monitoring years relevant for such applications.

2. The aircraft operator shall calculate tonne-kilometre data by multiplying the distance, calculated in accordance with section 3 of Annex III and expressed in kilometres (km), by the payload, calculated as the sum of the mass of freight, mail, passengers and checked baggage expressed in tonnes (t).

3. The aircraft operator shall determine the mass of freight and mail on the basis of the actual or standard mass contained in the mass and balance documentation for the relevant flights.

Aircraft operators not required to have a mass and balance documentation shall propose in the monitoring plan a suitable methodology for determining the mass of freight and mail, while excluding the tare weight of all pallets and containers that are not payload and the service weight.

4. The aircraft operator shall determine the mass of passengers using one of the following tiers:

- (a) tier 1: consisting in a default value of 100 kg for each passenger including their checked baggage;
- (b) tier 2: consisting in the mass for passengers and checked baggage contained in the mass and balance documentation for each flight.

However, the tier selected shall apply to all flights in the monitoring years relevant for applications pursuant to Article 3e or 3f of Directive 2003/87/EC.

CHAPTER V**DATA MANAGEMENT AND CONTROL***Article 58***Data flow activities**

1. The operator or aircraft operator shall establish, document, implement and maintain written procedures for data flow activities for the monitoring and reporting of greenhouse gas emissions and ensure that the annual emissions report resulting from data flow activities does not contain misstatements and is in conformance with the monitoring plan, those written procedures and this Regulation.

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Where the aircraft operator intends to apply for an allocation of allowances free of charge pursuant to Article 3e or 3f of Directive 2003/87/EC, the first subparagraph shall also apply to the monitoring and reporting of tonne-kilometre data.

2. Descriptions of written procedures for data flow activities in the monitoring plan shall at least cover the following elements:

- (a) the items of information listed in Article 12(2);
- (b) identification of the primary data sources;
- (c) each step in the data flow from primary data to annual emissions or tonne-kilometre data which shall reflect the sequence and interaction between the data flow activities, including relevant formulas and data aggregation steps applied;
- (d) the relevant processing steps related to each specific data flow activity, including the formulas and data used to determine the emissions or tonne-kilometre data;
- (e) relevant electronic data processing and storage systems used and the interaction between such systems and other inputs, including manual input;
- (f) the way outputs of data flow activities are recorded.

*Article 59***Control system**

1. The operator or aircraft operator shall establish, document, implement and maintain an effective control system to ensure that the annual emissions report and, where applicable, the tonne-kilometre report resulting from data flow activities does not contain misstatements and is in conformity with the monitoring plan and this Regulation.

2. The control system referred to in paragraph 1 shall consist of the following:

- (a) an operator's or aircraft operator's assessment of inherent risks and control risks based on a written procedure for carrying out the assessment;
- (b) written procedures related to control activities that are to mitigate the risks identified.

3. Written procedures related to control activities as referred to in point (b) of paragraph 2 shall at least include:

- (a) quality assurance of the measurement equipment;

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- (b) quality assurance of the information technology system used for data flow activities, including process control computer technology;
- (c) segregation of duties in the data flow activities and control activities, and management of necessary competencies;
- (d) internal reviews and validation of data;
- (e) corrections and corrective action;
- (f) control of out-sourced processes;
- (g) keeping records and documentation including the management of document versions.

4. The operator or aircraft operator shall monitor the effectiveness of the control system, including by carrying out internal reviews and taking into account the findings of the verifier during the verification of annual emissions reports and, where applicable, tonne-kilometre reports, carried out pursuant to Implementing Regulation (EU) 2018/2067.

Whenever the control system is found to be ineffective or not commensurate with the risks identified, the operator or aircraft operator shall seek to improve the control system and update the monitoring plan or the underlying written procedures for data flow activities, risk assessments and control activities as appropriate.

*Article 60***Quality assurance**

1. For the purposes of point (a) of Article 59(3), the operator shall ensure that all relevant measuring equipment is calibrated, adjusted and checked at regular intervals, including prior to use, and checked against measurement standards traceable to international measurement standards, where available, in accordance with the requirements of this Regulation and proportionate to the risks identified.

Where components of the measuring systems cannot be calibrated, the operator shall identify those in the monitoring plan and propose alternative control activities.

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

2. With regard to continuous emission measurement systems, the operator shall apply quality assurance based on the standard Quality assurance of automated measuring systems (EN 14181), including parallel measurements with standard reference methods at least once per year, performed by competent staff.

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Where such quality assurance requires emission limit values (ELVs) as necessary parameters for the basis of calibration and performance checks, the annual average hourly concentration of the greenhouse gas shall be used as a substitute for such ELVs. Where the operator finds a non-compliance with the quality assurance requirements, including that recalibration has to be performed, it shall report that circumstance to the competent authority and take corrective action without undue delay.

*Article 61***Quality assurance of information technology**

For the purposes of point (b) of Article 59(3), the operator or aircraft operator shall ensure that the information technology system is designed, documented, tested, implemented, controlled and maintained in a way to process reliable, accurate and timely data in accordance with the risks identified in accordance with point (a) of Article 59(2).

The control of the information technology system shall include access control, control of back up, recovery, continuity planning and security.

*Article 62***Segregation of duties**

For the purposes of point (c) of Article 59(3), the operator or aircraft operator shall assign responsible persons for all data flow activities and for all control activities in a way to segregate conflicting duties. In the absence of other control activities, it shall ensure for all data flow activities commensurate with the identified inherent risks that all relevant information and data shall be confirmed by at least one person who has not been involved in the determination and recording of that information or data.

The operator or aircraft operator shall manage the necessary competencies for the responsibilities involved, including the appropriate assignment of responsibilities, training, and performance reviews.

*Article 63***Internal reviews and validation of data**

1. For the purposes of point (d) of Article 59(3) and on the basis of the inherent risks and control risks identified in the risk assessment referred to in point (a) of Article 59(2), the operator or aircraft operator shall review and validate data resulting from the data flow activities referred to in Article 58.

Such review and validation of the data shall at least include:

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

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- (b) a comparison of the data that the operator or aircraft operator has obtained, monitored and reported over several years;
- (c) a comparison of data and values resulting from different operational data collection systems, including the following comparisons, where applicable:
 - (i) a comparison of fuel or material purchasing data with data on stock changes and data on consumption for the applicable source streams;
 - (ii) a comparison of calculation factors that have been determined by analysis, calculated or obtained from the supplier of the fuel or material, with national or international reference factors of comparable fuels or materials;
 - (iii) a comparison of emissions obtained from measurement-based methodologies and the results of the corroborating calculation pursuant to Article 46;
 - (iv) a comparison of aggregated data and raw data.

2. The operator or aircraft operator shall, to the extent possible, ensure the criteria for rejecting data as part of the review and validation are known in advance. For that purpose the criteria for rejecting data shall be laid down in the documentation of the relevant written procedures.

*Article 64***Corrections and corrective action**

1. Where any part of the data flow activities referred to in Article 58 or control activities referred to in Article 59 is found not to function effectively, or to function outside boundaries that are set in documentation of procedures for those data flow activities and control activities, the operator or aircraft operator shall make appropriate corrections and correct rejected data while avoiding underestimation of emissions.

2. For the purpose of paragraph 1, the operator or aircraft operator shall at least proceed to all of the following:

- (a) assessment of the validity of the outputs of the applicable steps in the data flow activities referred to in Article 58 or control activities referred to in Article 59;
- (b) determination of the cause of the malfunctioning or error concerned;
- (c) implementation of appropriate corrective action, including correcting any affected data in the emission report or tonne-kilometre report, as appropriate.

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3. The operator or aircraft operator shall carry out the corrections and corrective actions pursuant to paragraph 1 of this Article such that they are responsive to the inherent risks and control risks identified in the risk assessment referred to in Article 59.

*Article 65***Out-sourced processes**

Where the operator or aircraft operator outsources one or more data flow activities referred to in Article 58 or control activities referred to in Article 59, the operator or aircraft operator shall proceed to all of the following:

- (a) check the quality of the outsourced data flow activities and control activities in accordance with this Regulation;
- (b) define appropriate requirements for the outputs of the outsourced processes and the methods used in those processes;
- (c) check the quality of the outputs and methods referred to in point (b) of this Article;
- (d) ensure that outsourced activities are carried out such that those are responsive to the inherent risks and control risks identified in the risk assessment referred to in Article 59.

*Article 66***Treatment of data gaps**

1. Where data relevant for the determination of the emissions of an installation are missing, the operator shall use an appropriate estimation method to determine conservative surrogate data for the respective time period and missing parameter.

Where the operator has not laid down the estimation method in a written procedure, it shall establish such a written procedure and submit to the competent authority for approval an appropriate modification of the monitoring plan in accordance with Article 15.

2. Where data relevant for the determination of an aircraft operator's emissions for one or more flights are missing, the aircraft operator shall use surrogate data for the respective time period calculated in accordance with the alternative method defined in the monitoring plan.

Where surrogate data cannot be determined in accordance with the first subparagraph of this paragraph, the emissions for that flight or those flights may be estimated by the aircraft operator from the fuel consumption determined by using a tool referred to in Article 55(2).

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Where the number of flights with data gaps referred to in the first two sub-paraphraphs exceed 5 % of the annual flights that are reported, the operator shall inform the competent authority thereof without undue delay and shall take remedial action for improving the monitoring methodology.

*Article 67***Records and documentation**

1. The operator or aircraft operator shall keep records of all relevant data and information, including information as listed in Annex IX, for at least 10 years.

The documented and archived monitoring data shall allow for the verification of the annual emissions reports or tonne-kilometre reports in accordance with Implementing Regulation (EU) 2018/2067. Data reported by the operator or aircraft operator contained in an electronic reporting and data management system set up by the competent authority may be considered to be retained by the operator or aircraft operator, if they can access those data.

2. The operator or aircraft operator shall ensure that relevant documents are available when and where they are needed to perform the data flow activities and control activities.

The operator or aircraft operator shall, upon request, make those documents available to the competent authority and to the verifier verifying the emissions report or tonne-kilometre report in accordance with Implementing Regulation (EU) 2018/2067.

CHAPTER VI**REPORTING REQUIREMENTS***Article 68***Timing and obligations for reporting**

1. The operator or aircraft operator shall submit to the competent authority by 31 March of each year an emissions report that covers the annual emissions in the reporting period and that is verified in accordance with Implementing Regulation (EU) 2018/2067.

However, competent authorities may require operators or aircraft operators to submit the verified annual emission report earlier than by 31 March, but by 28 February at the earliest.

2. Where the aircraft operator chooses to apply for the allocation of emission allowances free of charge pursuant to Article 3e or 3f of Directive 2003/87/EC, the aircraft operator shall submit to the competent authority by 31 March of the year following the monitoring year referred to in Article 3e or 3f of that Directive a tonne-kilometre report that covers the tonne-kilometre data of the monitoring year and that is verified in accordance with Implementing Regulation (EU) 2018/2067.

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3. The annual emissions reports and tonne-kilometre reports shall contain at least the information listed in Annex X.

*Article 69***Reporting on improvements to the monitoring methodology**

1. Each operator or aircraft operator shall regularly check whether the monitoring methodology applied can be improved.

An operator of an installation shall submit to the competent authority for approval a report containing the information referred to in paragraph 2 or 3, where appropriate, by the following deadlines:

- (a) for a category A installation, by 30 June every four years;
- (b) for a category B installation, by 30 June every two years;
- (c) for a category C installation, by 30 June every year.

However, the competent authority may set an alternative date for submission of the report, but no later date than 30 September of the same year.

By way of derogation from the second and third subparagraphs, and without prejudice to the first subparagraph, the competent authority may approve, together with the monitoring plan or the improvement report, an extension of the deadline applicable pursuant to the second subparagraph, if the operator provides evidence to the satisfaction of the competent authority upon submission of a monitoring plan in accordance with Article 12 or upon notification of updates in accordance with Article 15, or upon submission of an improvement report in accordance with this Article, that the reasons for unreasonable costs or for improvement measures being technically not feasible will remain valid for a longer period of time. That extension shall take into account the number of years for which the operator provides evidence. The total time period between improvement reports shall not exceed three years for a category C installation, four years for a category B installation or five years for a category A installation.

2. Where the operator does not apply at least the tiers required pursuant to the first subparagraph of Article 26(1) to major source streams and minor source streams and pursuant to Article 41 to emission sources, the operator shall provide a justification as to why it is technically not feasible or would incur unreasonable costs to apply the required tiers.

However, where evidence is found that measures needed for reaching those tiers have become technically feasible and do not any more incur unreasonable costs, the operator shall notify the competent authority of appropriate modifications of the monitoring plan in accordance with Article 15, and submit proposals for implementing the related measures and its timing.

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3. Where the operator applies a fall-back monitoring methodology referred to in Article 22, the operator shall provide: a justification as to why it is technically not feasible or would incur unreasonable costs to apply at least tier 1 for one or more major or minor source streams.

However, where evidence is found that measures needed for reaching at least tier 1 for those source streams have become technically feasible and do not any more incur unreasonable costs, the operator shall notify the competent authority of appropriate modifications of the monitoring plan in accordance with Article 15 and submit proposals for implementing the related measures and its timing.

4. Where the verification report established in accordance with Implementing Regulation (EU) 2018/2067 states outstanding non-conformities or recommendations for improvements, in accordance with Articles 27, 29 and 30 of that Implementing Regulation, the operator or aircraft operator shall submit to the competent authority for approval a report by 30 June of the year in which that verification report is issued by the verifier. That report shall describe how and when the operator or aircraft operator has rectified or plans to rectify the non-conformities identified by the verifier and to implement recommended improvements.

The competent authority may set an alternative date for submission of the report as referred to in this paragraph, but no later date than 30 September of the same year. Where applicable, such report may be combined with the report referred to in paragraph 1 of this Article.

Where recommended improvements would not lead to an improvement of the monitoring methodology, the operator or aircraft operator shall provide a justification of why that is the case. Where the recommended improvements would incur unreasonable costs, the operator or aircraft operator shall provide evidence of the unreasonable nature of the costs.

5. Paragraph 4 of this Article shall not apply where the operator or aircraft operator has already resolved all non-conformities and recommendations for improvement and has submitted related modifications of the monitoring plan to the competent authority for approval in accordance with Article 15 of this Regulation before the date set pursuant to paragraph 4.

Article 70

Determination of emissions by the competent authority

1. The competent authority shall make a conservative estimate of the emissions of an installation or aircraft operator in any of the following situations:

- (a) no verified annual emission report has been submitted by the operator or aircraft operator by the deadline required pursuant to Article 68(1);
- (b) the verified annual emissions report referred to in Article 68(1) is not in compliance with this Regulation;
- (c) the annual emissions report of an operator or aircraft operator has not been verified in accordance with Implementing Regulation (EU) 2018/2067.

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2. Where a verifier has stated, in the verification report pursuant to Implementing Regulation (EU) 2018/2067, the existence of non-material misstatements which have not been corrected by the operator or aircraft operator before issuing the verification report, the competent authority shall assess those misstatements, and make a conservative estimate of the emissions of the installation or aircraft operator where appropriate. The competent authority shall inform the operator or aircraft operator whether and which corrections are required to the annual emissions report. The operator or aircraft operator shall make that information available to the verifier.

3. Member States shall establish an efficient exchange of information between competent authorities responsible for approval of monitoring plans and competent authorities responsible for acceptance of annual emissions reports.

*Article 71***Access to information**

Emission reports held by the competent authority shall be made available to the public by that authority subject to national rules adopted pursuant to Directive 2003/4/EC of the European Parliament and of the Council⁽¹⁾. With regard to the application of the exception, as specified in Article 4(2)(d) of Directive 2003/4/EC, operators or aircraft operators may indicate in their reports what information they consider commercially sensitive.

*Article 72***Rounding of data**

1. ►M1 Total annual emissions of each of the greenhouse gases CO₂, N₂O and PFCs shall be reported as rounded tonnes of CO₂ or CO_{2(e)}. The total annual emissions of the installation shall be calculated as the sum of the rounded values for CO₂, N₂O and PFCs. ◀

Tonne-kilometres shall be reported as rounded values of tonne-kilometres.

2. All variables used to calculate the emissions shall be rounded to include all significant digits for the purpose of calculating and reporting emissions.

3. All data per flights shall be rounded to include all significant digits for the purpose of calculating the distance and payload pursuant to Article 57 and reporting the tonne-kilometre data.

*Article 73***Ensuring consistency with other reporting**

Each activity listed in Annex I to Directive 2003/87/EC that is carried out by an operator or aircraft operator shall be labelled using the codes, where applicable, from the following reporting schemes:

⁽¹⁾ 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 (OJ L 41, 14.2.2003, p.26).

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- (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;
- (b) the installation's identification number in the European pollutant release and transfer register in accordance with Regulation (EC) No 166/2006 of the European Parliament and of the Council (⁽¹⁾);
- (c) the activity of Annex I to Regulation (EC) No 166/2006;
- (d) the NACE code in accordance with Regulation (EC) No 1893/2006 of the European Parliament and of the Council (⁽²⁾).

CHAPTER VII
INFORMATION TECHNOLOGY REQUIREMENTS

Article 74

Electronic data exchange formats

1. Member States may require the operator and aircraft operator to use electronic templates or specific file formats for submission of monitoring plans and changes to the monitoring plan, as well as for submission of annual emissions reports, tonne-kilometre reports, verification reports and improvement reports.

Those templates or file format specifications established by the Member States shall, at least, contain the information contained in electronic templates or file format specifications published by the Commission.

2. When establishing the templates or file-format specifications referred to in the second subparagraph of paragraph 1, Member States may choose one or both of the following options:

- (a) file-format specifications based on XML, such as the EU ETS reporting language published by the Commission for use in connection with advanced automated systems;
- (b) templates published in a form usable by standard office software, including spreadsheets and word processor files.

(⁽¹⁾) Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC (OJ L 33, 4.2.2006, p. 1).

(⁽²⁾) Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities NACE Revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains (OJ L 393, 30.12.2006, p. 1).

▼B*Article 75***Use of automated systems**

1. Where a Member State chooses to use automated systems for electronic data exchange based on file-format specifications in accordance with point (a) of Article 74(2), those systems shall ensure in a cost efficient way, through the implementation of technological measures in accordance with the current state of technology:

- (a) integrity of data, preventing modification of electronic messages during transmission;
- (b) confidentiality of data, through the use of security techniques, including encryption techniques, such that the data is only accessible to the party for which it was intended and that no data can be intercepted by unauthorised parties;
- (c) authenticity of data, such that the identity of both the sender and receiver of data is known and verified;
- (d) non-repudiation of data, such that one party of a transaction cannot deny having received a transaction nor can the other party deny having sent a transaction, by applying methods such as signing techniques, or independent auditing of system safeguards.

2. Any automated systems used by Member States based on file-format specifications in accordance with point (a) of Article 74(2) for communication between the competent authority, operator and aircraft operator, as well as verifier and national accreditation body within the meaning of Implementing Regulation (EU) 2018/2067, shall meet the following non-functional requirements, through implementation of technological measures in accordance with the current state of technology:

- (a) access control, such that the system is only accessible to authorised parties and no data can be read, written or updated by unauthorised parties, through implementation of technological measures in order to achieve the following:
 - (i) restriction of physical access to the hardware on which automated systems run through physical barriers;
 - (ii) restriction of logical access to the automated systems through the use of technology for identification, authentication and authorisation;
- (b) availability, such that data accessibility is ensured, even after significant time and the introduction of possible new software;
- (c) audit trail, such that it is ensured that changes to data can always be found and analysed in retrospect.

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CHAPTER VIII
FINAL PROVISIONS

*Article 76***Amendments to Regulation (EU) No 601/2012**

Regulation (EU) No 601/2012 is amended as follows:

- (1) In Article 12(1), third subparagraph, point (a) is replaced by the following:

‘(a) for installations, evidence for each major and minor source stream demonstrating compliance with the uncertainty thresholds for activity data and calculation factors, where applicable, for the applied tiers as defined in Annexes II and IV, as well as for each emission source demonstrating compliance with the uncertainty thresholds for the applied tiers as defined in Annex VIII, where applicable;’

- (2) In Article 15, paragraph 4, subparagraph (a) is replaced by the following:

‘(a) with regard to the emission monitoring plan:

(i) a change of emission factor values laid down in the monitoring plan;

(ii) a change between calculation methods as laid down in Annex III, or a change from the use of a calculation method to the use of estimation methodology in accordance with Article 55(2) or *vice versa*;

(iii) the introduction of new source streams;

(iv) changes in the status of the aircraft operator as a small emitter within the meaning of Article 55(1) or with regard to one of the thresholds provided by Article 28a(6) of Directive 2003/87/EC;’

- (3) Article 49 is replaced by the following:

*Article 49***Transferred CO₂**

1. The operator shall subtract from the emissions of the installation any amount of CO₂ originating from fossil carbon in activities covered by Annex I to Directive 2003/87/EC that is not emitted from the installation, but:

- (a) transferred out of the installation to any of the following:

(i) a capture installation for the purpose of transport and long-term geological storage in a storage site permitted under Directive 2009/31/EC;

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- (ii) a transport network with the purpose of long-term geological storage in a storage site permitted under Directive 2009/31/EC;
- (iii) a storage site permitted under Directive 2009/31/EC for the purpose of long-term geological storage;
- (b) transferred out of the installation and used to produce precipitated calcium carbonate, in which the used CO₂ is chemically bound.

2. In its annual emissions report, the operator of the transferring installation shall provide the receiving installation's installation identification code recognised in accordance with the acts adopted pursuant to Article 19(3) of Directive 2003/87/EC, if the receiving installation is covered by that Directive. In all other cases, the operator of the transferring installation shall provide the name, address and contact information of a contact person for the receiving installation.

The first subparagraph shall also apply to the receiving installation with respect to the transferring installation's installation identification code.

3. For the determination of the quantity of CO₂ transferred from one installation to another, the operator shall apply a measurement-based methodology, including in accordance with Articles 43, 44 and 45. The emission source shall correspond to the measurement point and the emissions shall be expressed as the quantity of CO₂ transferred.

For the purpose of point (b) of paragraph 1, the operator shall apply a calculation-based methodology.

4. For determining the quantity of CO₂ transferred from one installation to another, the operator shall apply the highest tier as defined in section 1 of Annex VIII.

However, the operator may apply the next lower tier provided that it establishes that applying the highest tier as defined in section 1 of Annex VIII is technically not feasible or incurs unreasonable costs.

For determining the quantity of CO₂ chemically bound in precipitated calcium carbonate, the operator shall use data sources representing highest achievable accuracy.

5. The operators may determine quantities of CO₂ transferred out of the installation both at the transferring and at the receiving installation. In such cases, Article 48(3) shall apply.'

(4) Article 52 is amended as follows:

- (a) paragraph 5 is deleted;
- (b) paragraph 6 is replaced by the following:

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‘6. Where the amount of fuel uplift or the amount of fuel remaining in the tanks is determined in units of volume, expressed in litres, the aircraft operator shall convert that amount from volume to mass by using density values. The aircraft operator shall use the fuel density (which may be an actual or a standard value of 0,8 kg per litre) that is used for operational and safety reasons.

The procedure for informing the use of actual or standard density shall be described in the monitoring plan along with a reference to the relevant aircraft operator documentation.’

(c) paragraph 7 is replaced by the following:

‘7. For the purposes of the calculation referred to in paragraph 1, the aircraft operator shall use the default emission factors set out in Table 2 in Annex III. For fuels not listed in that table, the aircraft operator shall determine the emission factor in accordance with Article 32. For such fuels, the net calorific value shall be determined and reported as a memo-item.’

(5) In Article 54, paragraph 2, subparagraph 1 is replaced by the following:

‘2. By way of derogation from Article 52, small emitters may estimate the fuel consumption using tools implemented by Eurocontrol or another relevant organisation, which can process all relevant air traffic information and avoid any underestimations of emissions.’

(6) Article 55 is amended as follows:

(a) paragraph 1 is replaced by the following:

‘1. The aircraft operator shall consider sources of uncertainty and their associated levels of uncertainty when selecting the monitoring methodology pursuant to Article 52(2).’

(b) paragraphs 2, 3 and 4 are deleted

(7) In Article 59, paragraph 1 is replaced by the following:

‘For the purposes of point (a) of Article 58(3), the operator shall ensure that all relevant measuring equipment is calibrated, adjusted and checked at regular intervals including prior to use, and checked against measurement standards traceable to international measurement standards, where available, in accordance with the requirements of this Regulation and proportionate to the risks identified.

Where components of the measuring systems cannot be calibrated, the operator shall identify those in the monitoring plan and propose alternative control activities.

When the equipment is found not to comply with required performance, the operator shall promptly take necessary corrective action.’

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(8) In Article 65(2), a third subparagraph is added:

‘Where the number of flights with data gaps referred to in the first two sub-paragraphs exceed 5 % of the annual flights that are reported, the operator shall inform the competent authority thereof without undue delay and shall take remedial action for improving the monitoring methodology.’

(9) In Annex I, section 2 is amended as follows:

(a) point (2)(b)(ii) is replaced by the following:

‘(ii) procedures for the measurement of fuel uplifts and fuel in tanks, a description of the measuring instruments involved and the procedures for recording, retrieving, transmitting and storing information regarding measurements, as applicable;’

(b) point (2)(b)(iii) is replaced by the following:

‘(iii) the method for the determination of density, where applicable;’

(c) point (2)(b)(iv) is replaced by the following:

‘(iv) justification of the chosen monitoring methodology, in order to ensure lowest levels of uncertainty, according to Article 55 (1);’

(d) point (2)(d) is deleted

(e) point (2)(f) is replaced by the following:

‘(f) a description of the procedures and systems for identifying, assessing and handling data gaps pursuant to Article 65(2).’

(10) In Annex III, section 2 is deleted.

(11) Annex IV is amended as follows:

(a) in section 10, subsection B, the fourth paragraph is deleted;

(b) in section 14, subsection B, the third paragraph is deleted.

(12) Annex IX is amended as follows:

(a) section 1, point (2) is replaced by the following:

‘Documents justifying the selection of the monitoring methodology and the documents justifying temporal or non-temporal changes of monitoring methodologies and, where applicable, tiers approved by the competent authority;’

(b) section 3, point (5) is replaced by the following:

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- (5) Documentation on the methodology for data gaps where applicable, the number of flights where data gaps occurred, the data used for closing the data gaps, where they occurred, and, where the number of flights with data gaps exceeded 5 % of flights that were reported, reasons for the data gaps as well as documentation of remedial actions taken.'
- (13) In Annex X, section 2 is amended as follows:
- point (7) is replaced by the following:
'(7) The total number of flights per State pair covered by the report;'
 - the following point is added below point (7):
'(7a) Mass of fuel (in tonnes) per fuel type per State pair;'
 - point (10)(a) is replaced by the following:
'(a) the number of flights expressed as percentage of annual flights for which data gaps occurred; and the circumstances and reasons for data gaps that apply;'
 - point (11)(a) is replaced by the following:
'(a) the number of flights expressed as percentage of annual flights (rounded to the nearest 0,1 %) for which data gaps occurred; and the circumstances and reasons for data gaps that apply;'

*Article 77***Repeal of Regulation (EU) No 601/2012**

1. Regulation (EU) No 601/2012 is repealed with effect from 1 January 2021.

References to the repealed Regulation shall be construed as references to this Regulation and read in accordance with the correlation table in Annex XI.

2. The provisions of Regulation (EU) No 601/2012 shall continue to apply to the monitoring, reporting and verification of emissions and, where applicable, activity data, occurring prior to 1 January 2021.

*Article 78***Entry into force and application**

This Regulation shall enter into force on the day following that of its publication in the *Official Journal of the European Union*.

It shall apply from 1 January 2021.

However, Article 76 shall apply from 1 January 2019 or the date of entry into force of this Regulation, whichever is the later.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

▼B*ANNEX I***Minimum content of the monitoring plan (Article 12(1))****1. MINIMUM CONTENT OF THE MONITORING PLAN FOR INSTALLATIONS**

The monitoring plan for an installation shall contain at least the following information:

(1) general information on the installation:

- (a) a description of the installation and activities carried out by the installation to be monitored, containing a list of emissions sources and source streams to be monitored for each activity carried out within the installation and meeting the following criteria:
 - (i) the description must be sufficient for demonstrating that neither data gaps nor double counting of emissions occur;
 - (ii) a simple diagram of the emission sources, source streams, sampling points and metering equipment must be added where requested by the competent authority or where such diagram simplifies describing the installation or referencing emission sources, source streams, measuring instruments and any other parts of the installation relevant for the monitoring methodology including data flow activities and control activities;
- (b) a description of the procedure for managing the assignment of responsibilities for monitoring and reporting within the installation, and for managing the competences of responsible personnel;
- (c) a description of the procedure for regular evaluation of the monitoring plan's appropriateness, covering at least the following:
 - (i) checking the list of emissions sources and source streams, ensuring completeness of the emission sources and source streams and that all relevant changes in the nature and functioning of the installation will be included in the monitoring plan;
 - (ii) assessing compliance with the uncertainty thresholds for activity data and other parameters, where applicable, for the applied tiers for each source stream and emission source;
 - (iii) assessing potential measures for improvement of the monitoring methodology applied;
- (d) a description of the written procedures of the data flow activities pursuant to Article 58, including a diagram where appropriate for clarification;
- (e) a description of the written procedures for the control activities established pursuant to Article 59;
- (f) where applicable, information on relevant links with activities undertaken in the framework of the Community eco-management and audit scheme (EMAS) established pursuant to Regulation (EC) No 1221/2009 of the European Parliament and of the Council (⁽¹⁾), systems covered by harmonised standard ISO 14001:2004 and other environmental management systems including information on procedures and controls with relevance to greenhouse gas emissions monitoring and reporting;

⁽¹⁾ OJ L 342, 22.12.2009, p. 1.

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- (g) the version number of the monitoring plan and the date from which that version of the monitoring plan is applicable;
 - (h) the category of the installation;
- (2) a detailed description of the calculation-based methodologies where applied, consisting of the following:
- (a) a detailed description of the calculation-based methodology applied, including a list of input data and calculation formulae used, a list of the tiers applied for activity data and all relevant calculation factors for each of the source streams to be monitored;
 - (b) where applicable and where the operator intends to make use of simplification for minor and de-minimis source streams, a categorisation of the source streams into major, minor and de-minimis source streams;
 - (c) a description of the measurement systems used, and their measurement range, specified uncertainty and exact location of the measuring instruments to be used for each of the source streams to be monitored;
 - (d) where applicable, the default values used for calculation factors indicating the source of the factor, or the relevant source, from which the default factor will be retrieved periodically, for each of the source streams;
 - (e) where applicable, a list of the analysis methods to be used for the determination of all relevant calculation factors for each of the source streams, and a description of the written procedures for those analyses;
 - (f) where applicable, a description of the procedure underpinning the sampling plan for the sampling of fuel and materials to be analysed, and the procedure used to revise the appropriateness of the sampling plan;
 - (g) where applicable, a list of laboratories engaged in carrying out relevant analytical procedures and, where the laboratory is not accredited as referred to in Article 34(1) a description of the procedure used for demonstrating the compliance with equivalent requirements in accordance with Article 34(2) and (3);
- (3) where a fall-back monitoring methodology is applied in accordance with Article 22, a detailed description of the monitoring methodology applied for all source streams or emission sources, for which no tier methodology is used, and a description of the written procedure used for the associated uncertainty analysis to be carried out;
- (4) a detailed description of the measurement-based methodologies, where applied, including the following:
- (a) a description of the measurement method including descriptions of all written procedures relevant for the measurement and the following:
 - (i) any calculation formulae used for data aggregation and used to determine the annual emissions of each emission source;

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- (ii) the method for determining whether valid hours or shorter reference periods for each parameter can be calculated, and for substitution of missing data in accordance with Article 45;
 - (b) a list of all relevant emission points during typical operation, and during restrictive and transition phases, including breakdown periods or commissioning phases, supplemented by a process diagram where requested by the competent authority;
 - (c) where flue gas flow is derived by calculation, a description of the written procedure for that calculation for each emission source monitored using a measurement-based methodology;
 - (d) a list of all relevant equipment, indicating its measurement frequency, operating range and uncertainty;
 - (e) a list of applied standards and of any deviations from those standards;
 - (f) a description of the written procedure for carrying out the corroborating calculations in accordance with Article 46, where applicable;
 - (g) a description of the method, how CO₂ stemming from biomass is to be determined and subtracted from the measured CO₂ emissions, and of the written procedure used for that purpose, where applicable;
 - (h) where applicable and where the operator intends to make use of simplification for minor emission sources, a categorisation of the emission sources into major and minor emission sources;
- (5) in addition to elements listed in point 4, a detailed description of the monitoring methodology where N₂O emissions are monitored, where appropriate in the form of description of the written procedures applied, including a description of the following:
- (a) the method and parameters used to determine the quantity of materials used in the production process and the maximum quantity of material used at full capacity;
 - (b) the method and parameters used to determine the quantity of product produced as an hourly output, expressed as nitric acid (100 %), adipic acid (100 %), caprolactam, glyoxal and glyoxylic acid per hour respectively;
 - (c) the method and parameters used to determine the N₂O concentration in the flue gas from each emission source, its operating range, and its uncertainty, and details of any alternative methods to be applied where concentrations fall outside the operating range and the situations when this may occur;
 - (d) the calculation method used to determine N₂O emissions from periodic, unabated sources in nitric acid, adipic acid, caprolactam, glyoxal and glyoxylic acid production;
 - (e) the way in which or the extent to which the installation operates with variable loads, and the manner in which the operational management is carried out;
 - (f) the method and any calculation formulae used to determine the annual N₂O emissions and the corresponding CO_{2(e)} values of each emission source;

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- (g) information on process conditions that deviate from normal operations, an indication of the potential frequency and the duration of such conditions, as well as an indication of the volume of the N₂O emissions during the deviating process conditions such as abatement equipment malfunction;

- (6) a detailed description of the monitoring methodology as far as perfluorocarbons from primary aluminium production are monitored, where appropriate in the form of a description of the written procedures applied, including the following:
 - (a) where applicable, the dates of measurement for the determination of the installation-specific emission factors SEF_{CF4} or OVC, and F_{C2F6}, and a schedule for future repetitions of that determination;

 - (b) where applicable, the protocol describing the procedure used to determine the installation-specific emission factors for CF₄ and C₂F₆, showing also that the measurements have been and will be carried out for a sufficiently long time for measured values to converge, but at least for 72 hours;

 - (c) where applicable, the methodology for determining the collection efficiency for fugitive emissions at installations for primary aluminium production;

 - (d) a description of cell type and type of anode;

- (7) a detailed description of the monitoring methodology where transfer of inherent CO₂ as part of a source stream in accordance with Article 48, transfer of CO₂ in accordance with Article 49, or transfer of N₂O in accordance with Article 50 are carried out, where appropriate in the form of a description of the written procedures applied, including the following:
 - (a) where applicable, the location of equipment for temperature and pressure measurement in a transport network;

 - (b) where applicable, procedures for preventing, detecting and quantification of leakage events from transport networks;

 - (c) in the case of transport networks, procedures effectively ensuring that CO₂ is transferred only to installations which have a valid greenhouse gas emission permit, or where any emitted CO₂ is effectively monitored and accounted for in accordance with Article 49;

 - (d) identification of the receiving and transferring installations according to the installation identification code recognised in accordance with Regulation (EU) No 1193/2011;

 - (e) where applicable, a description of continuous measurement systems used at the points of transfer of CO₂ or N₂O between installations transferring CO₂ or N₂O or the determination method in accordance with Articles 48, 49 or 50;

 - (f) where applicable, a description of the conservative estimation method used for determining the biomass fraction of transferred CO₂ in accordance with Article 48 or 49;

 - (g) where applicable, quantification methodologies for emissions or CO₂ released to the water column from potential leakages as well as the applied and possibly adapted quantification methodologies for actual emissions or CO₂ released to the water column from leakages, as specified in section 23 of Annex IV.

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2. MINIMUM CONTENT OF MONITORING PLANS FOR AVIATION EMISSIONS

1. The monitoring plan shall contain the following information for all aircraft operators:
 - (a) the identification of the aircraft operator, call sign or other unique designator used for air traffic control purposes, contact details of the aircraft operator and of a responsible person at the aircraft operator, contact address, the administering Member State, the administering competent authority;
 - (b) an initial list of aircraft types in its fleet operated at the time of the submission of the monitoring plan and the number of aircraft per type, and an indicative list of additional aircraft types expected to be used including, where available, an estimated number of aircraft per type as well as the source streams (fuel types) associated with each aircraft type;
 - (c) a description of procedures, systems and responsibilities used to update the completeness of the list of emission sources over the monitoring year for the purpose of ensuring the completeness of monitoring and reporting of the emissions of owned aircraft as well as leased-in aircraft;
 - (d) a description of the procedures used to monitor the completeness of the list of flights operated under the unique designator by aerodrome pair, and the procedures used for determining whether flights are covered by Annex I to Directive 2003/87/EC for the purpose of ensuring completeness of flights and avoiding double counting;
 - (e) a description of the procedure for managing and assigning responsibilities for monitoring and reporting, and for managing the competences of responsible personnel;
 - (f) a description of the procedure for regular evaluation of the monitoring plan's appropriateness, including any potential measures for the improvement of the monitoring methodology and related procedures applied;
 - (g) a description of the written procedures of the data flow activities as required by Article 58, including a diagram, where appropriate, for clarification;
 - (h) a description of the written procedures for the control activities established under Article 59;
 - (i) where applicable, information on relevant links with activities undertaken in the framework of EMAS, systems covered by harmonised standard ISO 14001:2004 and other environmental management systems, including information on procedures and controls with relevance to greenhouse gas emissions monitoring and reporting;
 - (j) the version number of the monitoring plan and the date from which that version of the monitoring plan is applicable;
 - (k) confirmation if the aircraft operator intends to make use of the simplification pursuant to Article 28a(6) of Directive 2003/87/EC.
2. The monitoring plan shall contain the following information for aircraft operators which are not small emitters in accordance with Article 55(1) or which do not intend to use a small emitter tool in accordance with Article 55(2):

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- (a) a description of the written procedure to be used for defining the monitoring methodology for additional aircraft types which an aircraft operator expects to use;
- (b) a description of the written procedures for monitoring fuel consumption in every aircraft, including:
 - (i) the chosen methodology (Method A or Method B) for calculating the fuel consumption; and where the same method is not applied for all aircraft types, a justification for that methodology, as well as a list specifying which method is used under which conditions;
 - (ii) procedures for the measurement of fuel uplifts and fuel in tanks, a description of the measuring instruments involved and the procedures for recording, retrieving, transmitting and storing information regarding measurements, as applicable;
 - (iii) the method for the determination of density, where applicable;
 - (iv) justification of the chosen monitoring methodology, in order to ensure lowest levels of uncertainty, according to Article 56 (1);
- (c) a list of deviations for specific aerodromes from the general monitoring methodology as described in point (b) where it is not possible for the aircraft operator due to special circumstances to provide all the required data for the required monitoring methodology;
- (d) emission factors used for each fuel type, or in the case of alternative fuels, the methodologies for determining the emission factors, including the methodology for sampling, methods of analysis, a description of the laboratories used and of their accreditation and/or of their quality assurance procedures;
- (e) a description of the procedures and systems for identifying, assessing and handling data gaps pursuant to Article 66(2).

3. MINIMUM CONTENT OF MONITORING PLANS FOR TONNE-KILOMETRE DATA

The monitoring plan for tonne-kilometre data shall contain the following information:

- (a) the elements listed in point 1 of section 2 of this Annex;
- (b) a description of the written procedures used for determining tonne-kilometre data per flight, including:
 - (i) the procedures, responsibilities, data sources and calculation formulae for determining and recording the distance per aerodrome pair;
 - (ii) the tier used for determining the mass of passengers including the checked in baggage; in the case of tier 2, a description of the procedure for obtaining the mass of passengers and baggage is to be provided;
 - (iii) a description of the procedures used to determine the mass of freight and mail, where applicable;
 - (iv) a description of the measurement devices used for measuring the mass of passengers, freight and mail as applicable.

▼B*ANNEX II***Tier definitions for calculation-based methodologies related to installations
(Article 12(1))****1. DEFINITION OF TIERS FOR ACTIVITY DATA**

The uncertainty thresholds in Table 1 shall apply to tiers relevant to activity data requirements in accordance with point (a) of Article 28(1) and the first subparagraph of Article 29(2), and Annex IV, of this Regulation. The uncertainty thresholds shall be interpreted as maximum permissible uncertainties for the determination of source streams over a reporting period.

Where Table 1 does not include activities listed in Annex I to Directive 2003/87/EC and the mass balance is not applied, the operator shall use the tiers listed in Table 1 under ‘Combustion of fuels and fuels used as process input’ for those activities.

*Table 1***Tiers for activity data (maximum permissible uncertainty for each tier)**

Activity/source stream type	Parameter to which the uncertainty is applied	Tier 1	Tier 2	Tier 3	Tier 4
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Combustion of fuels and fuels used as process input

Commercial standard fuels	Amount of fuel [t] or [Nm ³]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
Other gaseous and liquid fuels	Amount of fuel [t] or [Nm ³]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
Solid fuels	Amount of fuel [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
Flaring	Amount of flare gas [Nm ³]	± 17,5 %	± 12,5 %	± 7,5 %	
Scrubbing: carbonate (Method A)	Amount carbonate consumed [t]	± 7,5 %			
Scrubbing: gypsum (Method B)	Amount gypsum produced [t]	± 7,5 %			
Scrubbing: urea	Amount urea consumed	± 7,5 %			

Refining of mineral oil

Catalytic cracker regeneration (*)	Uncertainty requirements apply separately for each emission source	± 10 %	± 7,5 %	± 5 %	± 2,5 %
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Activity/source stream type	Parameter to which the uncertainty is applied	Tier 1	Tier 2	Tier 3	Tier 4
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Production of coke

Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
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Metal ore roasting and sintering

Carbonate input and process residues	Carbonate input material and process residues [t]	± 5 %	± 2,5 %		
Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %

Production of iron and steel

Fuel as process input	Each mass flow into and from the installation [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %

Production of cement clinker

Kiln input based (Method A)	Each relevant kiln input [t]	± 7,5 %	± 5 %	± 2,5 %	
Clinker output (Method B)	Clinker produced [t]	± 5 %	± 2,5 %		
CKD	CKD or bypass dust [t]	n.a. (**)	± 7,5 %		
Non-carbonate carbon	Each raw material [t]	± 15 %	± 7,5 %		

Production of lime and calcination of dolomite and magnesite

Carbonates and other process materials (Method A)	Each relevant kiln input [t]	± 7,5 %	± 5 %	± 2,5 %	
Alkali earth oxide (Method B)	Lime produced [t]	± 5 %	± 2,5 %		
Kiln dust (Method B)	Kiln dust [t]	n.a. (**)	± 7,5 %		

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Activity/source stream type	Parameter to which the uncertainty is applied	Tier 1	Tier 2	Tier 3	Tier 4
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Manufacture of glass and mineral wool

Carbonates and other process materials (input)	Each carbonate raw material or additives associated with CO ₂ emissions [t]	± 2,5 %	± 1,5 %		
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Manufacture of ceramic products

Carbon inputs (Method A)	Each carbonate raw material or additive associated with CO ₂ emissions [t]	± 7,5 %	± 5 %	± 2,5 %	
Alkali oxide (Method B)	Gross production including rejected products and cullet from the kilns and shipment [t]	± 7,5 %	± 5 %	± 2,5 %	
Scrubbing	Dry CaCO ₃ consumed [t]	± 7,5 %			

Production of pulp and paper

Make up chemicals	Amount of CaCO ₃ and Na ₂ CO ₃ [t]	± 2,5 %	± 1,5 %		
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Production of carbon black

Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
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Production of ammonia

Fuel as process input	Amount fuel used as process input [t] or [Nm ³]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
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Production of hydrogen and synthesis gas

Fuel as process input	Amount fuel used as process input for hydrogen production [t] or [Nm ³]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %

Production of bulk organic chemicals

Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
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Activity/source stream type	Parameter to which the uncertainty is applied	Tier 1	Tier 2	Tier 3	Tier 4
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Production or processing of ferrous and non-ferrous metals, including secondary aluminium

Process emissions	Each input material or process residue used as input material in the process [t]	± 5 %	± 2,5 %		
Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %

Primary aluminium production

Mass balance methodology	Each input and output material [t]	± 7,5 %	± 5 %	± 2,5 %	± 1,5 %
PFC emissions (slope method)	primary aluminium production in [t], anode effect minutes in [number anode effects/cell day] and [anode effect minutes/occurrence]	± 2,5 %	± 1,5 %		
PFC emissions (over-voltage method)	primary aluminium production in [t], anode effect overvoltage [mV] and current efficiency [-]	± 2,5 %	± 1,5 %		

(*) For monitoring emissions from catalytic cracker regeneration (other catalyst regeneration and flexi-cokers) in mineral oil refineries, the required uncertainty is related to the total uncertainty of all emissions from that source.

(**) Amount [t] of CKD or bypass dust (where relevant) leaving the kiln system over a reporting period estimated using industry best practice guidelines.

2. DEFINITION OF TIERS FOR CALCULATION FACTORS FOR COMBUSTION EMISSIONS

Operators shall monitor CO₂ emissions from all types of combustion processes taking place under all activities as listed in Annex I to Directive 2003/87/EC or included in the Union system under Article 24 of that Directive using the tier definitions laid down in this section.

► **M1** Where fuels or combustible materials which give rise to CO₂ emissions are used as a process input, section 4 of this Annex shall apply. ◀ Where fuels form part of a mass balance in accordance with Article 25(1) of this Regulation, the tier definitions for mass balances in section 3 of this Annex apply.

For process emissions from related exhaust gas scrubbing tier definitions according to sections 4 and 5 of this Annex shall be used, as applicable.

2.1 Tiers for emission factors

Where a biomass fraction is determined for a mixed fuel or material, the tiers defined shall relate to the preliminary emission factor. For fossil fuels and materials the tiers shall relate to the emission factor.

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Tier 1: The operator shall apply one of the following:

- (a) the standard factors listed in section 1 of Annex VI;
- (b) other constant values in accordance with point (e) of Article 31(1), where no applicable value is contained in section 1 of Annex VI.

Tier 2a: The operator shall apply country specific emission factors for the respective fuel or material in accordance with points (b) and (c) of Article 31(1) or values in accordance with point (d) of Article 31(1).

Tier 2b: The operator shall derive emission factors for the fuel based on one of the following established proxies, in combination with an empirical correlation as determined at least once per year in accordance with Articles 32 to 35 and 39:

- (a) density measurement of specific oils or gases, including those common to the refinery or steel industry;
- (b) net calorific value for specific coal types.

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: The operator shall apply one of the following:

- (a) determination of the emission factor in accordance with the relevant provisions of Articles 32 to 35;
- (b) the empirical correlation as specified for Tier 2b, where the operator demonstrates to the satisfaction of the competent authority that the uncertainty of the empirical correlation does not exceed 1/3 of the uncertainty value to which the operator has to adhere with regard to the activity data determination of the relevant fuel or material.

2.2 Tiers for net calorific value (NCV)

Tier 1: The operator shall apply one of the following:

- (a) the standard factors listed in section 1 of Annex VI;
- (b) other constant values in accordance with point (e) of Article 31(1), where no applicable value is contained in section 1 of Annex VI.

Tier 2a: The operator shall apply country specific factors for the respective fuel in accordance with point (b) or (c) of Article 31(1) or values in accordance with point (d) of Article 31(1).

Tier 2b: For commercially traded fuels the net calorific value as derived from the purchasing records for the respective fuel provided by the fuel supplier shall be used provided it has been derived based on accepted national or international standards.

Tier 3: The operator shall determine the net calorific value in accordance with Article 32 to 35.

2.3 Tiers for oxidation factors

Tier 1: The operator shall apply an oxidation factor of 1.

Tier 2: The operator shall apply oxidation factors for the respective fuel in accordance with point (b) or (c) of Article 31(1).

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Tier 3: For fuels, the operator shall derive activity-specific factors based on the relevant carbon contents of ashes, effluents and other wastes and by-products, and other relevant incompletely oxidised gaseous forms of carbon emitted except CO. Composition data shall be determined in accordance with Article 32 to 35.

2.4 Tiers for biomass fraction

Tier 1: The operator shall apply an applicable value published by the competent authority or the Commission, or values in accordance with Article 31(1).

Tier 2: The operator shall apply an estimation method approved in accordance with the second subparagraph of Article 39(2).

Tier 3: The operator shall apply analyses in accordance with the first subparagraph of Article 39 (2), and in accordance with Articles 32 to 35.

Where an operator assumes a fossil fraction of 100 % in accordance with Article 39(1), no tier shall be assigned for the biomass fraction.

3. DEFINITION OF TIERS FOR CALCULATION FACTORS FOR MASS BALANCES

Where an operator uses a mass balance in accordance with Article 25, it shall use the tier definitions of this section.

3.1 Tiers for carbon content

The operator shall apply one of the tiers listed in this point. For deriving the carbon content from an emission factor, the operator shall use the following equations:

(a) for emission factors expressed as t CO₂/TJ : C = (EF × NCV) / f

(b) for emission factors expressed as t CO₂/t : C = EF / f

In those formulae, C is the carbon content expressed as fraction (tonne carbon per tonne product), EF is the emission factor, NCV is the net calorific value, and f is the factor laid down in Article 36(3).

Where a biomass fraction is determined for a mixed fuel or material, the tiers defined shall relate to the total carbon content. The biomass fraction of the carbon shall be determined using the tiers defined in section 2.4 of this Annex.

Tier 1: The operator shall apply one of the following:

(a) the carbon content derived from standard factors listed in Annex VI sections 1 and 2;

(b) other constant values in accordance with point (e) of Article 31(1), where no applicable value is contained in Annex VI sections 1 and 2.

Tier 2a: The operator shall derive the carbon content from country specific emission factors for the respective fuel or material in accordance with point (b) or (c) of Article 31(1) or values in accordance with point (d) of Article 31(1).

Tier 2b: The operator shall derive the carbon content from emission factors for the fuel based on one of the following established proxies in combination with an empirical correlation as determined at least once per year in accordance with Articles 32 to 35:

(a) density measurement of specific oils or gases common, for example, to the refinery or steel industry;

(b) net calorific value for specific coal types.

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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: The operator shall apply one of the following:

- (a) determination of the carbon content in accordance with the relevant provisions of Articles 32 to 35;
- (b) the empirical correlation as specified for Tier 2b, where the operator demonstrates to the satisfaction of the competent authority that the uncertainty of the empirical correlation does not exceed 1/3 of the uncertainty value to which the operator has to adhere with regard to the activity data determination of the relevant fuel or material.

3.2 Tiers for net calorific values

The tiers defined in section 2.2 of this Annex shall be used.

3.3 Tiers for biomass fraction

The tiers defined in section 2.4 of this Annex shall be used.

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4. DEFINITION OF TIERS FOR THE CALCULATION FACTORS FOR CO₂ PROCESS EMISSIONS

For all CO₂ process emissions, in particular for emissions from the decomposition of carbonates and from process materials containing carbon other than in form of carbonates, including urea, coke and graphite, where they are monitored using the standard methodology in accordance with Article 24(2), the tiers defined in this section for the applicable calculation factors shall be applied.

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

- to determine a total preliminary emission factor for the mixed material by analysing the total carbon content, and using a conversion factor and – if applicable – biomass fraction and net calorific value related to that total carbon content; or
- to determine the organic and inorganic contents separately and treat them as two separate source streams.

For emissions from the decomposition of carbonates, the operator may choose for each source stream one of the following methods:

- (a) **Method A** (Input based): The emission factor, conversion factor and activity data are related to the amount of material input into the process.
- (b) **Method B** (Output based): The emission factor, conversion factor and activity data are related to the amount of output from the process.

For other CO₂ process emissions, the operator shall apply only method A.

4.1. Tiers for the emission factor using Method A

Tier 1: The operator shall apply one of the following:

- (a) the standard factors listed in Annex VI section 2 Table 2 in case of carbonate decomposition, or in Tables 1, 4 or 5 for other process materials;

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- (b) other constant values in accordance with point (e) of Article 31(1), where no applicable value is contained in Annex VI.

Tier 2: The operator shall apply a country specific emission factor in accordance with point (b) or (c) of Article 31(1), or values in accordance with point (d) of Article 31(1).

Tier 3: The operator shall determine the emission factor in accordance with Articles 32 to 35. Stoichiometric ratios as listed in section 2 of Annex VI shall be used to convert composition data into emission factors, where relevant.

4.2. Tiers for the conversion factor using Method A

Tier 1: A conversion factor of 1 shall be used.

Tier 2: Carbonates and other carbon leaving the process shall be considered by means of a conversion factor with a value between 0 and 1. The operator may assume complete conversion for one or several inputs and attribute unconverted materials or other carbon to the remaining inputs. The additional determination of relevant chemical parameters of the products shall be carried out in accordance with Articles 32 to 35.

4.3. Tiers for the emission factor using Method B

Tier 1: The operator shall apply one of the following:

- (a) the standard factors listed in Annex VI section 2 Table 3.
- (b) other constant values in accordance with point (e) of Article 31(1), where no applicable value is contained in Annex VI.

Tier 2: The operator shall apply a country specific emission factor in accordance with point (b) or (c) of Article 31(1), or values in accordance with point (d) of Article 31(1).

Tier 3: The operator shall determine the emission factor in accordance with Articles 32 to 35. Stoichiometric ratios referred to in Annex VI section 2 Table 3 shall be used to convert composition data into emission factors assuming that all of the relevant metal oxides have been derived from respective carbonates. For this purpose the operator shall take into account at least CaO and MgO, and shall provide evidence to the competent authority as to which further metal oxides relate to carbonates in the raw materials.

4.4. Tiers for the conversion factor using Method B

Tier 1: A conversion factor of 1 shall be used.

Tier 2: The amount of non-carbonate compounds of the relevant metals in the raw materials, including return dust or fly ash or other already calcined materials, shall be reflected by means of conversion factors with a value between 0 and 1 with a value of 1 corresponding to a full conversion of raw material carbonates into oxides. The additional determination of relevant chemical parameters of the process inputs shall be carried out in accordance with Articles 32 to 35.

4.5. Tiers for the net calorific value (NCV)

If relevant, the operator shall determine the net calorific value of the process material using the tiers defined in section 2.2 of this Annex. NCV is considered not relevant for *de minimis* source streams or where the material is not itself combustible without other fuels being added. If in doubt, the operator shall seek confirmation by the competent authority on whether NCV has to be monitored and reported.

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4.6. Tiers for the biomass fraction

If relevant, the operator shall determine the biomass fraction of the carbon contained in the process material, using the tiers defined in section 2.4 of this Annex.

▼B*ANNEX III***Monitoring methodologies for aviation (Article 53 and Article 57)****1. CALCULATION METHODOLOGIES FOR THE DETERMINATION OF GHGS IN THE AVIATION SECTOR****Method A:**

The operator shall use the following formula:

Actual fuel consumption for each flight [t] = Amount of fuel contained in aircraft tanks once fuel uplift for the flight is complete [t] – Amount of fuel contained in aircraft tanks once fuel uplift for subsequent flight is complete [t] + Fuel uplift for that subsequent flight [t]

Where there is no fuel uplift for the flight or subsequent flight, the amount of fuel contained in aircraft tanks shall be determined at block-off for the flight or subsequent flight. In the exceptional case that an aircraft performs activities other than a flight, including undergoing major maintenance involving the emptying of the tanks, after the flight for which fuel consumption is being monitored, the aircraft operator may substitute the quantity ‘Amount of fuel contained in aircraft tanks once fuel uplift for subsequent flight is complete + Fuel uplift for that subsequent flight’ with the ‘Amount of fuel remaining in tanks at the start of the subsequent activity of the aircraft’, as recorded by technical logs.

Method B:

The operator shall use the following formula:

Actual fuel consumption for each flight [t] = Amount of fuel remaining in aircraft tanks at block-on at the end of the previous flight [t] + Fuel uplift for the flight [t] - Amount of fuel contained in tanks at block-on at the end of the flight [t]

The moment of block-on may be considered equivalent to the moment of engine shut down. Where an aircraft does not perform a flight previous to the flight for which fuel consumption is being monitored, the aircraft operator may substitute the quantity ‘Amount of fuel remaining in aircraft tanks at block-on at the end of the previous flight’ with the ‘Amount of fuel remaining in aircraft tanks at the end of the previous activity of the aircraft’, as recorded by technical logs.

2. EMISSION FACTORS FOR STANDARD FUELS*Table 1***Aviation fuel CO₂ emission factors**

Fuel	Emission factor (t CO ₂ /t fuel)
Aviation gasoline (AvGas)	3,10
Jet gasoline (Jet B)	3,10
Jet kerosene (Jet A1 or Jet A)	3,15

▼B**3. CALCULATION OF GREAT CIRCLE DISTANCE**

Distance [km] = Great Circle Distance [km] + 95 km

The Great Circle Distance shall be the shortest distance between any two points on the surface of the Earth, which shall be approximated using the system referred to in Article 3.7.1.1 of Annex 15 to the Chicago Convention (WGS 84).

The latitude and longitude of aerodromes shall be taken either from aerodrome location data published in Aeronautical Information Publications (AIP) in compliance with Annex 15 to the Chicago Convention or from a source using AIP data.

Distances calculated by software or by a third party may also be used, provided that the calculation methodology is based on the formula set out in this section, AIP data and WGS 84 requirements.

▼B*ANNEX IV***Activity-specific monitoring methodologies related to installations
(Article 20(2))****1. SPECIFIC MONITORING RULES FOR EMISSIONS FROM COMBUSTION PROCESSES****A. Scope**

Operators shall monitor CO₂ emissions from all types of combustion processes taking place under all activities as listed in Annex I to Directive 2003/87/EC or included in the Union system under Article 24 of that Directive including the related scrubbing processes using the rules laid down in this Annex. Any emissions from fuels used as process input shall be treated like combustion emissions with regard to monitoring and reporting methodologies, without prejudice to other classifications applied to emissions.

The operator shall not monitor and report emissions from internal combustion engines for transportation purposes. The operator shall assign all emissions from the combustion of fuels at the installation to the installation, regardless of exports of heat or electricity to other installations. The operator shall not assign emissions associated with the production of heat or electricity that is imported from other installations to the importing installation.

The operator shall include at least the following emission sources: boilers, burners, turbines, heaters, furnaces, incinerators, calciners, kilns, ovens, dryers, engines, fuel cells, chemical looping combustion units, flares, thermal or catalytic post-combustion units, and scrubbers (process emissions) and any other equipment or machinery that uses fuel, excluding equipment or machinery with combustion engines that are used for transportation purposes.

B. Specific monitoring rules

The emissions from combustion processes shall be calculated in accordance with Article 24(1), unless the fuels are included in a mass balance in accordance with Article 25. The tiers defined in section 2 of Annex II shall apply. In addition, process emissions from flue gas scrubbing shall be monitored using the provisions laid down in subsection C.

For emissions from flares special requirements shall apply, as laid down in subsection D of this section.

Combustion processes taking place in gas processing terminals may be monitored using a mass balance in accordance with Article 25.

C. Flue gas scrubbing**C.1 Desulphurisation**

Process CO₂ emissions from the use of carbonate for acid gas scrubbing from the flue gas stream shall be calculated in accordance with Article 24(2) on the basis of carbonate consumed, Method A as follows, or gypsum produced, Method B as follows. The following applies by way of derogation from section 4 of Annex II.

Method A: Emission factor

Tier 1: The emission factor shall be determined from stoichiometric ratios as laid down in section 2 of Annex VI. The determination of the amount of CaCO₃ and MgCO₃ or other carbonates in the relevant input material shall be carried out using industry best practice guidelines.

▼B**Method B: Emission factor**

Tier 1: The emission factor shall be the stoichiometric ratio of dry gypsum ($\text{CaSO}_4 \times 2\text{H}_2\text{O}$) to CO_2 emitted: 0,2558 t CO_2 /t gypsum.

Conversion Factor:

Tier 1: A conversion factor of 1 shall be used.

C.2 *De-NO_x*

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By way of derogation from section 4 of Annex II, process CO_2 emissions from the use of urea for scrubbing of the flue gas stream shall be calculated in accordance with Article 24(2) applying the following tiers.

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Emission factor:

Tier 1: The determination of the amount of urea in the relevant input material shall be carried out using industry best practice guidelines. The emission factor shall be determined using a stoichiometric ratio of 0,7328 t CO_2 /t urea.

Conversion Factor:

Only tier 1 shall be applicable.

D. Flares

When calculating emissions from flares the operator shall include routine flaring and operational flaring (trips, start-up and shutdown as well as emergency relieves). The operator shall also include inherent CO_2 in accordance with Article 48.

By way of derogation from section 2.1 of Annex II, tiers 1 and 2b for the emission factor shall be defined as follows:

Tier 1: The operator shall use a reference emission factor of 0,00393 t CO_2/Nm^3 derived from the combustion of pure ethane used as a conservative proxy for flare gases.

Tier 2b: Installation-specific emission factors shall be derived from an estimate of the molecular weight of the flare stream, using process modelling based on industry standard models. By considering the relative proportions and the molecular weights of each of the contributing streams, a weighted annual average figure shall be derived for the molecular weight of the flare gas.

By way of derogation from section 2.3 of Annex II, only tiers 1 and 2 shall be applied for the oxidation factor in the case of flares.

2. REFINING OF MINERAL OIL AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall monitor and report all CO_2 emissions from combustion and production processes as occurring in refineries.

The operator shall include at least the following potential sources of CO_2 emissions: boilers, process heaters/treaters, internal combustion engines/turbines, catalytic and thermal oxidisers, coke calcining kilns, firewater pumps, emergency/standby generators, flares, incinerators, crackers, hydrogen production units, Claus process units, catalyst regeneration (from catalytic cracking and other catalytic processes) and cokers (flexi-coking, delayed coking).

▼B**B. Specific monitoring rules**

The monitoring of mineral oil refining activities shall be carried out in accordance with section 1 of this Annex for combustion emissions including flue gas scrubbing. The operator may choose to use the mass balance methodology in accordance with Article 25 for the whole refinery or individual process units such as heavy oil gasification or calcinations plants. Where combinations of standard methodology and mass balance are used, the operator shall provide evidence to the competent authority demonstrating the completeness of emissions covered, and that no double counting of emissions occurs.

Emissions from dedicated hydrogen production units shall be monitored in accordance with section 19 of this Annex.

By way of derogation from Article 24 and 25, emissions from catalytic cracker regeneration, other catalyst regeneration and flexi-cokers shall be monitored using a mass balance, taking into account the state of the input air and the flue gas. All CO in the flue gas shall be accounted for as CO₂, applying the mass relation: t CO₂ = t CO * 1,571. The analysis of input air and flue gases and the choice of tiers shall be in accordance with the provisions of Articles 32 to 35. The specific calculation methodology shall be approved by the competent authority.

3. PRODUCTION OF COKE AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: raw materials (including coal or petroleum coke), conventional fuels (including natural gas), process gases (including blast furnace gas – BFG), other fuels and waste gas scrubbing.

B. Specific monitoring rules

For the monitoring of emissions from the production of coke, the operator may choose to use a mass balance in accordance with Article 25 and section 3 of Annex II, or the standard methodology in accordance with Article 24 and sections 2 and 4 of Annex II.

4. METAL ORE ROASTING AND SINTERING AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: raw materials (calcination of limestone, dolomite and carbonatic iron ores, including FeCO₃), conventional fuels (including natural gas and coke/coke breeze), process gases (including 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 and flue gas scrubbing.

▼M1**B. Specific monitoring rules**

For the monitoring of emissions from metal ore roasting, sintering or pelletisation, the operator may choose to use a mass balance in accordance with Article 25 and section 3 of Annex II or the standard methodology in accordance with Article 24 and sections 2 and 4 of Annex II.

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5. PRODUCTION OF PIG IRON AND STEEL AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: raw materials (calcination of limestone, dolomite and carbonatic iron ores, including FeCO₃), conventional fuels (natural gas, coal and coke), reducing agents (including coke, coal and plastics), process gases (coke oven gas – COG, blast furnace gas – BFG and basic oxygen furnace gas – BOFG), consumption of graphite electrodes, other fuels and waste gas scrubbing.

B. Specific monitoring rules

For the monitoring of emissions from production of pig iron and steel, the operator may choose to use a mass balance in accordance with Article 25 and section 3 of Annex II, or the standard methodology in accordance with Article 24 and sections 2 and 4 of Annex II, at least for a part of the source streams, avoiding any gaps or double counting of emissions.

By way of derogation from section 3.1 of Annex II, tier 3 for the carbon content is defined as follows:

Tier 3: The operator shall derive the carbon content of input or output stream following Articles 32 to 35 in respect to the representative sampling of fuels, products and by-products, the determination of their carbon contents and biomass fraction. The operator shall base the carbon content of products or semi-finished products on annual analyses following Articles 32 to 35 or derive the carbon content from mid-range composition values as specified by relevant international or national standards.

6. PRODUCTION OR PROCESSING OF FERROUS AND NON-FERROUS METALS AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall not apply the provisions in this section for the monitoring and reporting of CO₂ emissions from the production of pig iron and steel and primary aluminium.

The operator shall consider at least the following potential emission sources for CO₂ emissions: conventional fuels; alternative fuels including plastics granulated material from post shredder plants; reducing agents including coke, graphite electrodes; raw materials including limestone and dolomite; carbon containing metal ores and concentrates; and secondary feed materials.

B. Specific monitoring rules

Where carbon stemming from fuels or input materials used at this installation remains in the products or other outputs of the production, the operator shall use a mass balance in accordance with Article 25 and section 3 of Annex II. Where this is not the case the operator shall calculate combustion and process emission separately using the standard methodology in accordance with Article 24 and sections 2 and 4 of Annex II.

Where a mass balance is used, the operator may choose to include emissions from combustion processes in the mass balance or to use the standard methodology in accordance with Article 24 and section 1 of this Annex for a part of the source streams, avoiding any gaps or double counting of emissions.

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7. CO₂ EMISSIONS FROM PRODUCTION OR PROCESSING OF PRIMARY ALUMINIUM AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall apply the provisions of this section to the monitoring and reporting of CO₂ emissions from the production of electrodes for primary aluminium smelting, including stand-alone plants for the production of such electrodes, and the consumption of electrodes during electrolysis.

The operator shall consider at least the following potential sources for CO₂ emissions: fuels for the production of heat or steam, electrode production, reduction of Al₂O₃ during electrolysis which is related to electrode consumption, and use of soda ash or other carbonates for waste gas scrubbing.

The associated emissions of perfluorocarbons – PFCs, resulting from anode effects, including fugitive emissions, shall be monitored in accordance with section 8 of this Annex.

B. Specific monitoring rules

The operator shall determine CO₂ emissions from the production or processing of primary aluminium using the mass balance methodology in accordance with Article 25. The mass balance methodology shall consider all carbon in inputs, stocks, products and other exports from the mixing, forming, baking and recycling of electrodes as well as from electrode consumption in electrolysis. Where pre-baked anodes are used, either separate mass balances for production and consumption may be applied, or one common mass balance taking into account both production and consumption of electrodes. In the case of Söderberg cells, the operator shall use one common mass balance.

For emissions from combustion processes the operator may choose to include them in the mass balance or to use the standard methodology in accordance with Article 24 and section 1 of this Annex at least for a part of the source streams, avoiding any gaps or double counting of emissions.

8. PFC EMISSIONS FROM PRODUCTION OR PROCESSING OF PRIMARY ALUMINIUM AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall apply the following for emissions of perfluorocarbons (PFCs) resulting from anode effects including fugitive emissions of PFCs. For associated CO₂ emissions, including emissions from electrode production, the operator shall apply section 7 of this Annex. The operator shall furthermore calculate PFC emissions not related to anode effects based on estimation methods in accordance with industry best practice, and any guidelines published by the Commission for this purpose.

B. Determination of PFC emissions

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

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

The collection efficiency shall be measured when the installation-specific emission factors are determined. For its determination the most recent version of the guidance mentioned under Tier 3 of section 4.4.2.4 of the 2006 IPCC Guidelines shall be used.

▼B

The operator shall calculate emissions of CF₄ and C₂F₆ emitted through a duct or stack using one of the following methods:

(a) Method A where the anode effect minutes per cell-day are recorded;

(b) Method B where the anode effect overvoltage is recorded.

Calculation Method A – Slope Method:

The operator shall use the following equations for determining PFC emissions:

$$\text{CF}_4 \text{ emissions [t]} = \text{AEM} \times (\text{SEF}_{\text{CF}4}/1\,000) \times \text{Pr}_{\text{Al}}$$

$$\text{C}_2\text{F}_6 \text{ emissions [t]} = \text{CF}_4 \text{ emissions} \times F_{\text{C}_2\text{F}_6}$$

Where:

AEM = Anode effect minutes / cell-day;

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

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

F_{C2F6} = Weight fraction of C₂F₆ (t C₂F₆ / t CF₄).

The anode effect minutes per cell-day shall express the frequency of anode effects (number anode effects / cell-day) multiplied by the average duration of anode effects (anode effect minutes / occurrence):

$$\text{AEM} = \text{frequency} \times \text{average duration}$$

Emission factor: The emission factor for CF₄ (slope emission factor, SEF_{CF4}) expresses the amount [kg] of CF₄ emitted per tonne of aluminium produced per anode effect minute / cell-day. The emission factor (weight fraction F_{C2F6}) of C₂F₆ expresses the amount [t] of C₂F₆ emitted proportionate to the amount [t] of CF₄ emitted.

Tier 1: The operator shall use technology-specific emission factors from Table 1 of this section of Annex IV.

Tier 2: The operator shall use installation-specific emission factors for CF₄ and C₂F₆ established through continuous or intermittent field measurements. For the determination of those emission factors the operator shall use the most recent version of the guidance mentioned under Tier 3 of section 4.4.2.4 of the 2006 IPCC Guidelines⁽¹⁾. The emission factor shall also take into account emissions related to non-anode effects. The operator shall determine each emission factor with a maximum uncertainty of ± 15 %.

The operator shall determine the emission factors at least every three years or earlier where necessary due to relevant changes at the installation. Relevant changes shall include a change in the distribution of anode effect duration, or a change in the control algorithm affecting the mix of the types of anode effects or the nature of the anode effect termination routine.

⁽¹⁾ International Aluminium Institute; The Aluminium Sector Greenhouse Gas Protocol; October 2006; US Environmental Protection Agency and International Aluminium Institute; Protocol for Measurement of Tetrafluoromethane (CF₄) and Hexafluoroethane (C₂F₆) Emissions from Primary Aluminum Production; April 2008.

▼B

Table 1

Technology-specific emission factors related to activity data for the slope method.

Technology	Emission factor for CF ₄ (SEF _{CF4}) [(kg CF ₄ /t Al) / (AE-Mins/ cell-day)]	Emission factor for C ₂ F ₆ (F _{C2F6}) [t C ₂ F ₆ / t CF ₄]
Centre Worked Prebake (CWPB)	0,143	0,121
Vertical Stud Söderberg (VSS)	0,092	0,053

Calculation Method B – Overvoltage Method:

Where the anode effect overvoltage is measured, the operator shall use the following equations for the determination of PFC emissions:

$$\text{CF}_4 \text{ emissions [t]} = \text{OVC} \times (\text{AEO/CE}) \times \text{Pr}_{\text{Al}} \times 0,001$$

▼M1

$$\text{C}_2\text{F}_6 \text{ emissions [t]} = \text{CF}_4 \text{ emissions} \times F_{\text{C2F6}}$$

▼B

Where:

OVC = Overvoltage coefficient ('emission factor') expressed as kg CF₄ per tonne of aluminium produced per mV overvoltage;

AEO = Anode effect overvoltage per cell [mV] determined as the integral of (time × voltage above the target voltage) divided by the time (duration) of data collection;

CE = Average current efficiency of aluminium production [%];

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

▼M1

F_{C2F6} = Weight fraction of C₂F₆ (t C₂F₆/t CF₄).

▼B

The term AEO/CE (Anode effect overvoltage / current efficiency) expresses the time-integrated average anode effect overvoltage [mV overvoltage] per average current efficiency [%].

Emission factor: The emission factor for CF₄ ('overvoltage coefficient' OVC) shall express the amount [kg] of CF₄ emitted per tonne of aluminium produced per millivolt overvoltage [mV]. The emission factor of C₂F₆ (weight fraction F_{C2F6}) shall express the amount [t] of C₂F₆ emitted proportionate to the amount [t] of CF₄ emitted.

Tier 1: The operator shall apply technology-specific emission factors from Table 2 of this section of Annex IV.

Tier 2: The operator shall use installation-specific emission factors for CF₄ [(kg CF₄ / t Al) / (mV)] and C₂F₆ [t C₂F₆/ t CF₄] established through continuous or intermittent field measurements. For the determination of those emission factors, the operator shall use the most recent version of the guidance mentioned under Tier 3 of section 4.4.2.4 of the 2006 IPCC Guidelines. The operator shall determine the emission factors with a maximum uncertainty of ± 15 % each.

▼B

The operator shall determine the emission factors at least every three years or earlier where necessary due to relevant changes at the installation. Relevant changes shall include a change in the distribution of anode effect duration or a change in the control algorithm affecting the mix of the types of anode effects or the nature of the anode effect termination routine.

Table 2

Technology-specific emission factors related to overvoltage activity data.

Technology	Emission factor for CF ₄ [(kg CF ₄ /t Al) / mV]	Emission factor for C ₂ F ₆ [t C ₂ F ₆ / t CF ₄]
Centre Worked Prebake (CWPB)	1,16	0,121
Vertical Stud Søderberg (VSS)	N.A.	0,053

C. Determination of CO_{2(e)} emissions

The operator shall calculate CO_{2(e)} emissions from CF₄ and C₂F₆ emissions as follows, using the global warming potentials listed in Annex VI section 3 Table 6:

$$\text{PFC emissions [t CO}_{2(\text{e})}\text{]} = \text{CF}_4 \text{ emissions [t]} \times \text{GWP}_{\text{CF}4} + \text{C}_2\text{F}_6 \text{ emissions [t]} \times \text{GWP}_{\text{C}_2\text{F}_6}$$

9. PRODUCTION OF CEMENT CLINKER AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

▼M1**A. Scope**

The operator shall include at least the following potential sources of CO₂ emissions: 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, non-carbonate carbon content of limestone and shales and raw materials used for waste gas scrubbing.

▼B**B. Specific monitoring rules**

Emissions from combustion shall be monitored in accordance with section 1 of this Annex. Process emissions from raw meal components shall be monitored in accordance with section 4 of Annex II based on the carbonate content of the process input (calculation Method A) or on the amount of clinker produced (calculation Method B). In case of Method A, carbonates to be taken into account shall at least include CaCO₃, MgCO₃ and FeCO₃. In case of Method B, the operator shall take into account at least CaO and MgO, and shall provide evidence to the competent authority as to which extent further carbon sources have to be taken into account.

▼M1

CO₂ emissions related to dust removed from the process and non-carbonate carbon in the raw materials shall be added in accordance with subsections C and D of this section.

▼B**Calculation Method A: Kiln Input Based**

Where cement kiln dust (CKD) and bypass dust leave the kiln system the operator shall not consider the related raw material as process input, but calculate emissions from CKD in accordance with subsection C.

▼B

Unless the raw meal is characterised, the operator shall apply the uncertainty requirements for activity data separately to each of the relevant carbon-bearing kiln inputs, avoiding double counting or omissions from returned or by-passed materials. Where activity data is determined based on the clinker produced, the net amount of raw meal may be determined by means of a site-specific empirical raw meal/clinker ratio. That ratio shall be updated at least once per year applying industry best practice guidelines.

Calculation Method B: Clinker Output Based

The operator shall determine activity data as the clinker production [t] over the reporting period in one of the following ways:

- (a) by direct weighing of clinker;
- (b) based on cement deliveries, by material balance taking into account dispatch of clinker, clinker supplies as well as clinker stock variation, using the following formula:

$$\text{clinker produced [t]} = ((\text{cement deliveries [t]} - \text{cement stock variation [t]}) \times \text{clinker / cement ratio [t clinker / t cement]}) - (\text{clinker supplied [t]}) + (\text{clinker dispatched [t]}) - (\text{clinker stock variation [t]}).$$

The operator shall either derive the clinker / cement ratio for each of the different cement products based on the provisions of Articles 32 to 35 or calculate the ratio from the difference of cement deliveries and stock changes and all materials used as additives to the cement including by-pass dust and cement kiln dust.

By way of derogation from section 4 of Annex II, tier 1 for the emission factor shall be defined as follows:

Tier 1: The operator shall apply an emission factor of 0,525 t CO₂/t clinker.

C. Emissions Related to Discarded Dust

The operator shall add CO₂ emissions, from bypass dust or cement kiln dust (CKD) leaving the kiln system, corrected for a partial calcination ratio of CKD calculated as process emissions in accordance with Article 24(2). By way of derogation from section 4 of Annex II, tiers 1 and 2 for the emission factor shall be defined as follows:

Tier 1: The operator shall apply an emission factor of 0,525 t CO₂/t dust.

Tier 2: The operator shall determine the emission factor (EF) at least once annually following Articles 32 to 35 and using the following formula:

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

Where:

EF_{CKD} = Emission factor of partially calcined cement kiln dust [t CO₂/t CKD];

EF_{Cli} = Installation-specific emission factor of clinker [t CO₂/t clinker];

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

Tier 3 for the emission factor is not applicable.

▼B**D. Emissions from non-carbonate carbon in raw meal**

The operator shall determine the emissions from non-carbonate carbon at least from limestone, shale or alternative raw materials (for example, fly ash) used in the raw meal in the kiln in accordance with Article 24(2).

▼M1

By way of derogation from section 4 of Annex II, the following tier definitions for the emission factor shall apply:

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 non-carbonate carbon in the relevant raw material shall be determined at least annually following the provisions of Article 32 to 35.

By way of derogation from section 4 of Annex II, the following tier definitions for the conversion factor shall apply:

Tier 1: A conversion factor of 1 shall be applied.

Tier 2: The conversion factor shall be calculated applying industry best practice.

▼B

10. PRODUCTION OF LIME OR CALCINATION OF DOLOMITE OR MAGNESITE AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: calcination of limestone, dolomite or magnesite in the raw materials, conventional fossil kiln fuels, alternative fossil-based kiln fuels and raw materials, biomass kiln fuels (biomass wastes) and other fuels.

Where the burnt lime and the CO₂ stemming from the limestone are used for purification processes, such that approximately the same amount of CO₂ is bound again, the decomposition of carbonates as well as the purification process shall not be required to be included separately in the monitoring plan of the installation.

B. Specific monitoring rules**▼M1**

Emissions from combustion shall be monitored in accordance with section 1 of this Annex. Process emissions from raw materials shall be monitored in accordance with section 4 of Annex II. Carbonates of calcium and magnesium shall be always taken into account. Other carbonates and non-carbonate carbon in the raw material shall be taken into account, whenever they are relevant for emission calculation.

▼B

For the input based methodology, carbonate content values shall be adjusted for the respective moisture and gangue content of the material. In the case of magnesia production, other magnesium bearing minerals than carbonates must be taken into account, as appropriate.

Double counting or omissions resulting from returned or by-pass material must be avoided. When applying Method B, lime kiln dust shall be considered a separate source stream where relevant.

▼M1**C. Emissions from non-carbonate carbon in raw materials**

The operator shall determine the emissions from non-carbonate carbon at least from limestone, shale or alternative raw materials in the kiln in accordance with Article 24(2).

By way of derogation from section 4 of Annex II, the following tier definitions for the emission factor shall apply:

▼M1

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 non-carbonate carbon in the relevant raw material shall be determined at least annually following the provisions of Article 32 to 35.

By way of derogation from section 4 of Annex II, the following tier definitions for the conversion factor shall apply:

Tier 1: A conversion factor of 1 shall be applied.

Tier 2: The conversion factor shall be calculated applying industry best practice.

▼B

11. MANUFACTURE OF GLASS, GLASS FIBRE OR MINERAL WOOL INSULATION MATERIAL AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall apply the provisions in this section also to installations for the production of water glass and stone/rock wool.

The operator shall include at least the following potential sources of CO₂ emissions: decomposition of alkali- and alkali earth carbonates as the result of melting the raw material, conventional fossil fuels, alternative fossil-based fuels and raw materials, biomass fuels (biomass wastes), other fuels, carbon containing additives including coke, coal dust and graphite, post-combustion of flue gases and flue gas scrubbing.

B. Specific monitoring rules

▼M1

Emissions from combustion, including flue gas scrubbing, shall be monitored in accordance with section 1 of this Annex. Process emissions from raw materials shall be monitored in accordance with section 4 of Annex II. Carbonates to be taken into account include at least CaCO₃, MgCO₃, Na₂CO₃, NaHCO₃, BaCO₃, Li₂CO₃, K₂CO₃, and SrCO₃. Only Method A shall be used. Emissions from other process materials including coke, graphite and coal dust shall be monitored in accordance with section 4 of Annex II.

▼B

By way of derogation from section 4 of Annex II, the following tier definitions for the emission factor shall apply:

Tier 1: Stoichiometric ratios as listed in section 2 of Annex VI shall be used. The purity of relevant input materials shall be determined by means of industry best practice.

Tier 2: The determination of the amount of relevant carbonates in each relevant input material shall be carried out in accordance with Articles 32 to 35.

For the conversion factor, only tier 1 shall be applicable.

12. MANUFACTURE OF CERAMIC PRODUCTS AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

▼M1

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: kiln fuels, calcination of limestone/dolomite and other carbonates in the raw material, limestone and other carbonates for reducing air pollutants and other flue gas cleaning, fossil/biomass additives used to induce porosity including polystyrol, residues from paper production or sawdust, non-carbonate carbon content in the clay and other raw materials.

▼B**B. Specific monitoring rules****▼M1**

Emissions from combustion including flue gas scrubbing shall be monitored in accordance with section 1 of this Annex. Process emissions from raw meal components and additives shall be monitored in accordance with section 4 of Annex II. For ceramics based on purified or synthetic clays the operator may use either Method A or Method B. For ceramic products based on unprocessed clays and whenever clays or additives with significant non-carbonate carbon content are used, the operator shall use Method A. Carbonates of calcium shall be always taken into account. Other carbonates and non-carbonate carbon in the raw material shall be taken into account, where they are relevant for emission calculation.

▼B

Activity data for input materials for Method A may be determined by a suitable back-calculation based on industry best practice and approved by the competent authority. Such back-calculation shall take into account what metering is available for dried green products or fired products, and appropriate data sources for moisture of clay and additives and annealing loss (loss on ignition) of the materials involved.

By way of derogation from section 4 of Annex II, the following tier definitions for emission factors for process emissions of raw materials containing carbonates shall apply:

Method A (Input based):

Tier 1: A conservative value of 0,2 tonnes CaCO₃ (corresponding to 0,08794 tonnes of CO₂) per tonne of dry clay shall be applied for the calculation of the emission factor instead of results of analyses. All inorganic and organic carbon in the clay material shall be considered as included in this value. Additives shall be considered as not included in this value.

Tier 2: An emission factor for each source stream shall be derived and updated at least once per year using industry best practice reflecting site-specific conditions and the product mix of the installation.

Tier 3: The determination of the composition of the relevant raw materials shall be carried out in accordance with Articles 32 to 35. Stoichiometric ratios as listed in section 2 of Annex VI shall be used to convert composition data into emission factors, where relevant.

Method B (Output based):

Tier 1: A conservative value of 0,123 tonnes of CaO (corresponding to 0,09642 tonnes of CO₂) per tonne of product shall be applied for the calculation of the emission factor instead of the results of analyses. All inorganic and organic carbon in the clay material shall be considered as included in this value. Additives shall be considered as not included in this value.

Tier 2: An emission factor shall be derived and updated at least once per year using industry best practice reflecting site-specific conditions and the product mix of the installation.

Tier 3: The determination of the composition of the products shall be carried out in accordance with Articles 32 to 35. Stoichiometric ratios referred to in Annex VI section 2 Table 3 shall be used to convert composition data into emission factors assuming that all of the relevant metal oxides have been derived from respective carbonates, where relevant.

By way of derogation from section 1 of this Annex, for the scrubbing of flue gases the following tier for the emission factor shall apply:

▼B

Tier 1: The operator shall apply the stoichiometric ratio of CaCO₃ as shown in section 2 of Annex VI.

For scrubbing, no other tier and no conversion factor shall be used. Double counting from used limestone recycled as raw material in the same installation shall be avoided.

13. PRODUCTION OF GYPSUM PRODUCTS AND PLASTER BOARDS AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least CO₂ emissions from all types of combustion activities.

B. Specific monitoring rules

Emissions from combustion shall be monitored in accordance with section 1 of this Annex.

14. PULP AND PAPER PRODUCTION AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential sources of CO₂ emissions: boilers, gas turbines, and other combustion devices producing steam or power, recovery boilers and other devices burning spent pulping liquors, incinerators, lime kilns and calciners, waste gas scrubbing and fuel-fired dryers (such as infrared dryers).

B. Specific monitoring rules

The monitoring of emissions from combustion including flue gas scrubbing shall be carried out in accordance with section 1 of this Annex.

Process emissions from raw materials used as make-up chemicals, including at least limestone or soda ash, shall be monitored by Method A in accordance with section 4 of Annex II. CO₂ emissions from the recovery of limestone sludge in pulp production shall be assumed to be recycled biomass CO₂. Only the amount of CO₂ proportional to the input from make-up chemicals shall be assumed to give rise to fossil CO₂ emissions.

For emissions from make-up chemicals, the following tier definitions for the emission factor shall apply:

Tier 1: Stoichiometric ratios as listed in section 2 of Annex VI shall be used. The purity of relevant input materials shall be determined by means of industry best practice. The derived values shall be adjusted in accordance with the moisture and gangue content of the applied carbonate materials.

Tier 2: The determination of the amount of relevant carbonates in each relevant input material shall be carried out in accordance with Articles 32 to 35. Stoichiometric ratios as listed in section 2 of Annex VI shall be used to convert composition data into emission factors, where relevant.

For the conversion factor, only tier 1 shall be applicable.

▼B

15. PRODUCTION OF CARBON BLACK AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least all fuels for combustion and all fuels used as process material as sources for CO₂ emissions.

B. Specific monitoring rules

The monitoring of emissions from carbon black production may be monitored either as a combustion process, including flue gas scrubbing, in accordance with section 1 of this Annex or using a mass balance in accordance with Article 25 and section 3 of Annex II.

16. DETERMINATION OF NITROUS OXIDE (N₂O) EMISSIONS FROM NITRIC ACID, ADIPIC ACID, CAPROLACTAM, GLYOXAL AND GLYOXYLIC ACID PRODUCTION AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

Each operator shall consider for each activity from which N₂O emissions result, all sources emitting N₂O from production processes, including where N₂O emissions from production are channelled through any abatement equipment. This includes any of the following:

- (a) nitric acid production – N₂O emissions from the catalytic oxidation of ammonia and/or from the NO_x/N₂O abatement units;
- (b) adipic acid production – N₂O emissions including from the oxidation reaction, any direct process venting and/or any emissions control equipment;
- (c) glyoxal and glyoxylic acid production – N₂O emissions including from the process reactions, any direct process venting and/or any emissions control equipment;
- (d) caprolactam production – N₂O emissions including from the process reactions, any direct process venting and/or any emissions control equipment.

These provisions shall not apply to any N₂O emissions from the combustion of fuels.

B. Determination of N₂O emissions

B.1. Annual N₂O emissions

The operator shall monitor emissions of N₂O from nitric acid production using continuous emissions measurement. The operator shall monitor emissions of N₂O from adipic acid, caprolactam, glyoxal and glyoxylic acid production using a measurement-based methodology for abated emissions and a calculation-based method (based on a mass balance methodology) for temporary occurrences of unabated emissions.

For each emission source where continuous emissions measurement is applied, the operator shall consider the total annual emissions to be the sum of all hourly emissions using equation 1 given in section 3 of Annex VIII.

B.2. Hourly N₂O emissions

The operator shall calculate annual average hourly N₂O emissions for each source where continuous emission measurement is applied using equation 2 given in section 3 of Annex VIII.

▼B

The operator shall determine hourly N₂O concentrations in the flue gas from each emission source using a measurement-based methodology at a representative point, after the NO_x/N₂O abatement equipment, where abatement is used. The operator shall apply techniques capable of measuring N₂O concentrations of all emission sources during both abated and unabated conditions. Where uncertainties increase during such periods, the operator shall take them into account in the uncertainty assessment.

The operator shall adjust all measurements to a dry gas basis where required and report them consistently.

B.3. Determination of flue gas flow

The operator shall use the methods for monitoring flue gas flow set out in Article 43(5) of this Regulation for measuring the flue gas flow for N₂O emissions monitoring. For nitric acid production, the operator shall apply the method in accordance with point (a) of Article 43(5) unless it is technically not feasible. In that case and upon approval by the competent authority, the operator shall apply an alternative method, including by a mass balance methodology based on significant parameters such as ammonia input load, or determination of flow by continuous emissions flow measurement.

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

$$V_{\text{flue gas flow}} [\text{Nm}^3/\text{h}] = V_{\text{air}} * (1 - O_2, \text{ air}) / (1 - O_2, \text{ flue gas})$$

Where:

V_{air} = Total input air flow in Nm³/h at standard conditions;

$O_2, \text{ air}$ = Volume fraction of O₂ in dry air [= 0,2095];

$O_2, \text{ flue gas}$ = Volume fraction of O₂ in the flue gas.

The V_{air} shall be calculated as the sum of all air flows entering the nitric acid production unit.

The operator shall apply the following formula, unless stated otherwise in its monitoring plan:

$$V_{\text{air}} = V_{\text{prim}} + V_{\text{sec}} + V_{\text{seal}}$$

Where:

V_{prim} = Primary input air flow in Nm³/h at standard conditions;

V_{sec} = Secondary input air flow in Nm³/h at standard conditions;

V_{seal} = Seal input air flow in Nm³/h at standard conditions.

The operator shall determine V_{prim} by continuous flow measurement before the mixing with ammonia takes place. The operator shall determine V_{sec} by continuous flow measurement, including where the measurement is before the heat recovery unit. For V_{seal} the operator shall consider the purged airflow within the nitric acid production process.

For input air streams accounting for cumulatively less than 2,5 % of the total air flow, the competent authority may accept estimation methods for the determination of that air flow rate proposed by the operator based on industry best practices.

▼B

The operator shall provide evidence through measurements under normal operating conditions that the flue gas flow measured is sufficiently homogeneous to allow for the proposed measurement method. Where non-homogeneous flow is confirmed through these measurements, the operator shall take that into account when determining appropriate monitoring methods and when calculating the uncertainty in the N₂O emissions.

The operator shall adjust all measurements to a dry gas basis and report them consistently.

B.4. Oxygen (O_2) concentrations

The operator shall measure the oxygen concentrations in the flue gas where necessary for calculating the flue gas flow in accordance with subsection B.3 of this section of Annex IV. In doing so, the operator shall comply with the requirements for concentration measurements within Article 41(1) and (2). In determining the uncertainty of N₂O emissions, the operator shall take the uncertainty of O₂ concentration measurements into account.

The operator shall adjust all measurements to a dry gas basis where required and report them consistently.

B.5. Calculation of N₂O emissions

For specific periods of unabated emissions of N₂O from adipic acid, caprolactam, glyoxal and glyoxylic acid production, including unabated emissions from venting for safety reasons and when abatement plant fails, and where continuous emissions monitoring of N₂O is technically not feasible, the operator shall subject to the approval of the specific methodology by the competent authority calculate N₂O emissions using a mass balance methodology. For this purpose the overall uncertainty shall be similar to the result of applying the tier requirements of Article 41(1) and (2). The operator shall base the calculation method on the maximum potential emission rate of N₂O from the chemical reaction taking place at the time and the period of the emission.

The operator shall take the uncertainty in any calculated emissions for a specific emission source into account in determining the annual average hourly uncertainty for the emission source.

B.6. Determination of activity production rates

Production rates shall be calculated using daily production reports and hours of operation.

B.7. Sampling rates

Valid hourly averages or averages for shorter reference periods shall be calculated in accordance with Article 44 for:

- (a) concentration of N₂O in the flue gas;
- (b) total flue gas flow where this is measured directly and where required;
- (c) all gas flows and oxygen concentrations necessary to determine the total flue gas flow indirectly.

C. Determination of annual CO₂ equivalent – CO_{2(e)}

The operator shall convert the total annual N₂O emissions from all emissions sources, measured in tonnes to three decimal places, to annual CO_{2(e)} in rounded tonnes, using the following formula and the GWP values in Annex VI section 3:

$$\text{CO}_{2(\text{e})} [\text{t}] = \text{N}_2\text{O}_{\text{annual}}[\text{t}] \times \text{GWP}_{\text{N}_2\text{O}}$$

Where:

▼B

N_2O_{annual} = total annual N_2O emissions, calculated according to equation 1 given in section 3 of Annex VIII.

The total annual $CO_{2(e)}$ generated by all emission sources and any direct CO_2 emissions from other emission sources included under the greenhouse gas permit shall be added to the total annual CO_2 emissions generated by the installation and shall be used for reporting and surrendering allowances.

Total annual emissions of N_2O shall be reported in tonnes to three decimal places and as $CO_{2(e)}$ in rounded tonnes.

17. PRODUCTION OF AMMONIA AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential emission sources for CO_2 emissions: combustion of fuels supplying the heat for reforming or partial oxidation, fuels used as process input in the ammonia production process (reforming or partial oxidation), fuels used for other combustion processes including for the purpose of producing hot water or steam.

B. Specific monitoring rules

For monitoring of emissions from combustion processes and from fuels used as process inputs, the standard methodology in accordance with Article 24 and section 1 of this Annex shall be applied.

Where CO_2 from ammonia production is used as feedstock for the production of urea or other chemicals, or transferred out of the installation for any use not covered by Article 49(1), the related amount of CO_2 shall be considered as emitted by the installation producing the CO_2 .

18. PRODUCTION OF BULK ORGANIC CHEMICALS AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall take into account at least the following sources of CO_2 emissions: cracking (catalytic and non-catalytic), reforming, partial or full oxidation, similar processes which lead to CO_2 emissions from carbon contained in hydrocarbon based feedstock, combustion of waste gases and flaring, and the burning of fuel in other combustion processes.

B. Specific monitoring rules

Where the production of bulk organic chemicals is technically integrated in a mineral oil refinery, the operator of that installation shall apply the relevant provisions of section 2 of this Annex.

Notwithstanding the first subparagraph, the operator shall monitor emissions from combustion processes where the fuels used do not take part in or stem from chemical reactions for the production of bulk organic chemicals using the standard methodology in accordance with Article 24 and section 1 of this Annex. In all other cases, the operator may choose to monitor the emissions from bulk organic chemicals production by mass balance methodology in accordance with Article 25 or the standard methodology in accordance with Article 24. Where using the standard methodology, the operator shall provide evidence to the competent authority that the chosen methodology covers all relevant emissions that would also be covered by a mass-balance methodology.

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For the determination of the carbon content under Tier 1, the reference emission factors as listed in Table 5 in Annex VI shall be applied. For substances not listed in Table 5 of Annex VI or other provisions of this Regulation, the operator shall calculate the carbon content from the stoichiometric carbon content in the pure substance and the concentration of the substance in the input or output stream.

19. PRODUCTION OF HYDROGEN AND SYNTHESIS GAS AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The operator shall include at least the following potential emission sources for CO₂ emissions: fuels used in the hydrogen or synthesis gas production process (reforming or partial oxidation), and fuels used for other combustion processes including for the purpose of producing hot water or steam. Synthesis gas produced shall be considered as source stream under the mass balance methodology.

B. Specific monitoring rules

For monitoring of emissions from combustion processes and from fuels used as process inputs in hydrogen production, the standard methodology in accordance with Article 24 and section 1 of this Annex shall be used.

For the monitoring of emissions from the production of synthesis gas, a mass balance in accordance with Article 25 shall be used. For emissions from separate combustion processes, the operator may choose to include them in the mass balance or to use the standard methodology in accordance with Article 24 at least for a part of the source streams, avoiding any gaps or double counting of emissions.

Where hydrogen and synthesis gas are produced at the same installation, the operator shall calculate CO₂ emissions using either separate methodologies for hydrogen and for synthesis gas as outlined in the first two paragraphs of this subsection, or using one common mass balance.

20. PRODUCTION OF SODA ASH AND SODIUM BICARBONATE AS LISTED IN ANNEX I TO DIRECTIVE 2003/87/EC

A. Scope

The emission sources and source streams for CO₂ emissions from installations for the production of soda ash and sodium bicarbonate shall include:

- (a) fuels used for combustion processes, including fuels used for the purpose of producing hot water or steam;
- (b) raw materials, including vent gas from calcination of limestone, to the extent it is not used for carbonation;
- (c) waste gases from washing or filtration steps after carbonation, to the extent it is not used for carbonation.

B. Specific monitoring rules

For the monitoring of emissions from the production of soda ash and sodium bicarbonate, the operator shall use a mass balance in accordance with Article 25. For emissions from combustion processes, the operator may choose to include them in the mass balance or to use the standard methodology in accordance with Article 24 at least for a part of the source streams, avoiding any gaps or double counting of emissions.

Where CO₂ from the production of soda ash is used for the production of sodium bicarbonate, the amount of CO₂ used for producing sodium bicarbonate from soda ash shall be considered as emitted by the installation producing the CO₂.

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21. DETERMINATION OF GREENHOUSE GAS EMISSIONS FROM CO₂ CAPTURE ACTIVITIES FOR THE PURPOSES OF TRANSPORT AND GEOLOGICAL STORAGE IN A STORAGE SITE PERMITTED UNDER DIRECTIVE 2009/31/EC

A. Scope

CO₂ capture shall be performed either by a dedicated installation receiving CO₂ by transfer from one or more other installations, or by the same installation carrying out the activities producing the captured CO₂ under the same greenhouse gas emissions permit. All parts of the installation related to CO₂ capture, intermediate storage, transfer to a CO₂ transport network or to a site for geological storage of CO₂ greenhouse gas emissions shall be included in the greenhouse gas emissions permit and accounted for in the associated monitoring plan. In the case of the installation carrying out other activities covered by Directive 2003/87/EC, the emissions of those activities shall be monitored in accordance with the other relevant sections of this Annex.

The operator of a CO₂ capture activity shall at least include the following potential sources of CO₂ emission:

- (a) CO₂ transferred to the capture installation;
- (b) combustion and other associated activities at the installation that are related to the capture activity, including fuel and input material use.

B. Quantification of transferred and emitted CO₂ amounts

B.1. Installation level quantification

Each operator shall calculate the emissions by taking into account the potential CO₂ emissions from all emission relevant processes at the installation, as well as the amount of CO₂ captured and transferred to the transport network, using the following formula:

$$E_{\text{capture installation}} = T_{\text{input}} + E_{\text{without capture}} - T_{\text{for storage}}$$

Where:

$E_{\text{capture installation}}$ = Total greenhouse gas emissions of the capture installation;

T_{input} = Amount of CO₂ transferred to the capture installation, determined in accordance with Article 40 to 46 and Article 49.

$E_{\text{without capture}}$ = Emissions of the installation assuming the CO₂ were not captured, meaning the sum of the emissions from all other activities at the installation, monitored in accordance with relevant sections of Annex IV;

$T_{\text{for storage}}$ = Amount of CO₂ transferred to a transport network or a storage site, determined in accordance with Article 40 to 46 and Article 49.

In cases where CO₂ capture is carried out by the same installation as the one from which the captured CO₂ originates, the operator shall use zero for T_{input} .

In cases of stand-alone capture installations, the operator shall consider $E_{\text{without capture}}$ to represent the amount of emissions that occur from other sources than the CO₂ transferred to the installation for capture. The operator shall determine those emissions in accordance with this Regulation.

▼B

In the case of stand-alone capture installations, the operator of the installation transferring CO₂ to the capture installation shall deduct the amount T_{input} from the emissions of its installation in accordance with Article 49.

B.2. Determination of transferred CO₂

Each operator shall determine the amount of CO₂ transferred from and to the capture installation in accordance with Article 49 by means of measurement methodologies carried out in accordance with Articles 40 to 46.

Only where the operator of the installation transferring CO₂ to the capture installation demonstrates to the satisfaction of the competent authority that CO₂ transferred to the capture installation is transferred in total and to at least equivalent accuracy, may the competent authority allow that operator to use a calculation-based methodology in accordance with Article 24 or 25 to determine the amount T_{input} instead of a measurement-based methodology in accordance with Article 40 to 46 and Article 49.

22. DETERMINATION OF GREENHOUSE GAS EMISSIONS FROM THE TRANSPORT OF CO₂ BY PIPELINES FOR GEOLOGICAL STORAGE IN A STORAGE SITE PERMITTED UNDER DIRECTIVE 2009/31/EC

A. Scope

The boundaries for monitoring and reporting emissions from CO₂ transport by pipeline shall be laid down in the transport network's greenhouse gas emissions permit, including all ancillary plant functionally connected to the transport network, including booster stations and heaters. Each transport network shall have a minimum of one start point and one end point, each connected to other installations carrying out one or more of the activities: capture, transport or geological storage of CO₂. Start and end points may include bifurcations of the transport network and cross national borders. Start and end points as well as the installations they are connecting to, shall be laid down in the greenhouse gas emissions permit.

Each operator shall consider at least the following potential emission sources for CO₂ emissions: combustion and other processes at installations functionally connected to the transport network including booster stations; fugitive emissions from the transport network; vented emissions from the transport network; and emissions from leakage incidents in the transport network.

B. Quantification Methodologies for CO₂

The operator of transport networks shall determine emissions using one of the following methods:

- (a) Method A (overall mass balance of all input and output streams) set out in subsection B.1;
- (b) Method B (monitoring of emission sources individually) set out in subsection B.2.

In choosing either Method A or Method B, each operator shall demonstrate to the competent authority that the chosen methodology will lead to more reliable results with lower uncertainty of the overall emissions, using best available technology and knowledge at the time of the application for the greenhouse gas emissions permit and approval of the monitoring plan, without incurring unreasonable costs. Where Method B is chosen each operator shall demonstrate to the satisfaction of the competent authority that the overall uncertainty for the annual level of greenhouse gas emissions for the operator's transport network does not exceed 7,5 %.

▼B

The operator of a transport network using Method B shall not add CO₂ received from another installation permitted in accordance with Directive 2003/87/EC to its calculated level of emissions, and shall not subtract from its calculated level of emissions any CO₂ transferred to another installation permitted in accordance with Directive 2003/87/EC.

Each operator of a transport network shall use Method A for the validation of the results of Method B at least once annually. For that validation, the operator may use lower tiers for the application of Method A.

B.1. Method A

Each operator shall determine emissions in accordance with the following formula:

$$\text{Emissions}[t \text{ CO}_2] = E_{\text{own activity}} + \sum_i T_{IN,i} - \sum_i T_{OUT,i}$$

Where:

Emissions = Total CO₂ emissions of the transport network [t CO₂];

$E_{\text{own activity}}$ = Emissions from the transport network's own activity, meaning not emissions stemming from the CO₂ transported, but including emissions from fuel used in booster stations, monitored in accordance with the relevant sections of Annex IV;

$T_{IN,i}$ = Amount of CO₂ transferred to the transport network at entry point i , determined in accordance with Articles 40 to 46 and Article 49.

$T_{OUT,i}$ = Amount of CO₂ transferred out of the transport network at exit point i , determined in accordance with Articles 40 to 46 and Article 49.

B.2. Method B

Each operator shall determine emissions considering all processes relevant to emissions at the installation as well as the amount of CO₂ captured and transferred to the transport facility using the following formula:

$$\text{Emissions } [t \text{ CO}_2] = \text{CO}_2 \text{ fugitive} + \text{CO}_2 \text{ vented} + \text{CO}_2 \text{ leakage events} + \text{CO}_2 \text{ installations}$$

Where:

Emissions = Total CO₂ emissions of the transport network [t CO₂];

$\text{CO}_2 \text{ fugitive}$ = Amount of fugitive emissions [t CO₂] from CO₂ transported in the transport network, including from seals, valves, intermediate compressor stations and intermediate storage facilities;

$\text{CO}_2 \text{ vented}$ = Amount of vented emissions [t CO₂] from CO₂ transported in the transport network;

$\text{CO}_2 \text{ leakage events}$ = Amount of CO₂ [t CO₂] transported in the transport network, which is emitted as the result of the failure of one or more components of the transport network;

$\text{CO}_2 \text{ installations}$ = Amount of CO₂ [t CO₂] being emitted from combustion or other processes functionally connected to the pipeline transport in the transport network, monitored in accordance with the relevant sections of Annex IV.

▼B**B.2.1. Fugitive emissions from the transport network**

The operator shall consider fugitive emissions from any of the following types of equipment:

- (a) seals;
- (b) measurement devices;
- (c) valves;
- (d) intermediate compressor stations;
- (e) intermediate storage facilities.

The operator shall determine average emission factors EF (expressed in g CO₂/unit time) per piece of equipment per occurrence where fugitive emissions can be anticipated at the beginning of operation, and by the end of the first reporting year in which the transport network is in operation at the latest. The operator shall review those factors at least every 5 years in the light of the best available techniques and knowledge.

The operator shall calculate fugitive emissions by multiplying the number of pieces of equipment in each category by the emission factor and adding up the results for the single categories as shown in the following equation:

$$\text{Fugitive Em [t CO}_2\text{]} = \left(\sum_{\text{Category}} EF[\text{g CO}_2/\text{occurr}] \cdot N_{\text{occurr}} \right) / 10^6$$

The number of occurrences (N_{occurr}) shall be the number of pieces of the given equipment per category, multiplied by the number of time units per year.

B.2.2. Emissions from leakage events

The operator of a transport network shall provide evidence of the network integrity by using representative (spatial and time-related) temperature and pressure data. Where the data indicates that a leakage has occurred, the operator shall calculate the amount of CO₂ leaked with a suitable methodology documented in the monitoring plan, based on industry best practice guidelines, including by use of the differences in temperature and pressure data compared to integrity related average pressure and temperature values.

B.2.3. Vented emissions

Each operator shall provide in the monitoring plan an analysis regarding potential situations of venting emissions, including for maintenance or emergency reasons, and provide a suitable documented methodology for calculating the amount of CO₂ vented, based on industry best practice guidelines.

23. GEOLOGICAL STORAGE OF CO₂ IN A STORAGE SITE PERMITTED UNDER DIRECTIVE 2009/31/EC

A. Scope

The competent authority shall base the boundaries for monitoring and reporting of emissions from geological storage of CO₂ on the delimitation of the storage site and storage complex as specified in the permit pursuant to Directive 2009/31/EC. Where leakages from the storage complex are identified and lead to emissions or release of CO₂ into the water column, the operator shall immediately carry out all of the following:

- (a) notify the competent authority;
- (b) include the leakage as an emission source for the respective installation;
- (c) monitor and report the emissions.

▼B

Only when corrective measures in accordance with Article 16 of Directive 2009/31/EC have been taken and emissions or release into the water column from that leakage can no longer be detected shall the operator delete the respective leakage as emission source from the monitoring plan and no longer monitor and report those emissions.

Each operator of a geological storage activity shall consider at least the following potential emission sources for CO₂ overall: fuel use by associated booster stations and other combustion activities including on-site power plants; venting from injection or enhanced hydrocarbon recovery operations; fugitive emissions from injection; breakthrough CO₂ from enhanced hydrocarbon recovery operations; and leakages.

B. Quantification of CO₂ emissions

The operator of the geological storage activity shall not add CO₂ received from another installation to its calculated level of emissions, and shall not subtract from its calculated level of emissions any CO₂ which is geologically stored in the storage site or which is transferred to another installation.

B.1. Vented and fugitive emissions from injection

The operator shall determine emissions from venting and fugitive emissions as follows:

$$\text{CO}_2 \text{ emitted [t CO}_2\text{]} = V \text{ CO}_2 \text{ [t CO}_2\text{]} + F \text{ CO}_2 \text{ [t CO}_2\text{]}$$

Where:

V CO₂ = amount of CO₂ vented;

F CO₂ = amount of CO₂ from fugitive emissions.

Each operator shall determine V CO₂ using measurement-based methodologies in accordance with Articles 41 to 46 of this Regulation. By way of derogation from the first sentence and upon approval by the competent authority, the operator may include in the monitoring plan an appropriate methodology for determining V CO₂ based on industry best practice, where the application of measurement-based methodologies would incur unreasonable costs.

The operator shall consider F CO₂ as one source, meaning that the uncertainty requirements associated with the tiers in accordance with section 1 of Annex VIII are applied to the total value instead of the individual emission points. Each operator shall provide in the monitoring plan an analysis regarding potential sources of fugitive emissions, and provide a suitable documented methodology to calculate or measure the amount of F CO₂, based on industry best practice guidelines. For the determination of F CO₂ the operator may use data collected in accordance with Article 32 to 35 and Annex II(1.1)(e) to (h) of Directive 2009/31/EC for the injection facility, where they comply with the requirements of this Regulation.

B.2. Vented and fugitive emissions from enhanced hydrocarbon recovery operations

Each operator shall consider the following potential additional emission sources from enhanced hydrocarbon recovery (EHR):

- (a) the oil-gas separation units and gas recycling plant, where fugitive emissions of CO₂ could occur;
- (b) the flare stack, where emissions might occur due to the application of continuous positive purge systems and during depressurisation of the hydrocarbon production installation;
- (c) the CO₂ purge system, to avoid high concentrations of CO₂ extinguishing the flare.

▼B

Each operator shall determine fugitive emissions or vented CO₂ in accordance with subsection B.1 of this section of Annex IV.

Each operator shall determine emissions from the flare stack in accordance with subsection D of section 1 of this Annex, taking into account potential inherent CO₂ in the flare gas in accordance with Article 48.

B.3. Leakage from the storage complex

Emissions and release to the water column shall be quantified as follows:

$$CO_2\text{emitted } [t \text{ CO}_2] = \sum_{T_{Start}}^{T_{End}} L \text{ CO}_2[t \text{ CO}_2/d]$$

Where:

L CO₂ = the mass of CO₂ emitted or released per calendar day due to the leakage in accordance with all of the following:

- (a) for each calendar day for which leakage is monitored, each operator shall calculate L CO₂ as the average of the mass leaked per hour [t CO₂/h] multiplied by 24;
- (b) each operator shall determine the mass leaked per hour in accordance with the provisions in the approved monitoring plan for the storage site and the leakage;
- (c) for each calendar day prior to commencement of monitoring, the operator shall take the mass leaked per day to equal the mass leaked per day for the first day of monitoring ensuring no under-estimation occurs;

T_{start} = the latest of:

- (a) the last date when no emissions or release of CO₂ into the water column from the source under consideration were reported;
- (b) the date the CO₂ injection started;
- (c) another date such that there is evidence demonstrating to the satisfaction of the competent authority that the emission or release into the water column cannot have started before that date.

T_{end} = the date by which corrective measures in accordance with Article 16 of Directive 2009/31/EC have been taken and emissions or release of CO₂ into the water column can no longer be detected.

The competent authority shall approve and allow the use of other methods for the quantification of emissions or release of CO₂ into the water column from leakages where the operator can show to the satisfaction of the competent authority that such methods lead to a higher accuracy than the methodology set out in this subsection.

The operator shall quantify the amount of emissions leaked from the storage complex for each of the leakage events with a maximum overall uncertainty over the reporting period of 7,5 %. Where the overall uncertainty of the applied quantification methodology exceeds 7,5 %, each operator shall apply an adjustment, as follows:

$$CO_{2,\text{Reported}} [\text{t CO}_2] = CO_{2,\text{Quantified}} [\text{t CO}_2] \times (1 + (\text{Uncertainty}_{\text{System}} [\%]/100) - 0,075)$$

Where:

CO_{2,Reported} = the amount of CO₂ to be included in the annual emission report with regards to the leakage event in question;

CO_{2,Quantified} = the amount of CO₂ determined through the used quantification methodology for the leakage event in question;

Uncertainty_{System} = the level of uncertainty associated with the quantification methodology used for the leakage event in question.

▼B*ANNEX V*

Minimum tier requirements for calculation-based methodologies involving category A installations and calculation factors for commercial standard fuels used by category B and C installations (Article 26(1))

Table 1

Minimum tiers to be applied for calculation-based methodologies in the case of category A installations and in the case of calculation factors for commercial standard fuels for all installations in accordance with point (a) of Article 26(1)

Activity/Source stream type	Activity data		Emission factor (*)	Composition data (carbon content) (*)	Oxidation factor	Conversion factor
	Amount of fuel or material	Net calorific value				
Combustion of fuels						
Commercial standard fuels	2	2a/2b	2a/2b	n.a.	1	n.a.
Other gaseous and liquid fuels	2	2a/2b	2a/2b	n.a.	1	n.a.
Solid fuels	1	2a/2b	2a/2b	n.a.	1	n.a.
Mass balance methodology for Gas Processing Terminals	1	n.a.	n.a.	1	n.a.	n.a.
Flares	1	n.a.	1	n.a.	1	n.a.
Scrubbing (carbonate)	1	n.a.	1	n.a.	n.a.	1
Scrubbing (gypsum)	1	n.a.	1	n.a.	n.a.	1
Scrubbing (urea)	1	1	1	n.a.	1	n.a.
Refining of mineral oil						
Catalytic cracker regeneration	1	n.a.	n.a.	n.a.	n.a.	n.a.
Production of coke						
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.
Fuel as process input	1	2	2	n.a.	n.a.	n.a.
Metal ore roasting and sintering						
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.
Carbonate input	1	n.a.	1	n.a.	n.a.	1
Production of iron and steel						
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.
Fuel as process input	1	2a/2b	2	n.a.	n.a.	n.a.

▼B

Activity/Source stream type	Activity data		Emission factor (*)	Composition data (carbon content) (*)	Oxidation factor	Conversion factor
	Amount of fuel or material	Net calorific value				
Production or processing of ferrous and non-ferrous metals, including secondary aluminium						
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.
Process emissions	1	n.a.	1	n.a.	n.a.	1
Primary aluminium production						
Mass balance for CO ₂ emissions	1	n.a.	n.a.	2	n.a.	n.a.
PFC emissions (slope method)	1	n.a.	1	n.a.	n.a.	n.a.
PFC emissions (overvoltage method)	1	n.a.	1	n.a.	n.a.	n.a.
Production of cement clinker						
Kiln input based (Method A)	1	n.a.	1	n.a.	n.a.	1
Clinker output (Method B)	1	n.a.	1	n.a.	n.a.	1
CKD	1	n.a.	1	n.a.	n.a.	n.a.
Non-carbonate carbon input	1	n.a.	1	n.a.	n.a.	1
Production of lime and calcination of dolomite and magnesite						
Carbonates (Method A)	1	n.a.	1	n.a.	n.a.	1
Other process inputs	1	n.a.	1	n.a.	n.a.	1
Alkali earth oxide (Method B)	1	n.a.	1	n.a.	n.a.	1
Manufacture of glass and mineral wool						
Carbonate inputs	1	n.a.	1	n.a.	n.a.	n.a.
Other process inputs	1	n.a.	1	n.a.	n.a.	1
Manufacture of ceramic products						
Carbon inputs (Method A)	1	n.a.	1	n.a.	n.a.	1
Other process inputs	1	n.a.	1	n.a.	n.a.	1
Alkali oxide (Method B)	1	n.a.	1	n.a.	n.a.	1
Scrubbing	1	n.a.	1	n.a.	n.a.	n.a.

▼B

Activity/Source stream type	Activity data		Emission factor (*)	Composition data (carbon content) (*)	Oxidation factor	Conversion factor				
	Amount of fuel or material	Net calorific value								
Production of gypsum and plasterboard: see combustion of fuels										
Production of pulp and paper										
Make up chemicals	1	n.a.	1	n.a.	n.a.	n.a.				
Production of carbon black										
Mass balance methodology	1	n.a.	n.a.	1	n.a.	n.a.				
Production of ammonia										
Fuel as process input	2	2a/2b	2a/2b	n.a.	n.a.	n.a.				
Production of bulk organic chemicals										
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.				
Production of hydrogen and synthesis gas										
Fuel as process input	2	2a/2b	2a/2b	n.a.	n.a.	n.a.				
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.				
Production of soda ash and sodium bicarbonate										
Mass balance	1	n.a.	n.a.	2	n.a.	n.a.				

(‘n.a.’ means ‘not applicable’)

(*) Tiers for the emission factor relate to the preliminary emission factor, and carbon content relates to the total carbon content. For mixed materials, the biomass fraction must be determined separately. Tier 1 shall be the minimum tier to be applied for the biomass fraction in the case of category A installations and in the case of commercial standard fuels for all installations in accordance with point (a) of Article 26(1).

▼B*ANNEX VI***Reference values for calculation factors (Article 31(1)(a))****1. FUEL EMISSION FACTORS RELATED TO NET CALORIFIC VALUES
(NCV)***Table 1***Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of fuel.**

Fuel type description	Emission factor (t CO ₂ /TJ)	Net calorific value (TJ/Gg)	Source
Crude oil	73,3	42,3	IPCC 2006 GL
Orimulsion	77,0	27,5	IPCC 2006 GL
Natural gas liquids	64,2	44,2	IPCC 2006 GL
Motor gasoline	69,3	44,3	IPCC 2006 GL
Kerosene (other than jet kerosene)	71,9	43,8	IPCC 2006 GL
Shale oil	73,3	38,1	IPCC 2006 GL
Gas/Diesel oil	74,1	43,0	IPCC 2006 GL
Residual fuel oil	77,4	40,4	IPCC 2006 GL
Liquefied petroleum gases	63,1	47,3	IPCC 2006 GL
Ethane	61,6	46,4	IPCC 2006 GL
Naphtha	73,3	44,5	IPCC 2006 GL
Bitumen	80,7	40,2	IPCC 2006 GL
Lubricants	73,3	40,2	IPCC 2006 GL
Petroleum coke	97,5	32,5	IPCC 2006 GL
Refinery feedstocks	73,3	43,0	IPCC 2006 GL
Refinery gas	57,6	49,5	IPCC 2006 GL
Paraffin waxes	73,3	40,2	IPCC 2006 GL
White spirit and SBP	73,3	40,2	IPCC 2006 GL

▼B

Fuel type description	Emission factor (t CO ₂ /TJ)	Net calorific value (TJ/Gg)	Source
Other petroleum products	73,3	40,2	IPCC 2006 GL
Anthracite	98,3	26,7	IPCC 2006 GL
Coking coal	94,6	28,2	IPCC 2006 GL
Other bituminous coal	94,6	25,8	IPCC 2006 GL
Sub-bituminous coal	96,1	18,9	IPCC 2006 GL
Lignite	101,0	11,9	IPCC 2006 GL
Oil shale and tar sands	107,0	8,9	IPCC 2006 GL
Patent fuel	97,5	20,7	IPCC 2006 GL
Coke oven coke and lignite coke	107,0	28,2	IPCC 2006 GL
Gas coke	107,0	28,2	IPCC 2006 GL
Coal tar	80,7	28,0	IPCC 2006 GL
Gas works gas	44,4	38,7	IPCC 2006 GL
Coke oven gas	44,4	38,7	IPCC 2006 GL
Blast furnace gas	260	2,47	IPCC 2006 GL
Oxygen steel furnace gas	182	7,06	IPCC 2006 GL
Natural gas	56,1	48,0	IPCC 2006 GL
Industrial wastes	143	n.a.	IPCC 2006 GL
Waste oils	73,3	40,2	IPCC 2006 GL
Peat	106,0	9,76	IPCC 2006 GL
Wood/wood waste	—	15,6	IPCC 2006 GL
Other primary solid biomass	—	11,6	IPCC 2006 GL (only NCV)
Charcoal	—	29,5	IPCC 2006 GL (only NCV)
Biogasoline	—	27,0	IPCC 2006 GL (only NCV)

▼B

Fuel type description	Emission factor (t CO ₂ /TJ)	Net calorific value (TJ/Gg)	Source
Biodiesels	—	27,0	IPCC 2006 GL (only NCV)
Other liquid biofuels	—	27,4	IPCC 2006 GL (only NCV)
Landfill gas	—	50,4	IPCC 2006 GL (only NCV)
Sludge gas	—	50,4	IPCC 2006 GL (only NCV)
Other biogas	—	50,4	IPCC 2006 GL (only NCV)
Waste tyres	85,0 ⁽¹⁾	n.a.	WBCSD CSI
Carbon monoxide	155,2 ⁽²⁾	10,1	J. Falbe and M. Regitz, Römpf Chemie Lexikon, Stuttgart, 1995
Methane	54,9 ⁽³⁾	50,0	J. Falbe and M. Regitz, Römpf Chemie Lexikon, Stuttgart, 1995

⁽¹⁾ This value is the preliminary emission factor, i.e. before application of a biomass fraction, if applicable.

⁽²⁾ Based on NCV of 10,12 TJ/t

⁽³⁾ Based on NCV of 50,01 TJ/t

2. EMISSION FACTORS RELATED TO PROCESS EMISSIONS

Table 2

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

Carbonate	Emission factor [t CO ₂ / t Carbonate]
CaCO ₃	0,440
MgCO ₃	0,522
Na ₂ CO ₃	0,415
BaCO ₃	0,223
Li ₂ CO ₃	0,596
K ₂ CO ₃	0,318
SrCO ₃	0,298
NaHCO ₃	0,524
FeCO ₃	0,380

▼B

Carbonate	Emission factor [t CO ₂ / t Carbonate]
General	<p>Emission factor = $[M(CO_2)] / \{Y * [M(x)] + Z * [M(CO_3^{2-})]\}$</p> <p>X = metal</p> <p>M(x) = molecular weight of X in [g/mol]</p> <p>M(CO₂) = molecular weight of CO₂ in [g/mol]</p> <p>M(CO₃²⁻) = molecular weight of CO₃²⁻ in [g/mol]</p> <p>Y = stoichiometric number of X</p> <p>Z = stoichiometric number of CO₃²⁻</p>

Table 3

Stoichiometric emission factor for process emissions from carbonate decomposition based on alkali earth oxides (Method B)

Oxide	Emission factor [t CO ₂ / t Oxide]
CaO	0,785
MgO	1,092
BaO	0,287
general: X _Y O _Z	<p>Emission factor = $[M(CO_2)] / \{Y * [M(x)] + Z * [M(O)]\}$</p> <p>X = alkali earth or alkali metal</p> <p>M(x) = molecular weight of X in [g/mol]</p> <p>M(CO₂) = molecular weight of CO₂ [g/mol]</p> <p>M(O) = molecular weight of O [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>

Table 4

Emission factors for process emissions from other process materials (production of iron and steel, and processing of ferrous metals)^{(1)}}

Input or output material	Carbon content (t C/t)	Emission factor (t CO ₂ /t)
Direct reduced iron (DRI)	0,0191	0,07
EAF carbon electrodes	0,8188	3,00
EAF charge carbon	0,8297	3,04
Hot briquetted iron	0,0191	0,07
Oxygen steel furnace gas	0,3493	1,28

⁽¹⁾ IPCC 2006 Guidelines for National Greenhouse Gas Inventories

▼B

Input or output material	Carbon content (t C/t)	Emission factor (t CO ₂ /t)
Petroleum coke	0,8706	3,19
Pig iron	0,0409	0,15
Iron / iron scrap	0,0409	0,15
Steel / steel scrap	0,0109	0,04

Table 5

Stoichiometric emission factors for process emissions from other process materials (Bulk organic chemicals)⁽¹⁾

Substance	Carbon content (t C/t)	Emission factor (t CO ₂ / t)
Acetonitril	0,5852	2,144
Acrylonitrile	0,6664	2,442
Butadiene	0,888	3,254
Carbon black	0,97	3,554
Ethylene	0,856	3,136
Ethylene dichloride	0,245	0,898
Ethylene glycol	0,387	1,418
Ethylene oxide	0,545	1,997
Hydrogen cyanide	0,4444	1,628
Methanol	0,375	1,374
Methane	0,749	2,744
Propane	0,817	2,993
Propylene	0,8563	3,137
Vinyl chloride monomer	0,384	1,407

⁽¹⁾ IPCC 2006 Guidelines for National Greenhouse Gas Inventories

▼B3. GLOBAL WARMING POTENTIALS FOR NON-CO₂ GREENHOUSE GASES**▼M1***Table 6***Global warming potentials**

Gas	Global warming potential
N ₂ O	265 t CO _{2(e)} /t N ₂ O
CF ₄	6 630 t CO _{2(e)} /t CF ₄
C ₂ F ₆	11 100 t CO _{2(e)} /t C ₂ F ₆

▼B*ANNEX VII***Minimum frequency of analyses (Article 35)**

Fuel/material	Minimum frequency of analyses
Natural gas	At least weekly
Other gases, in particular synthesis gas and process gases such as refinery mixed gas, coke oven gas, blast-furnace gas, convertor gas, oilfield and gasfield gas	At least daily — using appropriate procedures at different parts of the day
Fuel oils (for example light, medium, heavy fuel oil, bitumen)	Every 20 000 tonnes of fuel and at least six times a year
Coal, coking coal, coke, petroleum coke, peat	Every 20 000 tonnes of fuel/material and at least six times a year
Other fuels	Every 10 000 tonnes of fuel and at least four times a year
Untreated solid waste (pure fossil or mixed biomass/fossil)	Every 5 000 tonnes of waste and at least four times a year
Liquid waste, pre-treated solid waste	Every 10 000 tonnes of waste and at least four times a year
Carbonate minerals (including limestone and dolomite)	Every 50 000 tonnes of material and at least four times a year
Clays and shales	Amounts of material corresponding to 50 000 tonnes of CO ₂ and at least four times a year
Other materials (primary, intermediate and final product)	Depending on the type of material and the variation, amounts of material corresponding to 50 000 tonnes of CO ₂ and at least four times a year

▼B*ANNEX VIII***Measurement-based methodologies (Article 41)****1. TIER DEFINITIONS FOR MEASUREMENT-BASED METHODOLOGIES**

Measurement-based methodologies shall be approved in accordance with tiers with the following maximum permissible uncertainties for the annual average hourly emissions calculated in accordance with Equation 2 set out in section 3 of this Annex.

*Table 1***Tiers for CEMS (maximum permissible uncertainty for each tier)**

In case of CO₂, the uncertainty is to be applied to the total amount of CO₂ measured. Where the biomass fraction is determined using a measurement based methodology, the same tier definition as for CO₂ shall be applied to the biomass fraction.

	Tier 1	Tier 2	Tier 3	Tier 4
CO ₂ emission sources	± 10 %	± 7,5 %	± 5 %	± 2,5 %
N ₂ O emission sources	± 10 %	± 7,5 %	± 5 %	N.A.
CO ₂ transfer	± 10 %	± 7,5 %	± 5 %	± 2,5 %

2. MINIMUM TIER REQUIREMENTS FOR CATEGORY A INSTALLATIONS*Table 2***Minimum tiers to be applied by category A installations for measurement-based methodologies in accordance with point (a) of Article 41(1)**

Greenhouse gas	Minimum tier level required
CO ₂	2
N ₂ O	2

3. DETERMINATION OF GHGS USING MEASUREMENT-BASED METHODOLOGIES

Equation 1: Calculation of annual emissions in accordance with Article 43(1):

$$GHG\ Em_{total}\ [t] = \sum_{i=1}^{HoursOp} GHG\ conc_{hourly,i} \cdot V_{hourly,i} \cdot 10^{-6}[t/g]$$

Equation 2: Determination of average hourly emissions:

$$GHG\ Em_{average}\ [kg/h] = \frac{GHG\ Em_{total}}{HoursOp} \cdot 10^3[kg/t]$$

Equation 2a: Determination of average hourly GHG concentration for the purpose of reporting in accordance with point 9(b) of Annex X, section 1:

$$GHG\ conc_{average}\ [g/Nm^3] = \frac{GHG\ Em_{total}}{\sum_{i=1}^{HoursOp} V_{hourly,i}} \cdot 10^6[g/t]$$

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Equation 2b: Determination of average hourly flue gas flow for the purpose of reporting in accordance with point 9(b) of Annex X, section 1:

$$\text{Flow}_{\text{average}} [\text{Nm}^3/\text{h}] = \frac{\sum_{i=1}^{\text{HoursOp}} V_{\text{hourly},i}}{\text{HoursOp}}$$

Equation 2c: Calculation of annual emissions for the purpose of the annual emission report in accordance with point 9(b) of Annex X, section 1:

$$\text{GHG Em}_{\text{total}}[t] = \text{GHG conc}_{\text{average}} \cdot \text{Flow}_{\text{average}} \cdot \text{HoursOp} \cdot 10^{-6}[\text{t/g}]$$

The following abbreviations are used in Equations 1 to 2c:

The index i refers to the individual operating hour. Where an operator uses shorter reference periods in accordance with Article 44(1), that reference period shall be used instead of hours for these calculations.

GHG Em_{total} = total annual GHG emissions in tonnes

GHG conc_{hourly, i} = hourly concentrations of GHG emissions in g/Nm³ in the flue gas flow measured during operation for hour i;

V_{hourly, i} = flue gas volume in Nm³ for hour i (i.e. integrated flow over the hour or shorter reference period);

GHG Em_{average} = annual average hourly emissions in kg/h from the source;

HoursOp = total number of hours for which the measurement-based methodology is applied, including the hours for which data has been substituted in accordance with Article 45(2) to (4);

GHG conc_{average} = annual average hourly concentrations of GHG emissions in g/Nm³;

Flow_{average} = annual average flue gas flow in Nm³/h.

4. CALCULATION OF THE CONCENTRATION USING INDIRECT CONCENTRATION MEASUREMENT

Equation 3: Calculation of the concentration

$$\text{GHG concentration}[\%] = 100\% - \sum_i \text{Concentration of component } i[\%]$$

5. SUBSTITUTION FOR MISSING CONCENTRATION DATA FOR MEASUREMENT-BASED METHODOLOGIES

Equation 4: Substitution for missing data for measurement-based methodologies

$$C_{\text{subst}}^* = \bar{C} + 2\sigma_{C_-}$$

Where:

\bar{C} = the arithmetic mean of the concentration of the specific parameter over the whole reporting period or, where specific circumstances applied when data loss occurred, an appropriate period reflecting the specific circumstances;

σ_{C_-} = the best estimate of the standard deviation of the concentration of the specific parameter over the whole reporting period or, where specific circumstances applied when data loss occurred, an appropriate period reflecting the specific circumstances.

▼B*ANNEX IX***Minimum data and information to be retained in accordance with Article 67(1)**

Operators and aircraft operators shall retain at least the following:

1. COMMON ELEMENTS FOR INSTALLATIONS AND AIRCRAFT OPERATORS

- (1) The monitoring plan approved by the competent authority;
- (2) Documents justifying the selection of the monitoring methodology and the documents justifying temporal or non-temporal changes of monitoring methodologies and, where applicable, tiers approved by the competent authority;
- (3) All relevant updates of monitoring plans notified to the competent authority in accordance with Article 15, and the competent authority's replies;
- (4) All written procedures referred to in the monitoring plan, including the sampling plan where relevant, the procedures for data flow activities and the procedures for control activities;
- (5) A list of all versions used of the monitoring plan and all related procedures;
- (6) Documentation of the responsibilities in connection to the monitoring and reporting;
- (7) The risk assessment performed by the operator or aircraft operator, where applicable;
- (8) The improvement reports in accordance with Article 69;
- (9) The verified annual emission report;
- (10) The verification report;
- (11) Any other information that is identified as required for the verification of the annual emissions report.

2. SPECIFIC ELEMENTS FOR STATIONARY SOURCE INSTALLATIONS:

- (1) The greenhouse gas emissions permit, and any updates thereof;
- (2) Any uncertainty assessments, where applicable;
- (3) For calculation-based methodologies applied in installations:
 - (a) the activity data used for any calculation of the emissions for each source stream, categorised according to process and fuel or material type;
 - (b) a list of all default values used as calculation factors, where applicable;
 - (c) the full set of sampling and analysis results for the determination of calculation factors;
 - (d) documentation about all ineffective procedures corrected and correction action taken in accordance with Article 64;
 - (e) any results of calibration and maintenance of measuring instruments.

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- (4) For measurement-based methodologies in installations, the following additional elements:
- (a) documentation justifying the selection of a measurement-based methodology;
 - (b) the data used for the uncertainty analysis of emissions from each emission source, categorised according to process;
 - (c) the data used for the corroborating calculations and results of the calculations;
 - (d) a detailed technical description of the continuous measurement system including the documentation of the approval from the competent authority;
 - (e) 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;
 - (f) documentation of any changes to the continuous measurement system;
 - (g) any results of the calibration and maintenance of measuring instruments;
 - (h) where applicable, the mass or energy balance model used for the purpose of determining surrogate data in accordance with Article 45(4) and underlying assumptions;
- (5) Where a fall-back methodology as referred to in Article 22 is applied, all data necessary for determining the emissions for the emission sources and source streams for which that methodology is applied, as well as proxy data for activity data, calculation factors and other parameters which would be reported under a tier methodology;
- (6) For primary aluminium production, the following additional elements:
- (a) documentation of results from measurement campaigns for the determination of the installation specific emission factors for CF₄ and C₂F₆;
 - (b) documentation of the results of the determination of the collection efficiency for fugitive emissions;
 - (c) all relevant data on primary aluminium production, anode effect frequency and duration or overvoltage data;
- (7) For CO₂ capture, transport and geological storage activities, where applicable, the following additional elements:
- (a) documentation of the amount of CO₂ injected into the storage complex by installations carrying out geological storage of CO₂;
 - (b) representatively aggregated pressure and temperature data from a transport network;
 - (c) a copy of the storage permit, including the approved monitoring plan, pursuant to Article 9 of Directive 2009/31/EC;
 - (d) the reports submitted in accordance with Article 14 of Directive 2009/31/EC;
 - (e) reports on the results of the inspections carried out in accordance with Article 15 of Directive 2009/31/EC;

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(f) documentation on corrective measures taken in accordance with Article 16 of Directive 2009/31/EC.

3. SPECIFIC ELEMENTS FOR AVIATION ACTIVITIES:

- (1) A list of aircraft owned, leased-in and leased-out, and necessary evidence for the completeness of that list; for each aircraft the date when it is added to or removed from the aircraft operator's fleet;
- (2) A list of flights covered in each reporting period, and necessary evidence for the completeness of that list;
- (3) Relevant data used for determining the fuel consumption and emissions;
- (4) Data used for determining the payload and distance relevant for the years for which tonne-kilometre data are reported;
- (5) Documentation on the methodology for data gaps where applicable, the number of flights where data gaps occurred, the data used for closing the data gaps, where they occurred, and, where the number of flights with data gaps exceeded 5 % of flights that were reported, reasons for the data gaps as well as documentation of remedial actions taken.

▼B*ANNEX X***Minimum content of Annual Reports (Article 68(3))****1. ANNUAL EMISSION REPORTS OF STATIONARY SOURCE INSTALLATIONS**

The annual emission report of an installation shall at least contain the following information:

- (1) Data identifying the installation, as specified in Annex IV to Directive 2003/87/EC, and its unique permit number;
- (2) Name and address of the verifier of the report;
- (3) The reporting year;
- (4) Reference to and version number of the latest approved monitoring plan and the date from which it is applicable, as well as reference to and version number of any other monitoring plans relevant for the reporting year;
- (5) Relevant changes in the operations of an installation and changes as well as temporary deviations that occurred during the reporting period to the monitoring plan approved by the competent authority; including temporal or permanent changes of tiers, reasons for those changes, starting date for the changes, and starting and ending dates of temporal changes;
- (6) Information for all emissions sources and source streams consisting of at least:
 - (a) the total emissions expressed as t CO₂(e);
 - (b) where greenhouse gases other than CO₂ are emitted, the total emissions expressed as t;
 - (c) whether the measurement or the calculation methodology referred to in Article 21 is applied;
 - (d) the tiers applied;
 - (e) activity data:
 - (i) in the case of fuels the amount of fuel (expressed as tonnes or Nm³) and the net calorific value (GJ/t or GJ/ Nm³) reported separately;
 - (ii) for all other source streams the amount expressed as tonnes or Nm³;
 - (f) emission factors, expressed in accordance with the requirements set out in Article 36(2); biomass fraction, oxidation and conversion factors, expressed as dimensionless fractions;
 - (g) where emission factors for fuels are related to mass or volume instead of energy, values determined pursuant to Article 26(5) for the net calorific value of the respective source stream;
- (7) Where a mass balance methodology is applied, the mass flow, and carbon content for each source stream into and out of the installation; biomass fraction and net calorific value, where relevant;
- (8) Information to be reported as memo items, consisting of at least:
 - (a) amounts of biomass combusted, expressed in TJ, or employed in processes, expressed in t or Nm³;

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- (b) CO₂ emissions from biomass, expressed in t CO₂, where measurement-based methodology is used to determine emissions;
- (c) a proxy for the net calorific value of the biomass source streams used as fuel, where relevant;
- (d) amounts and energy content of bioliquids and biofuels combusted, expressed in t and TJ.
- (e) CO₂ or N₂O transferred to an installation or received from an installation, where Article 49 or 50 is applicable, expressed in t CO_{2(e)};
- (f) inherent CO₂ transferred to an installation or received from an installation, where Article 48 is applicable, expressed in t CO₂;
- (g) where applicable, the name of the installation and its identification code as recognised in accordance with the acts adopted pursuant to Article 19(3) of Directive 2003/87/EC:
 - (i) of the installation(s) to which CO₂ or N₂O is transferred in accordance with points (e) and (f) of this point (8);
 - (ii) of the installation(s) from which CO₂ or N₂O is received in accordance with points (e) and (f) of this point (8);

Where that installation does not have such identification code, the name and address of the installation as well as relevant contact information of a contact person shall be provided.

- (h) transferred CO₂ from biomass, expressed in t CO₂;

(9) Where a measurement methodology is applied:

- (a) where CO₂ is measured as the annual fossil CO₂-emissions and the annual CO₂-emissions from biomass use;
- (b) the hours of operation of the continuous emission measurement system (CEMS), the measured greenhouse gas concentrations and the flue gas flow expressed as an annual hourly average, and as an annual total value;

- (10) Where a methodology referred to in Article 22 is applied, all data necessary for determining the emissions for the emission sources and source streams for which that methodology is applied, as well as proxy data for activity data, calculation factors and other parameters which would be reported under a tier methodology;

- (11) Where data gaps have occurred and have been closed by surrogate data in accordance with Article 66(1):
 - (a) the source stream or emission source to which each data gap applies;
 - (b) the reasons for each data gap;
 - (c) the starting and ending date and time of each data gap;
 - (d) the emissions calculated based on surrogate data;
 - (e) where the estimation method for surrogate data has not yet been included in the monitoring plan, a detailed description of the estimation method including evidence that the methodology used does not lead to an underestimation of emissions for the respective time period;

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- (12) Any other changes in the installation during the reporting period with relevance for that installation's greenhouse gas emissions during the reporting year;
- (13) Where applicable, the production level of primary aluminium, the frequency and average duration of anode effects during the reporting period, or the anode effect overvoltage data during the reporting period, as well as the results of the most recent determination of the installation-specific emission factors for CF₄ and C₂F₆ as outlined in Annex IV, and of the most recent determination of the collection efficiency of the ducts.

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

Where tiers have been changed within a reporting period, the operator shall calculate and report emission as separate sections of the annual report for the respective parts of the reporting period.

Operators of CO₂ storage sites may use simplified emission reports after closure of the storage site in accordance with Article 17 of Directive 2009/31/EC containing at least the elements listed under points 1 to 5, provided the greenhouse gas emissions permit contains no emission sources.

2. ANNUAL EMISSION REPORTS OF AIRCRAFT OPERATORS

The emission report for an aircraft operator shall at least contain the following information:

- (1) Data identifying the aircraft operator as set out by Annex IV to Directive 2003/87/EC, and the call sign or other unique designators used for air traffic control purposes, as well as relevant contact details;
- (2) Name and address of the verifier of the report;
- (3) The reporting year;
- (4) Reference to and version number of the latest approved monitoring plan and the date from which it is applicable, reference to and version number of other monitoring plans relevant for the reporting year;
- (5) Relevant changes in the operations and deviations from the approved monitoring plan during the reporting period;
- (6) The aircraft registration numbers and types of aircraft used in the period covered by the report to perform the aviation activities covered by Annex I to Directive 2003/87/EC carried out by the aircraft operator;
- (7) The total number of flights per State pair covered by the report;
- (8) Mass of fuel (in tonnes) per fuel type per State pair;
- (9) Total CO₂ emissions in tonnes of CO₂ disaggregated by the Member State of departure and arrival;
- (10) Where emissions are calculated using an emission factor or carbon content related to mass or volume, proxy data for the net calorific value of the fuel;

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- (11) Where data gaps have occurred and have been closed by surrogate data in accordance with Article 66(2):
 - (a) the number of flights expressed as percentage of annual flights (rounded to the nearest 0,1 %) for which data gaps occurred; and the circumstances and reasons for data gaps that apply;
 - (b) the estimation method for surrogate data applied;
 - (c) the emissions calculated based on surrogate data;
- (12) Memo-items:
 - (a) amount of biomass used as fuel during the reporting year (in tonnes or m³) listed per fuel type;
 - (b) the net calorific value of alternative fuels;
- (13) As an annex to the annual emission report, the operator shall include annual emissions and annual numbers of flights per aerodrome pair. Upon request of the operator the competent authority shall treat that information as confidential.

3. TONNE-KILOMETRE DATA REPORTS OF AIRCRAFT OPERATORS

The tonne-kilometre data report for an aircraft operator shall at least contain the following information:

- (1) Data identifying the aircraft operator as set out by Annex IV to Directive 2003/87/EC, and the call sign or other unique designator used for air traffic control purposes, as well as relevant contact details;
- (2) Name and address of the verifier of the report;
- (3) The reporting year;
- (4) Reference to and version number of the latest approved monitoring plan and the date from which it is applicable, reference to and version number of other monitoring plans relevant for the reporting year;
- (5) Relevant changes in the operations and deviations from the approved monitoring plan during the reporting period;
- (6) The aircraft registration numbers and types of aircraft used in the period covered by the report to perform the aviation activities covered by Annex I to Directive 2003/87/EC carried out by the aircraft operator;
- (7) Chosen method for calculating the mass of passengers and checked baggage, as well as freight and mail;
- (8) Total number of passenger-kilometres and tonne-kilometres for all flights performed during the year to which the report relates falling within the aviation activities listed in Annex I of Directive 2003/87/EC;
- (9) For each aerodrome pair, the: ICAO designator of the two aerodromes; distance (great circle distance + 95 km) in km; total number of flights per aerodrome pair in the reporting period; total mass of passengers and checked baggage (tonnes) during the reporting period per aerodrome pair; total number of passengers during the reporting period; total number of passenger multiplied by kilometres per aerodrome pair; total mass of freight and mail (tonnes) during the reporting period per aerodrome pair; total tonne-kilometres per aerodrome pair (t km).

▼B*ANNEX XI***Correlation table**

Commission Regulation (EU) No 601/2012	This Regulation
Article 1 to 49	Article 1 to 49
—	Article 50
Article 50 to 67	Article 51 to 68
Article 68	—
Article 69 to 75	Article 69 to 75
—	Article 76
Article 76 to 77	Article 77 to 78
Annex I to X	Annex I to X
—	Annex XI