

CLIMATE CHANGE

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Implications of the changed reporting requirements of the Effort Sharing Decision for the EU ETS and the national GHG inventory

Work package 1: Comparison of ETS and IPCC emission calculation methodologies

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Work package 1: Comparison of ETS and IPCC emission calculation methodologies

by


Anke Herold, Graham Anderson, Wolfram Jörß
Öko-Institut e.V. Berlin, Germany

On behalf of the German Environment Agency

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Umweltbundesamt
Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
Fax: +49 340-2103-2285
info@umweltbundesamt.de
Internet: www.umweltbundesamt.de

 /umweltbundesamt.de

 /umweltbundesamt

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Abstract

This report analyses the technical provisions related to monitoring and reporting of greenhouse gas emissions under the EU ETS and the 2006 IPCC guidelines for national GHG inventories as of beginning 2014. Differences can lead to different reported CO₂ (equivalent) emissions under the EU ETS and in the GHG inventory. Some of these issues may also prevent inventory compilers from using verified emissions reported under the ETS directly for emission reporting in the national GHG inventory.

Both 2006 IPCC Guidelines and UNFCCC Reporting guidelines for the inventories provide general options for the choice of inventory methodologies, but do not prescribe the country's choices. Hence, the inventory methods explained in the document at hand have to be seen as recommendations for the adaptation of German inventory according to the new guidelines. They do not describe the actual implementation in Germany.

Cross cutting differences relate to

- ▶ inherent CO₂ contained in fuels transferred to other installations,
- ▶ exclusion of small installations,
- ▶ differences in determination and estimation methods
- ▶ differences in tier systematic,
- ▶ minor, de minimis rules, technical feasibility and unreasonable costs and
- ▶ treatment of biomass.

Sector specific differences are analysed for the ETS activities as of 2013, using the structure of the activity classification of the German ETS act of 2011 (TEHG 2020) which transposes the 2009 revision of the ETS Directive into national law. Based on that analysis, the reports presents specific conclusions on the usability of German ETS data for inventory purposes.

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List of Abbreviations

CEM	Continuous Emission Measurement
CEMS	Continuous Emission Measurement System
ETS Directive	Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
ETS	Emission Trading Scheme
MRG	Monitoring and Reporting Guidelines
MRG 2007	Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
MRR	Monitoring and Reporting Regulation (Commission Regulation (EU) No. 601/2012 of 21 June 2012)
NIR	National Inventory Report for the German Greenhouse Gas Inventory. The most recent issue covering the period 1990 – 2011 was published in 2013.
ZSE	Umweltbundesamt's emission database used for inventory reporting (Zentrales System Emissionen)

1 Introduction

There are a number of detailed technical provisions that are different in the monitoring and reporting regulation (MRR) for the EU ETS and the IPCC 2006 Guidelines and the UNFCCC Reporting guidelines for national GHG inventories. These differences can lead to different reported CO₂ emissions under the EU ETS and in the GHG inventory. Some of these issues may also prevent inventory compilers from using verified emissions reported under the ETS directly for emission reporting in the national GHG inventory.

Both 2006 IPCC Guidelines and UNFCCC Reporting guidelines for the inventories provide general options for the choice of inventory methodologies, but do not prescribe the country's choices. Hence, the inventory methods explained in the document at hand have to be seen as recommendations for the adaptation of German inventory according to the new guidelines. They do not describe the actual implementation in Germany.

In the report both cross-cutting (2) and sector-specific differences (section 3) are analysed. An overview on identified key sector specific issues to be followed up in a data analysis is given in section 4).

2 Cross-cutting differences

2.1 Transferred CO₂, carbon captured in products

Article 48 of the ETS MRR allows for the subtraction of ‘inherent’ CO₂ originating from activities covered by Annex I to Directive 2003/87/EC (or included pursuant to Article 24 of the ETS Directive). Inherent CO₂ which is subsequently transferred out of the installation as part of a fuel to another installation and activity covered by the ETS Directive shall not be counted as emissions of the installation where they originated. However, where inherent CO₂ is emitted, or transferred out of the installation to entities not covered by the ETS Directive, it shall be counted as emissions of the installation where it originates.¹ Inherent CO₂ is defined as CO₂ in gaseous form that is contained in natural gas or in waste gas including blast furnace gas or coke oven gas.

The 2006 IPCC Guidelines and inventory guidelines do not make a distinction related to the transfer of CO₂ to which type of installation it is transferred (either ETS and non-ETS installation), therefore this provision is likely to produce differences between the allocation of emissions to specific activities between the ETS and the inventory.

CO₂ transfer between ETS installations

In accordance with the definition of inherent CO₂, these transfers include natural gas, blast furnace gas or coke oven gas which is likely to be the most relevant transfer of CO₂ between ETS installations. These transfers would mostly be from the iron and steel installations to public or industrial power and heat generation plants.

The previous project “Datenaustausch zwischen Emissionshandel und Nationaler Klimaschutz” showed that the installations using process gases can be identified in the ETS data. However, this project also showed that a big part of blast furnace gas and coke oven gas is used by the iron and steel industry itself (and not transferred to other installations). Due to the use of mass balance methods this part of blast furnace gas is not explicitly reported by the ETS installations. The previous project also showed that a reallocation of transferred CO₂ to the emissions from iron and steel in the inventory improved the comparability between ETS emissions and inventory emissions (Müller-BBM and IZT, 2012a, p. 46). Thus if the transfer of CO₂ was allocated correctly, comparability between ETS data and inventory data could be achieved. As this provision did not change compared to the previous project, the results and allocation performed in the previous project still seem relevant.

CO₂ transfer out of the scope of the EU ETS

CO₂ transfers out of the scope of the ETS in the past was allowed and occurred in a general way from fuel combustion installations, from iron and steel production, from pulp and paper industry (precipitated calcium carbonate) and from mineral industry. Such transfers are no longer possible in the third ETS period and emissions have to be accounted at the installation where they originated. In the ETS MRR, only the transfer of pure CO₂ for the purposes of storage in a geological storage site pursuant to the Union’s greenhouse gas emission allowance trading scheme is allowed to be deducted from the reported CO₂ emissions by installations.

For some ETS installations, this may result in a change of deductible emissions between the third ETS phase and the first and second phase (e.g. transferred CO₂ for the use in beverages

¹ See section 3.24 related to transfer of CO₂ for carbon capture and storage.

was deductible in the second trading period). Compared to where these transferred emissions are assigned to in the inventory, there is a bigger difference in the third trading period than in the first and second period, as transferred CO₂ is reported in the NIR at the source category where the emissions occur (in the example: beverage industry).

In the 2006 IPCC Guidelines for GHG inventories and the revised UNFCCC reporting guidelines for GHG inventories, the same rules apply for CO₂ transferred to geological storage sites. However, in the GHG inventories certain additional transfers and related deductions from CO₂ emissions are possible or even required:

For the inventory categories ammonia production, CO₂ transfers from ammonia production to urea production should be subtracted from CO₂ emissions from ammonia production. The CO₂ emissions are reported in the agriculture sector under 'urea application'. Due to exports and imports of urea fertilizers, the amounts of CO₂ subtracted from ammonia production and the CO₂ emissions estimated for urea application are different. These differences in allocation need to be taken into account when in the future emissions between GHG inventory and the ETS are compared.

In addition, CO₂ captured for long-term storage for some other purposes is also deducted from CO₂ emissions in GHG inventories. Examples listed in the 2006 IPCC Guidelines (IPCC 2006, Volume 3, p. 2.19) are

- ▶ CO₂ capture in precipitated calcium carbonate (PCC) which is used in the paper industry as well as for other industrial applications is a product derived from reacting hydrated high-calcium quicklime with CO₂. PCC in paper and paperboard will form a long-term storage for the captured CO₂ except in cases where the paper or sludge from recycled paper is combusted. The emissions from combustion therefore should be taken into account separately under relevant categories in the energy sector. Long-term storage is the main criteria used for inclusion of CO₂ capture and storage in the inventory.
- ▶ During the process of sugar refining, lime is used to remove impurities from the raw cane juice; any excess lime can be removed through carbonation.
- ▶ The use of hydrated lime for water softening, for example, also results in CO₂ reacting with lime to reform calcium carbonate, resulting in a capture of CO₂.

2.2 Exclusion of small installations under Article 27

Article 27 of Directive 2003/87/EC allows Member States to exclude small installations, subject to equivalent measures, from the Union's greenhouse gas emission allowance trading scheme provided that the conditions contained in that Article are met.

Such exclusion is not possible in the GHG inventory and this provision, if applied therefore leads to differences in emissions between the ETS and the inventories for all activities where small installations are excluded. However, this theoretical difference is not relevant for Germany where only 4 (in 2013) installations are excluded based on this provision with total emissions of about 10.4 kt CO₂.

2.3 Differences in determination methods

The ETS distinguishes a **standard method** (based on the use of fuels or materials or based on the amount of produced product), a **mass balance method** (based on material entering and leaving the boundaries of the mass balance and the carbon content for each of these input and output source streams) and **continuous emission measurement** (based on the THG concentration and the flue gas flow)

In a similar way, the 2006 IPCC guidelines are mostly based on a standard estimation methods based on the consumption of fuels or materials or the amount of a produced product and multiply the consumption or production with specific emission factors. This method can be applied at an aggregate level based on aggregate consumption/ production statistics or at the level of individual plants based on plant-specific data from operators which are subsequently aggregated to a national estimate.

Mass balance methods to generate emission estimates at country level are only mentioned for the following emission sources in the 2006 IPCC Guidelines

- ▶ As an alternative Tier 2 approach that may be applied to estimate the amount of venting and flaring emissions from oil production using country-specific production volumes, gas-to-oil ratios (GORs), gas compositions and information regarding the level of gas conservation;
- ▶ As a tier 2 methods for emissions from iron and steel production;
- ▶ As method for ferroalloy production (for emissions from reducing agents and electrodes, the calcination of carbonate fluxes when used);
- ▶ As tier 2/tier 3 methods for CO₂ emissions from aluminium production (for CO₂ emissions from anode or paste consumption);
- ▶ For chemical industry (CO₂ emissions from calcium carbide production from the heating of limestone and reducing CaO with carbon)
- ▶ CO₂ emissions from petrochemical industry and carbon black industry (carbon balance method calculates the difference between the total amount of carbon entering into the production process as primary and secondary feedstock and the amount of carbon leaving the production process as petrochemical products).

The comparison of ETS data and inventory data is not easy in cases where mass balances are used in the ETS and a standard calculation based approach is used in the inventory. Different input and output materials from a large number of installations in the ETS have to be compared to aggregations of activity data and emission factors for particular materials (products) in ZSE (see also chapter 3.5.2).

Continuous emission measurement is a method relevant at plant-level, but not for the determination of aggregate emissions for a specific source category in a country. Therefore continuous measurement does not appear as a self-standing method in the 2006 IPCC Guidelines, but as a method that can be used by plants as part of tier 3 methods.

2.4 Differences in tier systematic

The ETS monitoring and reporting regulation is based on a tier system which defines a hierarchy of different quality levels for activity data and calculation factors in case of calculation based approaches. Tiers apply at installation level based on the emissions at the particular installation (thresholds are ≤ 50 kt (category A installations), > 50 kt (category B installations) and ≤ 500 kt and > 500 kt CO₂ (category C installations)). At sectoral level, e.g. for cement and lime production, verified emissions can result from category A, B and C emitters. A category A emitter may use lower ETS tiers than B or C emitters (category B and C emitters have both to meet the same (highest) tier requirements).

The operator must, in principle, apply the highest tier level unless there are simplifications allowed due to the size of an installation or the size of a source stream/emission source (see section 2.5). Moreover there is the possibility to deviate from the required tier if it can be demonstrated to the competent authority that it is technically not feasible or would lead to unreasonably high costs to meet the tier requirement (see section 2.5). Besides deviations from one

required tier to another tier (e.g. from individual analysis (tier 3) to the use of a national standard factor (tier 2a)), a deviation can also take place within a tier. For instance, using a different analysis frequency than required for a particular source stream type is a deviation within tier 3. This means that the determination method stays the same (individual analysis), but there is a deviation within the method. The tier system in ETS also distinguishes between different kinds of standard factors. Using a national standard factor (which in Germany is based on an average of historical data) is tier 2a, using an international standard factor (e.g. from IPCC) is tier 1. For cost effectiveness reasons higher tier levels (i.e. lower uncertainty) are only required for larger emission sources under the EU ETS.

In contrast, in the inventory reporting the concept of “key category” determines which methodological tier should be used. The tier for the inventory is selected based on the contribution of a source category to the total inventory emission level and the emissions trend. If a source category is determined as key, all emissions from this source/sector have to be determined based on the same tier methodology, independent whether individual installations are small or large emitters.

In the 2006 IPCC Guidelines three tiers are defined. Tier 1 is the basic method that should enable all countries to calculate emissions from a source category. Tier 1 methods use readily available national or international statistics in combination with default emission factors and additional parameters that are provided in the IPCC Guidelines. Tier 2 is an intermediate method that is more accurate than tier 1 and reflects country-specific emission factors and other calculation parameters instead of default parameters. National aggregate statistics are mostly required as activity data for tier 2 methods. Since country-specific emission factors might differ for different specific fuels, combustion or production technologies applied in a country, it may also be necessary to disaggregate activity data in relation to technologies or more disaggregate fuel types in tier 2 methods. Tier 3 methods are the most demanding methods in terms of complexity and data requirements and are considered to be more accurate than tier 1 and tier 2 methods. In the energy and industry sector, either data at individual plant level is used, measurement data or detailed emission models. Specific methods for all three tier levels are presented for each source category in the 2006 IPCC Guidelines.

For example category 2.A.2 CO₂ emissions from lime production is a key category in the GHG inventory due to the contribution to the total level of emissions. For key categories 2006 IPCC Guidelines for lime production require the application of either Tier 2 or Tier 3 methods. Tier 2 requires disaggregate data for all lime types produced in a country as well as data for lime kiln dust. Tier 3 is based on plant-specific data on the type(s) and quantity(ies) of carbonate(s) consumed to produce lime, as well as the respective emission factor(s) of the carbonate(s) consumed. These higher tier methodologies need to cover complete lime production including non-marketed lime production, irrespective of their size of the producers.

If ETS emissions would be directly used for the purposes of estimating a key category of the national GHG inventory, it could happen that not all verified emissions reported under the EU ETS comply with the tier methods required for the entire key category in the GHG inventory. This may happen in particular where some emission determinations for small installations would be based on standard factors listed in the Annexes VI of the ETS monitoring regulation. The use of such standard factors for inventory key categories would not be in line with UNFCCC reporting guidelines which require at least country-specific calculation parameters. Thus, the use of different tiers for an activity under the EU ETS may in some cases theoretically not allow the use of ETS emissions for the purposes of the GHG inventory, even when the coverage of ETS emissions would be complete and the scope of the ETS activity and the inventory category would be identical.

2.5 Minor, De minimis rules, technical feasibility and unreasonable costs

De minimis, minor and major source streams

The ETS MMR (Article 19, paragraph 3) classifies three types of source streams of emissions in an installation:

- **Minor source streams:** less than 5 000 tonnes of fossil CO₂ per year or less than 10% of emissions sources in an installation, up to a total maximum contribution of 100 000 tonnes of fossil CO₂ per year, whichever is the highest in terms of absolute value;
- **De-minimis source streams:** less than 1 000 tonnes of fossil CO₂ per year or to less than 2%, up to a total maximum contribution of 20 000 tonnes of fossil CO₂ per year, whichever is the highest in terms of absolute value
- **Major source streams:** all source streams that are neither minor nor de minimis.

In the ETS, de-minimis source streams have to be reported by the operators, but can be determined based on no tier approach (i.e. estimation), unless a defined tier is achievable without additional effort (e.g. if standard values are available for a source stream).

For minor source streams, at least tier 1 methods under the calculation-based methodology have to be used in the ETS.

The revised UNFCCC GHG inventory reporting guidelines that will be mandatory from 2015 onwards, include a significance threshold below which a Party may decide not to estimate the emissions of a specific source category when a disproportionate amount of effort would be required to collect data for a gas from a specific category that would be insignificant in terms of the overall level and trend in national emissions. An emission should only be considered insignificant if the likely level of emissions is below 0.05 per cent of the national total GHG emissions, and does not exceed 500 kt CO₂ eq. The total national aggregate of estimated emissions for all gases and categories considered insignificant shall remain below 0.1 per cent of the national total GHG emissions.

This means that the significance of emission sources are determined in different ways under the ETS and inventory reporting. Under the ETS the definition is based on the contribution of a source stream to emissions of an installation and for inventory reporting the definition is in relation to total emissions in the country. Whereas the ETS MRR allows deviation from required determination methods, but still requires a quantification of the de minimis and minor source streams, the UNFCCC reporting guidelines allow for an omission of an insignificant emission source.

Conclusions on the comparability of ETS and inventory data due to de minimis rules can only be made at the specific level of ETS activities and corresponding inventory categories. Section 3 of this report compares the specific ETS activities and inventory categories. Section 3 identifies for each activity how well the (variety of) actually applied ETS methodologies (depending on the size of individual source streams) concur with the specific inventory methodology tiers required for UNFCCC reporting. Note that the possibility exists for a source category to be omitted in the UNFCCC inventory due to that source category's estimated size, even though it may have been identified as the appropriate inventory category for selected ETS source streams.

Technical feasibility

The ETS MRR includes a specific provision that an operator can claim that applying a specific monitoring methodology is technically not feasible (Article 17 of MRR). In such cases a justification has to be provided that shows that the operator has no 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 the MRR.

A similar provision that a certain monitoring methodology is technically not feasible does not exist for the GHG inventory reporting. In the ETS technical feasibility doesn't play a big role. Usually operators argue with unreasonable costs to use a different approach. Therefore it is assumed that this concept in the ETS MRR does not lead to significant differences between the ETS and the inventory data.

Unreasonable costs

Under the ETS MRR, the concept of 'unreasonable costs' applies. Where an operator claims that applying a specific monitoring methodology incurs unreasonable costs, the competent authority shall assess the operator's justification of unreasonable costs. The competent authority shall consider costs unreasonable where the cost estimation exceeds the benefit. To that end, the benefit shall be calculated by multiplying an improvement factor with a reference price of EUR 20 per allowance and costs shall include an appropriate depreciation period based on the economic lifetime of the equipment. If costs are unreasonable the operator may for example switch to a lower tier methodology.

For the GHG inventories the concept of unreasonable costs cannot be applied to switch to a different method. However also IPCC 2006 Guidelines acknowledge costs as an important factor. Therefore the revised inventory reporting guidelines have introduced a significance threshold below which a Party may decide not to estimate the emissions of a specific source category when a disproportionate amount of effort would be required to collect data for a gas from a specific category that would be insignificant in terms of the overall level and trend in national emissions (see section on de minimis rules above). This is the only concrete example how cost considerations have been implemented in GHG inventory guidelines.

Thus both types of guidelines differ in the way how unreasonable or disproportionate costs are defined. In practice it is not very likely that these differences would result in large data discrepancies.

2.6 Treatment of biomass

Consistent with the definition of the terms 'biomass', 'bioliquids' and 'biofuels' set out in Article 2 of Directive 2009/28/EC, Article 3(20, 21 and 22) of the Monitoring and Reporting Regulation - Commission Regulation (EU) No. 601/2012 of 21 June 2012 (MRR) has the following definitions of 'biomass', 'bioliquids' and 'biofuels':

- ▶ '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;
- ▶ 'bioliquids' means liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass;
- ▶ 'biofuels' means liquid or gaseous fuel for transport produced from biomass;

The MRR Guidance Document, *Biomass issues in the EU ETS* (European Commission, 2012b), cautions that this definition is completely aligned with the definition in the RES Directive, and is therefore different from the definition in the MRG 2007 especially with regard to zero rating of emissions.

There are also differences in the treatment of biomass between ETS MRR and IPCC 2006 inventory guidelines. In inventory reporting, biomass related activity data and emissions are reported as information items with the CO₂ emissions from biomass combustion not being included in the sectoral or national totals. E.g. CO₂ emissions from biomass combustion for energy are reported in the AFOLU Sector as part of net changes in carbon stocks and harvested biomass for combustion appear as emissions in the AFOLU sector, either directly from forest harvest or as emissions from the use of harvested wood products. Therefore the CO₂ emissions from biomass combustion are not calculated in the energy sector, as this would result in a double-counting of emissions between the energy and AFOLU sector. Therefore combustion emissions from biomass are not included in the national total of emissions from the energy sector due to reasons of double-counting, however information on CO₂ emissions from biomass are included under Memo items and are estimated with appropriate emission factors.

Under the ETS, the following approach is used:

1. All bioliquids that meet sustainability criteria have an emission factor of zero under the ETS (MMR Article 38, paragraph 2). Bioliquids and biofuels must comply with sustainability criteria set out in Article 17 of the Directive 2009/28/EC on Renewable Energy Sources. Although operators are required to report the emissions of sustainable biomass as Memo Items, practically no emissions are reported due to the use of an emission factor of zero in the MMR.
2. Solid and gaseous biomass do not yet have to meet sustainability criteria and it is assumed that they have an emission factor of zero.
3. All installations which use a source streams with fossil and biogenic carbon content must report on their biomass use and deliver a preliminary emission factor (meaning an emission factor based on the total carbon content composed of biomass fraction and fossil fraction).
4. Installations exclusively using biomass are not covered by the ETS. Annex I to Directive 2003/87/EC explicitly states that installations exclusively using biomass are not covered by the Directive. Note also that the ETS reporting thresholds effectively exclude small operations that generate electricity from *biogas*, *landfill gas*, *sewage-treatment gas* or solid or liquid biomass and feed the electricity into the public grid (Energy Balance line 14).

Points 1, 2 and 4 mean that the ETS data on biomass emissions will be incomplete compared to the inventory reporting of biomass emissions from the energy sector under memo items. The differences for bioliquids are however very small, as there is currently not a large use of liquid biomass in the ETS. The differences in coverage of installations using biomass are likely to result in the largest differences if inventories are compared with ETS data related to biomass consumption.

Operators covered by the MRR are required to report biomass fraction and carbon content including sustainable and non-sustainable biomass carbon content. Such differentiation between sustainable and non-sustainable biomass does not exist in the inventory reporting.

In particular the differences in coverage (scope) mean that data on biomass activity and emissions will not correspond to the 2006 IPCC Guidelines.

A comparison of biomass carbon using the ETS and German inventories data is made difficult due to the fact that biomass fuels are less standardized into specific fuel names and a large number of fuel names can be used by operators to categorize the biomass fuels and the same biomass type could be reported under different names whereas data at national level is available for more aggregate categories. Therefore a detailed comparison would need to access ETS data at the level of detail which reveals fuel type, reported biomass fraction and sustainable and non-sustainable biomass carbon content.

3 Activity-specific differences

The ETS includes CO₂ emissions from installations in a set of activities (cf. Table 3-1) if the installations exceed certain capacity thresholds. Such capacity thresholds are not used for inventory reporting. In addition different understandings of installation boundaries (furthermore, completeness of the installations included in an industry sector group) and the interpretation as to what constitutes certain activities under the EU ETS, may be different to a source category for the inventory reporting. These differences in the scope of activities and the installation boundaries will be further described in the sections below.

Table 3-1 gives an overview on the ETS activities as covered in the subsequent sections. The column new and revised activity refers to the changes as implemented in the German TEHG.

Table 3-1: Overview on ETS activities as defined in the German TEHG

Tätigkeit nach TEHG 2020 Anhang 1	Bezeichnung der Tätigkeit (Kurzform)	New or revised activity in TEHG 2020 vs TEHG 2012	Activity (Annex I ETS Directive)
1	Verbrennung ≥ 20 MW FWL a.n.g.	X	Other combustion installations, iron and steel, ferrous metals, non-ferrous metals, chemical industry
2	Energieumwandlung ≥ 50 MW FWL		Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste)
3	Energieumwandlung 20–50 MW FWL		
4	Energieumwandlung 20–50 MW FWL, andere Brennstoffe		
5	Antriebsmaschinen (Motoren)		
6	Antriebsmaschinen (Turbinen)		
7	Raffinerien		Refining of mineral oil
8	Kokereien		Production of coke
9	Verarbeitung von Metallerzen	X	Metal ore (including sulphide ore) roasting or sintering, including pelletisation
10	Herstellung von Roheisen und Stahl	(X) revised category names used in TEHG	Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
11	Verarbeitung von Eisenmetallen	X	Production or processing of ferrous metals (including ferro-alloys) where combustion units with a total rated thermal input exceeding 20

Tätigkeit nach TEHG 2020 Anhang 1	Bezeichnung der Tätigkeit (Kurzform)	New or revised activity in TEHG 2020 vs TEHG 2012	Activity (Annex I ETS Directive)
			MW are operated. Processing includes, inter alia, rolling mills, re-heaters, annealing furnaces, smitheries, foundries
12	Herstellung von Primäraluminium	X	Production of primary aluminium
13	Verarbeitung von Nichteisenmetallen	X	Production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated
14			Herstellung von Zementklinker
15	Herstellung von Kalk	(X) magnesite included in new TEHG	Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day
16	Herstellung von Glas		Production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day
17	Herstellung von Keramik	(X) thresholds	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
			Manufacture of ceramic products by firing, in par-

Tätigkeit nach TEHG 2020 Anhang 1	Bezeichnung der Tätigkeit (Kurzform)	New or revised activity in TEHG 2020 vs TEHG 2012	Activity (Annex I ETS Directive)
		changed in new TEHG	ticular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day
18	Herstellung von Mineralfasern		Manufacture of mineral wool insulation material using glass, rock or slag with a melting capacity exceeding 20 tonnes per day
19	Herstellung von Gips	X	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated
20	Herstellung von Zellstoff		Production of pulp from timber or other fibrous materials
21	Herstellung von Papier		Production of paper or cardboard with a production capacity exceeding 20 tonnes per day
22	Herstellung von Industrieruß		Production of carbon black involving the carbonisation of organic substances such as oils, tars, cracker and distillation residues, where combustion units with a total rated thermal input exceeding 20 MW are operated
23	Herstellung von Salpetersäure	X	Production of nitric acid
24	Herstellung von Adipinsäure	X	Production of adipic acid
25	Herstellung von Glyoxal und Glyoxylsäure	X	Production of glyoxal and glyoxylic acid
26	Herstellung von Ammoniak	X	Production of ammonia

Tätigkeit nach TEHG 2020 Anhang 1	Bezeichnung der Tätigkeit (Kurzform)	New or revised activity in TEHG 2020 vs TEHG 2012	Activity (Annex I ETS Directive)
27	Herstellung organischer Grundchemikalien	(x) Propylen & Ethylen in TEHG 2012	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day
28	Herstellung von Wasserstoff und Synthesegas	X	Production of hydrogen (H ₂) and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tonnes per day
29	Herstellung von Soda	X	Production of soda ash (Na ₂ CO ₃) and sodium bicarbonate (NaHCO ₃)
30	Anlagen zur Abscheidung von Treibhausgasen	X	Capture of greenhouse gases from installations covered by this Directive for the purpose of transport and geological storage in a storage site permitted under Directive 2009/31/EC
31	Rohrleitungsanlagen zur Beförderung von Treibhausgasen zum Zwecke der geologischen Speicherung	X	Transport of greenhouse gases by pipelines for geological storage in a storage site permitted under Directive 2009/31/EC
32	Speicherstätte zur geologischen Speicherung von Treibhausgasen	X	Geological storage of greenhouse gases in a storage site permitted under Directive 2009/31/EC

3.1 Fuel combustion installations (TEHG activities 01-06)

3.1.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

Combustion emissions are defined in the ETS MRV in a broad sense as ‘greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen’. The key difference to the inventory reporting is the threshold of rated thermal input of 20 MW applied under the ETS whereas no capacity threshold exists for the inventory reporting.

The revision of Annex I of the EU ETS Directive for the 3rd ETS period has clarified the scope of the combustion emissions included in the ETS in a way that the purpose of the combustion for energy generation is not relevant and that all units in which combustion processes occur are included provided that the total rated thermal input exceeds 20 MW.

These changes have extended the scope of combustion emissions under the ETS in Germany and additional activities were added in TEHG (e.g. “Verbrennung \geq 20 MW FWL”) which decreased the difference in scope between the ETS emissions from fuel combustion activities and the inventories, however the key difference related to the use of a general threshold under the ETS for combustion emissions remains.

For the inventory emissions, combustion emissions are still classified not only related to the fact that combustion takes place, but also related to the purpose of the combustion activity (heat and electricity generation in the energy sector). This means that the additional combustion activities and source streams that entered the ETS in 2013 need a careful consideration related to the appropriate allocation of emissions to the ZSE installations. Potential relevant inventory categories are

- ▶ 1.A.1.a Public electricity and heat production
- ▶ 1.A.1.b Petroleum refining
- ▶ 1.A.2 Manufacturing Industries and Construction and related subcategories, in particular 1.A.2.a. Iron and steel, 1.A.2.b Non-ferrous metals, 1.A.2.c Chemicals (e.g. flaring in chemical industry) and 1.A.2.d. Pulp, paper and print
- ▶ 1.A.3.e Pipeline transport
- ▶ 1.A.4. Other sectors (combustion in installations > 20 MW in the commercial / institutional (1.A.4.a) or agriculture/forestry/fishery sectors (1.A.4.c))
- ▶ 1.B.2 Fugitive emissions from oil and gas
- ▶ 2.B. Chemical industry
- ▶ 2.C Metal production

Thus a comparison between the ETS data and ZSE data would need to select all ZSE combustion emissions from installations with a rated thermal input < 20 MW and deduct those from the inventory emissions to achieve a ZSE dataset that is comparable to the ETS data. In particular the latter distinction is unlikely to be available from energy statistics used for the inventory in the ZSE data.

The second important difference between the ETS data and the inventory data is that under the ETS, the installations are classified in accordance with their main ETS activity into combustion or other ETS Annex I activities with process emissions such as e.g. cement production or glass production. However, also the ETS activities with predominantly process emissions include fuel combustion emissions for these ETS activities. Therefore a comparison of the datasets requires a separation of the ETS data for all ETS activities into fuel combustion and process-related emissions. This separation has already been conducted in the previous project (Müller-BBM and IZT 2011). For those installations that entered the ETS in the third phase, such separation between combustion emissions and process-related emissions based on the ETS source streams has to be conducted for all activities in order to achieve a comparable data set with the ZSE data.

Other differences in scope between the ETS and the inventory are the following:

- ▶ Combustion units for the incineration of hazardous or municipal waste are excluded from the ETS, but included in the fuel combustion activities of the inventory. This however only concerns plants that only incinerate waste. Industrial installations whose main purpose is

not waste incineration, but which may use waste fuels among other fuels are included in the ETS activities. The waste incineration plants can be identified easily in the ZSE data in relation to the activity and the fuels used and excluded from a comparison of fuel combustion data between ETS and inventories.

- ▶ Installations or parts of installations used for research, development and testing of new products and processes below 20 MW are not covered by the EU ETS, but included in the GHG inventory. Whether combustion installations included in the inventory are used for research, development and testing of new products and process, is unlikely to be identifiable in the ZSE data as such criteria are not used in the energy balances and other fuel-related statistics.
- ▶ Fuel combustion emissions under the ETS include the emission source streams from limestone used for flue gas scrubbing. In the inventory methodologies used in the past these emissions had to be allocated in a separate industrial process category ‘Other limestone and dolomite use’. In the 2006 IPCC Guidelines, this allocation has changed and the guidance now allows allocating the emissions from limestone use under the fuel combustion activities where the use occurs. Thus, this previous difference between ETS data and inventory data has been eliminated.
- ▶ The previous project (Müller-BBM and IZT 2012a) identified materials reported by combustion installations that could not be allocated to ZSE materials or for which the allocation was uncertain. Some of these materials identified in the ETS data become important for the inventory reporting from 2013 onwards. On the one hand this concerns urea use (see section 3.18 on ammonia production). On the other hand this concerns new inventory source categories introduced in the 2006 IPCC Guidelines, in particular the inventory categories 2.D.1 Non-energy products from fuels and solvent use - Lubricant use and 2.D.2 Non-energy products from fuels and solvent use - Paraffin wax use. The previous project already identified lubricants and paraffin waxes as materials reported by ETS combustion installations. These materials are waste fuels such as used lubricants and paraffin waxes that are used for fuel combustion after their first use. In the 2006 IPCC Guidelines these emissions should be allocated to the energy sector when energy recovery from combustion occurs. A separate reporting under 2.D.1 and 2.D.2 only concerns the use of lubricants and paraffin waxes as first non-energy use. Thus, the allocation of emissions from waste lubricants or waste paraffin waxes under fuel combustion activities as implicit in the ETS data is consistent with the inventory requirements. However, the ETS emissions resulting from these waste fuels would potentially allow a more transparent reporting in the national inventory report that shows that a use of lubricants and paraffin waxes as waste fuels is correctly accounted in the energy sector in the inventory.
- ▶ Combustion related emissions from the operation of pump stations and maintenance of pipelines for the transport via pipelines includes transport of gases, liquids, slurry and other commodities is reported as part of transport emissions (CRF category 1.A.3.e Other transportation). The difference in the reporting is mainly that these emissions are considered to be part of transport emissions in the inventory, a sector which is generally not covered by the ETS.

3.1.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

Combustion emissions

In the ETS MRR the standard methodology in accordance with Article 24(1) of the MRR is to calculate combustion emissions per source stream by multiplying the activity data related to

the amount of fuel combusted with the corresponding fuel-specific emission factor, the corresponding net calorific value and with the corresponding oxidation factor. This method is fully consistent with the 2006 IPCC Guidelines methodologies for the sectoral approach.

Only for gas processing terminals the use of a mass balance in accordance with Article 25 of the MRR is allowed.

The use of these two methods in parallel under the ETS doesn't have a big influence on ETS data and inventory data for TEHG 1-6 activities, as only gas processing terminals are allowed to use a mass balance.

Flue gas scrubbing

For CO₂ emissions from flue gas scrubbing also two methods are provided in the ETS MRR:

Method A: determination of the amount of CaCO₃ and MgCO₂ in the input materials and EF based on stoichiometric ratios EF CaCO₃ = 0.44 t CO₂/t carbonate and EF MgCO₃ = 0.522 t CO₂/t carbonate. Method A is consistent with 2006 IPCC Guidelines and the EFs in Table 2.1, Volume 3, Chapter 2: Mineral Industry Emissions.

Method B: default EF of 0.2558 t CO₂ /t gypsum. This gypsum is the end product of a wet purification procedure with natural lime, formed in the same but speeded-up process as natural gypsum in the flue gas desulphurization plant.

The 2006 IPCC Guidelines tier 2 method is also based on carbonate input, but EF the same as in method A with 0.43971 t CO₂/t CaCO₃ and 0.52197 t CO₂/t MgCO₃ and 0.47732 t CO₂/t CaMg(CO₃)₂ for dolomite.

Method B does not exist in 2006 IPCC Guidelines. It is not common in the inventory methodology to define the EFs on the basis of the output product gypsum, but this is more likely to be related to the fact that data on gypsum productions from FGDPs is usually not available as a national production estimate. As the EF is also derived based on stoichiometric ratios, this difference does not seem to be an important inconsistency.

Flares

For emissions from flares the ETS MRR provides a tier 2b method that is based on the molecular weight of the flare stream.

The tier 1 method of the ETS MRR provides a default EF of 0.00393 t CO₂/Nm³ derived from the combustion of pure ethane used as a conservative proxy for flare gases.

Such approximation is not part of the 2006 IPCC Guidelines and default emission factors differ for the flaring source (gas production, processing, transmission and storage, distribution) because the flare gas stream in m³ is not easily available for all types of flaring activities. The default weighted total for CO₂ emissions from flaring in table 4.2.4 of 2006 IPCC Guidelines is 0.003 t CO₂/Nm³ which is very close to the ETS MRR, therefore no large differences should be expected.

3.1.3 Differences in emission factors and calorific values

Table 1 'Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of fuel' in Annex VI of the ETS MRR lists EFs and NCVs for individual fuels (Tier 1). These EFs and NCVs are taken from 2006 IPCC Guidelines. Thus these default factors are

consistent between the ETS MRR and inventory guidelines. The ETS MRR also provides default EFs for waste tyres (Annex VI Table 1) which are not provided in the 2006 IPCC Guidelines.

Both IPCC Guidelines and the ETS regulation require countries and installations to use measured/ installation-specific or country-specific EFs and NCVs. In this respect the ETS data provide useful additional information for the national GHG inventory to derive country-specific EFs and NCVs for fuels based on the measured data reported by installations. Where neither country specific standard factors nor IPCC standard factors are applicable in the ETS, other constant values can be used where either the supplier of a material guarantees the carbon content or which are based on past representative analysis.

As the inventory also covers small installations, average carbon contents of fuels and NCVs for a source category can vary between the inventory and the ETS data because the average carbon contents are composed of the average C contents of fuels used in installations > 20 MW and those < 20 MW. Thus, it would be misleading to automatically assume complete consistency of these calculation parameters and many EU countries provided data analysis for the first and second ETS phase indicating that the average carbon contents and NCVs for the complete inventory categories deviate from the averages aggregated from the reporting of ETS installations.

When ETS data is used to derive country-specific EFs or NCVs for fuels for the purposes of the GHG inventory, EFs and NCVs for the smaller installations outside the scope of the ETS would also be needed to be estimated and combined with the parameters derived from ETS installations based on weighted averages that consider the contribution of installations within and outside the ETS to total emissions.

3.1.4 Differences in other parameters such as oxidation factors

The Tier 1 method for combustion installations 2004 ETS MRG assumed an oxidation factor of 0.99 for conversion of C to CO₂ for all solid fuels and of 0.995 for all other fuels. IPCC 1996 Guidelines recommend 0.98 for coal, 0.99 for oil and oil products, 0.995 for gas and 0.99 for peat and electricity generation.² The changed Tier 1 requirement is to use an oxidation factor of 1.0 (i.e. default assumption of 100% oxidation). Moreover the national Emission Trading Law (TEHG) requires the use of an oxidation factor 1. This is consistent with 2006 IPCC Guidelines, table 1.4 'Default CO₂ emission factors for combustion', Volume 2 Energy, Chapter 1 introduction of the 2006 IPCC Guidelines.

Table 3-2: Comparison of default oxidation factors used for GHG inventories and for ETS reporting

Fuel type	Fraction of carbon oxidised, default parameters for tier 1			
	1996 IPCC Guidelines valid for GHG inventories until 2014	2004 ETS MRG	MRR	2006 IPCC Guidelines
Coal	0.98	0.99	1	1
Oil and oil products	0.99	0.995	1	1

² Table 1-6 Revised 1996 IPCC Guidelines for national GHG Inventories, Reference manual, chapter energy

	Fraction of carbon oxidised, default parameters for tier 1			
Gas	0.995	0.995	1	1
Peat for electricity generation	0.99	0.99	1	1

Thus, the default oxidation factors are completely consistent between the ETS and the inventory guidance.

3.1.5 Conclusions

Due to the extension of the scope of the combustion activities under the ETS, the analysis of CO₂ emission consistency would need to be updated based on the dataset that includes additional emission sources for the 3rd ETS phase. However due to the differences in the scope and methodologies described above, CO₂ emissions will not match between ETS and ZSE.

Thus the focus for comparison of ETS and ZSE data related to fuel combustion emissions should be to

- ▶ check to what extent installations rely on mass balance methods in which specific areas and whether this decreases the comparability of the ETS data with inventory data;
- ▶ aggregate ETS data for fuel types and aggregate source categories that match with ZSE fuel types and derive country-specific EFs and NCVs for the fuels used by ETS installations;
- ▶ estimate the fraction of non-ETS fuel consumption for this aggregate ZSE source category;
- ▶ derive EFs and NCVs for the non-ETS fuel consumption for this aggregate ZSE source category;
- ▶ calculate a weighted average EF and NCV for each fuel for this aggregate ZSE source category. These parameters could be used as EFs and NCVs in the ZSE for the inventory estimation.

3.2 Refining of Mineral Oil (TEHG activity 07)

3.2.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The ETS activity ‘Refining of mineral oil’ has no capacity threshold. In accordance with the ETS MRR, the operator shall monitor and report all CO₂ emissions from combustion and production processes as occurring in refineries and the following potential sources of CO₂ emissions are mentioned: 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) as well as flue gas scrubbing.

The scope of IPCC/CRF category 1.A.1.b – Petroleum Refining has not changed, therefore the work already conducted to identify combustion emissions from refineries continue to be relevant in the future.

Previous reports (Müller-BBM and IZT, 2011) have already determined the concordance between the EU ETS reporting and the inventory reporting for mineral oil refineries. These findings are still relevant, however due to 2006 IPCC Guidelines and revised UNFCCC CRF tables, the allocation of some related emissions sources has changed for the inventory reporting.

The previous project separated ETS emissions into the following subcategories:

- ▶ Flaring (Fackel)
- ▶ Regeneration of catalysts (Katalysatorregeneration, Entkokung)
- ▶ Hydrogen production (Wasserstoffherzeugung)
- ▶ Coke production / calcining (Koksherstellung/ Kalzinierung)
- ▶ Combustion (Verbrennung)
- ▶ Flue gas scrubbing (Abgaswäsche)
- ▶ Heavy oil gasification, methanol production (Schwerölvergasung/ Methanolherstellung)
- ▶ Production of Terephthalic acid (Terephthalsäureherstellung)
- ▶ Claus-process plants (Claus plants)

The corresponding ZSE data were identified to be

- ▶ 1.B.2.c - Venting and Flaring
- ▶ 2.B.5 (old CRF)- Chemical Industry - Other (1) – Technology: catalyst burn off (Katalysatorabbrand) (in new CRF likely to be reported in CRF (new) 2.B.8 Petrochemical and Carbon black production or 2.B.10 other Chemical industry)
- ▶ 1.A.1.b - Petroleum Refining

Table 10 of Müller-BBM and IZT (2011) suggested an allocation of emissions from refineries reported under the EU ETS to inventory CRF categories. As some of the CRF codes changed with the revised UNFCCC inventory reporting guidelines, Table 3-3 below adds the CRF categories next to the classification performed in the previous project.

Table 3-3: Allocation of emission sources from refineries in previous project and in accordance with 2006 IPCC Guidelines and revised CRF categories

Emission source	Allocation to 1996 CRF/ ZSE category	Rationale	Allocation to revised CRF categories for reporting after 2015
Combustion	1.A.1.b – Petroleum Refining		1.A.1.b – Petroleum Refining – no change
Flaring	1.B.2.c - Venting and Flaring in refineries		1.B.2.c - Venting and Flaring,
			1.B.2.a.4 – Fugitive emissions from oil. Refining/ storage: Fugitive emissions (excluding venting and flaring) at petroleum refineries
Regeneration of catalysts (Katalysatorregeneration, Entkokung)	2.B.5 - Chemical Industry - Other (1) – Technology: catalyst burn-off		2006 IPCC Guidelines do not mention where these emissions should be allocated. Current practice in Parties is either under 1.B.2.a.4 – Fugitive emissions from oil. Refining/ storage or under 2.B.10 Chemical Industry – other (old categories 2.B.5) – the 2.B.5 category is currently chosen in the German

Emission source	Allocation to 1996 CRF/ ZSE category	Rationale	Allocation to revised CRF categories for reporting after 2015
Hydrogen production	2.B.5 - Chemical Industry – Other	There is no specific method or CRF category for hydrogen production in the IPCC Guidelines or CRF tables	inventory. 2006 IPCC Guidelines: The CO ₂ resulting from the production of hydrogen at refineries and heavy oil/bitumen upgraders should be reported under subcategory 1.B.2.a.i. (p. 4.36)
Coke production/ calcining (Koksherstellung/ Kalzinierung)	1.A.1.c.i - Manufacture of Solid Fuels	Coke is explicitly mentioned in the definition of this CRF category	1.A.1.c.i - Manufacture of Solid Fuels
Flue gas scrubbing (Abgaswäsche)	1.A.1.b Petroleum Refining	Flue gas scrubbing results in process emissions, however the emissions are indirectly caused by the combustion of fuels.	1.A.1.b Petroleum Refining 2006 IPCC GL: It is good practice to report emissions from the consumption of carbonates in the source category where the carbonates are consumed and the CO ₂ emitted.
Gasification of heavy fuel oil, methanol production (Schwerölvergasung/ Methanolherstellung)	2.B.5 Chemical Industry – Other	Methanol production is explicitly mentioned in this CRF category	2.B.8 Petrochemical and carbon black production
Production of terephthalic acid (Terephthalsäureherstellung)	2.B.5 Chemical Industry – Other	Terephthalic acid is not mentioned in 2006 IPCC Guidelines and would therefore be reported under other.	2.B.10 Other Chemical Industry
Claus plants (Claus-Anlagen)	1.A.1.b Petroleum Refining	The category is defined as “All combustion activities supporting the refining of petroleum products ...” which includes Claus plants.	1.A.1.b Petroleum Refining

The GHG inventory includes a category related to fugitive emissions from refineries which is 1.B.2.a.4 – Fugitive emissions from oil - refining/ storage (new CRF categories). In this CRF category fugitive emissions (excluding venting and flaring) at petroleum refineries should be

reported. The German GHG inventory reports fugitive emissions from refinery tank storage systems to store both crude oil and intermediate and finished petroleum products. However, there are no CO₂ emissions, but emissions of CH₄ and NMVOC released from this activity and this subcategory is not covered under the EU ETS because the ETS focuses on CO₂ emissions.

In addition in the category 2.B.5 (old CRF) and 2.B.10 (new CRF) representing other emissions from chemical industry, coke burn-off for catalyst regeneration in refineries is reported in the German inventory.

Other countries report emissions from the regeneration of catalysts in this category (e.g. Denmark, Spain), however 2006 IPCC Guidelines are not very specific and do not provide clear indications.

3.2.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The monitoring of emissions from mineral oil refining in the ETS MRR shall be carried out in accordance with the methodologies 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.

By way of derogation from Article 24 and 25, emissions from catalytic cracker regeneration, other catalyst regeneration and flexi-cokers shall be monitored by continuous measurement, 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: $t \text{ CO}_2 = t \text{ CO} * 1.571$. 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.

By way of derogation from Article 24, emissions from hydrogen production³ shall be calculated as activity data (expressed as tonnes of hydrocarbon feed) multiplied by the emission factor (expressed as t CO₂ /t feed). The following tiers are defined for the emission factor:

Tier 1: The operator shall use a reference value of 2.9 t CO₂ per tonne feed processed, conservatively based on ethane.

Tier 2: The operator shall use an activity-specific emission factor calculated from the carbon content of the feed gas determined in accordance with Articles 32 to 35.

The methodologies for combustion emissions are consistent with 2006 IPCC Guidelines.

2006 IPCC Guidelines do not provide a method for catalytic cracker regeneration at petroleum refining plants. The continuous measurement methods used under the ETS is consistent with tier 3 plant-specific emission factors as defined in 2006 IPCC guidelines for petrochemical industry.

2006 IPCC Guidelines also do not provide a method for hydrogen production.

In those areas where inventory emissions are not available, ETS methodologies cannot be inconsistent and lead to consistent and accurate emissions.

³ Note that the TEHG activity 28 'production of hydrogen & synthesis gas' (section 3.21.1) relates to production facilities in separate plants which are not part of refineries.

3.2.3 Differences in emission factors

No specific other default parameters apart from those already discussed under combustion are defined in the ETS MRR. Where the list with standard factors is not applicable, other constant values can be used under the ETS MRR where either the supplier of a material guarantees the carbon content or which are based on past representative analysis. Both approaches would qualify as country-specific EFs in 2006 IPCC Guidelines for Tier 2 methods. Thus, the approach under the ETS is consistent with tier 2 methods for the GHG inventory.

3.2.4 Conclusions

The analysis of concordance conducted in previous reports (Müller-BBM and IZT, 2011) between the EU ETS reporting and the inventory reporting for mineral oil refineries is still relevant, as neither the underlying methodologies and scopes of the ETS data nor the inventory data changed. However some of the CRF category codes were changed in the Revised UNFCCC reporting guidelines which leads to some changes in the ZSE and subsequently to the concordance analysis.

3.3 Production of coke (TEHG activity 08)

3.3.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of this activity is defined in the ETS MRR as ‘at least’ the following potential sources of CO₂:

- ▶ Raw materials including coal or petroleum coke;
- ▶ Conventional fuels (including natural gas);
- ▶ Process gases (including blast furnace gas)
- ▶ Other fuels and waste gas scrubbing

Waste gas scrubbing is not part of the scope of inventory emissions from metallurgical coke production as described in Volume 3, chapter 4 of 2006 IPCC Guidelines. However, in accordance with 2006 IPCC Guidelines emissions from flue gas desulphurization should be allocated to the industry sectors where they occur. Therefore the scope seems consistent with the inventory category 1.A.1.c Manufacture of solid fuels and other energy industries.

3.3.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The methodology provided in the ETS MRR is either a mass balance method or the standard methodology.

2006 IPCC Guidelines define a Tier 3 method for metallurgical coke production as a method that uses plant specific data, thus the ETS data would qualify as a tier 3 method.

3.3.3 Differences in emission factors

There are not separate EFs defined in the ETS MRR apart from the fuel specific EFs and EFs from carbonate use in flue gas desulphurization which are discussed in other sections.

3.3.4 Differences in other parameters

Not relevant for coke production.

3.3.5 Conclusions

Already the previous project (Müller-BBM and IZT 2011) showed that emissions from coke production from ETS data and inventory data compare well when the ETS activity is com-

pared with CRF category 1.A.1.c.i. Neither the ETS MRR, nor 2006 IPCC Guidelines include major revisions of the methodologies for coke production and it is assumed that data should still be consistent. However, the previous project also showed that changes in the reporting of transferred CO₂ under the ETS can decrease the comparability.

3.4 Metal ore roasting and sintering (TEHG activity 09)

3.4.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

This activity includes metal ore (including sulphide ore) roasting or sintering, including pelletisation. The ETS MRR list the following emissions sources related to metal ore roasting and sintering:

- ▶ Raw materials (calcination of limestone, dolomite and carbonate iron ores)
- ▶ Conventional fuels (including natural gas, coke, coke breeze);
- ▶ Process gases (including blast furnace gas and coke oven gas);
- ▶ Process residues used as input material;
- ▶ Other fuels and waste gas scrubbing.

In the 2006 IPCC Guidelines, emissions from metal ore roasting and sintering are part of the emissions from iron and steel production and are not included in separate categories. Besides this difference, the scope is the same. However in the inventory the emissions are allocated between the source categories 1.A.2.a Iron and steel – combustion emissions and 2.C.1 Iron and Steel – process emissions.

3.4.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The methodology provided in the ETS MRR is either a mass balance method or the standard methodology.

2006 IPCC Guidelines define a Tier 3 method for iron and steel production as a method that uses plant specific data, thus the ETS data would qualify as a tier 3 method and the use of mass balance methods is consistent with the 2006 IPCC Guidelines.

3.4.3 Differences in emission factors

There are not separate EFs defined in the ETS MRR apart from the fuel specific EFs and EFs from carbonate use in flue gas desulphurization which are discussed in section 3.1.2.

3.4.4 Differences in other parameters

Not relevant for this activity.

3.4.5 Conclusions

For a comparison of ETS data and inventory data, ETS emissions from metal ore roasting and sintering should be aggregated with emissions from iron and steel production.

On the inventory side, emissions from 1.A.2.a Iron and Steel production and 2.C.1 Iron and steel should also be aggregated to generate more comparable datasets.

3.5 Production of pig iron and steel (TEHG activity 10)

3.5.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

This ETS activity covers the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour. ETS MRR list the following emissions sources related to production of pig iron and steel:

- ▶ raw materials (calcination of limestone, dolomite and carbonatic iron ores, including FeCO_3)
- ▶ 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.

In the 2006 IPCC Guidelines, emissions from metal ore roasting and sintering are part of the emissions from iron and steel production and are not included in separate categories. Besides this difference, the scope of sub-activities is the same, however no production threshold of 2,5 tonnes per hour is applied for the inventory. As most iron and steel installations are large, it is not likely that this threshold is relevant in a similar way as for fuel combustion activities, but there may be plants not covered by the ETS data and only in the inventory.

The comparability of the iron and steel emissions is also strongly influenced by the transfer of CO_2 in the process gases coke oven gas, blast furnace gas and basic oxygen furnace gas and a matching of the CO_2 emissions related to these process gases has already shown to be difficult in the previous project.

3.5.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The ETS MRR require for the monitoring of emissions from production of pig iron and steel, 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.

If tier 3 has to be applied, the operator shall derive the carbon content of input or output stream following Articles 32 to 35 of the MRR 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.

The Tier 1 method in the 2006 IPCC Guidelines is to multiply default emission factors by national production data.

The Tier 2 method for estimating CO_2 emissions from iron and steel production in the 2006 IPCC Guidelines is based on data for the consumption of raw materials, including reducing agents. It uses a mass balance approach and material-specific carbon contents.

The Tier 3 method in the inventory is the use of plant-specific data.

ETS methodologies therefore are consistent with either the tier 2 or tier 3 inventory methodologies in 2006 IPCC Guidelines (both mass balance method). However the use of mass bal-

ance methods at the levels of individual installations may eventually be less transparent for a comparison of emissions between the ETS and the ZSE (see section 2.3).

3.5.3 Differences in emission factors

Individual analysis of C contents should be applied if tier 3 is required under the ETS which is fully adequate for the inventory purposes and equivalent to a higher tier method in the inventory.

Only for installations of Category A or minor and de-minimis source streams the standard factors from Annex VI (Tier 1) of the ETS MRR can be used. The following table provides the emission factors for iron and steel:

Table 3-4 Stoichiometric emission factors for process emissions from production of iron and steel and processing of ferrous metals

Input or output material	Carbon content [t C/t]	Emission Factor [t CO ₂ /t]
Direct reduced iron	0.0191	0.07
EAF carbon electrodes	0.8188	3.00
EAF charge carbon	0.8297	3.04
Hot briquetted iron	0.0191	0.07
Oxygen steel furnace gas	0.3493	1.28
Petroleum coke	0.8706	3.19
Purchased pig iron	0.0409	0.15
Scrap iron	0.0409	0.15
Steel	0.0109	0.04

These emission factors are consistent with those provided in table 4.3 ‘Tier 2 material specific carbon contents for iron and steel production’ as provided in 2006 IPCC Guidelines, volume 3, Chapter 4: Metal Industry Emissions.

3.5.4 Differences in other parameters

Not relevant for this section.

3.5.5 Conclusions

The previous project (Müller-BBM and IZT 2011) showed that the aggregation of ETS activities metal ore roasting and sintering and iron and steel production (TEHG 9 and 10) compared relatively well with emissions from CRF categories 1A2a and 2C1 for the years 2008 and 2009 after some installations changed the reporting of transferred blast furnace gas, coke oven gas and converter gas. The transfer of these gases to other installations being part of the ETS, will remain an important aspect for any data comparison similar to the results indicated for the previous project.

It may be useful for to repeat this analysis for the more recent years available from the ETS data in order to analyse whether these differences occur in the same way for more recent years.

The revised CRF categories in the IPPU sector for the inventory include a larger disaggregation of emission sources under iron and steel production and include the following subcategories:

- ▶ 2.C.1.a. Steel
- ▶ 2.C.1.b. Pig iron
- ▶ 2.C.1.c. Direct reduced iron
- ▶ 2.C.1.d. Sinter
- ▶ 2.C.1.e. Pellet
- ▶ 2.C.1.f. Other (please specify)

It should be checked whether source streams for activities reported under the ETS would allow for such further disaggregation in line with the new inventory CRF categories.

3.6 Production or processing of ferrous metals (TEHG activity 11)

3.6.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

This activity covers the production or processing of ferrous metals (including ferro-alloys) where combustion units with a total rated thermal input exceeding 20 MW are operated. Processing includes, inter alia, rolling mills, re-heaters, annealing furnaces, smitheries, foundries, coating and pickling.

ETS MRR lists the following emissions sources related to the production or processing of ferrous metals:

- ▶ 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.

For the inventory reporting the scope is different as no thresholds for the thermal input apply. In addition, in the inventory the emissions from the production of ferrous metals are partly included in CRF category 2.C.2 Ferroalloys production (process emissions), but combustion emissions could also be allocated under CRF category 1.A.2.a Iron and steel.

The CRF category 2.C.2 includes emissions from reducing agents and input materials such as raw ore, carbon materials and slag forming materials as well as the emissions from graphite electrodes. The category also includes emissions from the calcination of carbonate fluxes such as limestone or dolomite use.

In the inventory allocation CO₂ emissions from coke production are included under 1.A.1.c Manufacture of solid fuels and other energy industries.

Primary emissions in covered arc furnaces consist almost entirely of CO as opposed to CO₂, due to the strong reducing environment. This CO is either utilised for energy production in boilers, or it is flared. The energy produced is assumed to be used internally at the site and the carbon content of the CO subsequently converted to CO₂ in-plant. The CO gas produced in open or semi-closed furnaces is burnt to CO₂ above the charge level. Any CO emitted to the atmosphere is assumed to be converted to CO₂ within days afterwards.

In the German inventory emissions from five ferroalloy producers are included. Ferrochromium, ferrosilicon and silicon metal are each produced by only one company, and other ferroalloys are produced only in small quantities. The only process in use since 1995 is the electric arc process, a process that releases only small amounts of process-related CO₂ through electrode consumption.

Thus, it may be the case that emissions from other ferroalloys produced in small quantities are not covered by the ETS emissions. The fact that only electric arc process is used facilitates the data comparison between the ETS and inventory data as fewer source streams need to be allocated.

3.6.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

In the ETS MRR the following methodologies are described:

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 Annex II for a part of the source streams, avoiding any gaps or double counting of emissions.

In the 2006 IPCC Guidelines a mass balance approach is used where all CO emitted is reported as emitted CO₂. Tier 2 and Tier 3 methods include all materials and their carbon contents in the balance. In general ETS methodologies and inventory methodologies seem to be consistent.

However, for the German inventory a simple calculation approach ($AD * EF$) is currently used which is based on data of the U.S. Geological Survey (USGS) which is usually not available for the most recent year.

3.6.3 Differences in emission factors

For the German inventory the emission factors for the electric-arc processes were determined in the research project "NEW CO₂" ("NEU-CO₂") (FKZ 203 41 253/02).

No specific default EFs apart from those already discussed under combustion and in Table 3-4 are defined in the ETS MRR.

3.6.4 Differences in other parameters

No specific other default parameters apart from those already discussed under combustion are defined in the ETS MRR.

3.6.5 Conclusions

As there does not seem to be a good national activity data source for emissions from ferroalloys production it seems very relevant to consider whether ETS data can be used for the inventory in the future instead of data from US Geological survey.

It would also be useful to try to compare EFs for the electrode consumption currently used in the ZSE and those reported by the ETS installations.

For this purpose it would be necessary to separate emissions related to graphite electrodes from other emissions and it should be investigated whether this is possible from the reported ETS data. If mass balance approaches are reported, not all necessary elements may be available.

It should also be investigated whether limestone and dolomite use occurs. These emissions may currently not yet be included in the GHG inventory and should be added to the ferroalloy emissions in the future, if they are reported under the ETS.

3.7 Production or processing of non-ferrous metals (TEHG activity 13)

3.7.1 Differences in scope of activities/ source categories

This activity covers two separate sub-activities:

- ▶ The production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated.
- ▶ Production or processing of non-ferrous metals, including production of alloys, refining, foundry casting, etc., where combustion units with a total rated thermal input (including fuels used as reducing agents) exceeding 20 MW are operated.

No process emissions are described in the 2006 IPCC Guidelines for the production of secondary aluminium production. Combustion emissions from secondary production of aluminium and other non-ferrous metals are included under 1.A.2.b Non-ferrous metals in the inventory. The thresholds for thermal input of 20 MW used for combustion units lead to a different scope of ETS combustion emissions compared to the inventory emissions.

Related to process emissions from non-ferrous metals, 2006 IPCC Guidelines distinguish the following categories:

- ▶ Magnesium production
- ▶ Lead production
- ▶ Zinc production

Due to the thresholds applied for combustion, not all production processes for these non-ferrous metals may be included in the ETS data.

According to the current German GHG inventory no process emissions of CO₂ occurs from Magnesium production or the production of non-ferrous metals.

3.7.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The ETS MRR provides the following methods:

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.

The 2006 IPCC Guidelines describe a tier 2 method for zinc and lead production where emission are calculated using country specific emission factor based on aggregated plant statistics on the use of reducing agents, furnace types and raw input materials and other process materials of interest is developed based on default emission factors applicable to those materials. And a tier 3 method based on actual measured CO₂ emissions data are available from zinc facilities.

For Magnesium production 2006 IPCC Guidelines highlight that the processing of carbonate raw materials (magnesite and dolomite) will release CO₂ during manufacturing. The CO₂ is released during calcination of carbonate-based ores (dolomite/magnesite) - a 'pre-treatment' step to the main electrolytic/thermal reduction processes. This process is similar to the generation of CO₂ in the mineral industry.

3.7.3 Differences in emission factors

No specific default EFs are provided in the ETS MRR.

3.7.4 Differences in other parameters

No specific default factors for other parameters are provided in the ETS MRR.

3.7.5 Conclusions

A small amount of combustion emissions (160 Gg CO₂ in 2011) is currently reported under 1.A.2.b Non-Ferrous metals in the inventory and it would be relevant to check whether combustion emissions reported under the ETS are similar or lower than these reported emissions. If they would be higher, some reallocation of combustion emissions to this inventory category should occur.

With regard to process-related emissions it would be necessary to distinguish between the non-ferrous metals that are produced in the ETS data in order to match them with the inventory CRF categories.

The process emissions from non-ferrous metals are currently reported as not occurring in the national GHG inventory. An analysis of the source stream reported under the ETS would therefore be useful to confirm that only combustion emissions occur.

3.8 CO₂ Emissions from production of primary aluminium (TEHG activity 12)

3.8.1 Differences in scope of activities/ source categories

The scope of this activity under the EU ETS covers

CO₂ emissions from the production of electrodes for primary aluminium smelting, including stand-alone plants for the production of such electrodes, including

- ▶ fuels for the production of heat or steam,
- ▶ electrode production,
- ▶ electrode consumption which is related to reduction of Al₂O₃ during electrolysis ,
- ▶ and use of soda ash or other carbonates for waste gas scrubbing.

No capacity threshold or production threshold applies for this activity under the EU ETS.

In the inventory reporting, combustion emissions from fuels used in primary aluminium production are allocated under 1.A.2.c Manufacturing Industries and Construction – non-ferrous metals in the energy sector and not under 2.C.3 Aluminium Production the industrial processes sector.

Also emissions from electrode production are part of the energy sector (Manufacturing Industries and Construction) in the inventory reporting while the ETS MRR also includes facilities that produce electrodes for aluminium production without producing aluminium. These emissions include CO₂ emissions from the combustion of volatile matter released during the baking operation and the combustion of baking furnace packing material (coke).

Also the allocation of emissions from the use of soda ash and other carbonates in primary aluminium production is different in the GHG inventory. Under the 1996 IPCC guidelines, these CO₂ emissions are allocated to the old CRF categories 2.A.4 Soda Ash production and use and 2.A.3 Limestone and dolomite use. Under the 2006 IPCC guidelines which will apply starting from the reporting year 2015, these emissions will be included in the respective end use sectors where soda ash is used.

In the 2006 IPCC guidelines emissions from primary aluminium production only cover CO₂ emissions from the consumption of carbon anodes in the reaction to convert aluminium oxide to aluminium metal.

Thus, total CO₂ emissions from primary aluminium production under the ETS cover more source streams than inventory emissions for aluminium production and will likely be higher and will lack comparability.

3.8.2 Differences in methodologies and algorithms

Under the EU ETS CO₂ emissions have to be determined in the following way:

“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.” (MRR, Annex IV Nr. 7 B.)

“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.”

2006 IPCC Guidelines provide a Tier 1 methodology based on aluminium production and default EFs for prebake and Söderberg process which is however not considered to be good practice.

The IPCC Tier 2 and Tier 3 methods are calculated using a mass balance approach that assumes that the carbon content of net anode consumption or paste consumption is ultimately emitted as CO₂. While in general the IPCC guidelines also use a mass balance approach, the mass balance only includes the electrode consumption, whereas the ETS MRR refers to a broader range of processes which are *“all carbon in inputs, stocks, products and other exports from the mixing, forming, baking and recycling of electrodes as well as from electrode consumption.”*

3.8.3 Differences in emission factors

The mass balance method applied in the ETS does not include default EFs or carbon contents.

3.8.4 Differences in other parameters

Tier 2 and 3 in the 2006 IPCC Guidelines include other terms in the equation to make minor adjustments for non-carbon components of the anodes:

CO₂ emissions from prebaked anode consumption include a correction for non-carbon components of the anodes and consider sulphur content as well as ash content in baked anodes. In addition for corrections based on sulphur and ash content, the equation for Söderberg process also corrects for hydrogen content in pitch. No such correction is explicitly foreseen in the ETS mass balance method. However, higher tier methods use direct analysis data that include sulphur ash content. The 2006 IPCC Guidelines estimate that these parameters improve accuracy of the emission estimates by 5% (IPCC 2006, Volume 3, p. 4.49).

IPCC Tier 2 methods for both Prebake and Söderberg processes make use of typical industry values for these impurities while the Tier 3 methods uses actual concentrations of impurities. The choice of method between the Tier 2 and Tier 3 method will depend on whether anode or paste composition data are available at the individual plant level.

3.8.5 Conclusions

Total CO₂ emissions from primary aluminium production under the ETS cover more source streams than inventory emissions for aluminium production and will likely be higher and will lack comparability at the level of total emissions. IAI (2006) estimates that process CO₂ emissions from state-of the art aluminium smelters comprise around 90% of total direct CO₂ emissions from aluminium production. Using this estimate, total ETS emissions from this category should be around 10% higher than inventory emissions due to this difference in scope of the category.

Whether other data reported under the ETS from aluminium producing facilities could be used for the purposes of the GHG inventory depends on the fact what facilities are actually required to report and to what extent the data is reported separately for CO₂ emissions from the consumption of carbon anode. For the IPCC tier 2 methods, separate information from each installation on aluminium production as well as on net anode consumption per tonne of aluminium (prebaked process) or paste consumption (Söderberg process) would be required and whether installation report separately CO₂ emissions from the combustion of volatile matter released during the baking operation and the combustion of baking furnace packing material (coke).

As explained above, the ETS mass balance method do not make an explicit reference to corrections for non-carbon components of the anodes (sulphur content and ash content in baked anodes, also corrects for hydrogen content in pitch for Söderberg process). No such correction is explicitly foreseen in the ETS mass balance method. Further assessment of the actual data reported by German installation is necessary to know whether anode or paste composition data are reported at the individual installation level that could correspond to a tier 3 inventory calculation.

It would be necessary to identify the CO₂ emissions from anode consumption separately from the reported source streams. These CO₂ emissions should be allocated to CRF(new) 2C3 'Aluminium Production'. All other CO₂ emissions reported under the ETS would need to be allocated to the respective fuel category in CRF(new) 1A2b 'Non-Ferrous Metals'.

3.9 PFC emissions from production of primary aluminium (TEHG activity 12)

3.9.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of this activity under the EU ETS covers PFC emissions (CF_4 and C_2F_6) resulting from anode effects in aluminium production including fugitive emissions of PFCs. This scope is consistent with the scope of the same category in the 2006 IPCC Guidelines and CRF code 2.C.3 Aluminium Production. No thresholds apply under the EU ETS.

3.9.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

In accordance with MRR under the ETS, PFC emissions shall be calculated from the emissions measurable in a duct or stack ('point source emissions') as well as fugitive emissions using the collection efficiency of the duct:

PFC emissions (total) = PFC emissions (duct)/collection efficiency

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.

This means that the Tier 3 method is fully consistent between the ETS and the 2006 IPCC Guidelines.

The operator shall calculate emissions of CF_4 and C_2F_6 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.

These two methods are also consistent with the 2006 IPCC Guidelines.

3.9.3 Definition of tiers for ETS activities and inventory source categories

In the ETS MRR the following tiers are defined:

- ▶ 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 CF_4 and C_2F_6 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. Thus, also the tier 2 method is consistent with GHG inventories.

In the IPCC guidelines tier 1 as defined in the ETS MRR is equivalent to the tier 2 method, whereas in the IPCC tier 3 method the PFC emission factors are based on a facility specific relationship between anode effect performance and PFC emissions from periodic or continuous measurements that are consistent with established measurement practices (U.S. EPA and IAI, 2003) and the International Aluminium Institute GHG Protocol (IAI, 2005a). Thus the IPCC tier 3 method is equivalent to the ETS Tier 2 method.

In the German inventory, PFC emissions are based on measurements conducted in all German smelters in the years 1996 and 2001. From these measurements, specific CF_4 emission figures per anode effect were calculated for the technologies used. The number of anode effects is recorded and documented in the foundries. The total CF_4 emissions were calculated by mul-

tipling the total anode effects for the year by the specific CF₄ emissions per anode effect determined in 2001. The total emission factor for CF₄ is obtained by adding the CF₄ emissions of the smelters and then dividing the sum by the total aluminium production of the smelters. C₂F₆ and CF₄ occur in a constant ratio of about 1:10. The above described method was applied to the entire time series.

Under the ETS the German aluminium production installations report based on default values from Table 1 of Annex IV which are equivalent to the Tier 2 emission factors as provided in table 4.16 of IPCC 2006 Guidelines, Volume 3, p. 4.54 (IPCC, 2006).

If higher tiers would be applicable under the EU ETS, updated data for a higher tier method would be available for the GHG inventory. However PFC emissions from the aluminium production have already been reduced substantially and 2006 IPCC Guidelines indicate that ‘High performing facilities emit so little PFCs that no significant improvement can be expected in the overall facility GHG inventory by using the Tier 3 method rather than the Tier 2 method.’ (2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 4: Metal Industry Emissions, p. 4.53).

3.9.4 Differences in emission factors

The ETS MRR provide the technology-specific emission factors related to activity data for the slope method in table 1 of annex IV of the MRR for Centre Worked Prebake Anodes and Vertical Stud Søderberg and in table 2 of annex IV for the overvoltage method. These EFs are consistent with EFs in 2006 IPCC Guidelines in table 4.16, Chapter 4 Metal Industry emissions, Volume 3 Industrial Processes and Product Use.

3.9.5 Conclusions

Both the scope and the methods for PFC emissions from primary aluminium production are consistent between the ETS and the GHG inventory. The PFC emissions reported under the ETS should therefore be comparable in a relatively straightforward way, if individual reports of the gases CF₄ and C₂F₆ are available from the ETS data and are compared with emissions reported under 2.C.3 Aluminium Production.

3.10 Production of cement clinker (TEHG activity 14)

3.10.1 Differences in scope of activities/ source categories

The Annex I to the ETS Directive 2003/87/EC covers only those installations involved in production of cement clinker in rotary kilns with capacity exceeding 500 tonnes per day or in other furnaces with capacity exceeding 50 tonnes per day, while the IPCC methodology has no threshold. The previous project (Müller-BBM and IZT 2012) showed that process emissions from cement production reported under the ETS match completely with inventory emissions, therefore it can be assumed that the capacity thresholds do not lead to a change in the coverage of emissions between the ETS and the inventory data in Germany.

The ETS category on cement clinker production encompasses emissions activities that are reported in the German NIR under separate IPCC source categories for combustion and process emissions:

- ▶ 1.A.2.f Manufacturing industries and construction (1.A.2.f, 'Other', sub-category 'Cement' in the old CRF, 1.A.2.f 'non-metallic minerals' in the new CRF) for combustion related emissions,
- ▶ 2.A.1. Cement Production for process emissions (both old and new CRF).

The scope specified in Annex IV of the ETS MRR includes the following potential process and combustion 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,
- ▶ organic carbon content of limestone and shales
- ▶ and raw materials used for waste gas scrubbing.

To be useful for inventory compilation it will therefore be necessary to access ETS information that is disaggregated for emissions from process activity and emissions from combustion. The combustion related data will also need to include fuel type and quantity. The process related data would need to include clinker production quantity.

3.10.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

Annex IV of the ETS MRR requires the monitoring of emissions from cement clinker to be based on the carbonate content of the process input (calculation Method A) or on the amount of clinker produced (calculation Method B). Carbonates that should be taken into account shall at least include CaCO₃, MgCO₃ and FeCO₃.

The IPCC 1996 and 2006 guidelines both recommend the same two methods for the estimation of process emissions from cement and for the German inventory the NIR (2013) documents the method based on reported clinker production. For the ETS, while operators may calculate and report emissions based on Method A or B, it is likely that most use Method B as this is simpler although a mixture of reporting methods would not affect the usability of the ETS data for inventory purposes.

The ETS MRR also indicates that CO₂ emissions related to dust removed from the process and organic carbon in the raw materials shall be added in accordance with subsections C and D of this section of Annex IV. This is consistent with the treatment of cement kiln dust in the inventory.

For ETS combustion emissions from clinker production, operators must also report quantities of standard and non-standard fuel types, emission factors, net calorific value and biomass content.

The previous project (Müller-BBM and IZT 2012) has already provided a detailed comparison of process and combustion emissions disaggregated to the reported materials for cement production.

3.10.3 Differences in emission factors

In the German NIR (2013), cement production process-related CO₂ emissions are calculated with a country-specific material-related emission factor from plant-specific data determined by Verein Deutscher Zementwerke e.V. (German Cement Works Association). The NIR states that the “emission factor used differs only slightly (1 %) from the emission factor used in connection with the ETS in Germany, an emission factor which is checked by authorities and reviewed in light of companies' obligations to provide records” (NIR 2013, 4.2.1.4). The NIR uses a factor of 0.53 t CO₂/t of clinker; Annex IV specifies 0.525 t CO₂/t of clinker.

Thus, the previous analysis conducted already showed consistency of the EFs and parameters used.

3.10.4 Conclusions

The previous project (Müller-BBM and IZT 2012) has already provided a detailed comparison of process and combustion emissions disaggregated to the reported materials for cement production indicating that process related emissions are consistent between the ETS and the inventory data. For combustion-related emissions, the previous project faced difficulties in allocating all materials reported under the ETS to ZSE materials, in particular for the differentiation between fossil and biogenic fractions of secondary fuels. A data consolidation with the organization Verein deutscher Zementwerke e.V. was recommended. As neither under the ETS, nor for the inventory the reporting for cement production changed, these results remain valid. However the analysis could be updated in particular for process emissions to show that ETS emissions and inventory emissions continue to match.

3.11 Production of lime or calcination of dolomite or magnesite (TEHG activity 15)

3.11.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The Annex I to the ETS Directive 2003/87/EC covers only those installations involved in production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day, while the IPCC methodology has no threshold.

The previous project (Müller-BBM and IZT 2012) identified a difference of 1,029 kt CO₂ for 2009 less than emissions reported in the GHG inventory (5,454 kt CO₂). Thus process-related ETS emissions (4,425 kt CO₂) were only about 81% of process-related inventory emissions in 2009. This is consistent with the fact that for lime production there are usually a larger amount of small installations below the thresholds in Annex I of the ETS Directive. A larger coverage of inventory emissions compared to the ETS emissions can also be found in other EU countries.

The scope in the ETS MRR includes the following potential process and combustion 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 (Annex IV, Section 10, MRR).

In the GHG inventory these emissions activities are reported under separate IPCC/CRF source categories for combustion and process emissions:

- ▶ Combustion emissions are reported under 1A2 Manufacturing industries and construction, f Non-metallic minerals (new CRF), f other -lime (current German CRF).
- ▶ Process emissions are reported under 2A2 Lime Production.

In addition, the previous project (Müller-BBM and IZT 2012) identified ETS sugar plants that also report to have lime kilns and produce lime. Non-marketed lime production in sugar industry also has to be reported in the GHG inventory under 2.A.2 Lime Production. It is there-

fore relevant to identify lime production in installations not part of the lime production activity as already conducted in the previous project. AN analysis of the German sugar industry however showed that limestone is used and there are almost no CO₂ emissions-and that sugar plants covered under the ETS mainly report combustion related CO₂ emissions.

Other industries beyond sugar industry that in accordance to 2006 IPCC Guidelines may produce lime are metallurgy, pulp and paper and precipitated calcium carbonate. As the amounts of process emissions from these sugar plants are not indicated in the previous report (Müller-BBM and IZT 2012), it is unclear whether they match with the amounts reported in the German inventory (NIR, table 114, limestone balance sheet). It is therefore recommended to repeat similar search requests related to lime for more recent years to identify any additional industries that produce non-marketed lime. Non-marketed lime is usually not represented in national statistics or statistics by associations, therefore the reporting under the ETS is an important source for such information.

3.11.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

Annex IV of the ETS MRR requires the monitoring of emissions from lime production to be based on either an input or an output based method where the activity data related to the output/input material is multiplied with corresponding emission factors. Carbonates of calcium and magnesium shall be always taken into account. Other carbonates and organic carbon in the raw material shall be taken into account, where relevant.

In the 2006 IPCC Guidelines Tier 1 and Tier 2 methods are output-based methods and Tier 3 is an input-based method that requires carbonate input data at plant level. Thus the methodologies used in the ETS and the GHG inventory are consistent.

Section 10 of Annex IV of the MRR states that: “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.” This statement is in effect acknowledging a specific type of non-market production. Neither the 2006 IPCC Guidelines nor the NIR mention any accounting for burnt lime used for purification processes where CO₂ may be emitted and then re absorbed. This issue does not appear to be a problem as neither the ETS nor the 2006 Guidelines or the NIR include data on this activity.

The previous project (Müller-BBM and IZT 2012) has already provided a detailed comparison of process and combustion emissions disaggregated to the reported materials for lime production (see above). For the combustion-related emissions, some inconsistencies were found for solid fuels in particular petroleum coke.

3.11.3 Differences in emission factors and other parameters

The GHG inventory uses some assumptions in the estimation method, in particular that 95% of the lime consists of CaO, 95% of the dolomite lime consists of CaO·MgO and that 5% of the total mass consists of impurities that are not CO₂ –relevant. It would be interesting to analyse whether ETS data are available to confirm these assumptions related to impurities.

3.11.4 Conclusions

The previous project (Müller-BBM and IZT 2012) identified sugar plants that also report to have lime kilns and produce lime. It is recommended to repeat similar search requests related

to lime for more recent years to identify any additional industries that produce non-marketed lime and to compare with the quantities reported in the limestone balance in the NIR.

In the previous project it was identified that ETS process emissions from lime production are lower than inventory emissions. Such analysis should be repeated for more recent years to see whether the fraction of ETS emissions relative to inventory emissions is relatively constant.

In addition, it may be interesting to check, whether in the ETS data information on impurities is reported that are not CO₂ –relevant and if available, to analyse whether ETS data related to impurities confirm the assumptions included in the inventory estimation.

3.12 Manufacture of glass, glass fibre or mineral wool insulation material (TEHG activities 16 & 18)

3.12.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

Annex I to the ETS Directive 2003/87/EC covers only those installations involved in the manufacture of glass or mineral wool that have a melting capacity exceeding 20 tonnes per day, while the IPCC methodology has no threshold.

However, the previous project (Müller-BBM and IZT 2012c) concluded that ETS emissions both for combustion and process emissions exceed those reported in the GHG inventory. This is not consistent with the potentially larger scope of the GHG inventory. For combustion emissions, it had been concluded that this might be due to the fact that power production at glass production installation are not included in the fuel use data used for the inventory.

According to (Müller-BBM and IZT 2012c), ETS emissions also exceed GHG inventory emissions when the ETS emissions identified for waterglass production are excluded. In the German inventory, process emissions from waterglass production are not included in CRF 2A7 glass (old) / CRF 2A3 (new) but have been accounted for in CRF 2A4 (old) “soda ash production and use” / CRF 2A4b (new) “other uses of soda ash” (NIR 2013).

The scope in the ETS MRR includes the following potential process and combustion sources of CO₂ emissions:

- ▶ decomposition of alkali and alkaline 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 (Annex IV, Section 11, MRR).

This explicitly also applies to production of water glass and stone/rock wool.

In the GHG inventory these emissions activities are reported under separate IPCC/CRF source categories for combustion and process emissions:

- ▶ Combustion emissions are reported under 1A2 Manufacturing industries and construction, f Non-metallic minerals (new CRF), f other -glass (current German CRF).
- ▶ In the German inventory, process emissions have been reported under 2A7 (old) ”other: Glass” (including stone wool) and 2A4 (old) Soda ash production and use; under the new CRF the respective categories would be 2A3 (new): glass (according to the guidelines for all

glass / glass fibre production including waterglass) and 2A4 (new) b "other uses of soda ash" (for all mineral wool CO₂ emissions from Soda use) or 2A4 (new) d "other" (for other CO₂ process emissions from mineral wool production).

The German inventory does not account for CO₂ emission from flue gas scrubbing (NIR 2013).

3.12.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The 2006 IPCC guidelines for process emissions allow for Tier 1, 2 and 3 methodologies. Germany is applying Tier 2 (NIR 2013), what means that country-specific emission factors are applied to the production of different gas types (container glass production, flat-glass production, concave-glass production, production of glass fibre and rock wool are applied per ton of molten glass, taking into account the scrap glass used in the production process. The ETS monitoring rules for the big installations (Category B and C) are equivalent to a Tier 3 approach in the inventory as individual determined carbonate input data is being used for the calculation. This approach is also implemented for category B installations, which also use individually determined carbon input data and EF based on stoichiometric relationships assuming pure input materials.

3.12.3 Differences in emission factors and other parameters

CO₂ conversion factors used for carbonates in small installations in the ETS (Annex VI of MRR) are the same as those used in the 2006 IPCC guidelines (Volume 3, Chapter 2.1, Table 2.1, page 2.7).

3.12.4 Conclusions

In order to facilitate a comparison of combustion emissions in the ETS with those in the inventory it is recommended that CO₂ combustion emissions from power plants located at glass / mineral wool production installations are identified separately.

ETS process emissions from glass / glass fibre production on one hand and mineral wool emissions on the other hand should be distinguished. Mineral wool process emissions should be distinguished into soda-based emissions and other emissions, as the respective CRF categories differ in the new CRF. Respective new CRF categories are 2A3 (glass), 2A4b (other use of soda ash) and 2A4d (other).

For the inventory, process emissions from waterglass production should be allocated into 2A4 (new) and emissions from stone wool production should be allocated into 2A4b/2A4d (new).

Where scope issues are solved, ETS data in terms of emission calculation methodologies per installation would qualify for use under high inventory tiers.

3.13 Manufacture of ceramic products (TEHG activity 17)

3.13.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of ceramic industry installation covered by the ETS changed between 2012 and 2013.

Under ETS directive 2009/29/EC, the ETS as of 2013 covers "manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day". The ETS until 2012 was restricted to "Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75

tonnes per day, and/or with a kiln capacity exceeding 4m³ and with a setting density per kiln exceeding 300 kg/m³.” The elimination of the definition related to “a kiln capacity exceeding 4m³ and with a setting density per kiln exceeding 300 kg/m³” has resulted in the exclusion of some small plants (such as abrasive paper manufacturers). The removal of the kiln setting density means that other plants such as tile and roof tile manufacturer are now included. The change in the definition also led to the inclusion of installations with high emissions that applied processes that keep them under the setting density which was applied in previous ETS phases.

The scope in the ETS MRR includes the following potential process and combustion 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,
- ▶ fossil organic material in the clay and other raw materials (Annex IV, Section 12, MRR).

Under the 2006 IPCC guidelines no threshold values apply related to production capacity, kiln capacity and/or setting density. In the GHG inventory these emissions activities that are reported under separate IPCC/CRF source categories for combustion and process emissions:

- ▶ Combustion emissions are reported under 1A2 Manufacturing industries and construction, f Non-metallic minerals (new CRF), f other -ceramics (current German CRF).
- ▶ Process emissions are reported under 2A4a ”Other process uses of carbonates – ceramics”.

The previous project (Müller-BBM and IZT 2012) concluded that for 2005-2009 ETS combustion emissions were at approximately 50% – 70% of inventory emissions. Qualitatively, this is plausible with the scope thresholds applied by the ETS. It would be worthwhile to repeat that analysis for 2013 data in order to monitor the effect of the ETS scope change. For Process emissions, however, ETS emissions exceeded inventory emissions by 40% to 80%. This had been attributed to the fact that inventory emissions rely on production data for two major ceramic products only (bricks and tiles). In the sum of combustion and process emissions, inventory emissions exceeded ETS emissions for ceramic industry for all years 2005-2009.

3.13.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The ETS offers two methods for process emissions from raw materials:

- ▶ Method A is based on the carbonate input,
- ▶ Method B calculates the CO₂ from calcinated carbonates based on the alkali oxide output in the products.

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 organic content are used, the operator shall use Method A. However, method B is no longer used in Germany by ETS operators as it overestimates emissions.

According to the 2006 IPCC guidelines, process-related emissions from ceramics result from the calcination of carbonates in the clay, as well as the addition of additives (Vol 3, page 2.33). The methodologies for emission estimation focus on calcination of carbonates only. The ap-

proach used for these emissions relies on carbonate inputs (in Tier 1 to 3), i.e. resembling Method A of the ETS MRR. No equivalent to ETS method B is contained in the 2006 IPCC guidelines. Thus, ETS data based on Method B approaches would not be strictly according to the IPCC guidelines.

However, no methods are given in the IPCC guidelines to estimate the emissions from other additives. For the ETS, emissions from additives are to be calculated in Tier 2 and higher. This may be another reason contributing to the ETS process emissions exceeding the inventory emissions as identified in the previous project. In the German inventory, however, process emissions from the non-renewable carbon content of additives to brick production are taken into account by means of a slightly higher emission factor for bricks (29.1 kg CO₂/t masonry bricks) compared to the emission factor for tiles (28.6 kg CO₂/t roof tiles) (NIR, 2013).

3.13.3 Differences in emission factors and other parameters

According to the 2006 IPCC guidelines, for clays a default carbonate content of 10 percent can be assumed, if no other information is available. Under the ETS however, in Tier 1 of method A, 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 analysis. Under these circumstances, the ETS would end up in higher emissions compared to the inventory.

However, German ceramic sector ETS installations avoid using that rather high Tier 1 EFs. Instead, they perform self-sampling and analysis to determine a plant-specific emission factor (Tier 2).

3.13.4 Conclusions

It is difficult to align the emissions reported under the ETS and the emissions in the national GHG inventory over the time series, due to the scope threshold(s) of the ETS which changed between 2012 and 2013. In Germany some small plants (such as abrasive paper manufacturers) are no longer included due to the change in the definition of this activity. The removal of the kiln setting density means that plants with significant emissions, but low kiln density (e.g. tile and roof tile manufacturer) are now included under the ETS.

Methods offered for emission calculation of process emissions are not fully compatible between ETS and 2006 IPCC guidelines. In that context it would be worthwhile identifying:

- ▶ ETS emissions calculated under method B (output based, alkali oxide) and
- ▶ non-carbonate process emissions under the ETS.

It would also be appropriate to investigate whether combustible materials which are accounted for as additives / process emissions under the ETS correspond to parts of the fuel use data used for the calculation of combustion emissions from the ceramic industry for the inventory.

Where scope issues are solved, ETS data in terms of emission calculation methodologies per installation would qualify for use under high inventory tiers, given the practice of using ETS Tier 2 methods for emission factors.

3.14 Production of gypsum products and plaster boards (TEHG activity 19)

3.14.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of this activity under the EU ETS includes CO₂ emissions from all fuels used for the drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated.

There is no difference in the scope or source categories, because the drying or calcination of gypsum does not have an explicit category in either the 1996 or 2006 IPCC Guidelines. Reporting of combustion emissions from this activity will fall within the new IPCC 2006 category 1.A.2.f "Non-metallic minerals", which includes products such as glass, ceramic, cement, etc.; ISIC (Rev.4) Division: 23 - Manufacture of other non-metallic mineral products.

3.14.2 Differences in emission factors and other parameters

There are no differences in emission factors and other parameters. The gypsum industry only has CO₂ emissions from fuel combustion (no process emissions). This activity is listed in Annex I of Directive 2003/87/EC, for enhanced clarity and coverage (European Parliament 2008).

3.14.3 Conclusions

While it would be possible to use the ETS emissions reported for gypsum products and plaster boards directly in the national GHG inventory, this will not be useful until the issues identified for glass, glass fibre or mineral wool (3.12), and ceramic products (3.13), are addressed.

3.15 Pulp and paper production (TEHG activities 20 & 21)

3.15.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

Under the ETS directive, production of pulp from timber or other fibrous materials is included in the ETS without a threshold. For production of paper or cardboard, a production capacity threshold of 20 tonnes per day holds.

The scope in the ETS MRR includes the following potential process and combustion 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) (Annex IV, Section 14, MRR).

Next to combustion emissions, emissions from flue gas scrubbing and process emissions from raw materials used as make-up chemicals (CaCO₃, Na₂CO₃) are to be monitored.

Under the 2006 IPCC guidelines no threshold values apply related to production capacity. In the GHG inventory these emissions activities that are reported under separate IPCC/CRF source categories for combustion and process emissions:

- ▶ Combustion emissions shall be reported under 1A2 Manufacturing industries and construction, Pulp, paper and print (both old & new CRF).
- ▶ Process emissions should be reported under CRF (new) 2A4 "other process uses of carbonates", subcategories b) "other uses of soda ash" (for emissions from Na₂CO₃) or d) "other" (for emissions from other carbonates used in pulp and paper industries).

In the German inventory, however, in CRF 1A2d only combustion emissions from substitute fuels are reported, combustion emissions from regular fuels cannot be identified and are included in emissions reported in CRF (old) 1A2f-other (NIR, 2013). As identified in the previous project (Müller-BBM and IZT 2012), the ETS pulp and paper emissions thus by far exceed inventory emissions identified for pulp and paper industries.

In the German inventory, so far no CO₂ process emissions have been reported in CRF (old) 2D1 "Pulp and paper". Under the new CRF, no separate category for process emissions in pulp and paper industries exists. Emissions from carbonates used in these industries can be reported in CRF (new) 2A4 "other process uses of carbonates".

3.15.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

According to the MRR, process emissions from raw materials used as make-up chemicals, including at least limestone or soda ash, shall be monitored. 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.

Where CO₂ is used in the plant or transferred to another plant for the production of PCC (precipitated calcium carbonate), under the ETS that amount of CO₂ shall be considered as emitted by the installation producing the CO₂. Under the 2006 IPCC guidelines, such CO₂ amounts would be considered emitted for the original CO₂ source (combustion), as well.

According to 1996 IPCC guidelines, no CO₂ process emissions were expected for pulp and paper (CRF (old) 2D1). According to the 2006 IPCC guidelines, however, emissions from carbonates used in pulp and paper industries can be reported in CRF (new) 2A4 "other process uses of carbonates".

3.15.3 Differences in emission factors and other parameters

The emission factors to be used for carbonates match between ETS MRR and the 2006 IPCC guidelines.

3.15.4 Conclusions

There is a gap between the ETS and inventory scopes of pulp and paper industries as paper production installations with a production capacity up to 20 tonnes per day are not included in the ETS.

For ETS combustion emissions, CO₂ emissions from substitute fuels should be identified separately from CO₂ emissions from regular fuels in order to facilitate a comparison with German inventory data. Special care should be taken in differentiating biogenic and fossil CO₂.

ETS process emission from carbonates should be differentiated from other reported process emissions if any. Carbonate emissions should be differentiated into emissions from soda (Na₂CO₃) application and other carbonates in order to facilitate an allocation to CRF (new) 2A4b (other process uses of soda) and 2A4d ('other' other process uses of carbonates) respectively.

3.16 Production of carbon black (TEHG activity 22)

3.16.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of this activity under the EU ETS includes "all fuels for combustion and all fuels used as process material as sources for CO₂ emissions". Production of carbon black is listed in

Annex I to Directive 2003/87/EC for combustion units with a total rated thermal input exceeding 20 MW.

Production facilities that include carbon black production are typically very large so it is likely that the ETS has a complete coverage. The German NIR refers to “the three German producers of carbon black” (NIR 2013, 4.3.5.2), this should match the number of companies reporting this activity in the ETS.

3.16.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

The ETS MRR states that emissions from carbon black production may be monitored either as a combustion process or using a mass balance.

For key categories, the IPCC 2006 Guidelines require Tier 2 or 3 methodologies based on mass balance or plant specific emissions calculations.

For the IPCC Tier 2 method the calculation has to take into account each type of feedstock used and each type of process used for carbon black production. The Tier 2 methodology is a mass balance approach that includes both carbon flows of primary and secondary feedstocks to the process. Carbon flows of primary fuels to the process may involve combustion of part of the hydrocarbon content for heat raising and the production of secondary fuels (e.g. off gases). In order to apply the Tier 2 methodology the flows of primary and secondary feedstocks to the process and the flows of primary and secondary products must be characterised, and the flows of by-products burned for energy recovery within the process and flows of by-products transferred out of the process must be characterised. The IPCC Tier 3 method uses plant-specific data for the petrochemical process (2006 IPCC Guidelines, Volume 3), p. 3.64).

As the emission calculation under the ETS is performed for individual source streams and plants, the ETS data confirms with the IPCC Tier 3 method.

In the German inventory under the 1996 IPCC guidelines, carbon black production is reported within CRF (old) 2B5 “other chemical industry”. 2B5 used to be a key category for CO₂ emissions (NIR 2013). Under the 2006 IPCC guidelines, carbon black is reported in the new CRF category 2B8 “Petrochemical and Carbon black production”, subcategory 2B8f “Carbon black”. A key source analysis for CRF (new) 2B8 / 2B8f is not yet available. The German inventory uses IPCC default factors from Table 3.23 of Volume 3 of 2006 IPCC Guidelines for CO₂ emissions from carbon black for primary consumption for the furnace black process (Tier 2 method). The ETS data therefore could allow implementing a higher Tier method for CO₂ emissions from carbon black production based on plant-specific data as well as a check of the default parameters applied in the GHG inventory.

3.16.3 Conclusions

It should be checked whether all three German plants report under the ETS and whether the reported data include the individual source streams for primary and secondary feedstocks for the production processes applied. If this can be confirmed, the methodology used for the GHG inventory could be improved based on the ETS data.

3.17 Production of nitric acid (TEHG activity 23), production of adipic acid (TEHG activity 24) and production of glyoxal and glyoxylic acid (TEHG activity 25)

These activities featuring N₂O emissions are subject to complex processes and methodologies in the ETS monitoring. A detailed analysis was excluded from the scope of this report.

3.18 Production of ammonia (TEHG activity 26)

3.18.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of ammonia production activity under the EU ETS (Section 17 of Annex IV of the MRR) includes CO₂ emissions from:

- ▶ 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.

No minimum threshold applies.

In the GHG inventory, category 2.B.1 Ammonia production covers CO₂ process emissions from fuels (mostly natural gas) used as process inputs in the steam reforming process and the regeneration of the CO₂ scrubbing solution. In the past, CO₂ emissions from combustion processes were reported in the inventory under category 1.A.2.c Manufacturing industries and construction – Chemicals, however this has been changed with the 2006 IPCC Guidelines and Revised UNFCCC Reporting guidelines for GHG inventories and a footnote to Ammonia production in the revised CRF tables now indicates: “To ensure that double counting does not occur, fuel consumption (e.g. natural gas) in ammonia production should not be included in the energy sector.” Note that the emissions from the production of hydrogen or synthesis gas used in the 2.B.1 Ammonia production may be reported in TEHG activity 28, see section 3.20 below.

3.18.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

In accordance with the ETS MRR 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 Annex IV of the MRR shall be applied which is the multiplication of fuel use with an EF. This approach for process emissions is consistent with the inventory estimation.

Under the ETS MRR, where CO₂ 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 CO₂ shall be considered as emitted by the installation producing the CO₂ (Section 17 of Annex IV of the MRR).

This approach related to the transfer of CO₂ to urea production and other CO₂ uses as feedstocks is not consistent with the approach in the 2006 IPCC Guidelines and the revised UNFCCC reporting guidelines for GHG inventories.

A footnote to ammonia production in the CRF tables indicates:

“Should CO₂ from ammonia production be recovered for downstream use and be excluded from the reporting in category 2.B.1, the products and the purposes for which the CO₂ is used should be clearly explained in the NIR for the most recent inventory year. The related CO₂ emissions from these products and significant uses shall be reported in the relevant source categories in the inventory if these emissions occur within the borders of the Party concerned. Parties shall provide an overview in the NIR in which other source categories of the GHG inventory CO₂ emissions from significant uses of urea are reported.” (Footnote to CRF Table 2(I).A- Hs1).

Thus, while under the ETS the CO₂ transfer via urea out of the ETS system cannot be deducted from ammonia production, it will be deducted in the inventory reporting from 2015 onwards. In the current inventories, the same rules apply as under the ETS and such CO₂ transfer cannot be subtracted from ammonia production.

Most of the CO₂ captured from ammonia production is used for urea production which is mostly applied as fertilizers in agriculture and used in catalysts in transport. Thus, it is likely that considerably amounts of the CO₂ transfers are outside the ETS boundaries and therefore this difference in the accounting of CO₂ transfers is relevant for the comparison of ETS data and inventory data.

Since the 2010 submission of the German inventory, emissions data for this source category have been collected and reported in accordance with the Tier 3 method. This is on the basis of a co-operation agreement with the relevant plant operators for delivery of plant-specific data (NIR 2013). Plant operators provide plant-specific data via the agrochemical industry association:

- ▶ ammonia quantities produced (activity data),
- ▶ quantities of raw materials used in the process (natural gas, heavy mineral oil),
- ▶ fuel quantities used for energy purposes and so reported in the Energy Balance,
- ▶ raw materials' carbon content factor and carbon oxidization factor,
- ▶ quantity of CO₂ that undergoes further processing.

The association checks and aggregates the data and provides the Federal Environment Agency the relevant activity data, process-related CO₂ emissions and quantities of CO₂ recovered and subjected to further processing (NIR 2013, 4.3.1.2).

Thus, in principle, the data between ETS reporting and inventory reporting should be comparable, provided that they can be compared at a sufficiently disaggregated level

3.18.3 Differences in emission factors

Both ETS MRR and IPCC Tier 3 use plant specific emissions factors.

3.18.4 Conclusions

For the comparison of ETS data from ammonia production with inventory emissions, it is essential to disaggregate ETS data to separate source streams and elements that allow a comparison with the German inventory at the following level of detail:

- ▶ ammonia quantities produced which are however not provided in the emission reports by ETS installations as not relevant in the approach under the ETS, but could be gained from the operator's notification about planned or effective changes to the capacity, activity level and operation of an installation.
- ▶ quantities of fuels used. In the 2006 IPCC Guidelines fuel consumption is no longer separated between process emissions and combustion for ammonia production and the CRF tables include the footnote: "To ensure that double counting does not occur, fuel consumption (e.g. natural gas) in ammonia production should not be included in the energy sector." This change in the inventory reporting enhanced the consistency of the scope of ETS data and inventory data.
- ▶ fuel types and quantities used,
- ▶ carbon content of fuels used,
- ▶ carbon content factor and carbon oxidization factor of fuels used,

- ▶ quantity of CO₂ of captured and used in urea production or other feedstock uses and transferred to other ETS installations,
- ▶ quantity of CO₂ of captured and used in urea production or other feedstock uses and transferred outside the ETS.
- ▶ emissions from the production of hydrogen or synthesis gas for ammonia production that may have been reported in TEHG activity 28, see section 3.20.

Theoretically also the CO₂ amounts captured and stored in geological storage sites (CCS) is relevant. This is currently not relevant in Germany.

With this information ammonia production emissions reported under the ETS should be comparable in a relatively straightforward way.

Urea is one of the main products in ammonia production in which CO₂ from fuel consumption is stored. The revised UNFCCC reporting guidelines for GHG inventory applicable from 2015 onwards indicate that the products such as urea should be tracked and reported in the categories where they are consumed. For this purpose an overview should be provided in the NIR in which other source categories CO₂ in urea subtracted from ammonia production is consumed.

The previous project (Müller-BBM and IZT) already identified urea as material reported as part of the ETS data which has no material description in the ZSE. Thus, in the ETS data urea use as part of fuel combustion activities can be identified and reported which could be an input for such new overview of urea uses required in the GHG inventory from 2015 onwards. This can be done already based on the existing ETS data in 2014 as the previous project already identified urea as a material.

3.19 Production of bulk organic chemicals (TEHG activity 27)

3.19.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of this activity under the EU ETS covers the “Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day” (Annex I to Directive 2003/87/EC).

Where a facility for the production of bulk organic chemicals is integrated in a mineral oil refinery, no threshold applies, because the reporting obligation that apply to the refining of mineral oil (which has no threshold) also applies. It may be the case that separate bulk organic chemicals production facilities below the 100 tonnes per day capacity level are in operation. However, usually chemical plants that include cracking activities are relatively large and it is likely that the ETS has a relatively complete coverage of these plants. However it is necessary to assess the coverage of the ETS emissions compared to the inventory emissions.

These ETS bulk organic activities are largely aligned with those listed in 2006 IPCC Guidelines: 3.9 Petrochemical and Carbon Black Production. However it is not clear whether under the MRR emissions associated with the production of bulk organic chemicals requires specification of each organic chemical type. For the purposes of the GHG inventory, emissions related to individual organic chemicals need to be reported separately as indicated in the list below. In the 2006 IPCC Guidelines the following products are specified with separate methods:

- ▶ Methanol production
- ▶ Ethylene and propylene production
- ▶ Ethylene Dichloride and Vinyl Chloride Monomer Production
- ▶ Ethylene oxide production,

- ▶ Acrylonitrile production,
- ▶ Other, e.g. styrene production

It would be important to identify these products separately in the reported ETS data under this activity. Methanol, ethylene, propylene, ethylene dichloride, vinyl chloride monomer and ethylene oxide are reported separately under the ETS and could therefore be aggregated for the GHG inventories.

In accordance with the ETS MRR, the scope of the bulk organic chemicals includes the following sources:

- ▶ cracking (catalytic and non-catalytic),
- ▶ reforming,
- ▶ partial or full oxidation,
- ▶ similar processes which lead to CO₂ emissions from carbon contained in hydrocarbon based feedstock,
- ▶ combustion of waste gases and flaring,
- ▶ and the burning of fuel in other combustion processes.

The 2006 IPCC Guidelines introduce a change in the allocation of combustion emissions from fuels obtained from feedstocks. Combustion emissions from fuels obtained from the feedstocks should be allocated to the source category in the IPPU (industrial processes and product use) Sector. However, where the fuels are not used within the source category but are transferred out of the process for combustion elsewhere (e.g. for district heating purposes) the emissions should be reported in the appropriate Energy Sector source category (IPCC 2006 Guidelines, Volume 3, Chapter 3, p. 3.57). Thus, the new CRF source category 2.B.8 Petrochemical and carbon black production should be generally consistent with the ETS emissions from bulk organic chemicals. However, this describes the future reporting situation starting from 2015.

The current German GHG inventory only reports CO₂ emissions from the production of methanol and coke burn-off for catalyst regeneration in refineries, other emission sources from refineries for the production of organic chemicals (heavy-oil gasification, calcination and hydrogen production) are covered as part of the emission estimation for refineries in the energy sector.

The reporting of CO₂ emissions from bulk organic chemicals under the ETS could serve as a verification to check whether additional organic chemicals are produced that are not yet included in the GHG inventory. A comparison of the scope of emissions should also take into account that petrochemical production may be also included to some extent under petroleum refining and not reported separately where this production occurs at integrated petrochemical plants. This allocation between refineries and chemical production may also be different in the inventory and the ETS data.

In petrochemical plants pure CO₂ may be captured and transferred and utilized to other plants as a feedstock. Such transfer of pure CO₂ cannot be deducted by the transferring ETS installations. 2006 IPCC Guidelines recommend that “to avoid double counting the CO₂ captured should not be reported as CO₂ emissions from the process from which the CO₂ is captured.” (2006 IPCC Guidelines, Volume 3, p. 3.57). Therefore the transfer of CO₂ may result in potential inconsistencies in the reported CO₂ emissions, if the CO₂ is transferred to a Non-ETS installation.

3.19.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

Both ETS and 2006 IPCC Guidelines allow mass balance or standard methodology (activity data and emission factors) methodologies. Tier 1 method in the IPCC Guidelines as an emission factor methodology is applied to estimate CO₂ emissions from the petrochemical process in cases where neither plant specific data nor activity data for carbon flows are available for the petrochemical process. The Tier 1 emission factor method does not require activity data for the consumption of each carbon containing feedstock to the petrochemical production process. It requires only activity data for the amount of product produced. The Tier 1 methodology does not consider the carbon content of emissions of carbon monoxide or NMVOC that may be generated by the petrochemical processes. The IPCC Tier 2 method is a feedstock-specific and process-specific carbon balance approach while Tier 3 uses plant-specific data.

For the ETS MRR whether or not the production facility is part of a mineral oil refinery, emissions due to production of bulk organic chemicals are calculated using a mass balance or standard methodology (activity data and emission factors). For the standard methodology the MRR specifies default stoichiometric emission factors for process emissions from other process materials (Bulk organic chemicals) from the 2006 IPCC Guidelines. Large facilities (categories B and C) have to determine plant-specific parameters.

The emissions from this category combined with carbon black emissions have been identified as key categories in the German 2014 inventory submission which requires to use Tier 2 or 3 IPCC methods. Whether the methods used under the ETS are sufficient related to the requirements for GHG inventories depends on the size of installations. If default parameters would be applied for small installations under the ETS, the approach would not be consistent with the inventory requirements. However, if the installations fall under large facilities in categories B and C of the ETS MRR, the ETS requirements are sufficient for the inventory purposes.

3.19.3 Differences in emission factors

What has been explained related to the methodology also applies to the emission factors. Default factors applied under the EU ETS for small installations would only be consistent with IPCC guidelines, if the source category is not a key category.

3.19.4 Conclusions

The reporting of CO₂ emissions from bulk organic chemicals under the ETS could serve as a verification to check whether additional organic chemicals are produced that are not yet included in the GHG inventory. For this purpose it would be necessary to disaggregate ETS data into separate chemical products.

In addition the CO₂ emissions reported for methanol production should be compared between the ETS and the GHG inventory to check the consistency. However, it has to be taken into account that due to ETS thresholds, there may not be a complete coverage of emissions under the ETS compared to the inventory emissions. In addition, the allocation of combustion emissions to CRF source categories will change between the 2014 and 2015 inventory submission.

3.20 Production of hydrogen and synthesis gas (TEHG activity 28)

The GHG inventory does not report hydrogen or synthesis gas production apart from hydrogen production in petroleum refineries. These emissions activities are covered as part of refineries' own consumption (NIR 2013, 4.3.5.2) and may appear in the ETS activity petroleum refining

(section 3.2). Some countries however (e.g. USA, Finland) report the production of hydrogen separately.

While separate hydrogen and synthesis gas plants, which are not part of petroleum refineries, could report TEHG activity 28, this is not necessarily a GHG inventory reporting omission. It is possible that these plants are part of other non-refinery chemical plants, such as synthesis gas for ammonia production, in which case the associated emissions would appear in the GHG inventory in the IPPU (industrial processes and product use) sector.

3.20.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The IPCC 2006 Guidelines do not specifically identify hydrogen and synthesis gas production as occurring outside refineries other than as intermediates in the production of other chemicals. Synthesis gas is a transition stage in the production of chemicals such as ammonia, formaldehyde, methanol, carbon monoxide and hydrogen. The Guidelines state that emissions from these processes should be accounted for in the IPPU sector (2006 IPCC Guidelines, Volume 2: Energy, 2.3.3.3, p. 2.32). The Guidelines also state that the CO₂ resulting from the production of hydrogen at refineries and heavy oil/bitumen upgraders should be reported under subcategory 1.B.2.a.i. (under Fugitive Emissions). GHG reporting has no minimum threshold for reporting.

The scope of this activity under the EU ETS includes CO₂ emissions from facilities for production of hydrogen (H₂) and synthesis gas (H₂ and CO) production by reforming or partial oxidation with a capacity exceeding 25 tonnes per day.

3.20.2 Differences in emission factors and other parameters

The EU ETS (Section 19 of Annex IV of the MRR) includes CO₂ emissions from:

- ▶ 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.

Separate specific monitoring rules apply for synthesis gas (mass balance) and hydrogen production standard methodology (see section 3.2.2).

IPCC parameters are not defined as the emissions associated with the production of hydrogen and synthesis gas outside petroleum refineries is recognised as part of integrated chemical production and not captured in a separate method.

3.20.3 Conclusions

Investigation of differences in reported emissions under the EU ETS and in the GHG inventory should bear in mind that emissions reported under TEHG activity 28 could be counted in different parts of the inventory. Potential sub-sectors to include when analysing TEHG activity 28 could include: 2B1 Ammonia Production, 2B2 Nitric Acid Production, and 2B8a Methanol Production, 2.B.8 Petrochemical production.

3.21 Production of soda ash and sodium bicarbonate (TEHG activity 29)

3.21.1 Differences in scope of activities/ source categories (definition in the ETS Directive)

The scope of soda ash (Na₂CO₃) and sodium bicarbonate (NaHCO₃) production activity under the EU ETS (Section 20 of Annex IV of the MRR) includes CO₂ emissions from:

- ▶ fuels used for combustion processes, including fuels used for the purpose of producing hot water or steam;
- ▶ raw materials, including vent gas from calcination of limestone, to the extent it is not used for carbonation;
- ▶ waste gases from washing or filtration steps after carbonation, to the extent it is not used for carbonation

No minimum threshold applies.

Under the 2006 IPCC Guidelines, combustion emissions for soda **production** are counted under CRF 1A2c: “Manufacturing Industries and Construction: Chemical Industry”. Process emissions from the production on soda ash are accounted for under CRF (new) 2B7. However, emissions from the **use** of soda ash are allocated to the Industrial process emissions in CRF 2A: In contrast to the old 1996 IPCC guidelines, however those emissions from soda use are no more accounted for jointly in a single source category (2A4 under the old CRF). Instead, the emissions from soda ash (and other carbonate) applications are accounted for in the respective application sectors: 2A1 Cement production, 2A2 Lime production, 2A3 Glass production, 2A4a Ceramics or 2A4b Other uses of soda ash.

3.21.2 Differences in methodologies and algorithms (Annex IV Activity-specific monitoring methodologies related to installations for ETS)

According to section 20 of Annex IV of the MRR, a mass balance approach is to be used under the ETS. Operators may choose to include combustion emissions in the mass balance. If not, they have to avoid gaps or double counting. For CO₂ fixed in soda, the rules on inherent CO₂ (cf. section 2.1) do not apply as soda is no fuel. While CO₂ fixed in soda will thus be subtracted in the mass balance, this is not the case for CO₂ fixed in sodium bicarbonates: The amount of CO₂ used for producing sodium bicarbonate from soda ash shall be considered as emitted by the installation producing the CO₂.

3.21.3 Differences in emission factors and other parameters

Annex VI of the MRR specifies an emission factor of 0.524 t CO₂ /t NaHCO₃. The 2006 IPCC guidelines do not specify a conversion factor for sodium bicarbonate.

3.21.4 Conclusions

ETS net emissions (combustion emissions minus CO₂ fixed in soda) do contain CO₂ fixed in sodium bicarbonate. CO₂ fixed in sodium bicarbonates (and counted as emissions under the ETS) should be identified and subtracted from ETS net emissions in order to enable a comparison with combustion emissions calculated in the inventory (380 kg CO₂ per t Soda according to NIR 2013).

3.22 Greenhouse gas emissions from CO₂ capture activities, CO₂ transport and storage in a storage site permitted under Directive 2009/31/EC (TEHG activities 30, 31 and 32)

The ETS activities covered under TEHG 30, 31 and 32 related to

- ▶ Capture of greenhouse gases from installations covered by this Directive for the purpose of transport and geological storage in a storage site permitted under Directive 2009/31/EC
- ▶ Transport of greenhouse gases by pipelines for geological storage in a storage site permitted under Directive 2009/31/EC

- ▶ Geological storage of greenhouse gases in a storage site permitted under Directive 2009/31/EC

currently do not occur in Germany and no CO₂ emissions are reported under the ETS. Therefore it is also not necessary to further elaborate on these activities as no data comparisons can be performed.

4 Summary of conclusions on usability of ETS data for inventory purposes

Table 4-1 presents an overview on the findings of the analysis by ETS activity. Therein, the activities are allocated into three categories related to likely comparability with the inventory data:

- ▶ Category 1: ETS activities featuring little systematic differences and relatively high comparability and consistency to the respective inventory source categories
- ▶ Category 2: ETS activities featuring clear systematic differences, where comparability can be achieved by means of calculations and allocation rules or using additional data and assumptions.
- ▶ Category 3: ETS activities featuring considerable systematic differences which cannot easily be quantified

Table 4-1: Overview on ETS activities as defined in the German TEHG and the EU ETS Directive

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
1 - 6	Fuel combustion >20 MWth	1.A.1, 1.A.2, 1.A.3.e, 1.A.4, 1.A.5, 1.B.2, 2.B, 2.C	check to what extent installations rely on mass balance methods in which specific areas and whether this decreases the comparability of the ETS data with inventory data;	derive country-specific EFs and NCVs for the fuels used by ETS installations on ZSE source category aggregation level estimate the fraction of non-ETS fuel consumption for this aggregate ZSE source category; derive EFs and NCVs for the non-ETS fuel consumption for this aggregate ZSE source category;	2 – 3
7	Refining of mineral oil	1.A.1.b, 1.A.1.c 1.A.2.c 1.B.2.a, 1.B.2.c, 1.B.2.a.iv 2.B.8	reflect changes in CRF codes on top of activity-specific allocation conclusions from Müller-BBM and IZT (2012)	in case where emissions from coke burn-off in catalyst regeneration can be identified: check inventory allocation 2.B.8 (petrochemical and carbon black production) or 2.B.10 (other chemical industry)	2
8	Production of coke	1.A.1.c, 2.B.1.b 1.A.2 2.C.2	check for changing patterns on CO ₂ transfers on top of activity-specific allocation conclusions from Müller-BBM and IZT (2012)	As major part of coke production is covered in integrated steel plant installations, To be aggregated with activities 9 'metal ore processing & 10	1

⁴ CRF categories based on CRF tables as adopted as part of decision 24/CP.19 "Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention" that implemented 2006 IPCC Guidelines for GHG inventories

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
9	Metal ore processing	1.A.2.a, 2.C.1 2.C.5 2.C.6 2.C.7	identify transfers of inherent CO ₂	'production of pig iron or steel' for inventory comparison To be aggregated with activities 8 'coke production' and 10 'iron & steel' for inventory comparison	3
10	Production of pig iron or steel	1.A.2.a, 2.C.1 , 1.B. 1.A.1.c	Analyse CO ₂ transfers	To be aggregated with activities 8 'coke production' and 9 'metal ore processing' for inventory comparison Repeat analysis of Müller-BBM and IZT (2012) regarding process gases for recent years	3
11	Production or processing of ferrous metals (including ferro-alloys)	1.A.1.c, 1.A.2.a, 2.C.1, 2.C.2,	Identify emissions from graphite electrodes Identify limestone and dolomite use	Consider using ETS data as activity data source for ferro-alloys Compare EF for electrode consumption in ETS & ZSE Consider use of ETS data on limestone & dolomite use for ferroalloys inventory	2-3
12	Production of primary aluminium	1.A.2.b, 2.C.3,	Distinguish PFC and CO ₂ emissions Distinguish among PFCs: CH ₄ & C ₂ F ₆ Separately identify CO ₂ emissions from anode consumption (for comparison to new CRF 2C3) Other CO ₂ for comparison with CRF 1A2b	Compare CRF 1.A.2.b Non-Ferrous metals inventory data to ETS emissions (non-process emissions from activities 12 6 13)	1 (PFC), 2-3 (CO ₂)

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
13	Production or processing of non-ferrous metals	1.A.2.b, 2.C.4, 2.C.5, 2.C.6, 2.C.7	Distinguish process emissions for new CRF categories Magnesium (2A4), lead (2A5), zinc (2A6) and other (2A7)	Compare CRF 1.A.2.b Non-Ferrous metals inventory data to ETS emissions (non-process emissions from activities 12 6 13) Reconfirm non-occurrence of process emission as presently reported in inventory	2-3
14	Production of cement clinker	1.A.2.f, 2.A.1	Confirm for more recent years that process emissions from cement production are consistent between inventory and ETS data.		1 (process emissions, 2 (combustion emissions)
15	Production of lime or calcination of dolomite or magnesite	1.A.2.f, 2.A.2	Separate process emissions from lime under ETS and compare with inventory data for more recent years. Identify lime production in installations that are not under the activity 15 (sugar plants) Analyse whether ETS data includes information on impurities of CaO and CaO·MgO.	Compare emissions and productions in sugar plants and potentially other non-marketed lime with inventory data Check whether inventory assumptions related to impurities	2
16	Manufacture of glass	1.A.2.f, 2.A.3, ,	Separate process and combustion emissions For combustion emissions separate power plants For process emissions, identify waterglass production For process emissions, identify soda based CO ₂ emissions Identify emissions from flue gas scrubbing	Consider allocation of stone wool emission into the new non-glass CRF codes (2A4b/d) Consider reporting waterglass emissions in 2A3 (new): glass Consider using ETS data on flue gas scrubbing for inventory	2

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
				Consider using ETS data on soda based emissions for quality control of soda balance in CRF (old) 2A4 'soda ash production and use' / CRF (new) 2A4b "other uses of soda ash"	
17	Manufacture of ceramic products	1.A.2.f, 2A4a	Identify ETS emissions calculated under method B (output based, alkali oxide) Identify non-carbonate process emissions under the ETS.	Check trend break between 2012 and 2013 due to change of ETS scope: Number of reporting installations & ETS to inventory ratios for combustion and process emissions investigate whether combustible materials which are accounted for as additives / process emissions under the ETS correspond to parts of the fuel use data used for the calculation of combustion emissions from the ceramic industry for the inventory	3
18	Manufacture of mineral wool insulation material	1.A.2.f, 2.A.3, 2.A.4.b, 2.A.4.d 2.A.5	Separate process and combustion emissions For combustion emissions separate power plants For process emissions, identify soda based CO ₂ emissions Identify emissions from flue gas scrubbing	Consider allocation of stone wool emission into the new non-glass CRF codes (2A4b/d) Consider using ETS data on flue gas scrubbing for inventory Consider using ETS data on soda based emissions for CRF	2

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
19	Manufacture of gypsum	1.A.2.f	Confirm that only combustion emissions (for CRF (new) 1A2f are reported under the ETS	(new) 2A4b “other uses of soda ash” & other ETS process emission for CRF (new) 2A4d: “other” other uses of carbonates	1 (no separate CRF section, though)
20	Production of pulp	1.A.2.d, 2.A.4	CO ₂ combustion emissions from substitute fuels should be identified separately from CO ₂ emissions from regular fuels Special care should be taken in differentiating biogenic and fossil CO ₂ Process emission from carbonates should be differentiated from other reported process emissions if any CO ₂ process emissions from carbonates should be differentiated into emissions from soda (Na ₂ CO ₃) application and other carbonates	Consider using ETS data on process emissions for the inventory Compare ETS combustion emission from substitute fuels with inventory data in 1A2d (jointly with activity 21 paper production)	2
21	Production of paper	1.A.2.d, 2.A.4	CO ₂ combustion emissions from substitute fuels should be identified separately from CO ₂ emissions from regular fuels Process emission from carbonates should be differentiated from other reported process emissions if any CO ₂ process emissions from carbonates should be differentiated into emissions from	Consider using ETS data on process emissions for the inventory Compare ETS combustion emission from substitute fuels with inventory data in 1A2d (jointly with activity 20 pulp production)	2 - 3

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
			soda (Na ₂ CO ₃) application and other carbonates		
22	Production of carbon black	1.A.2.c, 2.B.8.f	Check whether all three German plant operators mentioned in the NIR do report under the ETS (in total 6 plants from 7 are covered under ETS)	Compare ETS & inventory CO ₂ emissions	1
23	Production of nitric acid	1.A.2.c, 2.B.2	No detailed analysis in this report	Comparison of ETS with inventory should confirm comparability for N ₂ O emissions	1 -2 (N ₂ O)
24	Production of adipic acid	1.A.2.c, 2.B.3	No detailed analysis in this report	Comparison of ETS with inventory should confirm comparability for N ₂ O emissions	1 -2 (N ₂ O)
25	Production of glyoxal and glyoxylic acid	1.A.2.c, 2.B.4.b, 2.B.4.c	No detailed analysis in this report	Use ETS for inventory in case of N ₂ O emissions from ETS	1 -2 (N ₂ O)
26	Production of ammonia	1.A.2.c, 2.B.1, CO₂ captured: 3.H 1.A.3.b 2.D.3	Identify quantities of ammonia produced Identify quantities of fuels used in the process (relevant fuels used indicated in the inventory are natural gas, heavy mineral oil), Identify fuel types and quantities used for combustion processes Identify carbon content factor and carbon oxidization factor of fuels used, Identify quantity of CO ₂ of captured and used in urea production or other feedstock uses and transferred to other ETS installations, Identify quantity of CO ₂ of captured and	Emissions associated with hydrogen or synthetic gas production, used for ammonia production may be reported in TEHG activity 28	2 - 3

TEHG 2020 activity No	Activity (short name)	Expected CRF categories ⁴	Issues for ETS data analysis	Issues for follow-up analysis and comparison with inventory	categorisation
			used in urea production or other feedstock uses and transferred outside the ETS. Identify urea use as part of fuel combustion activities		
27	Production of bulk organic chemicals	1.A.2.c, 2.B.8 2.b.10	Disaggregate ETS data into separate chemical products Assess whether additional chemical production with CO ₂ emissions occur apart from methanol production	Compare emissions for methanol production with inventory emissions	2
28	Production of hydrogen and synthesis gas	1.A.2.c, 1.A.1.b, 1.B.2.a.4, 2.B.1, 2.B.2, 2.B.8.a	Does not occur in GHG inventory, should be checked whether emissions are reported under ETS For emissions reported under the ETS, a potential allocation to refineries should be checked, based on information on the economic sector (NACE code)	Hydrogen or synthetic gas production emissions reported in TEHG activity 28 may be counted in the inventory under ammonia production (and possibly nitric acid or methanol production).	2 – 3
29	Production of soda	1.A.2.c, 2.B.7	Combustion component of emissions to be allocated to CRF (old/new) 1A2c. Chemical industry CO ₂ fixed in sodium bicarbonates (and counted as emissions under the ETS) to be identified and subtracted	Cross check ETS results with inventory data on combustion emission (380 kg CO ₂ / t soda)	1

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