Methodology for the free allocation of emission allowances in the EU ETS post 2012

Report on the project approach and general issues

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Disclaimer and acknowledgements

Disclaimer
The views expressed in this study represent only the views of the authors and not those of the European Commission. The focus of this study is on preparing a first blueprint of an allocation methodology for free allocation of emission allowances under the EU Emission Trading Scheme (EU ETS) for the period 2013 – 2020. Given this blueprint status, the report contains several open issues that will need further consideration in the further process that should ultimately result in Community-wide and fully-harmonised implementing measures for free allocation to be adopted in December 2010. This report assumes from the reader a good understanding of the EU Emission Trading Scheme including the text of the amended EU ETS directive. Together with this report on the project approach and general issues, thirteen sector reports are published for the refinery, iron ore, iron and steel, aluminium, other non-ferrous metals, cement, lime, glass, ceramics, mineral wool, gypsum, pulp and paper, and chemical industry with a proposed allocation methodology for those sectors.

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Summary

Introduction and scope

In 2013, the third trading period of the EU emission trading scheme (EU ETS) will start. With a few exceptions, no free allocation of emission allowances is foreseen in this third trading period for the emissions related to the production of electricity. These emission allowances will be auctioned. For other emissions, transitional free allocation of emission allowances is envisioned. This free allocation will be based on Community wide allocation rules that will, to the extent feasible, be based on ex-ante benchmarks.

In 2013, the free allocation is 80% of the quantity determined via these rules, going down to 30% in 2020. An exception is made for activities that are deemed to be exposed to a significant risk of carbon leakage. These activities will receive an allocation of 100% of the quantity determined via the rules. The benchmarks should in principle be calculated for products, i.e. a specific performance per unit productive output, to ensure that they maximize greenhouse gas reductions throughout each production process of the sectors concerned.

In this study for the European Commission, a blueprint for a methodology based on benchmarking is developed to determine the allocation rules in the EU ETS from 2013 onwards. In case where benchmarking is not regarded feasible, alternative approaches are suggested. The methodology allows determining the allocation for each EU ETS installation eligible for free allocation of emission allowances.

Methodological approach and basic principles

Some industrial activities are included in the EU ETS via the inclusion of their product or main production process (e.g. iron and steel, oil refineries, lime or ammonia) in the scope of the Directive. We grouped these activities into 13 sectors and explored the feasibility of product benchmarks for each of these sectors. Other installations may be included in the EU ETS, because they operate units for the combustion of fuels with a total thermal input exceeding 20 MW. Via this activity, electricity producing installations are included, but also installations in a variety of other sectors. The existence and size of the combustion installation determines the inclusion of these installations in the EU ETS. As a result, many of these sectors are only partially included in the EU ETS, either because not all installations in the sector have combustion units installed above the threshold of 20 MW or because some installations in these sectors receive heat (e.g. steam or hot water) from other installations. We did not focus on developing product benchmarks for these sectors, but propose to apply, in principle, for those installations the fall-back approaches outlined below. At a later stage, additional product benchmarks for some of those sectors might be considered.

The amended EU ETS Directive prescribes that the starting point in setting the benchmark levels should be the average performance of the 10% most efficient installations in the Community (interpreted in this context as the European Economic Area) in 2007 – 2008. In view of the ultimate goal of the EU ETS as a policy instrument to reduce emissions of greenhouse gases, "most efficient" is for the purpose of this study read as "most greenhouse gas efficient". We thus aimed to determine benchmarks that are representative for the 10% most greenhouse gas efficient installations in the Community that produce a certain benchmarked product. In principle, all emissions (including those related to heat generation) are taken into account in these benchmarks apart from those attributed to electricity consumption.

In developing product benchmarks, we followed a "one product, one benchmark" principle, implying that benchmarks are not differentiated by technology, fuel mix, size, age, climatic circumstances or raw material quality of the installations producing the product. This way, all greenhouse gas emission reduction options remain an integral part of the benchmarking methodology.

In product benchmarking, the way a product is defined is an important issue. We followed the principle that intermediate products that are traded between EU ETS installations should get an individual benchmark, because otherwise the calculation of the allocation for installations only producing intermediates or starting from intermediate products becomes complex. Furthermore, each distinguished product should be definable based on unambiguous product classifications, allowing verification of production data and a uniform application of the benchmarks across the EU. To determine which products should be distinguished within a sector, we looked at:

- The difference in emission intensity between the products in a sector that are similar in general type of application (i.e. to judge whether products could be grouped into an aggregated product group with the same benchmark)
- The share of the emissions from a product group in the total emissions of the sector (we tried to develop product benchmarks for the majority of the emissions in a sector)
- The share of the emissions from a product group in the total EU ETS (we tried to cover the majority of the emissions eligible for free allocation with a product benchmark)
- The number of installations producing a certain product (if there are too few installations, a benchmark is difficult to determine)

We have tried to be transparent in how these factors were taken into account to decide on a final proposal for the number of distinguished products. For the non-benchmarked products of sectors for which product benchmarks are developed and for sectors for which no product benchmarks are developed, the fall-back approaches outlined below are envisioned.

The EU ETS Directive prescribes an ex-ante allocation system. This means that the benchmarks (i.e. the specific performance per unit of production) need to be combined with historical activity data determine an allocation. We recommend applying historical production figures (as opposed to capacity data with standardized utilisation rates) for existing installations and historic product-specific capacity utilization rates with capacity data for new installations. Within the scope of this study, we do not further discuss which historical years to apply.

Fall-back approaches when product benchmarks are not proposed

Product benchmarks are not proposed for the installations that are only included in the EU ETS, because they operate units for the combustion of fuel. Furthermore, product benchmarks have not been developed for all the products in sectors for which benchmarks are proposed. For the emissions related to the activities not covered via product benchmarks, we propose the following three alternative approaches:

- A heat production benchmark (i.e. t CO_2 / unit of heat produced) for combustion of fuel activities where an intermediate heat carrier (e.g. hot water, steam) is produced that can be measured and monitored
- A fuel mix benchmark (i.e. t CO_2 / GJ of fuel used) for combustion of fuel activities where the heat or mechanical energy produced cannot be measures and monitored (e.g. furnaces)
- Grandfathering for non fuel related process emissions (for this a proper definition of process emissions is required which is not further discussed in this study)

Using these methodologies, an allocation can be calculated for all emissions sources in the EU ETS that are eligible for free allocation.

It should be stressed that these fall-back approaches differ in the way that the factors influencing the overall greenhouse gas performance of a combustion process are taken into account. In product benchmarking, the fuel mix chosen, the efficiency of heat production and the efficiency of heat end-use are all taken into account in determining the benchmark value. When a heat production benchmark is used, the efficiency of the heat end-use is not included in the approaches. In fuel mix benchmarking, also the efficiency of heat production is no longer included in the benchmark. Obviously, in the case of grandfathering, none of these factors are taken into account.

These considerations could be the starting point for discussions on including additional correction factors to the fall-back approaches to bring these approaches more in line with the approach for activities for which a product benchmark is developed. No final recommendation is given in this study on such factors.

Cross-sectoral issues

Cross-boundary heat flows

In many instances, heat is crossing the boundary of EU ETS installations. In case of product benchmarks, the allocation is in such cases determined based on the activity of the entity consuming heat, whereas (part of) the actual emissions occur at the heat producing installation. This raises the question how the allowances should be divided between consumer and producer of heat.

In finding a solution for this, an underlying principle should be that the total amount of allowances for the heat concerned should be equal, regardless the greenhouse gas permitting situation of the heat producing and consuming installation. A straightforward approach ensuring this is to allocate allowances to the consumer of heat when the consumer is under the EU ETS. This would, however, result in the situation that for some EU ETS installations, there is no longer a direct relation between the allowance allocation and the emissions of the installation. We leave it to the process following the publication of this report to decide whether this is regarded acceptable. In case this is not regarded acceptable, we also included other options to deal with cross-boundary heat flows that are based on a heat benchmark for the heat crossing the boundary. Also these options are in line with the underlying principle.

Waste gases

Another cross-sectoral issue is that of waste gases produced in e.g. the iron and steel and chemical industry. The waste gases are a direct result from the production processes, but in itself also have an intrinsic value, because they can be used as fuel in other processes. As such, the waste gases have a relation to two different activities, i.e. the production process where the waste gas is produced and the production process where the waste gas is consumed.

For the determination of the benchmark of the waste gas producer, we propose to deal with this by calculating the emission intensity of the waste gas producer as the sum of the non-waste gas emissions in the process and the emissions in the waste gas produced corrected for the export of waste gas from the production process using the emission factor of natural gas. This formula enables a proper performance comparison between different process configurations where waste gases are either used internally or used in other production units on the site outside the system boundary of the process. To which extent the remaining allowances (i.e. the part related to the exported waste gas) will be allocated to the consumer of the gas depends on the allocation used in the consuming installation. For these consuming installations, the waste gas should, in constructing benchmark curves, be taken into account as natural gas to avoid double counting of emission allowances.

Substitution between electricity and fuel

In some processes, direct emissions (i.e. eligible for free allocation) and indirect emissions related to electricity consumption (i.e. not eligible for free allocation) are to a certain extent interchangeable. Examples are electric versus fuel based furnaces in the rock and glass wool industry. If a benchmark would be based only on the direct emissions of all installations, these benchmarks would be dominated by the electricity intensive processes with little direct emissions, which is an unreasonable outcome if view of the overall greenhouse gas performance.

To avoid this, we propose a benchmark including some of the indirect emissions for mineral wool, refineries (where indirect emissions are an integral part of the approach) and aluminium (casting and secondary aluminium). In the final allocation, these benchmarks need to be multiplied with the share of the direct emissions in the total emissions to avoid free allocation for emissions related to electricity.

For some other processes, such an approach might also be necessary, but no quantitative information is yet available for making a decision. An alternative could be to exclude the electricity intensive processes from the benchmark curve and apply the fall-back approaches for those installations. However, this is more difficult to apply in cases where the share of electricity varies from small to quite large.

Proposed product benchmark by sector

Box 1 lists the products for which a benchmark is currently proposed in this study, including an estimate of the total emission size of the sector in the EU ETS in 2013 and the percentage of these emissions, covered by the product benchmark. The sectors studied have an estimated emission size of 873 Mt CO_2 in the third phase of the EU ETS. This estimate is based on 2008 emissions, but includes the new sectors and installations that will be added in phase III of the EU ETS (in particular most of the chemical sector and the non-ferrous metals). Between 785 and 823 Mt CO_2 (depending on the currently still unknown share of the pulp and paper industry covered by product benchmarks) is covered by the product benchmarks proposed.

For each of the products, preliminary benchmark values have been determined via stakeholder consultations of the relevant European sector organizations representing the relevant sectors. Given the limited time frame available for this study, not all sector organizations were able to deliver data for determining the benchmark values already within the scope of this study. In these cases, alternative sources (e.g. literature values) have been used. All values included in the sector reports should therefore be seen as preliminary, needing further (methodological) refinements. In total, 42 benchmarks are distinguished in the box below (counting the refinery CWT approach applied for refineries, but also for hydrogen and aromatics production in the chemical industry as one), but it should be noted that for some of the sectors (iron and steel, chemicals, ceramics and glass) it is suggested to consider additional or more differentiated benchmarks once more data becomes available. This could enlarge the number of benchmarks to around 60.

For iron and steel, the majority of emissions can be covered via four products, implying that the more diverse downstream activities will be covered via the fall-back approaches. Based on further data evidence, the EAF steel product could be further differentiated.

For the chemical industry, 6 different product benchmarks are proposed and for two of the products (hydrogen and synthesis gas and aromatics), it is proposed to follow the CO_2 weighted t approach for refineries to ensure that the same products are treated the same regardless whether they are produced at refineries or in the chemical industry. By analogy, for steam crackers operated by refineries, the same methodology is foreseen as for those operated by the chemical industry. The 8 product covered with a product benchmark cover the majority of the emissions of the products that are specified in the amended Directive.

Box 1 Summary of product benchmarks proposed in this study. Estimated emissions including emissions related to the on-site production of electricity and the estimated share of the emissions covered by product benchmarks are given between brackets. Values are indicative only.

Sectors > 30 Mt CO_2	Sectors < 30 Mt CO_2
Iron and steel (252.5 Mt CO_2, 94%)	**Ceramic products (26.5 Mt CO_2, 66%)**
Coke	Low density and high density clay blocks
Sinter	Facing bricks and pavers
Hot metal	Roof tiles
EAF non-alloy, high alloy and other alloy steel	Spray-dried powder for wall and floor tiles
Chemical industry (168.0 Mt CO_2-eq., 89%)	Dry-pressed wall and floor tiles
Nitric acid	High heat resistant refractory products
High value chemicals from steam cracking	Low heat resistant refractory products
Adipic acid	**Glass (19.3 Mt CO_2, 100%)**
Ammonia	**(excluding specialty glass)**
Hydrogen / Synthesis gas (refinery CO_2 weighted t methodology)	Flat glass
Soda ash	Hollow glass
Aromatics (refinery CO_2 weighted t methodology)	Continuous filiament fibre
Carbon black	**Aluminium (13.5 Mt CO_2-eq., 96%)**
Cement (157.9 Mt CO_2, 100%)	Alumina
Clinker	Pre-baked anodes
Refineries (155.9 Mt CO_2, 100%)	Primary aluminium
CO_2 weighted t methodology	Secondary aluminium
High value chemicals from steam cracking	**Other non-ferrous metals (4.0 Mt CO_2, 0%)**
Pulp and paper (37.8 Mt CO_2, unknown)	No product benchmarks proposed
Kraft pulp	**Mineral wool (3.0 Mt CO_2, 100%)**
Thermomechanical, Chemi-thermo-mechanical & other mechanical pulp	Mineral wool
Recovered paper	**Gypsum (0.7 Mt CO_2, 100%)**
Newsprint	Raw gypsum / land plaster
Uncoated fine paper	Plaster
Coated fine paper	Gypsum blocks, plaster boards and coving
Tissue	Glass fibre reinforced gypsum
Container board	**Iron ore (0.6 Mt CO_2, 0%)**
Carton board	No product benchmarks proposed
Lime (32.4 Mt CO_2, 96%)	
Lime	
Dolime	
Total 805 Mt CO_2, 23 benchmarks	**Total 68 Mt CO_2, 19 benchmarks**

For cement, a single clinker benchmark is proposed that covers (almost) all of the emissions of the cement sector. A benchmark for cement rather than clinker has been considered, but mainly in view of the principle to develop separate benchmarks for intermediate products to be able to determine an allocation for installations that trade the intermediate product, we propose to apply a clinker benchmark for the cement sector. An additional benchmark for cement making from clinker is then not necessary, because (almost) no direct emissions producing cement from clinker.

For refineries, the envisioned approach is based on the CO_2 weighted t approach in which the individual units at the refinery are combined into a single overall metric for the refinery as a whole. This approach enables a fair comparison of refineries differing widely in complexity with many intermediate products traded between installations and with highly integrated production processes.

For pulp and paper, individual benchmarks are determined for two different pulp groups, recovered paper processing and 6 different paper grades. The preliminary benchmarks are based on literature values. The benchmarks for the paper products are based on non-integrated paper mills. Currently, a bottom-up verification of these values is undertaken by the sector. Once the results of this analysis are available, it should also be assessed to which extent the chosen approach results in significant over-allocation of integrated pulp and paper mills. Based on this assessment, an appropriate solution for this should be found.

For the lime industry, two product benchmarks are proposed (one for lime and one for dolime) based on the same fuel use benchmark, but differing in the amount of process emissions.

For the much differentiated ceramics industry, in total 7 product benchmarks are proposed for the three main sub sectors in terms of emissions (bricks and roof tiles, floor and wall tiles and refractory products). Once further data becomes available, the three products distinguished for the bricks and tiles sector could be further differentiated.

For glass, currently three different benchmarks are proposed with the specialty glass sector being covered by the fall-back approaches. A more differentiated approach with in the order of 10 product benchmarks could be considered once more detailed quantitative information becomes available. It could then also be further considered to include electricity emissions in the benchmark curves (following the methodology outlined above) for some of the products. Alternatively, these furnaces could be treated with the fall-back approaches

For aluminium, similar to the iron and steel industry, four products cover the majority of the industry emissions. The more diverse downstream activities are covered via the fall-back approaches.

For the other non-ferrous metals industry, the relatively small size of the sector in combination with the limited number of installations producing individual products resulted in the proposal not to cover these sectors via product benchmarks, but to apply the fall-back approaches.

For mineral wool, a single benchmark, including indirect emissions from electricity consumption is determined based on a dataset covering the majority of relevant installations in the EU ETS.

For another relatively small sector, the gypsum industry, 4 benchmarks are proposed for the various (intermediate) products in the gypsum product chain. The data basis for this sector is still very weak. In view of the small size of the sector, also the fall-back approach might be a sensible option.

For the iron ore sector, given the relatively small size of the sector in combination with the limited number of installations, the fall-back approach is proposed.

National implementation measures and next steps

The methodology proposed in this study implies that Member States need to take four basic steps in determining the free allocation for each installation. First, basic data needs to be collected such as the NACE code of all activities of the installation. Secondly, the allocation according to the product benchmarks needs to be calculated, if applicable. For this, historical activity data for the base period is required.

For those products, where benchmarks including emissions related to electricity consumption are used, information on the share of electricity emissions in the total emissions is required per installation. In a third step, the fall-back approach needs to be applied for those activities for which no product benchmarks are proposed. This requires historical data on process emissions (if relevant), on the heat output of combustion installations and on the fuel types used by the installation.

It is envisioned that the community wide allocation rules will be accompanied by guidance documents on how to deal with situations such as a lack of data and the need to divide emissions over more than one allocation approach. This if for example the case if part of the heat produced by a boiler is used for a product with a product benchmark and part for non benchmarked activities.

In a fourth step, the allocation might have to be adapted for heat that is crossing the boundary of the EU ETS installation. Finally, depending on the final decisions regarding correction factors for the various fall-back approaches, and the linear and cross-sectoral reduction factor, these factors needs to be applied in order to calculate the final free allocation of the installation.

This study aimed to prepare a first blueprint for a methodology to allocate emission allowances to installations eligible for free allocation in the third trading phase of the EU ETS. The methodologies as described in the various sector reports and the summarizing rule book given in the previous chapter allow the calculation of a basic allocation for each EU ETS installation. Yet, several steps need to be made to come to a harmonized allocation methodology which can unambiguously be applied by the Member States for the calculation of an allocation to each installation.

The benchmark values included in this study are based on preliminary results from benchmark studies conducted by industrial stakeholders or are based on literature values. In some cases, small methodological differences remain between the methodology proposed in this study and the methodologies used by stakeholders in preparing the preliminary benchmark values. It is recommended to decide as soon as possible on the further process to come to the final allocation rules, including clear deadlines on data delivery and data verification.

In this process, it can for some sectors be considered to distinguish additional product groups with a separate benchmark (e.g. based on further quantitative proof of emission intensity differences). Also, it can be considered to develop further product benchmarks for those sectors included in the EU ETS via the combustion of fuel activity for which now the fall-back options are proposed. In any case, the three fall-back options proposed have been described at a rather conceptual level in this report.

Further choices regarding these approaches need to be made such as the necessity to apply additional correction factors to these approaches and a proper definition of emissions that are regarded process emissions. Also a choice needs to be made regarding the choice of historical activity data to be used in the final allocation.

Although many additional steps are to be taken, we are confident that this study forms a solid basis towards the development of a community wide allocation methodology for the third phase of the EU ETS.

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1 Introduction

1.1 Background

An EU-wide greenhouse gas allowance trading scheme (EU ETS) was implemented in January 2005 in accordance with the Greenhouse Gas Emission Allowance Trading Directive (EU, 2003). For Phase I (2005-2007) and Phase II (2008-2012) of the system, the Directive left the choice and design of allocation methodologies largely to the Member States (MS). The third trading period will start in 2013 and is proposed to last until 2020. Following a review of the EU ETS in 2006 and 2007, the European Commission came with a proposal for a revision of the EU ETS in January 2008 (EC, 2008) that went into a co-decision procedure with the European Parliament and Council. This resulted in an amended Directive that was adopted on 17 December 2008. Throughout this report, we refer to this amended directive as the revised Directive. The revised Directive was published as 2009/29/EC on 5 June 2009 in the Official Journal L140/63 of the European Union (EU, 2009).

An important element of the revised directive is that a Community-wide harmonised allocation system is foreseen. In this harmonised allocation system, “auctioning should be the basic principle for allocation, as it is the simplest and generally considered to be the most economically efficient system” (recital 15). No free allocation shall, according to the revised directive, be made in respect of any electricity production except for electricity produced from waste gases and for MS allowed to give free allocation to electricity producing installations with the aim to modernise electricity generation. Also, no free allocation shall be given to installations for the capture, pipelines for the transport or to storage sites for carbon dioxide (article 10a and c).

For other emissions, transitional free allocation is foreseen. This free allocation will be based on EU-wide harmonised rules for free allocation to be based as much as possible on benchmarking. This free allocation is 80% of the quantity determined via the Community-wide allocation rules in 2013, “and thereafter, the free allocation shall decrease each year by equal amounts resulting 30% free allocation in 2020, with a view to reaching no free allocation in 2027” (article 10a, paragraph 11).

Exceptions are installations in sectors which are exposed to significant risk of carbon leakage, i.e. “an increase in greenhouse gas emissions in third countries where industry would not be subject to comparable carbon constraints” (recital 25). Those installations will receive free allowances of 100% of the quantity determined via the Community-wide allocation rules. The criteria that will be used to determine whether sectors and sub-sectors are exposed to carbon leakage are in detail described in the amended directive (Paragraphs 14 – 17 of Article 10a) and include an assessment of additional costs related to the EU ETS and non-EU trade intensity. EU MS approved in September 2009 a draft Decision listing 164 industrial sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage. The final decision should by adopted by the European Commission by the end of 2009.

To summarise, emission allowances under the ETS can, based on the amended directive, be categorized into two groups:

1. Allowances that will be auctioned and do not fall under the Community wide and fully harmonised implementing measures for free allocation of allowances.
2. Allowances that will be allocated for free and fall under the Community wide and fully harmonised implementing measures.

Regarding the 2nd group, the following two main groups can be distinguished[1]:

1. Activities, exposed to a significant risk of carbon leakage, receiving free allowances of 100% of the quantity determined via the harmonised rules.
2. Installations receiving 80% of this amount in 2013, decreasing to 30% in 2020.

The Community wide and fully-harmonised implementing measures (CIMs) for free allocation "shall, to the extent feasible, determine Community-wide ex-ante benchmarks so as to ensure that the allocation takes place in a manner that gives incentives for reductions in greenhouse gas emissions and energy efficiency efficient techniques … For each sector and sub-sector, in principle, the benchmark shall be calculated for products rather than for inputs, so as to maximise greenhouse gas emission reductions and energy efficiency savings throughout each production process of the sector or the sub-sector concerned" (article 10a, paragraph 1).

1.2 Aims of the study

The CIMs should be adopted by the Commission no later than 31 December 2010. This study aims to support the European Commission in setting up these measures by:

1. Ensuring a sound stakeholder involvement process assuring timely involvement of relevant stakeholders during the project
2. Designing allocation rules based on benchmarking that are transparent and as simple as reasonably possible
3. Developing fall-back approaches in case allocation based on benchmarking turns out to be unfeasible, e.g. in view of data requirements
4. Assessing the (additional) data necessary to apply the allocation rules, including issues such as availability, confidentiality, availability and accuracy

Under the same study contract, the European Commission has been supported in the assessment of carbon leakage. This part of the study is not included in this report.

[1] In addition, allowances are set aside for new entrants (Article 10a, paragraph 7), for carbon dioxide capture and storage projects (Article 10a, paragraph 8) and for emissions from electricity in countries modernizing the electricity generation system (Article 10c). Since these are outside the scope of the current study, we do not further discuss these.

1.3 Link to previous work

In 2008, Ecofys and Fraunhofer Institute for Systems and Innovation research (further referred to as Fraunhofer – ISI) supported the European Commission in developing criteria for the development of benchmarking as allocation methodology. Aims of that study, published in February 2009 (Ecofys/Fraunhofer-ISI, 2009) were:

- To summarise benchmarking experiences in Members States (MS) in the first phases of the EU ETS
- To develop rules and criteria for a benchmark based allocation methodology
- To apply the rules and criteria to a selected number of activities.

The 2008 study was based on the Commission Proposal for an amended directive dated 23 January 2008 and did not take into account any changes made to this proposal in the co-decision procedure that resulted in the adoption of the amended directive in December 2008. The 2008 study is an important input to the current study:

- The rules and criteria developed in the 2008 study have been an important basis for determining the allocation rules as outlined in Chapter 4. Required changes resulting from the co-decision procedure will be discussed there.
- The sector studies already performed in the 2008 study for the iron and steel, pulp and paper, lime and glass sector have been an important input into the sector reports for these industries in the current study.

Also the pilot study performed by Öko-Institut and Ecofys in which allocation based on benchmarking for the cement and refinery sectors were discussed (Öko-Institut/Ecofys, 2008) have been an important input for the sector reports for these industries.

1.4 Structure of this report

This report has the following structure. Chapter 2 describes how the various stakeholders (Member States, industry representatives, other stakeholders) have been involved in the execution of this project. The text in the amended Directive on free allocation is discussed in Chapter 3 where also the scope of this study is further explained. In Chapter 4, the basic principles towards the free allocation methodology that have been followed in this study are introduced. The principles are applied to test the feasibility of developing product benchmarks for thirteen industrial sectors included in the EU ETS. The results are discussed in thirteen sector reports. The outcomes are briefly summarised in Chapter 7 of this main report. For emissions that cannot be covered via product benchmarks, fall-back options are required that are discussed in Chapter 5. In Chapter 6, three key cross-cutting issues are discussed (heat flows over installation boundaries, waste gases and the substitutability of electricity and fuel use). In Chapter 0, the allocation rules as developed in this stud are worked out in a summarizing rule book that could (after being worked out further) be used by Member States to determine the allocation for each individual installation. Finally, Chapter 9 summarises the most important next steps that are required in the process to come to adopted CIMs in December 2010.

2 Stakeholder involvement and timeline

2.1 Introduction

Stakeholder involvement is a critical step in the process to come to the CIMs as it will offer a platform for discussion and exchange of information and feedback. In addition it gives an opportunity to all parties involved to overcome bottlenecks and agree on satisfactory outcomes. In this chapter, we briefly describe the stakeholder involvement that played a direct role in the execution of this project (Section 2.2 to 2.4). Given the scope of the study, the stakeholder involvement is discussed here only for the draft allocation rules for free allocation (including issues such as sector classification, data requirements, benchmark levels etc.) and only for the involvement following adoption of the amended Directive in December 2008[2]:

In this study, stakeholder involvement was given shape via three types of stakeholder interactions[3]:

1. The Member State Technical Working Group (MS TWG) meetings
2. The European Climate Change Program (ECCP) meetings
3. Bilateral meetings between the European Commission, the consortium and industrial stakeholders

These three stakeholder interactions will be discussed in more detail below. For each of the three, summarise the type of stakeholders involved, the topics involved, and the level of interaction.

2.2 Member State – Technical working group

Stakeholders: Member States
Interaction: Informative / Active involvement

Under Working Group 3 of the Climate Change Committee (the Comitology Committee), an informal technical working group has been formed comprising key technical benchmarking experts from several Member States. This MS TWG is expected to be the main point of reference for MS to be involved in the discussion on national requirements up the Commission proposal for the harmonised allocation rules expected in September 2010[4]. The group meets

[2] This implies that stakeholder involvement in issues such as the EU ETS auctioning rules and new entrant and close rules are not discussed. The supporting role of the consortium in the assessment of industries that are exposed to a significant risk of carbon leakage is discussed in a separate report and is as such also not included in this overview.
[3] The consortium also took part in other initiatives that were set up around the issue of benchmarking for the EU ETS such as the initiative by the German Member of the European Parliament Erika Mann and the Centre for European Policy Studies (CEPS) task force on benchmarking for the EU ETS and beyond.
[4] Adoption in December 2010

regularly throughout the year to discuss key issues. Within the timeframe of the execution of this project, three meetings have been organized:

- 13 February 2009
- 17 April 2009
- 7 July 2009
- 23 September 2009

In the first meeting in February 2009 the consortium presented the results of the 2008 study on benchmarking criteria (Ecofys/Fraunhofer-ISI, 2009) and the proposed approach for this study. Germany presented the benchmarking experience for Phase II and the pilot project for Phase III (Ecofys/Ökö-Institut, 2009).

In the second meeting in April 2009, consortium presented a discussion paper to stimulate discussion around the following topics:

1. Criteria for determining which product groups and sectors to benchmark
2. Fall-back options in case benchmarking is not feasible
3. How to determine the average performance of the 10% most efficient installations / confidentiality
4. Cross-boundary heat flows
5. Substitutability between electricity and fuel / heat use
6. Activity data

MS were asked to contribute to the discussion in writing and sent their responses after the meeting. These comments are taken into account in this final report[5] and a summary was presented in the July meeting. The meeting also included a presentation on the progress of the work concerning the questionnaire on sector classification and a first overview of the proposed benchmarks for the various sectors. At the September meeting, presentations were given on the fall-back approaches envisioned (Chapter 5 of this report), the outline for the national implementation measures (Chapter 8 of this report) and the envisioned approach for a number of sectors.

2.3 European Climate Change Program (ECCP) meetings

Stakeholders: Member States, Industry Associations, NGOs, Social partners
Interaction: Informative / Active involvement

Member States, a selection of representatives of industry sectors, NGOs and social partners come together in the stakeholder meetings of the European Climate Change Program (ECCP) Working Group on the review of the EU ETS. The ECCP meetings are organised by the Commission to involve and inform stakeholder on issues related to the EU ETS review,

[5] In May 2009, a consultation paper on the project approach and general issues was distributed to the sector organizations (see Section 2.4). This paper was also sent to the MS TWG members. Comments to this paper have been used in drafting this final report.

including the harmonised free allocation rules. The meetings are by invitation including experts from MS, industry associations usually representing large emitters within the ETS (e.g. CEMBUREAU, CEPI, etc) and key NGOs (e.g. WWF and Friends of the Earth)[6].

Within the timeframe of the execution of this project, three meetings have been organized:

- 30 March 2009
- 29 April 2009
- 1 July 2009

In the first meeting the consortium presented the results of the 2008 study on benchmarking criteria (Ecofys/Fraunhofer-ISI, 2009) and the proposed approach for this study. In addition, the exposure of industries to the risk of carbon leakage was discussed. Carbon leakage was also the discussion topic at the 2nd and 3rd meeting[7].

2.4 Bilateral meetings with industrial stakeholders

Stakeholders: Industrial stakeholders
Interaction: Active involvement / informative

In addition to the stakeholder interactions discussed above, bilateral informal meetings were organised by the consortium and industry representatives. In close agreement with the European Commission, it was decided to focus of this study on the industrial sectors individually specified in the amended Directive (for more information the classification of installations in the EU ETS and the choice to focus on the sector individually specified in the amended Directive, see Chapter 4). We used the following project approach in involving the industrial stakeholders:

- The point of contact for each industry was the European sector organization
- Where possible, umbrella organizations were used as primary point of contact and not the organizations representing smaller sub-sectors
- For each of the thirteen sectors distinguished, a separate report is written on the proposed allocation rules for free allocation.
- Key methodological choices were communicated to the sectors in an interim report that was finalized in May / June 2009. Reactions to these drafts are either taken into account in the final deliverables for this study or are included as "stakeholder comments" in this final report[8].

In the initial contacts with the stakeholders, the list of issues as given in Appendix A has been used. It should be stressed that the requests for data and further information were fully based

[6] Smaller stakeholder can be invited to the meetings if they request the participation. This somehow guarantees a broader representation of all the ETS participants as well as increasing the fairness of the process and increasing the access to information to everyone involved.
[7] As explained in the introduction, we do not discuss the supporting role of the consortium in the carbon leakage assessment in this report.
[8] In May 2009, also a consultation on the project approach and general issues was distributed to the sectors. Comments to this paper were taken into account in drafting this final report.

on voluntary participation of the relevant sector organizations. The degree to which sectors were capable and willing of delivering the information requested differed between sectors. In the sector reports, we will in more detail describe the level of participation of the sectors. The difference in stakeholder participation is also reflected in the type of sources that are used to come to a proposal for benchmark values in this study. In some cases, these benchmark values could be based on actual performance data of installations as submitted by the various industries, whereas in other cases, only literature studies were available. In the sector reports, we will describe carefully the data sources used to come to the benchmark proposals. Table 1 summarises the European sectors organizations that have been used as primary points of contact for the sectors concerned. Please note that many of the organizations mentioned are umbrella organizations representing also smaller organizations covering the interests of sub-sectors. This is described in the relevant sector reports. Also, in some cases, the sector organizations do not represent all the installations in a certain sector. An example of a sector where this occurs is iron and steel industry. The coke ovens that are part of integrated iron and steel plants are represented by EUROFER whereas independent coke ovens (e.g. belonging to mining companies) are not represented by EUROFER or another sector organization. For some sectors, the incomplete coverage of a sector organization is also reflected in benchmark curves, which often only includes installations from association members. In the sector reports, we explain what the coverage of the sector organization is with respect to the total number of installations in the sector, but within the scope of this study, it was not possible to directly involve the relevant installations.

Table 1 Key European sector organizations used as primary contact point.

Sector[1]	**Sector organization**
Combustion of fuel (1)	[2]
Mineral oil refineries (2)	EUROPIA / CONCAWE
Metal ore (4)	EUROMINES
Iron and steel industry (3 / 5 / 6)	EUROFER
Aluminium (7 / 8)	EAA
Other non-ferrous metals (9)	EUROMETAUX
Cement (10)	CEMBUREAU
Lime (11)	EULA
Glass (12)	CPIV
Ceramic products (13)	CERAME-UNIE
Mineral Wool (14)	EURIMA
Gypsum (15)	EUROGYPSUM
Pulp and paper (16 / 17)	CEPI
Chemical industry (18 – 25)	CEFIC
	EFMA

[1] For more information on the sector abbreviations used here and the link to the descriptions in the EU ETS Directive, see Chapter 4.2 and Appendix C.
[2] As discussed in Chapter 4.2, the type of installations in this group is very diverse. About the specific treatment of cross-boundary het flows (Chapter 6.1), the consortium has been in contact with COGEN Europe, Euro Heat and Power and IFIEES.

3 Free allocation in the amended directive – scope of this study

In this chapter, we briefly discuss the scope of this study by introducing the total emission cap that is available in the EU ETS in the period 2013 – 2020 and the share of emissions that is eligible for free allocation of allowances. We then explain that the scope of this study is to propose a methodology to determine this amount, followed by a section in which we make explicit the issues, which are, although they certainly need further consideration in the further process to come to community wide harmonised allocation rules, outside the scope of this study.

3.1 Total emission cap

The total quantity of emission allowances for 2013 – 2020 in the EU[9] from 2013 onwards is determined by Article 9 and 9a of the amended directive and consists of four parts:

A1: The average annual total quantity of allowances issued by the MS in accordance with the Commission Decisions on their National Allocation Plans (NAPs) for 2008 – 2012. This quantity shall decrease by a linear factor of 1.74% beginning from the mid-point of the period 2008 – 2012 (Article 9)

A2: An adjustment for opt-ins in the period 2008 – 2012 subject to the same linear factor (Article 9a (1))

A3: An adjustment for excluded installations pursuant to article 27 of the amended directive (small installations with annual emissions below 25 kt CO_2 and which, in the case of combustion activities, have a rated thermal input below 35 MW) subject to the same linear factor (Article 9a (4))

A4: An adjustment for installations carrying out activities that are included in the Community scheme only from 2013 onwards (Article 9a (2))

The linear factor should result in a 21% reduction factor of the emissions of EU ETS installations compared to 2005 emission levels. Based on the NAPs as accepted by the Commission so far, the quantity A1 can be calculated as 1974 Mt CO_2 in 2013, thus going down to 1720 Mt CO_2 in 2020 (assuming no opt-ins or exclusions of installations and without the new sectors and gases).

3.2 Share of allowances eligible for free allocation

Auctioning will be the basic principle for allocation from 2013 onwards, "as it is the simplest, and generally considered to be the most economically efficient system" (recital 15). Member

[9] This emission cap is supplemented by the amount for aviation activities as defined by Article 3c, and emission for countries which have linked to the EU ETS, which are currently Norway, Iceland and Liechtenstein.

States shall thus, according to Article 10 of the amended directive, auction all allowances which are not allocated free of charge in accordance with Article 10a and 10c of the amended directive. These articles describe the activities eligible and not eligible for free allocation:

- Article 10a (1) states that no free allocation shall be made in respect of any electricity production, except for case falling within Art. 10c (see below) and electricity produced from waste gases.
- Article 10a (3) rules out, subject to article 10a (4) and (8)[10], free allocation to electricity generators and to installations for the capture, transport and storage of CO_2. According to Art. 3u, electricity generators are installations in which only the activity "combustion of fuels"[11] is carried out and that have on or after 1 January 2005 produced electricity for sale to third parties.
- Article 10a (4) states that free allocation shall be given to district heating as well as to high efficiency cogeneration for economically justifiable demand, in respect of the production of heating and cooling.
- Article 10c states that MS may give transitional free allocation to installations for electricity production under certain conditions.[12]

From these articles, it is very clear that no free allocation shall be given for electricity regardless whether it is falling under the definition of electricity generator. For heat, the wording of Article 10a (3) might lead to some confusion. It could be read in such as way that an installation performing the activity "combustion of fuels", but whose main activity is clearly not electricity production (but e.g. beer brewing) would not receive free allowances for emissions related to heat production if they sold electricity which was generated onsite (unless this electricity was produced via high efficiency cogeneration). However, another producer with the same main activity (e.g. a beer brewer without a cogeneration facility) would be eligible for free allocation even if the heat was produced via inefficient boilers. Based on these considerations it can easily be conducted that all heat production is in principle eligible for free allocation according to the CIMs, regardless the type of production for this heat. Assuming that heat production will receive free allowances according to a uniform method, high efficiency cogeneration causes fewer emissions per unit of electricity and as such has an advantage compared to cogeneration which is not classified as high efficiency cogeneration.

The scope of this study is to define allocation rules for this free allocation. The free allocation rules for electricity according to Article 10c is outside the scope of this study (see also Section 3.4).

Now we have defined which emissions are in principle eligible for free allocation (i.e. all emissions not related to electricity production), the amount of those emissions can

[10] According to Article 10a (8), part of the new entrant reserve is available to stimulate the construction of commercial demonstration projects for the capture and storage of CO_2 and demonstration projects for innovative renewable energy technologies.

[11] For more information on the categorization of activities, see Chapter 4.

[12] The conditions are that "in 2007, the national electricity network was only directly or indirectly connected to the network interconnected system operated by the Union for the Coordination of Transmission of Electricity (UCTE); only connected with a single line with a capacity of less than 400 MW to this network; or in 2006, more than 30% of electricity was produced from a single fuel, and the GDP per capita did not exceed 50% of the average GDP per capita in the Community."

indicatively[13] be estimated based on the reported EU ETS emissions and statistics on energy use and CO_2 emissions (available up to 2006).

As a first step, the share of electricity related emissions in the EU 25 is estimated based on the energy balances and CO_2 emission statistics published by the International Energy Agency for 2006 (IEA, 2008a, b). Four types of electricity producers are distinguished in these statistics:

- Main activity electricity only plants
- Main activity Combined Heat and Power (CHP) plants
- Autoproducer[14] electricity only plants
- Autoproducer CHP plants

CO_2 emissions from main activity and autoproducers electricity only plants can directly be taken from this source. For CHP installations that produce both electricity and heat, we estimate the share of electricity via the following formula[15]:

Share of CO_2 emissions allocated to electricity =

$$1 - (\text{Heat production} / 0.9) / ((\text{Heat production} / 0.9) + \text{Electricity production})$$

Equation 1

In Table 2, we give the resulting shares of emissions related to electricity production for CHP plants and in Table 3 the estimate for total emissions from electricity production in 2006. This amount is thus estimated to be 1159 Mt CO_2 in 2006.

Table 2 Electricity and heat production by main activity and autoproducers CHP plants in 2006 for the EU 25 (IEA, 2008a and own calculations)

Installation	**Electricity Production ktoe**	**Heat production ktoe**	**Share of emissions allocated to electricity %[1]**
Main activity CHP	43557	33112	59%
Auto producers CHP	15839	15795	53%

[1] Calculated using Equation 1.

[13] It should be stressed that these are only indicative estimates based on energy statistics. These estimates have no direct relation with the maximum total amount of free allowances that can be allocated for free in accordance with Article 10a (3) of the amended directive (see also Section 3.4.1).

[14] Autoproducers are defined in the annual joint EUROSTAT/IEA/UN electricity questionnaire (EUROSTAT/IEA/UN, 2008) as *undertakings that generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity.* Main activity producers are undertakings that generate electricity and/or heat for sale to third parties *as their primary activity.*

[15] This estimation assumes a reference boiler efficiency of 90% for heat production. This methodology enables equal treatment of heat produced in CHP installations and heat produced otherwise as explained in Ecofys / Fraunhofer – ISI (2009). The 90% boiler efficiency corresponds to reference boiler efficiency for natural gas as given Commission Decision 2007/74/EC (EC, 2007). For other fuels, other reference efficiencies are given, but for simplicity and given the fact that we look for an indicative figure only, we use the 90% independent of the fuels used.

Table 3 Estimate of CO_2 emissions from electricity production in 2006 (IEA, 2008b)

Installation	Total emissions Mt CO_2	Electricity Mt CO_2	Heat Mt CO_2
Main activity CHP	365	217	148
Auto producers CHP	103	54	49
Main activity electricity	835	835	
Auto producer electricity	53	53	
Total	1391	1159	232

If we assume all these emissions to result from installations that are included in the EU ETS, we can use the total EU ETS emissions to estimate the share of EU ETS eligible for free allocation. In doing so, a small error is made, because some electricity producers (e.g. waste incineration plants) are not included in the EU ETS.

Total EU ETS emissions in 2006 are given in Table 4.

Table 4 EU ETS emissions in 2006 in the CITL database (download: 1 June 2009)

	Allocated allowances Mt CO_2 equivalents	Verified emissions Mt CO_2 equivalents
1. Combustion installations	1445	1470
2. Mineral oil refineries	157	149
3. Coke ovens	23	21
4. Metal ore roasting or sintering	21	14
5. Pig iron or steel	155	133
6. Cement clinker or lime	190	182
7. Glass including glass fibre	22	20
8. Ceramic products by firing	18	15
9. Pulp, paper and board	37	30
99. Other activity opted-in	2	2
Total	2072	2036

If the amended Directive would have been applied in 2006, the emissions that would have been eligible for free allocation can be estimated to be 877 Mt[16], which is 43% of the total.

In this study, a questionnaire was sent to all MS (Appendix B) with as main aim to get a better understanding of the type of installations included in the EU ETS, because they perform the Annex I activity "combustion of fuel". This questionnaire also contained questions on electricity and heat production by EU ETS installations. Based on the responses, the total emissions of installations producing electricity were estimated to be around 1500 Mt CO_2. However, if an installation is reported by the MS to produce electricity, not all emissions are directly related to electricity production or combined production of electricity and heat. Instead, the account in CITL may refer to a large site incorporating both boilers and onsite

[16] Total verified emissions (2036 Mt) minus the estimated emissions from electricity production (1159 Mt)

power generation. According to the questionnaire response, approximately 500 Mt CO_2 is associated with installations only producing electricity, which is considerably lower than the estimate according to the IEA statistics (close to 900 Mt CO_2). This can have to do with the interpretation of heat production by the MS in returning the questionnaire and / or by the definitions of electricity versus CHP plants in the IEA statistics[17]. Since the questionnaire did not ask for quantitative information on heat versus electricity produced, it does not allow dividing emissions over electricity and heat production.

It should be stressed that the calculation in this section are based on the current scope of the directive without the new activities and gases that are added in the amended Directive. For this reason, the estimate of emissions eligible for free allocation derived here (43%) should only be regarded as rough estimate.

3.3 Amount of free allocation – scope of this study

Free allocation via the CIMs will take place, to the extent feasible based on ex-ante benchmarks, calculated for products rather than for inputs (see next chapters for more details on how we apply the directive text). Where these benchmarks are not feasible, other approaches (referred to in this study as fall-back approaches) will apply. Furthermore, activities will either be classified as being "exposed" to a significant risk of carbon leakage (100% free allocation according to the rules set out in the CIMs, Article 10a (12)) and sector not exposed to this risk (80% free allocation according to the rules in 2013, going down to 30% in 2020, Article 10a (11)).

The scope of this study is to come up with:

- A proposal for activities for which a product benchmark is feasible and a proposal for appropriate benchmarks for these products
- A proposal for allocation rules in case product benchmarks are regarded not feasible.

3.4 Outside the scope of this study

Below we discuss a number of issues, which are explicitly left outside the scope of this study.

3.4.1 Cross-sectoral correction factor and linear reduction factor

In the text of the amended Directive, two factors are mentioned that influence the annual allocation for an installation. In Article 9, reference is made to the quantity of allowances that will reduce with a <u>linear factor</u> over the years. This linear factor comes back at six other places in the amended directive:

[17] In principle, in the IEA questionnaire, countries should report on a unit level. Units only producing electricity on a site where also CHP units are operated are thus classified as electricity only in the IEA statistics, whereas in the MS response to the questionnaire in this study, the site would have both electricity and heat production.

1. Article 9a (1) on the adjustment of the total amount of allowances for opt-ins
2. Article 9a (2) on the adjustment of the total amount of allowances for new installations included in the EU ETS after 2012
3. Article 9a (4) on the adjustment or the total amount for excluded installations
4. Article 10a (4) on the free allocation for district heating and high efficiency cogeneration
5. Article 10a (5) on the total amount of allowances eligible for free allocation for new installations included in the EU ETS after 2012
6. Article 10a (7) on the allocation to new entrants

Another factor mentioned in the amended directive is the cross-sectoral factor introduced in Article 10a (5). This article states that the maximum amount of allowances that is the basis for calculating allocations to installations which are not covered by Article 10a (3) and which are not new entrants shall not exceed the sum of:

B1: The total Community-wide total quantity multiplied by the share of emissions from installations not covered by Article 10a (3) in the total verified emissions in the period 2005 to 2007 for installations included in the EU ETS in the period 2008 – 2012.

B2: The total average verified emissions in the period 2005 – 2007 from installations which are only included in the EU ETS from 2013 onwards and are not covered by paragraph 3, adjusted by the linear factor as given in paragraph 9.

A uniform cross-sectoral correction factor shall be applied if necessary.

The interpretation of the paragraphs on the linear reduction factor and the cross-sectoral factor and the resulting application of these factors is outside the scope of this study and is therefore not further discussed[18].

3.4.2 Financial compensation for indirect emissions

The amended Directive allows that "*Member States may also adopt financial measures in favour of sectors or sub-sectors determined to be exposed to a significant risk of carbon leakage due to costs relating to greenhouse gas emissions passed on in electricity prices…. These measures shall be based on ex-ante benchmarks for the indirect emissions of CO_2 per unit of production*" (Article 10a, (6)).

This provision raises the question whether benchmarks for direct emissions[19] (used for the allocation of allowances) could not be combined with the benchmarks for indirect emissions[20] used for determining potential financial compensation, e.g. via an overall (direct and indirect)

[18] Questions that could be raised on these paragraphs are a consistent use of the linear factor so that the factor is not twice applied and the treatment of installations that both have activities eligible for free allocation and activities not eligible for free allocation (i.e. electricity production).

[19] With direct emissions, we mean all emissions with the exception of emissions related to the production of electricity, including also process emissions occurring at the installation under consideration and emissions related to heat production consumed by the installation under consideration.

[20] Emissions resulting from electricity production (not necessarily at the installation itself) for the amount of electricity consumed at the installation under consideration.

CO_2 emission benchmark which can then be used for both allocation of allowances for direct emissions and the financial compensation for indirect emissions. Although the link between direct and indirect emission is further discussed in Section 6.3 for production processes where electricity and fuel use are interchangeable, this study is contracted to develop an allocation methodology for direct emissions only. This is important, because it is currently not yet clear which sectors or subsectors will receive financial compensation and which MS will give this compensation. The allocation methodology for direct emissions should thus function independently from the financial compensation, which is also guaranteed by the proposed solution in Section 6.3.

The allocation methodologies for direct emissions will thus be dealt with independently of any benchmarks linked to financial compensations for indirect emission. However, in terms of data collection and stakeholder interaction, the process goes hand in hand to some degree and at appropriate places, (specific) electricity use in the production processes of certain products will get attention in the sector reports.

3.4.3 New entrant and closure rules and benchmarks

According to Article 10a (7), the European Commission shall adopt harmonised rules for the application of the definition of new entrants in particular in relation to the definition of "significant extensions"[21] that are mentioned in Article 3 of the Directive. Similarly, Article 10a (19) and (20) describes measures for installations that fully or partially cease operations in relation to their allowance allocation. The link between benchmark based allocation rules and rules for new entrants and closing installations is without doubt an important one. As an example, consider an installation for which the allocation is based on a product benchmark and for which the heat demand in the reference period on which the allocation is based, is delivered by a boiler house operated by the operator itself. If, during the trading period, the installation decides to outsource its heat supply to a utility company constructing a CHP plant and (partially) closes its boiler house, it is important that the new entrant and closure rules take into account that the "capacity" on which the allocation is based (i.e. the product that is being benchmarked) is not necessarily extended significantly, although, obviously, the CHP plant is a new installation. Although we acknowledge the importance of this issue at this point, we do not further discuss the new entrant and closure rules in this study and leave the relation between the allocation rules proposed in this study and the new entrant and closure rules as an issue for further consideration.

3.4.4 Free allocation for electricity production

According to Article 10c, optional transitional free allocation can be given by certain Member States for the modernisation of electricity generation. The rules for this free allocation are not within the scope of this study and are not further discussed.

[21] In recital 16 it is stated that significant extensions should be defined as an extension by at least 10% of the installation's existing installed capacity.

4 Allocation rules for free allocation – basic principles

In this chapter we discuss the text of the amended Directive on the free allocation methodology including links to the section on the interpretation of the text used in this study in the development of a free allocation methodology (Section 4.1). We then discuss the required classification for applying the uniform allocation rules (Section 4.2), followed by sections on the key principles used to come to allocation rules in this study.

4.1 The text of the amended Directive

In Section 3.3, we discussed that the free allocation to an installation eligible for such free allocation is determined via benchmarks and / or via other approaches. The relevant text in the amended Directive can be found in Article 10a (1) and (2):

Article 10a (1)[22]:

By 31 December 2010, the Commission shall adopt Community-wide and fully-harmonised implementing measures[23] for the free allocation of allowances including any necessary provisions for a harmonised application of closure rules. The measures shall, to the extent feasible, determine Community-wide ex-ante benchmarks so as to ensure that allocation takes place in a manner that provides incentives for reductions in greenhouse gas emissions and energy efficient techniques, by taking into account the most efficient techniques, substitutes, alternative production processes, high efficiency cogeneration, efficient energy recovery of waste gases, use of biomass and capture and storage of CO_2, where such facilities are available, and shall not provide incentives to increase emissions. No free allocation shall be made in respect of any electricity production, except for cases falling within article 10c and electricity produced from waste gases.

For each sector and sub-sector, in principle, the benchmark shall be calculated for products rather than for inputs, in order to maximise greenhouse gas emissions reductions and energy efficiency savings throughout each production process of the sector or the sub-sector concerned.

Article 10a (2):

In defining the principles for setting ex-ante benchmarks in individual sectors or sub-sectors, the starting point shall be the average performance of the 10% most efficient installations in a sector or sub-sector in the Community in the years 2007 – 2008.

[22] Text slightly adapted to improve readability.
[23] Further referred to as CIMs

In the following sections, the use of the underlined parts of these texts in the scope of this study is discussed:

- Benchmarks, to the extent feasible (Section 4.3)
- Provides incentives (Section 4.4)
- Free allocation for electricity from waste gases (Section 6.2)
- Benchmarks for products rather than for inputs (Section 4.3)
- Average of the 10% most efficient installations in the Community (Section 4.4.1)

Article 10a (11) and (12) determine how much of the amounts determined via the CIMs are actually allocated to installations. Sectors or sub-sectors which are exposed to a significant risk of carbon leakage, allowances free of charge up to 100% of the quantity determined in accordance with the CIMs shall be allocated, whereas for others, the amount of allowances will be 80% in 2013 decreasing to 30% in 2020. For this, the sector and sub-sector classification of installations is important. We discuss this in the next section.

4.2 Classification of installations and carbon leakage

The amended Directive contains statements on installations, activities, sectors, sub-sectors and products:

- Annex I of the Directive contains a list of activities that are included in the EU ETS.
- Installations[24] performing one or more of the listed activities are included in the EU ETS and shall have a greenhouse gas emission permit (Article 4). Operators of these installations are the entities in the EU ETS receiving allowances (Article 11) and for which emissions are reported (Article 14).
- In the amended Directive, "sectors" and "sub-sectors" are introduced[25]: in Article 10a (1, 2), it is stated that for each sector and sub-sector, benchmarks should be calculated. In Article 10a (6), financial measures are described for sector or sub-sectors exposed to a significant risk of carbon leakage due to costs relating to indirect costs associated with electricity use. In Article 10a (12-15), the exposure of sectors and sub-sectors to a significant risk of carbon leakage and the allocation rules for those sectors and sub-sectors is described. Although the terms sectors and subsectors are used in the articles mentioned, the definitions of sectors and sub-sectors are not included in the list of definitions (Article 3).
- Article 10a (1) formulates that for each sector and sub-sector, in principle, the benchmark shall be calculated for products rather than for inputs.

As a direct result of the Directive text as summarised above, the following categorizations are required for each installation in the EU ETS:

[24] Definition from Article 3 of the ETS : Installation means a stationary technical unit where one or more activities listed in Annex I are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which would have an effect on emissions and pollution.

[25] The original ETS directive also contains statements on "sectors", but only in Article 31 on the further extension of the scheme and in Annex III on the criteria for the National Allocation Plans.

- Categorization into the relevant Annex I activities (Section 4.2.1)
- Categorization into a sector or sub-sector (Section 4.2.2)
- Categorization into relevant 'products' for which benchmarks are developed (Section 4.3)

4.2.1 Categorization of Annex I activity

Annex I of the amended Directive determines which activities are included in the ETS. The list consists of the following 25 activities. Full descriptions of these activities are given in Appendix C.

1. Combustion of fuel
2. Refining of mineral oil
3. Coke
4. Metal ore
5. Pig iron and steel
6. Ferrous metals
7. Primary aluminium
8. Secondary aluminium
9. Non-ferrous metals
10. Cement clinker
11. Lime, dolomite and magnesite
12. Glass
13. Ceramics
14. Mineral wool insulation materials
15. Gypsum
16. Pulp
17. Paper and card board
18. Carbon black
19. Nitric acid
20. Adipic acid
21. Glyoxal and glyoxilic acid
22. Ammonia
23. Bulk organic chemicals
24. Hydrogen and synthesis gas
25. Soda ash and sodium bicarbonate

The activities 6 – 9, part of 11 14, 15 and 18 – 25 were not individually mentioned in Annex I of the original Directive, although some of the installations operating these activities are already included in phase I and II of the EU ETS (2008 – 2012). This is, because they operate combustion installations with a rated thermal input above 20 MW they were, via this criterion, included under the activity "combustion of fuel". Not all MS followed exactly the same interpretation of "combustion" in phase I and II of the EU ETS[26]. Via the questionnaire to the

[26] The further guidance for the allocation plans for the 2008 – 2012 trading period of the EU Emission Trading Scheme (EC, 2005) resulted in some harmonization of combustion installations.

MS (Appendix B, see also Section 4.2.2), some information was retrieved on installations in the EU ETS phase II that could be classified into the new specified activities from Annex I of the amended Directive. We provide an overview in Appendix D.

The list in Annex I of the amended Directive contains three different types of definitions of activities:

1. Definitions of activities using the product output of industrial processes (e.g. production of pulp) or a clear description of the activity based on the type of products made (e.g. coke ovens, mineral oil refineries), in some cases combined with a minimum production capacity.
2. Definitions of activities (e.g. production or processing of ferrous metals and non-ferrous metals, production of secondary aluminium and production of carbon black) using the product output of industrial processes in combination with the criterion that combustion units with a total rated thermal input exceeding 20 MW should be operated by the installation.
3. The activity “combustion of fuels in installations with a total rated thermal input exceeding 20 MW”.

The categorization of installations into Annex I activities is less straightforward as it may seem. Many installations conduct more than one activity listed in Annex I such as:

- Combustion activities and other specified Annex I activities. Examples are Combined Heat and Power (CHP) units operated in industrial sectors such as the pulp and paper industry.
- More than one specified Annex I activities. Examples are the production of hydrogen at mineral oil refineries, lime kilns in the pulp and paper industry and the combined production of various chemical products that are individually specified in Annex I.

As will be discussed in detail later on, the categorization of installations into Annex I activities does not directly affect the proposed allocation rules applied to the installation. These rules are determined by the products of the installation for which product benchmarks apply, the applicability of the fall-back approaches (Chapter 5) and (e.g. regarding the percentage of free allocation as resulting from the carbon leakage assessment) by the NACE classification of the activities carried out by the installation.

However, to further increase the transparency of e.g. the ETS registries (CITL and national registries), we propose to apply the following rules in the categorization of installations from 2013 onwards:

- Installations that conduct within their system boundaries the activity “combustion of fuels” and other specified Annex I activities should always be listed under the more specific Annex I activity (when both are covered by the same permit).
- This does not apply for electricity and heat producing installations that operate under a separate GHG emission permit than the electricity and heat consumer. These should remain classified under the activity “combustion of fuels”.

- For those installations that conduct more than one specified activity from Annex I of the amended directive, generic rules should be established for the categorization. In evident cases where two activities are in many cases combined (e.g. pulp and paper and various chemical operations), a grouping of Annex I activities can be envisioned for national and CITL registers as is currently also the case in e.g. the CITL register.

The procedures for GHG permits differ between the various MS. In some MS, industrial sites (e.g. in the chemical industry) have one overarching GHG permit for the total site and are thus regarded as a single installation, whereas in other MS, individual units on this site get different GHG permits and are thus seen as different installations. This also depends on different ownership structures for CHP plants (e.g. joint ventures with utility companies etc.).

As a result of these different procedures, which are assumed to remain unchanged in the third phase of the EU ETS, the categorization as outlined above will result in differences between MS. For example, industrial CHP installations will in one country operate under a separate GHG permit and will in other countries operate under an integrated permit, together with the industrial installation the CHP plant is operated in. It could be envisioned that for the application of the allocation rules and the assessment of exposure to a risk of carbon leakage (see below), some grouping of individual installations (e.g. various units operations on a refinery if they have separate permits) under one GHG permit could be worthwhile to consider by MS.

In addition, it is recommended to include proper definitions for those Annex I activities for which the description can give rise to different interpretation. An example are the organic chemical products with a production capacity over 100 t per day. In the sector chapters, we give, in relevant cases, recommendations for such definitions.

It could also be considered to include even more detailed information in the national and CITL registries, which could be subject to verification by the competent authorities. Such information could include all Annex I activities that carried out, the CO_2 emissions associated to individual activities etc.

4.2.2 NACE codes of installations – carbon leakage

For the assessment of exposure to risk of carbon leakage, sectors and sub-sectors are mentioned in the amended directive (Article 10a, 15 – 17). A number of sector and sub-sector classifications of economic activities are in use at the worldwide, EU and national level (Appendix E). For the EU ETS carbon leakage assessment, the European NACE classification is used (Recital 25 of the Directive) resulting in a list, approved by the MS in September 2009, of 164 sectors level that are considered to be exposed to a significant risk of carbon leakage.

Appendix C provides a match between the amended Annex I activities and the NACE (revision 1.1) classification. Such a match is possible for Annex I activities where there is a clear link with the type of product produced by the activity (i.e. for the first two definitions of activities applied in Annex I as described in Section 4.2.1).

The activity "combustion of fuel" has no clear link to industrial sectors and sub-sectors. In order to get an overview of the sectors in which no Annex I activity is carried out other than "combustion of fuels", we requested all 27 MS and Norway to submit amongst others the NACE code of each installation as part of the questionnaire on sector classification. For more information about the questionnaire, the reader is referred to Appendix B.

Based on the result of the questionnaire in which for 99% of EU ETS installations categorized as "combustion of fuel" a NACE code was provided, it was estimated that 92% of the emissions and 61% of the installations categorized in the activity "combustion of fuels" are accounted for by the two-digit code NACE 40: Electricity, gas, steam and hot water supply. A breakdown of this sector is shown in see Table 5. The data in the table is presented as reported by the MS and Norway. No quality checks were performed.

Table 5 Number of installations and 2007 verified emissions of installations categorized in "combustion of fuels" and in NACE sector 40 (CITL data, 11 May 2009, NACE classification based on MS response to questionnaire)[1]

NACE Rev. 1.1 code	Description of NACE code	Nr. of installations [2]	2007 Verified emissions[3] (Mt CO_2-eq)
40 (no further categorization)	Electricity, gas, steam and hot water supply	145	53
40.1	Production and distribution of electricity	1181	1122
40.2	Manufacture of gas; distribution of gaseous fuels through mains	103	3
40.3	Steam and hot water supply	2192	129
Total		**3621**	**1308**

[1] NACE code was obtained for 99% of open accounts (11 May 2009) accounting for 99.9% of emissions categorized in Annex I activity 'combustion of fuels'.
[2] Only accounts that were open according to CITL (11 May 2009); includes installations in Norway.
[3] Excludes Norwegian emissions.

Part of the remaining emissions and installations in the "combustion of fuel" category was found to be attributed to installations that were given a NACE code by the MS that could be attributed to one of the other amended Annex I activities. An overview of this group is provided by Table 6. The data in the table is presented as reported by the MS and Norway. No quality checks were performed. The table indicates that a match between NACE code (often only available at the company level and not at the level of individual sites, let alone for individual production units of that site) is often not straightforward. Since, together with the product list for which benchmarks are developed[27], the NACE code of the installation is a key factor determining its allocation; it should receive significant attention when the National Implementing Measures (NIMs) are drafted by the MS.

[27] As is discussed in Section 4.3, the products for which an emission benchmark is developed should be linked to a NACE 4 code (and thereby to the list of carbon leakage sectors). This should ensure that equal products get an equal treatment regardless of the sector classification of the installation they belong to. The same holds for activities for which another allocation approach is followed.

Table 6 Number of installations and 2007 verified emissions of installations categorized in "combustion of fuels" with a NACE code associated with other Annex I activities (CITL data, download 11 May 2009, NACE classification based on MS response to questionnaire[1])

Annex I activity in amended Directive[2]	**Nr. of installations[3]**	**2007 Verified emissions[4] (Mt CO_2-eq)**
2. Refining of mineral oil	22	0.8
3. Coke	3	0.6
4. Metal ore	2	<0.1
5. Pig iron and steel / 6. Processing of ferrous metals	56	18.8
7. Primary Aluminium / 8. Secondary Aluminium	9	0.3
9. Non-ferrous metals	5	1.5
10. Cement clinker	1	<0.1
12. Glass[5]	3	<0.1
13. Ceramics	8	<0.1
14. Mineral wool insulation materials[6]	35	3.0
16. Pulp / 17. Paper and card board	24	1.8
18 – 25 Part of the chemical industry		
- 24.1 Manufacture of basic chemicals[7]	5	0.9
-24.11 Manufacture of industrial gases[7]	3	0.5
-24.13 Manufacture of other inorganic basic chemicals[7]	36	4.8
-24.14 Manufacture of other organic chemicals[7]	81	10.8
-24.15 Manufacture of fertilisers and nitrogen compounds[7]	27	3.7
-24.16 Manufacture of plastics in primary forms[7]	24	1.2
-24.17 Manufacture of synthetic rubber in primary forms[7]	1	0
Total	**344**	**48.9**

[1] NACE code was obtained for 99% of open accounts (11 May 2009) accounting for 99.9% of 2007 verified emissions categorized in Annex I activity 'combustion of fuels' of the amended Directive.
[2] See Appendix C for full description of Annex I activities in the amended Directive.
[3] Only account that were open according to CITL (11 May 2009); includes installations in Norway.
[4] Excludes Norwegian emissions.
[5] Including NACE 26.14 Manufacture of glass fibre, could partly be in mineral wool sector
[6] NACE 26.82 Manufacture of other non-metallic mineral products, not elsewhere classified, not all in mineral wool sector
[7] Not all installations in this NACE sector perform one of the specified Annex I activities 18 – 25 in the amended Directive.

The remaining emissions and installations categorized in the "combustion of fuels" activity are accounted for by as many as 174 other NACE 4-digit sectors. The amount of emissions from these installations is often very small. In Table 7 we give an overview of the 12 sectors in this group that in 2007 emitted more than 1 Mt CO_2 eq., in Appendix F a full list of the sectors is provided. The data in Table 7 reflect the reported number of installations and 2007 verified emissions of sectors that only perform Annex I activity 'combustion of fuels'.

Table 7 Number of installations and 2007 verified emissions associated with 4-digit NACE sectors with total emissions above 1 Mt CO_2 that only perform Annex I activity "combustion of fuels" (CITL data, download 11 May 2009, NACE classification based on MS response to questionnaire[1])

NACE Rev. 1.1 code	Description	Nr. of Installations[2]	2007 Verified emissions[3] (Mt CO_2-eq)
11.10	Extraction of crude petroleum and natural gas	189	15.9
15.83	Manufacture of sugar	247	11.6
15.51	Operation of dairies and cheese making	131	2.8
15.62	Manufacture of starches and starch products	44	2.6
20.20	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	106	2.1
15.41	Manufacture of crude oil and fats	38	1.9
34.10	Manufacture of motor vehicles	77	1.5
25.11	Manufacture of rubber tyres and tubes	40	1.3
24.70	Manufacture of man-made fibres	20	1.2
60.30	Transport via pipelines	64	1.1
15.42	Manufacture of refined oils and fats	33	1.1
26.66	Manufacture of other chemical products n.e.c.	30	1.0
85.11	Hospital activities	98	1.0

[1] NACE code was obtained for 93% of open accounts in EU ETS (11 May 2009) accounting for 97% of 2007 verified emissions of open accounts in EU ETS (11 May 2009).
[3] Only account that were open according to CITL (11 May 2009); includes installations in Norway.
[4] 2007 verified emissions are emissions reported by installations in 2007, excludes Norwegian emissions.

The NACE codes of installations in the EU ETS have also been considered by the European Commission in the context of the carbon leakage assessment, based on sources such as company databases etc. rather than based on MS information. Within the scope of this study, the results of both approaches have not been compared. The overview presented in this sector can be a useful input for determining which sectors are affected by the EU ETS and as input into considerations on the most appropriate allocation methodology for the sectors concerned (e.g. the question if also product benchmarks should be developed for additional sectors under the EU ETS).

4.3 Benchmarking for products, to the extent feasible

The text of Article 10a (1) states that, for each sector and sub-sector, to the extent feasible, benchmarking should be the preferred allocation methodology and that, in principle, the benchmark should be calculated for products rather than for inputs.

Above, three types of activities were distinguished from Annex I of the amended Directive:

1. Activities included via a definition of product
2. Activities included via a definition of product in combination with the criterion that combustion units with a total rated thermal input exceeding 20 MW are operated
3. The activity "combustion of fuel"

For the 1st and 2nd category of activities, a direct consequence of the text of Article 10a (1) is, in our interpretation, that benchmarks should be considered for the products (i.e. iron, steel, paper etc.) of the activities concerned. Leaving indirect electricity related emissions outside the scope, production processes for these processes result in CO_2 emissions (or N_2O or PFC emissions which are also partly covered by the amended Directive) from four different sources:

1. Direct fuel emissions from e.g. furnaces
2. The generation of carbon-containing or CO_2 containing waste products that ultimately result in CO_2 emissions when the waste is burned
3. Emissions from the generation of heat in the form of heat carriers such as steam used for the production of these products
4. If applicable, non fossil fuel related process emissions

Whereas direct fuel emissions and the non fossil fuel related process emissions normally occur at the installation where the product is produced, this is not always the case for the 2nd and 3rd emission source. This is schematically shown in Figure 1 and Figure 2 for two paper mills: one with a CHP plant operated as part of the same EU ETS installation and one with outsourced heat supply from e.g. a nearby utility.

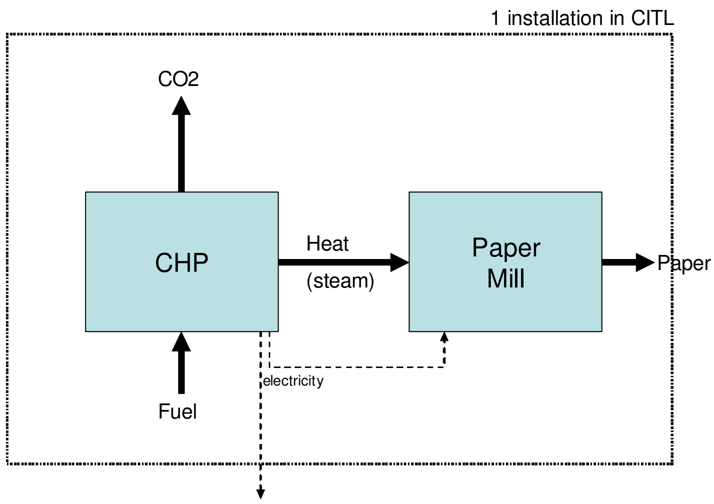

Figure 1 Paper mill with a CHP plant operated as part of the same EU ETS installation

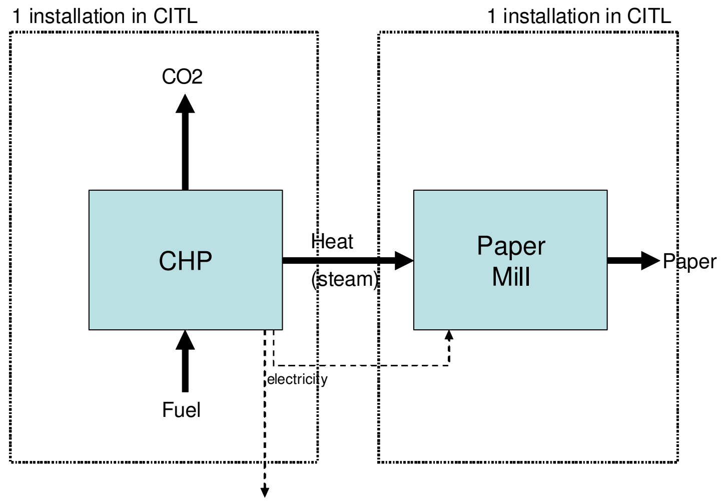

Figure 2 Paper mill with outsourced heat supply

The outsourced utility will be categorized in the activity "combustion of fuel". Recital 23 of the amended Directive states that undue distortions of competition between industrial activities carried out in installations operated by a single operator and production in outsourced installations should be avoided. We translate this into the principle that the allocation to the total system in the case of outsourced installations (i.e. Figure 2) should be the same as that for the system in the case of a single operator. This implies that the risk of exposure to carbon leakage should be assessed at the product level for which benchmark are developed and that the resulting leakage factor should be applied in both systems to calculate the total allocation, regardless whether the heat supplying installation is part of an exposed sector or not[28].

It also implies that in cases where heat flows take place over the system boundaries of EU ETS installations or, by analogy for the third emission source identified above where carbon containing waste products flow over the system boundaries, the allocation for the two entities can be seen as dependent on each other. We further discuss the issue of heat flows and waste product flows over the system boundaries in Section 6.1 and 6.2.

In addition, the activity "combustion of fuels" contains combustion installations (furnaces, dryers, steam boilers, CHP installations) in a variety of sectors including installations in e.g. the food and beverage and other industrial sectors, but also in non-industrial sectors such as hospitals (Table 7, Appendix F). Also it contains combustion installations (e.g. CHP units) that sell heat to such industrial and non-industrial costumers.

Since the combustion installation determines the inclusion in the ETS, many of the sectors concerned are only partly represented in the EU ETS, because they contain many installations that either have a total rated thermal input less than 20 MW[29] or because they mainly have a heat supply from installations under different ownership. Developing benchmarks for the

[28] Via the statistical codes used for product definition, the link between products (determining the benchmark) and NACE codes (determining the risk of carbon leakage) can be established.
[29] This can also be the case for activities in Annex I where the definition includes a product definition and the 20 MW criterion (e.g. gypsum).

products of these sectors would imply that for the application of the benchmark-based allocation and for determining the benchmark, production data would be required from entities that by itself are not necessarily included in the EU ETS. This is schematically indicated for a beverage plant with heat supply from a heat producing installation included in the EU ETS in Figure 3.

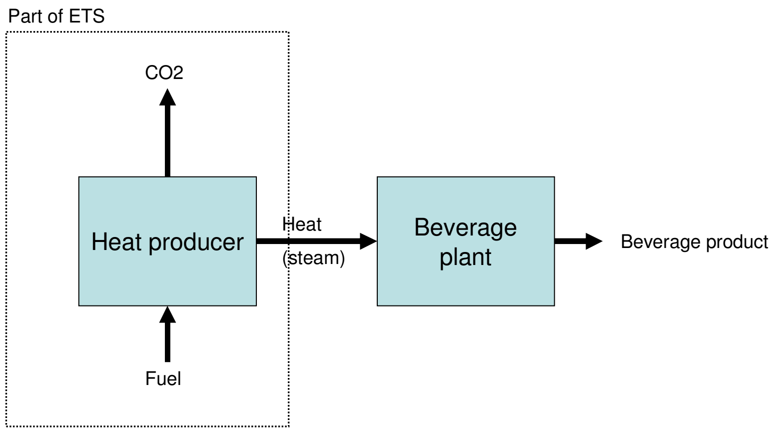

Figure 3 Benchmark for the heat producer in terms of CO_2 per unit of beverage product would require a transfer of production data from the beverage plant (outside ETS) to the heat producer

It would also potentially enlarge substantially the total number of products for which a product benchmark can be considered as becomes visible from the overview of the sectors concerned in Table 7.

For this reason, we followed the following approach in this project:

1. We focused on testing the feasibility of product benchmarks for the products that are specified in Annex I of the amended Directive (i.e. the first and second group identified at the start of this section) (see the sector reports).
2. Secondly, we develop a default alternative approach for free allocation to installations only included in the EU ETS via the activity “combustion of fuels” (i.e. the third group identified above) (Chapter 5)
3. Finally, in a later stage, beyond the scope of this project, additional product benchmarks for certain specified sectors might be considered. Based on the considerations in this section, product benchmarks can be considered if a substantial part of the production facilities producing the product are by their nature included in the EU ETS (e.g. because they always operate as part of the production process a direct emitting combustion installations with an input above 20 MW) and if the sector produces a relatively homogenous product for which benchmarking is a feasible option. In Section 5.5, we give a list of sectors included via the “combustion of fuel” activity, from which inputs were received in the course of this study.

For the purpose of the sector studies in this study, we thereby group the 25 activities listed in Section 4.2.1 in the following 13 sector reports.

1. Mineral oil refineries (2)
2. Metal ore (4)
3. Iron and steel industry (3 / 5 / 6)
4. Aluminium (7 / 8)
5. Other non-ferrous metals (9)
6. Cement (10)
7. Lime (11)[30]
8. Glass (12)
9. Ceramic products (13)
10. Mineral wool (14)
11. Drying or calcination of gypsum (15)
12. Pulp and paper (16 / 17)
13. Chemical industry (18 – 25)

4.4 Principles for product benchmarks

Benchmarks should, according to the amended Directive, ensure that allocation takes place in a manner that provides incentives for reductions in greenhouse gas emissions and improve energy efficiency. In a 2008 study on benchmarking principles (Ecofys / Fraunhofer Institute, 2009), 11 benchmarking principles have been developed for the design of benchmark allocation rules. Principle 9 and 10 concerned the choice of activity levels in the final allocation formula and principle 11 the treatment of installations for which no product benchmark is developed. We discuss these issues in Section 4.5 and Chapter 5 respectively.

The other principles developed in the 2008 study are summarised in Box 2.

The 2008 study was based on the Commission proposal for a amended Directive put forward on 23 January 2008. In this proposal, the reference level for the benchmark was not yet given as is currently the case (average of the 10% most efficient installations in the Community in 2007 – 2008). As such, the principle regarding the choice of benchmark level (principle 1, most energy efficient technology) is no longer valid. We discuss the choice regarding the benchmark level followed in this study in Section 4.4.1. It was agreed with the European Commission to use the other principles (2 – 8) also as basis for this study. We discuss them in Section 4.4.2 and 4.4.3.

[30] The calcination of dolomite and magnesite has been added to Annex I of the amended Directive. The calcination of dolomite to produce dolime is covered by the sector report on the lime industry (see Section 4.3). The calcination of magnesite to produce magnesia is not covered by this study and it is recommended to the European Commission to further discuss the characteristics of this sector with Euromines, representing the magnesia industry, following the publication of this study.

Box 2 Allocation principles for product benchmarks – 2008 study (Ecofys / Fraunhofer Institute, 2009)

Benchmark level
~~*1: Base the benchmark level on the most energy efficient technology*~~[1]
Technology and other corrections
2: Do not use technology-specific benchmarks for technologies producing the same product
3: Do not differentiate between existing and new plants
4: Do not apply corrections for plant age, plant size, raw material quality and climatic circumstances
Number of benchmarks to distinguish
5: Only use separate benchmarks for different products if verifiable production data is available based on unambiguous and justifiable product classifications
6: Use separate benchmarks for intermediate products if these products are traded between installations
From energy efficiency to CO_2 performance
7: Do not use fuel-specific benchmarks for individual installations or for installations in specific countries
8: Take technology-specific fuel choices into account in determining benchmarks

[1] Principle no longer valid due to changes between Commission's proposal and adopted amended Directive

4.4.1 Benchmark level: average of the 10% most efficient installations

In accordance with the amended Directive, the starting point in setting the benchmarks levels will be the average performance of the 10% most efficient installations in a sector or sub-sector in the Community in the years 2007-2008.

In view of the overall role of the amended Directive as a policy instrument aiming at reductions of greenhouse gas emissions, it was agreed with the European Commission to read "most efficient" for the purpose of this study as "most greenhouse gas efficient".

The definition further specified that the number of installations is the basis for the determination of the 10% most efficient. There is no consideration given to the size of the individual installation, hence no weighting occurs with respect to the GHG emissions and/or production volume of the installation (i.e. all installations get the same weight).

The key individual drivers determining the greenhouse gas efficiency (energy efficiency, fuel mix and sometimes process emissions) of installations will be individually discussed in the sector reports to explain key differences in the overall greenhouse gas efficiency, but the final proposed benchmark value should be related to the overall greenhouse gas intensity of installations. In other words, on the y-axis of the benchmark curve, the actual GHG intensity per unit of production should be given. Uniform benchmarks determined in such as way do by definition not correct for country-specific fuel choices (principle 7 in the 2008 study) and automatically take into account fuel mix choices made in certain production processes (principle 8 in the 2008 study) [31].

In constructing benchmark curves, focusing on the greenhouse gas intensity is straightforward to apply for the production processes of products where no heat carriers such as steam or carbon containing waste product cross the system boundary. The benchmark curve can in such a case directly contain the GHG intensity per unit of production, consisting of direct fuel related emissions and, if applicable, process emissions.

For the production processes of products where heat carriers and carbon containing waste gases cross the system boundary of the installation (Figure 4), directly constructing a greenhouse gas intensity curve is less straightforward.

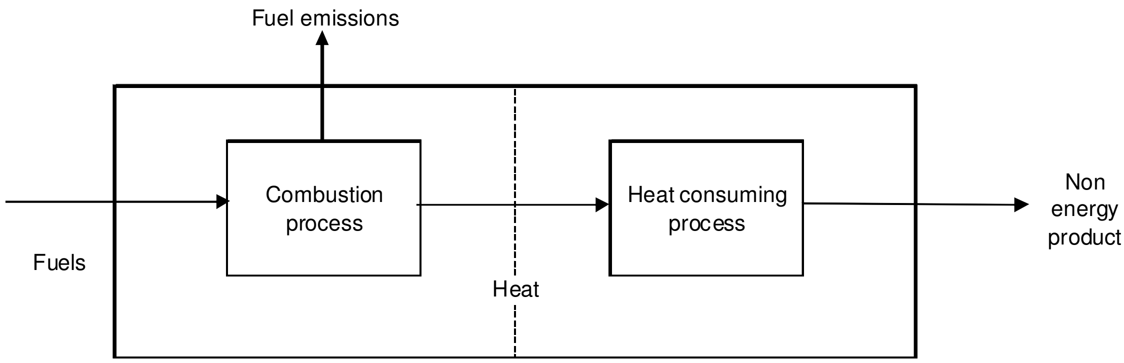

Figure 4 Installation with separate heat producing and heat consuming process

In this situation, the heat consuming process is separated from the combustion process where the heat is produced. Constructing a benchmark curve taking into account both the process where the heat is produced and the process where it is consumed would thus require combining the two processes together. This can easily be done for situations where the consuming process has a heat supply from clearly identified sources of which the greenhouse gas performance (i.e. the fuel mix and heat generation efficiency) is known. However, this is in many cases not the case. On integrated chemical sites, for example, one or multiple steam networks exist connecting several steam consuming and steam producing pieces of equipment. Also, steam is often coming from an outsourced utility of which the steam consumer does not know the greenhouse gas performance is recovered in production processes.

For the aim of constructing benchmark curves for production processes that consume secondary heat carriers such as steam, it is therefore most straightforward to combine the energy consumption (measured via the heat flows consumed in the process) with a benchmark for heat production (i.e. the fuel mix and heat generation efficiency) that is appropriate for the sector where the heat is consumed. In the relevant sector reports it is explained how this is

[31] Principle 7 and 8 are thus inherent to how the relevant Articles of the amended Directive are used in this study and thus, because by definition valid, do need to be specified as principles.

done. This also means that for exothermic processes with heat recovery in e.g. the chemical industry, a product benchmark could become negative, because the process exports a secondary energy carrier from the process[32].

Another issue is how to construct benchmark curves for production process that produce waste gases. The treatment of this waste gas is relevant for both the producer and the consumer of the waste gas. The approach for waste gases is explained in more detail in chapter 6.2.

Within the scope of this study, the consortium aimed to involve to the extent possible the European sector organizations representing the relevant sectors. Ideally, the organizations would prepare benchmark curves that can be used, after verification, to determine the average of the 10% most efficient installations in the Community in 2007 – 2008. In assessing the benchmark curves that are supplied by the relevant European sector organizations, in addition to the interpretation of "most greenhouse gas efficient" as explained above, we used the following interpretation of the Directive text and rules for constructing benchmark curves:

- Given that benchmarks are envisioned for products rather than for "sectors" or "sub-sectors" as a whole, the words "*most efficient installations in a sector or sub-sector*" in Article 10a (2) are used as "*most efficient installations producing a certain product or product group for which a benchmark is defined*".
- All installations in the Community in 2007 – 2008 need to be taken into account in determining the benchmark. In view of the EEA agreement on the implementation of the amended Directive, this means that also Norway and Iceland should be included. In this study this is done to the extent feasible (see sector reports for more details).
- All installations that are in the ETS according to Annex I of the amended Directive (including those with emissions lower than 25 000 t of CO_2 equivalent) should, in principle, be taken into account in the development of benchmarks even if they are outside the current EU ETS.
- All installations (regardless their emission or production volume) should be given an equal weight in determining the benchmark. On the x-axis, installations should thus be given rather than cumulative production or cumulative emissions.
- No installations should a-priori be excluded from the benchmark curves. Exclusion of installations in exceptional cases for specific reasons should be made transparent as input for the discussions on potentially removing them from the complete benchmark curve that includes all installations.
- The methodology used to construct the benchmark curves should be publicly available, including information on the compatibility with e.g. the ETS monitoring guidelines.
- The actual data points on the curve should in principle be verifiable by independent verification before the final adoption of the benchmark values[33].

[32] This negative value is compensated by an equivalent positive amount for the process consuming the steam, thereby resulting in 0 allowances. For the processes in the chemical industry for which no product benchmark is developed, no negative benchmarks occur and allocation for heat consumption would thus result in emission allowances for such cases. In order not to disadvantage heat recovery from exothermic processes, it could be considered not to correct for this. Alternatively, this heat could be excluded in the allocation rules (see also Section 5.3.2 and 6.1).

[33] Guided by confidentiality arrangements if necessary. The verification is not within the scope of the current study.

The starting point for the benchmarks is based on the average of the 10% most efficient installations. This study aims to find this starting point to which we further refer as "the benchmark". It has to be emphasised that this study does not further discuss what the resulting distribution of allowances over installations and sectors is as compared to their historical emissions and whether this division is fair considering that the allocation should take place in a manner that provides incentives for reductions in greenhouse gas emissions and energy efficient techniques.

Given the limited timeframe available for this study, not all sector organizations were able to deliver benchmark curves already within the scope of this study or could only deliver partial information (representative sample, different years etc.). This can be due to the fact that data collection only has started recently and/or is rather cumbersome (many installations, multiple products per installation, missing guidance on how to divide emissions over multiple products etc.). Ideally, all methodological decisions (e.g. on the treatment of waste gases, cross-boundary heat flows, production differentiation etc.) would have been made before the sector embarked on data collection efforts. Within the timeframe available for this study, this has not been fully possible. In the sector reports, we summarise the remaining methodological challenges for the sectors concerned.

In some cases, also confidentiality concerns are important, e.g. if a product is only produced by a rather limited number of producers. The background of the benchmark curve presented in the sector reports and the difficulties in constructing these benchmark curves are carefully described in this report. If necessary, actual benchmark data are supplemented by additional sources. In summary, the values presented consist of:

- Values from benchmark studies as developed by the individual sector organizations based on performance data from EU ETS installations
- Literature values
- Expert judgements

In the course of the ongoing political process following the finalization of this study, these values will have to be further refined, resulting in the final values to be adopted in December 2010. Also these values will, however, be based on combinations of the three sources as outlined above.

The benchmark values proposed in this study are based on the uncorrected benchmark curves (if available, see above). Many sectors argue that the resulting benchmark curves contain installations that are for several reasons not representative for the sector as a whole. The consortium has assessed the arguments put forward by stakeholders carefully, but has, in view of the "one product – one benchmark" approach (Section 4.4.2) been reluctant to exclude installations from the curve because of e.g. the use of certain energy carriers or raw materials by certain installations. This would also require a set of clear rules for such exclusions. The arguments brought forward by the sectors can be found in the relevant sector reports. As a general rule, if installations are on purpose excluded from the benchmark curve, because for specific reasons (i.e. thus not because data is not available), the benchmark should also not be applied for the allocation, but instead, a fall-back approach should be used.

4.4.2 One product, one benchmark

Principle 2, 3, and 4 (Box 2) are all specifications of a more general "one product, one benchmark" principle. Benchmarks developed for individual products should not be specified by technology (2), should not be different for existing and new plants (3) should not be corrected for age and size of the installation, for climatic circumstances and for raw material quality (4). In this way, all greenhouse gas emission reduction options remain an integral part of the benchmarking methodology and as such, the methodology does not distort incentives for greenhouse gas emission reductions[34]. A consequence of defining benchmarks by product is that product substitution is no part of the benchmarking methodology.

An issue not directly dealt with via the principle on raw material[35] quality corrections is to which extent the availability of raw material should be taken into account in cases where different raw materials are available in limited quantities across regions. Not correcting for the raw material, because of availability issues provides adequate incentives to invest in the technology with the lowest overall greenhouse gas emissions and is for this reason the preferred option.

For illustration, we refer to the example of lime production. Limestone quarries result in a mixture of small and large pebble size limestone. The smaller pebble size can only be processed in horizontal lime kilns, thereby resulting in higher greenhouse gas emissions (as compared to vertical kilns). Due to the significant contribution of process emission in lime production, the difference in overall emission benchmark between the two lime kilns is still relatively small. Furthermore, a technology specific benchmark as such would give an incentive for horizontal kilns regardless of whether all the horizontal kilns are required from a resource efficiency point of view. Correcting for this (e.g. by allocating to horizontal kilns only up to a certain share) would unnecessarily complicate the methodology. For these reasons, we propose a single benchmark for lime. For more details, we refer to the sector report.

In line with the approach regarding corrections for country or installation-specific fuel mix choices, local or country-specific availability issues should in any case not be corrected for to provide a system-wide optimization. For this reason, we for example do not propose separate benchmarks for the production of ammonia from natural gas and from coal, corrections for different raw materials in the production of ceramics or corrections for differences in moisture content of limestone used for the production of clinker.

An issue related to the raw material quality criterion is how the use of primary versus secondary materials is accounted for. We belief that the methodologies chosen for the various relevant sectors do not provide negative incentives for further recycling of materials:

[34] The incentive for reducing CO_2 emissions within a trading period is for existing plants equal to the allowance price times the amount of avoided emissions. This is independent of the allocation methodology. Reference here to "incentives remaining within the system" relate to the assumption that product benchmarks will also play a role in the allocation in the next trading period after 2020. If this were the case, the incentive to reduce greenhouse emissions in the third trading period can partly be taken away this could, via technology-specific or fuel specific benchmarks, lead to another (lower) benchmark to be applied in the next trading period. Regarding new installations, differentiated benchmarks could distort incentives to invest in the most carbon efficient technologies to produce a certain product and could result in ETS companies optimizing within benchmark classes.

[35] The notion of raw material quality includes also for example scrap as the basis for recycled materials.

- For paper, the primary raw material is an intermediate product and for this reason we propose separate benchmarks for pulp, recycled paper processing and paper making in which the benchmark for paper making is based on non-integrated paper mills.
- For iron and steel, the primary and secondary routes are clearly distinguishable product routes. Not all products can be made via either route, justifying separate benchmarks for products produced via the two routes.
- For aluminium the primary and secondary routes are clearly distinguishable product routes. Not all products can be made via either route, justifying separate benchmarks for products produced via the two routes.
- For other non-ferrous metals, we propose a fall-back approach (mainly because of the limited amount of producers and emissions) in which the use of secondary raw materials with different quality is by default taken into account, because the approach is based on the actual energy use in the production processes.
- For glass, melting of either the primary raw material or the secondary raw material (cullet) is done in the same (batch) furnace. The benchmark without corrections for the actual share of cullet used reflects a realistic share of secondary input material that can be achieved in view of product quality and availability and there is no need for further corrections, except for a differentiation by product.

4.4.3 How many different products to distinguish

An important issue in the application of the “one product, one benchmark” principle is the question how a product is defined and how many products can be distinguished. Principle 5 and 6 from the 2008 study give directions for this:

Only use separate benchmarks for different products if verifiable production data is available based on unambiguous and justifiable product classifications (principle 5)

Use separate benchmarks for intermediate products if these products are traded between installations (principle 6)

The need for proper product definitions using classifications available at the European level is required to ensure that the allocation methodology can be applied in a uniform way across Europe and that the production data can be verified and checked using appropriate product classification. Several statistical product classifications (CPA, PRODCOM, and CN) are available at the European levels which are briefly discussed in Appendix E. In addition, various additional industrial classifications are in use by the various economic sectors involved. The 8-digit PRODCOM classification is the most detailed product classification available EU-wide and has as additional advantage that it is directly linked to the NACE classification. For this reason, it can be the most logical choice for product definition, but there might be good reasons (e.g. the level of detail required) to use other classifications. We describe the proposed classifications for each sector in the sector chapters.

Principle 6 is based on the argument that it should be possible to calculate an allocation for all installations in the EU ETS. In case only end products are benchmarked, allocation to installations only producing the intermediate product would not be possible or would involve transfer of allowances between various EU ETS installations[36].

Neither of the two principles provides direct guidance on the number of products for which individual benchmark should be developed and on the possible grouping of products into different product groups.

We used the following criteria to make the choice for the number of product groups to distinguish:

1. Different products within a product group that has a similar application should only be considered if the difference in emission intensity is significant. As guiding rule, in grouping comparable products, a 20% difference in the benchmark[37] emission intensity will be guiding in determining whether different benchmarks will be proposed for separate products within the same product group[38].
2. The share of emissions of a product group in the total emissions of a sector. We aim to develop, to the extent possible, similar allocation rules (i.e. either benchmarking or an alternative approach) for a large share of clearly distinguishable sectors (NACE 4-digit or other more appropriate sector definitions) within the EU ETS. For sectors where a wide variety of diverse products are produced (e.g. the chemical and paper industry), applying an 80:20 principle (a limited number of different products covers 80% of the emissions) proved to be a pragmatic way of limiting the total number of individual benchmarks, thereby keeping the overall allocation methodology transparent[39].
3. The share of emissions of a product group in the overall EU ETS emissions. Similar to the 2nd criterion, also the contribution of product groups to the overall EU ETS emissions will be used as criterion. This could mean that for smaller sectors (in relation to the overall EU ETS emissions) a limited number of benchmarks will be proposed or they may be dealt with via a fallback approach as a whole.
4. The number of installations producing a certain product group. The number of installations is important to assess whether a reasonable benchmark (i.e. a benchmark approaching the average of the 10% most efficient installations in the Community) can be established.

We have been flexible, but transparent in applying these criteria (which by their nature cannot be applied to yield a unique solution for the number of product groups to distinguish) to ensure that the development of benchmarks is not discouraged for those sectors for which benchmarking would be appropriate, but which do not strictly meet all criteria (e.g. those on the number of installations). For the products of sectors for which no product benchmark is

[36] Contrary to heat flows (Chapter 6) where the allocation is based on the product and the allowances are divided over the producer and consumer, the two installations are not physically related to each other. The entity consuming the intermediate product (e.g. clinker) can even be outside the EU.
[37] This does thus not mean the difference of 20% between good and bad performing plants producing a single product, but a difference in benchmark emission intensity between different products.
[38] Obviously, this can only be done when data availability and product classifications allow calculating separate benchmarks.
[39] Please note that this 80:20 rule is applied at the sector level. At the individual installation level, the share of emissions covered by product benchmark can be far less or even the total amount of emissions will be covered via one of the fall-back approaches.

developed and for sectors for which no product benchmarks are developed, a fall-back approach is developed (Chapter 5).

4.5 Activity data

The EU ETS is within the framework of the Directive assumed to function as a complete ex-ante allocation system. This means that not only the benchmarks should be determined ex-ante, but that also historical activity data will be applied to determine the final allocation. It is not the primary focus of this study to assess in detail which activity levels are to be used to get from a benchmark (i.e. specific emissions per unit of production) to the actual allocation. The two starting points on allocation principles as included in the 2008 study on activity levels were based on the requirement of a full ex-ante distribution of allowances to incumbents. These starting points are maintained as part of this study:

- Use historical production figures to allocate allowances to existing installations[40]
- Use product-specific capacity utilization rates (e.g. based on the historic production rates of a sector) with verifiable capacity data to allocate allowances to new installations.

For the reasoning behind this choice, reference is made to the 2008 study on principles (Ecofys/Fraunhofer-ISI, 2009). The use of historical data from before the adoption of the amended Directive limits the period to before or including 2008. The desire to use data of good quality does not allow going too far into the past. Thus, the period 2005 – 2007 might be the most suitable reference period to be used, also in line with the determination of the share of free allowances according to Article 10a of the amended Directive. Either the highest production levels in one of those years or the average production level over the three years are reasonable options for using the 2005 – 2007 data. Both methods correct to some extent for special circumstances (e.g. planned maintenance etc.) in any of the three years. In addition, this period was a period of high economic growth leading to high production levels, in particular compared to production levels observed during the recession following the financial crisis in the fall of 2008. As said, a further discussion on the choice of activity data is left outside the scope of this study.

[40] As opposed to projected production or standard utilization rates in combination with capacity.

5 Fall-back approaches – combustion installations

5.1 The need for fall-back approaches

As discussed in Chapter 4, many different industrial activities take place within the EU ETS installations. While for a large share of the GHG emissions eligible for free allocation, product benchmarks are proposed to be used for allocation, this is not the case for all GHG emissions eligible for free allocation.

This means, that for emissions from a variety of activities, a different approach is required. We refer to these approaches as to fall-back approaches. These emissions can be divided into two groups:

1. Emissions from installations in the sectors included in the EU ETS via the activity "combustion of fuels" only.
2. (Some) emissions from installations included in the EU ETS via some of the other activities in Annex I for which no product benchmarks are developed or where not all products are covered via product benchmarks.

Regarding the first group, we concluded in Section 4.3 that additional product benchmarks could be considered if a substantial part of the production facilities producing the product are by the nature included in the EU ETS (e.g. because they always operate as part of the production process a direct emitting combustion installations with an input above 20 MW) and if the sector produces a relatively homogenous product for which benchmarking is a feasible option. We come back to this in Section 5.5. It should be noted that we use the term fall-back approach for all approaches other the approach where the non-energy product of an installation is benchmarked. This means that also the approach in which the product heat is benchmarked is referred to as a fall-back approach. The amount of emissions that will be treated via these approaches is substantial as it for example includes the district heating sector, which we will separately discuss in Section 5.3.3.

5.2 Emission sources

For the purpose of developing realistic fall-back approaches for emissions not covered via a product benchmark, we distinguish three types of emissions sources that different with respect to the fall-back approaches that are possible:

1. Small amounts of non fuel related process emissions (e.g. from carbon containing materials)[41]
2. Emissions from combustion equipment where a measureable heat carrier is produced that is subsequently used in a production process. Examples are boilers that produce steam and hot water.
3. Emissions from combustion equipment where the heat and / or mechanical energy is directly used in a production process without the intermediate production of a measurable heat carrier such as steam and hot water. Examples are ovens, hot air dryers, and furnaces.

In applying the fallback approaches that can realistically be used for allocation (discussed below), understanding of the range of activities involved and emission sources concerned will thus be required. In Chapter 4, an overview was presented to give insight in the NACE classification of EU ETS installations included via the "combustion of fuel" activity. This list is a useful starting point to assess the types of emissions that may occur, and need to be accounted for by the fall-back approaches suggested. However, the NACE classification by itself does not necessarily directly reveal the type of combustion processes operated in the installations. For example, an EU ETS installation in the NACE classification "operation of dairies and cheese" may include any choice of pasteurisers, sterilisation processes and homogenisation and mixing equipment, refrigerators and aseptic packaging equipment if it produces liquid milk and cream based products. However, if it produces milk powder, spray dryers will be the abundant equipment used. To conclude, the NACE classification as such does not provide direct information on the type of equipment present in an EU ETS installation.

5.3 Proposed fall-back approaches

5.3.1 Grandfathering for non fuel related process emissions

In the absence of a product benchmark that links the non fuel[42] related process emissions to a product output, grandfathering (free allocation based on historical emissions) can be regarded as the only practically feasible basic allocation methodology that can be applied for the allocation. Remaining question is to which extent the allocation based on grandfathering should be combined with correction factors to bring the methodology in line (i.e. with respect to the effort required by the installation to contribute to overall greenhouse gas emission reductions). We further discuss this in Section 5.4.2.

[41] These emissions are not very likely to occur in installations in the "combustion of fuel" Annex I activity (i.e. the 1st group of installations for which a fall-back is required), but can be relevant for non-benchmarked products in some of the other activities (i.e. the 2nd group of emissions for which a fall-back approach is required).

[42] For some emissions, it can be debated whether they are regarded fuel or non fuel related emissions. An example is the presence of organic material in clays used for ceramic production. The organic material can regarded as a fuel (the carbon is oxidized thereby releasing heat), but can also be regarded as process emissions (they are present in the raw material and are not deliberately chosen as fuel). In the scope of this study, we do not further discuss the definition of process emissions, but we do recommend to clearly defined process and fuel emissions in the further design of this fall-back option.

5.3.2 Approach for combustion emissions

For combustion processes, three factors influence specific CO_2 emissions:

- The choice of fuel mix
- The efficiency of the heat production
- The efficiency of the heat end use

We schematically show this in Figure 4 and Figure 5 for the two types of combustion processes distinguished in Section 5.2 (i.e. with an intermediate heat carrier and without an intermediate heat carrier).

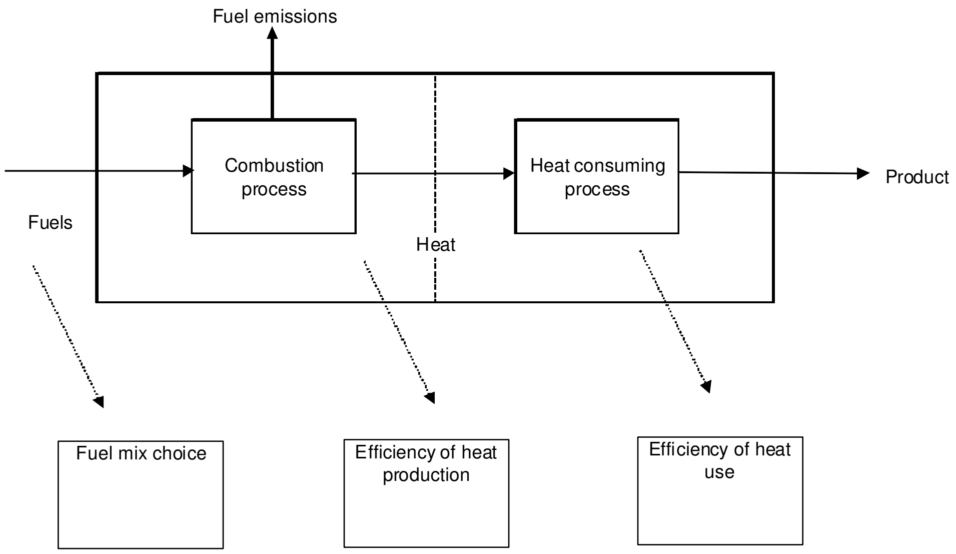

Figure 5 Combustion process with an intermediate heat carrier

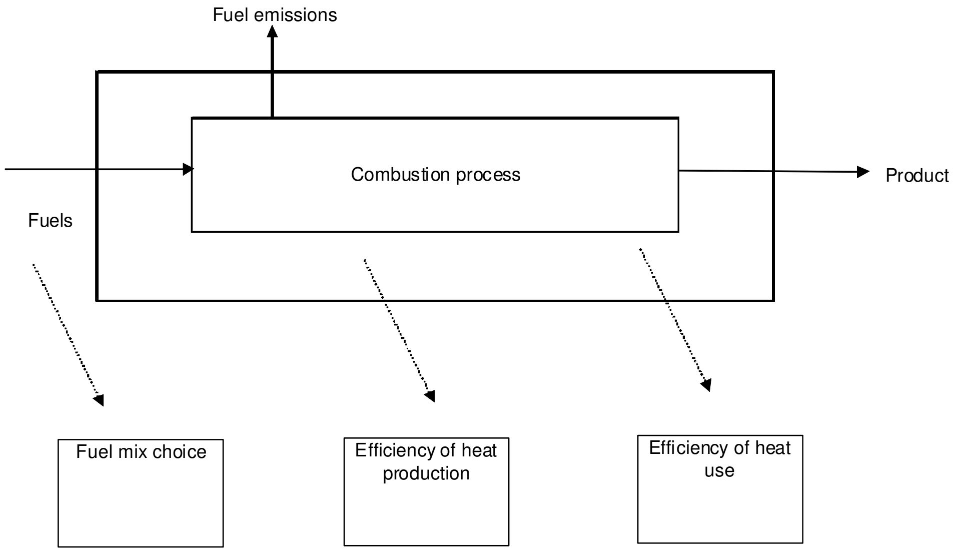

Figure 6 Combustion process without an intermediate heat carrier

In case of product benchmarking, all three factors (fuel mix, efficiency of heat production and efficiency of heat end use) are taken into account via a benchmark expressed as t CO_2 / unit of production. When product benchmarks are not possible, three alternative methods can be thought of

1. Grandfathering
2. A benchmark for heat production expressed as t CO_2 / energy unit of heat produced (referred to below as heat production benchmarking)
3. A benchmark for the fuel used in combustion processes expressed as t CO_2 / energy unit of fuel used (referred to below as fuel mix benchmarking)

We summarise in Table 8 which CO_2 performance elements are taken into account in product benchmarking on the one hand and the three generic fall-back approaches on the other hand.

Table 8 Overview of GHG performance elements taking into account in different allocation options

	Fuel mix choice	**Combustion process efficiency**	**Heat end-use efficiency**
1 Product benchmarking	Included[1]	Included	Included
2 Heat production benchmarking	Included	Included	Not included
3 Fuel mix benchmarking	Included	Not included	Not included
4 Grandfathering	Not included	Not included	Not included

[1] "Included" means that potentials to improve on the corresponding factor and hence to reduce GHG emissions influenced by this factor are directly included in the approach

If product benchmarking is not possible, heat production benchmarking should be preferred over fuel mix benchmarking, and fuel mix benchmarking should be preferred over grandfathering if one would like to include as many of the factors affecting specific CO_2 emissions in the fall-back approach as possible.

We argue here that heat production benchmarking is only possible in cases where the heat is transferred from the combustion process to the heat end-user and the amount of heat produced and delivered to the user can be measured and monitored. Examples are hot water production in a district heating plant (the hot water is consumed by households), steam production in an industrial boiler (the steam is consumed in an industrial process). We propose to use a heat production benchmark for these emissions. A large sector for which such a heat production benchmark would thus be applied is district heating. We separately discuss this sector in Section 5.3.3.

In the second category combustion processes (e.g. furnaces, direct dryers etc.), there is no intermediate heat product and the combustion process and the heat consuming process are combined. It is in those cases more difficult to benchmark the combustion process itself via an intermediate heat product. Doing so would imply to define and monitor furnace and burner efficiencies). If product benchmarking for the process is really not possible, there is in this case still the opportunity to benchmark the fuel mix applied in the combustion process. The energy intake of the fuels in the combustion process (measure in an energy unit, e.g. GJ) can be combined with a benchmark for the fuel mix (e.g. t CO_2 per GJ). We propose using this as default methodology for this category of combustion processes.

Table 9 provides an overview of different proposed fall-back approaches for the emission sources in processes without a product benchmark.

Table 9 Proposed fall-back approach for emission sources not covered via product benchmarks

Emission source	Grandfathering	Fuel mix benchmark	Heat production benchmark
Combustion process with monitored heat output			Proposed
Combustion process without monitored heat output		Proposed	
No fuel related process emissions	Proposed		

5.3.3 District heating

In the approach chosen in this study, the focus is on developing product benchmarks for the activities in Annex I of the amended Directive that are covered via a definition of their product and not on sectors included in the EU ETS as part of the "combustion of fuel" activity (Section 4.3). Obviously, next to the production of electricity, the district heating sector is the largest source of emissions in this activity. Although exact estimates of the total amount of emission associated with district heating are not available, the overview given in Table 5 indicates that installations categorized as "steam and hot water supply" by the MS are responsible for a large amount of emissions (129 Mt CO_2 in as many as 2192 installations). Free allocation for district heating is also explicitly mentioned in Article 10a (4) of the amended Directive. There are significant differences in the type of fuel mix used for district heating in various regions across regions. The discussion on possible differentiation of the heat production benchmark (Section 5.4.2) is therefore particularly important for this sector. Also, it could be envisioned that for this specific sector, a benchmark based on the service provided by a district heating system (e.g. the number of m^2 served) is developed, although this is not easy in view of monitoring requirements etc.

Given the chosen approach for this study (Section 4.3), we will not further discuss district heating in this study, but given the importance of the sector, it is recommended to involve the relevant stakeholders as soon as possible in the further development of the heat production fall-back approach or other approaches for the district heating sector.

5.4 Benchmark values and correction factors

5.4.1 Benchmark values

Above, heat production and fuel mix benchmarks have been proposed as default fall-back approaches for combustion process without and with a measurable heat output. A question remains what values these benchmarks should have. We distinguish two basic options for this:

1. A non-differentiated benchmark value for all emissions that make use of the fall-back approach, possibly combined with a factor relating this value to historical emissions
2. Benchmark values differentiated by sectors / installations / countries, possibly combined with a factor relating these values to historical emissions

Non-differentiated benchmark values

A non-differentiated heat production and fuel mix benchmark could in principle be evaluated by constructing a benchmark curve containing all the relevant installations. The benchmarks could then be set as the average of the 10% most efficient installations, comparable to the benchmark curves for which a product benchmark is developed. This option is not regarded feasible, because the information for such a curve should come from a variety of different sectors and installations and the number of steam boilers and other heat production and combustion equipment operated by EU ETS installations is very large. The timeframe available to set a benchmark value is too short to embark on a data collection exercise for this number of installations. Also, it can be expected that the resulting benchmark value will be very close to a value that can be found as reference heat production efficiencies in other sources.

One of these sources is the Commission Decision 2007/74/EC establishing harmonised efficiency reference values for separate production of electricity and heat in the application of Directive 2004/8/EC on the promotion of cogeneration (EU, 2004; EC, 2007). For steam and hot water, reference efficiency values are given ranging from 70% for biogas to 90% for natural gas. For all fossil fuels (excluding waste flows and biomass), the reference efficiency value is between 86 and 90%. Using the 90% efficiency for natural gas as reference and combining this with an emission factor of 56.1 t CO_2 / TJ for natural gas (IPPC, 1997) results in a heat production benchmark of 62.3 t CO_2 / TJ heat produced as heat production benchmark. By analogy, using natural gas as reference fuel for a fuel mix benchmark results in a fuel mix benchmark of 56.1 t CO_2 / TJ of fuel used. The reference values mentioned in Commission Decision 2007/74/EC do not differentiate between hot water and various types of steam. Generation efficiencies measures in energy terms in general do not differ much between hot water and steam of different temperature.

The main advantage of such a uniform approach is its simplicity and transparency. However, such a non-differentiated benchmark value for both the heat production benchmark and the fuel mix benchmark has a strong distributional effect between installations. It would for example mean that industrial boilers in the food sector that make use of biomass residues would receive an allocation based on natural gas as fuel which does not have any relation to their historical emissions.

A way of avoiding this could be to relate the basic calculation of the heat or fuel mix benchmark to the historical emissions[43]. A decision on this strongly depends on the political acceptability of allocations beyond historical emissions (inherent to any benchmarking approach) and the acceptability of not correcting benchmark based allocations for the actual fuel mix applied by the installation also in view of fuel availability. We do not further discuss this issue here.

Benchmark values differentiated by sector

Another option would be to differentiate the heat production and / or the fuel mix benchmark by sector. Disadvantage is that the approach becomes more complex and less transparent and will contain by definition choices, which can in length be debated (e.g. which sectors to distinguish). Given the overall timeframe available before adoption of the CIMs, this is a serious drawback of having many differentiated heat production and fuel mix benchmarks and we recommend, as a general principle, not to apply a differentiated approach regarding the heat production and fuel mix benchmarks. For sectors in which heat flows over the system boundaries of installations (chemicals, paper), it is nevertheless important that the same approach is followed for heat consumed by a certain sector regardless whether it is produced within the sector itself or via an outsourced utility. In other words, the consuming sector should determine the heat production benchmark to be applied if differentiated heat benchmarks would, in the final allocation rules be applied.

5.4.2 Correction factors

Obviously, the different allocation methodologies proposed in this study (product benchmarks, heat production benchmarks, fuel mix benchmarks, grandfathering) differ in the extent to which the factors influencing CO_2 emissions (fuel mix, heat production efficiency and heat end-use efficiency) are considered in the allocation (Table 8).

This raises the question whether allocation methodologies not taking account all the factors influencing CO_2 emissions should be corrected with additional correction factors to account for CO_2 emission reduction potentials related to the factors influencing CO_2 emissions that are not included. Such improvement factors should thus take into account:

- Potentials to reduce these process emissions for the grandfathered non fuel process emissions
- Potentials to improve heat end-use efficiency for emissions allocated via the heat production benchmark
- Potentials to improve heat end-use efficiency and heat generation / conversions efficiencies for emissions allocated via the fuel mix benchmark

[43] Linking the basic allocation somehow to the historical emission can of course also be applied for emissions related to benchmarked products.

Regarding the stringency of these possible (generic) improvement factors and of the fall-back option in general, the fall-back approach should ideally be comparably stringent compared to product benchmarking to ensure a level playing field between the sectors for which product benchmarking is reasonably possible, and for non-benchmarked sectors. At the same time, there is a desire to keep the number of product benchmarks should remain within limits so that the overall transparency of the allocation methodology is guaranteed. To ensure this, a fall-back option should not be unnecessary restrictive so that many additional sectors will propose product benchmarks or sectors for which only a limited number of products are proposed will show preference for additional benchmarks.

We discuss the following options for improvement factors, but do not give a final recommendation on whether such factors should be applied:

- Improvement factors based on an assessment of reduction potentials
- Improvement factors based on factors derived from benchmarked products

Corrections based on an assessment of reduction potentials

An option for an improvement factor could be to make a sector or even installation-specific assessment of the most greenhouse gas efficient technology and to estimate the improvement potential on such as an assessment. Just as an example, a heat benchmark for district heating could be multiplied by a factor that takes into account best practice end-use efficiency improvements (best commonly used insulation) in the building sector.

Such an approach ensures that the allocation is somehow based on an achievable emission level of the installation concerned, but obvious drawbacks of such approaches are:

- Degree of complexity
- Necessity to have installation expertise in competent authorities
- Difficult to harmonise across the EU

Correction based on factor derived from benchmarked products

A correction factor can also be calculated by considering the differences between historical emissions and allocation based on benchmarks for all products for which a product benchmark is developed. Such an improvement factor is a measure for the average improvement potential that is possible for producing products with a product benchmark.

It should be noted that an improvement factor calculated via this method can not directly be applied in the case of a heat production benchmark, because part of the improvement potential (i.e. the potential related to heat production and fuel mix) would in this case be double-counted in the allocation for installations with a heat production benchmark. By analogy, for emissions allocated via a fuel mix benchmark, the potential related to fuel mix changes would be double counted. Furthermore, the use of such a generic factor applied is rather disadvantageous for early movers with little improvement potential left.

5.5 Additional product benchmarks

In the course of this project, several organizations representing sectors included in the EU ETS via the “combustion of fuel” activity contacted the consortium. Below we give an overview of these organizations. Several of these organizations are investigating whether output based benchmarks for their installations (or output based benchmarks for part of their installations) could be developed. Organizations denoted with an * already provided detailed information for their sectors or presented preferred approaches for the allocation methodology. Given the chosen approach in this study (Section 4.3), we do not discuss the contributions from these sectors in detail in this report[44].

- Confederation of the Food and Drink Industry in the EU (CIAA)
- Scotch Whisky Association (SWA)
- Comité Européen des Fabricants de Sucre (CEFS); sugar industry *
- The European Power Plant Suppliers Association (EPPSA)
- European Tyre and Rubber Manufacturers association (ETRMA) *
- European Panel Federation (EPF)
- European Association of Mining Industries (Euromines)
- European Starch Industry Association (CAA)
- The Brewers of Europe
- European Salt Producers' Association (EUSalt)
- EU Oil and Protein meal Industry (FEDIOL)
- European Semiconductor Industry Association (ESIA)
- The European Flour Millers
- Euromilk: European Dairy Association (EDA) and European Whey Products Association (EWPA)
- European Coffee Federation (ECF)
- Euromalt; malting industry
- European Bio ethanol Fuel Association (eBio)
- European Foundry Association (CAEF)

[44] The public consultation that will take place following publication of this study can be a good forum for the sectors to provide this input

6 Generic issues

6.1 Cross boundary heat flows between ETS installations

As explained in Section 4.4.1, it can occur that the consumer of heat is not the same EU ETS installation as the producer of the heat, because heat is transferred between different EU ETS installations. An example of such a situation is depicted in Figure 7: one EU ETS installation (right) produces a variety of products by a number of processes while another EU ETS installation (left) supplies part of this heat (e.g. steam or hot water) needed for these processes. This section addresses the question how to account for these cross-boundary heat flows in the allocation of allowances. This is necessary, because at least in the case of product benchmarks, the allocation is based on the activity of the heat consuming installations, whereas obviously, (part) of the actual emissions occur at the heat producing installations. This raises the question how allowances should be distributed over the producing and heat consuming installation.

This section is only dealing with heat that is flowing across the boundaries of the EU ETS installation. This installation boundary may be different from the organisational boundary. The permitting procedure varies across the MS: In some countries, large industrial sites are treated as one EU ETS installation (e.g. via a separate legal entity responsible for the permit of the full site), while in others individual process units are considered as individual EU ETS installations. When multiple entities operate within the same EU ETS installation that receives the allowances, a further division of the allowances may thus be required. Since allowances are allocated to EU ETS installations as defined by GHG permits, such divisions are beyond the scope of this study and should be dealt with by the entities represented under the single EU ETS installation. We do not further discuss this in this section.

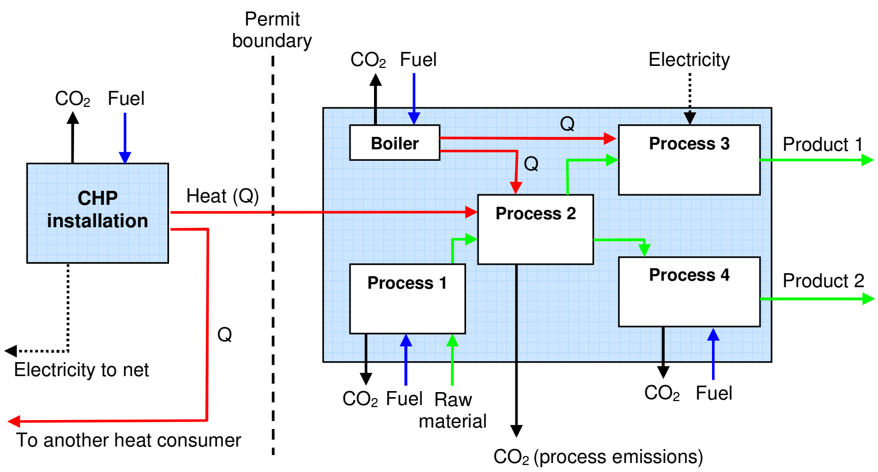

Figure 7 Schematic of an installation with some internal processes and partly outsourced heat supply

6.1.1 Underlying principles

Total amount of allowances should be independent of heat supply structure
Recital 23 of the amended Directive state the allocation rules should avoid "undue distortions of competition between industrial activities carried out in installations operated by a single operator and production in outsourced installations".

Combined with the notion that heat is eligible for free allocation as explained in Section 3.2[45], we translate this into the principle that the methodology to allocate allowances in case of cross-boundary heat flows should ensure that the total amount of emission allowances for the heat concerned should be equal in all cases, regardless the permitting structures of the heat producing and heat consuming installation. In other words, from an end-use perspective, all heat should be treated equal, regardless the installation in which the heat is produced. This also implies that in the calculation of the total amount of allowances, the carbon leakage factor of the consumer should form the basis[46] and, by analogy, the heat production benchmark for the consuming sector if differentiated heat production benchmarks would be applied (Section 4.3, Section 5.4.1).

In the 2008 report on allocation principles (Ecofys/Fraunhofer-ISI, 2009), three possible options have been worked out that comply with this principle[47]:

1. Allocation of allowances to consumers of the heat
2. Allocation to both producers and consumers based on a heat production benchmark for the transferred heat
3. Allocation to both producers and consumers based on the contributions of the producer and consumer to the total emissions or total heat use

In the next sections, these allocation methodologies will be further discussed using a simplified model of the situation in Figure 7. All three methods considered can ensure equal total allocation independent of ownership structure if designed well. However, the three methodologies differ in the way allowances are distributed over consumers and producers.

Dynamic elements and cross-boundary heat flows
In accordance with the condition that the allocation methodology is a full ex-ante system, all activity levels and heat flows have to be based on historic data in the reference period used for the allocation (Section 4.5). The actual heat flow in a given year may differ from the heat flow in this reference period. None of the methodologies that will be presented precludes the possibility to update the allocation in order to better reflect the heat flows at a given moment. In order to be in line with the allocation methodology of an ex-ante system, no such updating is considered.

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45 In this respect, the situation for heat differs from that of electricity. Electricity is not eligible for free allocation, but compensation for increased electricity prices is done via financial compensation to electricity consumers.
46 In case a product would be produced using heat that is produced by the same installation, the carbon leakage factor of the consuming installation would obviously be used in line with the exposure to the risk of carbon leakage for this installation. This exposure to a risk of carbon leakage should thus be determining also in case (part of) the heat is coming from another installation.
47 In the 2008 report, a different wording was used. The wording used here better reflects how the methodology works.

Changes in the heat flows during the period can be due to three reasons:

1. Changes in activity levels of the heat consuming process
2. Changes in the structure of heat supply
3. Changes due to efficiency improvements by the heat consuming process

Since the distribution of allowances over the producer and consumers differs in the three methodologies discussed, also the consequences of these dynamic changes for consumers and producers (e.g. shortage and excess of allowances, potentials to pass on costs for allowances received for free, incentives to reduce emissions, free choice of heat provider etc.) differ between the three methodologies. We regard it as outside the scope of this study to discuss in detail if and how changes over time should be reflected in the number of allowances to be allocated over time and if the regulator should define rules for this, e.g. to avoid windfall profits to the outsourced utility. Although we do not discuss this in detail, we will briefly discuss the consequences of the three methodologies with respect to the changes as summarised above in the discussion of the methodologies. Special attention is in this respect required for the design of new entrant and closure rules. We briefly touch upon this in Section 6.1.3.

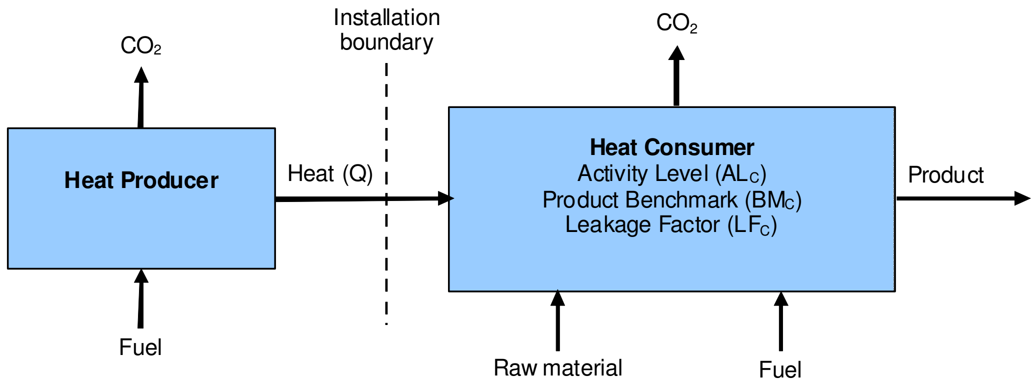
Allocation to producer in case the heat consumer is not part of the EU ETS
The methodologies as discussed below are for situations where both the heat producing and heat consuming entity are EU ETS installations. In cases where the consuming entity is not part of the EU ETS, no allowances can be given to the consuming entity unless the EU ETS architecture would be fundamentally changed. This is, because the consuming entity is not a part of the EU ETS and as such can not receive free emission allowances. Remember that this is also one of the reasons why product benchmarks for products that are not included n the EU ETS via a product definition is problematic (Section 4.3). We discuss for each of the options discussed below the consequence in relation to heat delivery to non EU ETS consumers.

6.1.2 Options for allocation methodologies between ETS installations

Underlying assumptions
Heat flows in the examples below refer to net heat flows between heat consumer and producer (i.e. net of e.g. return condensate flowing back to the producer)[48]. The examples assume that the allocation for the heat receiving installation (consumer) will be based on product benchmarking. The methodologies to account for heat flows as discussed in the next section could however also be applied in case of heat production benchmarking and fuel mix benchmarking (Chapter 5).

Methodology 1: Allocation of allowances to consumers of heat
According to this methodology, all allowances (calculated based on the product benchmark of the heat consumer) are to be allocated to the heat consumer (see below).

[48] Obviously, a clear definition of heat (reference temperature and pressure etc.) is required to make sure this is done in a uniform way across member states.



Allocation to producer:	No allocation
Allocation to consumer:	$AL_C \times BM_C \times LF_C$

The heat producer does not receive any allowances and has to buy all allowances on the market. This can influence the price of the traded heat. Alternatively, both entities might trade amongst themselves, thus eliminating (part of) the necessity of market trading and any associated costs.

This methodology has a number of advantages: for the calculation of the allocation, the heat flow over the system boundary does not need to be known. Secondly, the emission allowances are in this case with the entity on which the allocation is based. It avoids that the heat supplier will pass on opportunity costs for allowances it received for free. Regarding the three dynamic changes in the heat flows over time as introduced in Section 6.1.1, the method ensures that the heat consumer is free in the choice of heat provider and benefits fully (i.e. via an excess of allowances) from energy efficiency improvements resulting in a lower heat demand.

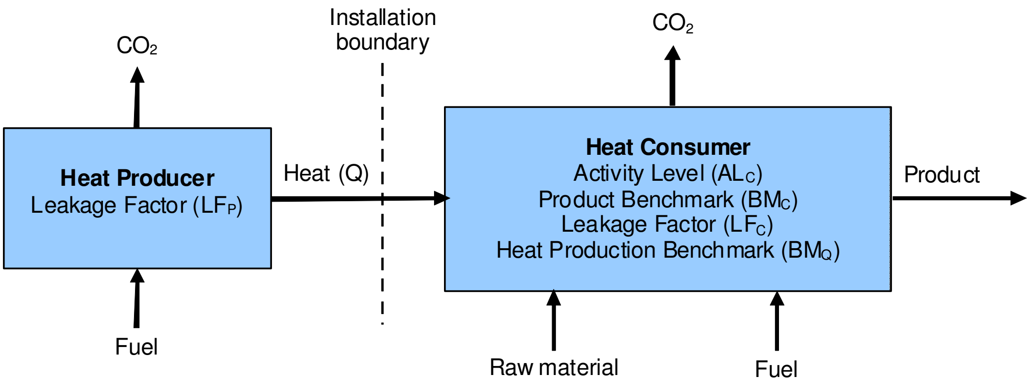
Key disadvantage is that when this methodology is used for many EU ETS installations there is no direct link between the emissions of the installation and the emission allowances that are allocated for free. In the most extreme case (e.g. a paper mill with fully outsource heat supply), a non-emitting EU ETS installation would receive significant amounts of emission allowances. It is left to the further political process following the publication of this report to make a decision on whether this is regarded as acceptable.

In case heat is transferred to non EU ETS costumers, no allocation can be given to the consumer. The producer in this case needs to receive the allocation. In line with the reasoning in Section 6.1.1, the leakage factor of the consuming entity should in such cases be applied and, in case differentiated benchmarks would be decided on, also the heat production benchmark of the consuming installation. We leave it open whether the legal text of the CIMs should include provisions to avoid that heat producers pass on the costs for the allowances received for free to the heat consuming installation in these situations. A practical difficulty of this methodology is that for heat networks with many different costumers (e.g. district heating), the activity of all heat consumers is required for the determination of the risk of exposure to carbon leakage. Since the heat concerned is part of an economic transaction, it is likely that this information (i.e. the heat flow to different costumers) can be retrieved. A simpler alternative in case this information is not known is to treat all costumers that are not in the EU ETS as being not exposed to a significant risk of carbon leakage. This would imply, however, that entities outside the EU ETS that have activities exposed to a significant risk of carbon leakage would not be compensated for this via free allowances for heat, whereas this heat production is part of the EU ETS.

Methodology 2: Allocation to both producers and consumers based on a heat production benchmark for the transferred heat

For the transferred heat Q, an allocation based on a heat-benchmark BM_Q can be calculated. The benchmarked amount of emissions associated with the heat production ($Q \times BM_Q$) is allocated to the producer. In order to keep the sum of the allowances distributed to the consumer and the producer equal in view of the principle of keeping the total allocation equal independent of the heat supply situation, the benchmarked emissions are subtracted from the allowances that were allocated to the consumer based on a product benchmark (see below; the options for the carbon leakage factor will be discussed later in this section).

Since we aim to develop a system that treats all heat equal from an end-use perspective (the consumer), regardless the installation that produces the heat, the heat production benchmark of the consuming installation should be used in case a differentiated heat production benchmark would be applied in the allocation methodology.



Allocation to producer: $Q \times BM_Q \times LF_?$

Allocation to consumer: $AL_C \times BM_C \times LF_C - Q \times BM_Q \times LF_?$

An advantage of this methodology is that the consumer of the heat is benchmarked for the efficiency of heat consumption (i.e. via the benchmark) and the producer of heat is benchmarked for the efficiency of heat production. However, it is not automatically avoided that the producers passes the costs for allowances it received for free to the heat consumer. We leave it open whether the legal text of the CIMs should include provisions for this. Furthermore, in case the heat flow changes over time during the trading period (either due to changes in activity level of the benchmarked product, due to a different heat supply structure, or due to efficiency improvements at the heat consumer), the excess or shortage of allowances in relation to historical emissions (partly) occur at the producing entity. As such, this methodology thus influences the incentive to improve energy efficiency (the resulting excess of allowances stays with the producer of the heat) and the freedom to change from energy supplier (the allowances might stay with the old energy supplier, depending on the design of closure and new entrant rules). We also leave it open whether the legal text of the CIMs should include provisions for this.

Another drawback is that the benchmarked emissions of the transferred heat may exceed the total allowances that would be allocated to the heat consuming installation in absence of corrections to account for heat flows. This can occur if the heat consumption according to the product-based benchmark exceeds the benchmark heat consumption and all this heat is coming from an outsourced heat supplier. This situation would in such a case result in negative allocations to the heat consumer, i.e. a requirement to surrender allowances even in the absence of direct emissions. Although the assessment of the legal feasibility of a negative allocation lies outside the scope of this project, we do regard the implications of negative allocations from a legal and practical perspective as a drawback of this methodology. The most frequent occurrence of negative allocations is expected in industries where installations exist with a fully or almost fully outsourced heat supply.

An open question is which leakage factors should be applied for the heat transferred over the system boundary. Three options on how to account for such situations are discussed below:

Methodology 2a: the heat producer will receive free allocation based on the transferred amount of heat and the leakage factor of the activity "heat production". Heat production is regarded an activity which is not exposed to a significant risk of carbon leakage. Allocation to the consumer will be based on its own leakage factor (see below).

Allocation to producer:	$Q \times BM_Q \times LF_{HEAT\ PRODUCTION}$
Allocation to consumer:	$AL_C \times BM_C \times LF_C - Q \times BM_Q \times LF_C$

In this methodology, the sum of the allocation to the producer and consumer is different from the allocation to an installation that would incorporate both the producer and the consumer. This is inconsistent with the guiding principle that the total amount of emission allowances for the production of a product for which a product benchmark is developed should be equal, regardless of the ownership structure of the heat producing and heat consuming installations and is for this reason discarded.

Methodology 2b: the heat producer will receive free allocation based on the transferred amount of heat and the leakage factor of the activity "heat production". Heat production is regarded an activity which is not exposed to a significant risk of carbon leakage. Allocation to the consumer will be based on its own leakage factor and the amount allocated to the producer (see below).

Allocation to producer:	$Q \times BM_Q \times LF_{HEAT\ PRODUCTION}$
Allocation to consumer:	$AL_C \times BM_C \times LF_C - Q \times BM_Q \times LF_{HEAT\ PRODUCTION}$

Since heat production is considered not exposed to carbon leakage, the leakage factor of the producer can be lower than the leakage factor of the consumer (i.e. if the consumer is part of an exposed sector). In that case, the consumer will receive a part of the free allowances $Q \times BM_Q \times (LF_C - LF_{HEAT\ PRODUCTION})$ for the emissions of the producer. These extra allowances could be seen as intended to compensate the (exposed) consumer for the higher heat prices. However, the consumer will receive allowances for emissions of the producer, the actual emitter. Similar to methodology 1, a disadvantage is that when this methodology is used, there is no direct link anymore between the emissions of the installation and the emission allowances that are allocated for free and that the discrepancy between the two increases over time. It is left to the further political process following the publication of this report to make a decision on whether this is regarded as acceptable.

In case the consumer is not part of the EU ETS, the allocation is in this case limited to the amount of heat multiplied with the leakage factor for heat production which is not considered as being exposed to a significant risk of carbon leakage regardless whether the consumer is being exposed or not. As a result of this, in case the consumers has its own heat supply and is in the EU ETS, it would receive free allowances based on the leakage factor of activities exposed to a significant risk of carbon leakage (100%) whereas in case the consumer would have outsourced heat supply, the leakage factor of non-exposed activities would be applied. This has the advantage of simplicity (there is no need to identify the leakage factor of heat consumer), but is in contradiction with the principle that the ownership structure of the heat supply should not influence the total number of allowances. Since most important industrial activities (from an emission perspective) are covered by the EU ETS, this will only occur for a limited amount of EU ETS emissions.

Methodology 2c: the heat producer will for each consumer receive free allocation based on the heat production and leakage factors of the considered consumer (see below). Allocation to the consumer will be based on its own leakage factor (see below).

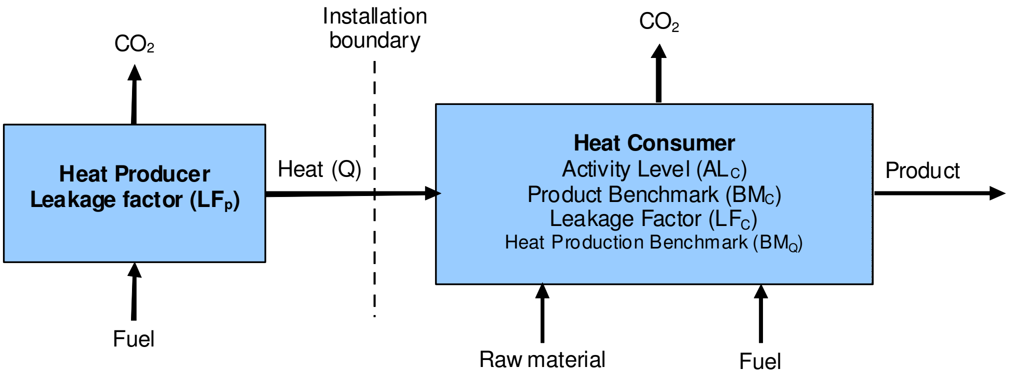
Allocation to producer:	$Q \times BM_Q \times LF_C$
Allocation to consumer:	$AL_C \times BM_C \times LF_C - Q \times BM_Q \times LF_C$

The leakage factor for the producer thus depends on the sector it supplies to. For the portion of heat supplied to exposed activities, the leakage factor of 100 percent will be applied. For supply to non-exposed activities; the non-exposed leakage factor will be applied. If customers of heat producers are not in ETS, this methodology still allows for free allocation related to the heat delivered to activities that are exposed to a significant risk of carbon leakage, but that are not included in the EU ETS. A practical difficulty of this methodology is that for heat networks with many different costumers (e.g. district heating), the activity of all heat consumers is required for the determination of the risk of exposure to carbon leakage, similar to methodology 1 (see discussion there). Another drawback of the method is that it can lead to negative allocation. It is not easy to judge in how many cases, negative allocations will occur. The most frequent occurrence of negative allocations is expected in industries where installations exist with a fully or almost fully outsourced heat supply. We propose to limit the allocation to a minimum of zero in order to avoid negative allocations.

Methodology 3: Allocation to both producers and consumers based on the contribution of the producers and consumers to the total heat use

In this methodology the producer receives a share of the allowances that were allocated to the consumer based, but this share has no direct relation to the heat transferred over the system boundary of the installation. Such a share can be defined in two ways which will be discussed below. The discussion on carbon leakage factors is analogous to that for methodology 2 and will not be repeated here. Also the drawback with regard to changes in heat flows over time as discussed for option 2 are analogous and will not be repeated here.

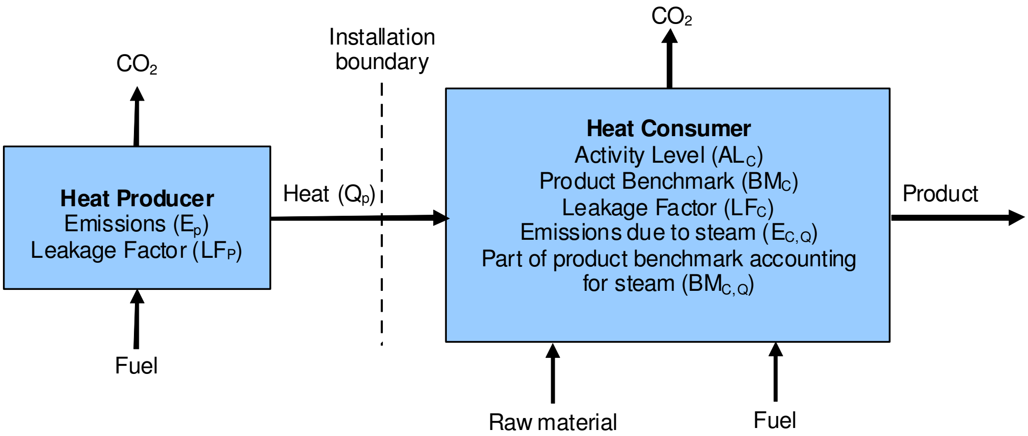
Methodology 3a: The simplest way to define a share of the allowances for the producer is to use the ratio of the emissions from the heat producer that attributed to the activity of the heat consumer over the total emissions that attributed to that activity (see below; for use of carbon leakage factors see discussion of methodology 2).



Allocation to producer: $(E_P/(E_P + E_C)) \times AL_C \times BM_C \times LF_?$

Allocation to consumer: $(E_C/(E_P + E_C)) \times AL_C \times BM_C \times LF_?$

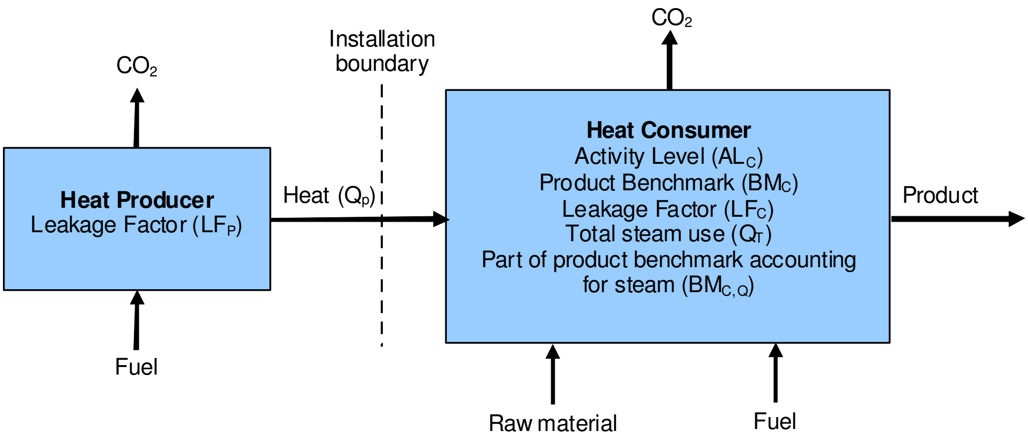
Emissions of the consumer may not only be from the generation of steam, but also due to for example process emissions or fossil fuel combustion in direct heat applications such as furnaces. In that case, the product benchmark to determine the share of emissions for the producer would no longer be appropriate to use. Instead, only that part of the product benchmark that accounts for steam production/consumption should be used. Equivalently, only the emissions due to the generation of steam should be considered (see below; for use of carbon leakage factors see discussion of methodology 2).



Allocation to producer: $(E_P/(E_P + E_{C,Q})) \times AL_C \times BM_{C,Q} \times LF_?$

Allocation to consumer: $AL_C \times BM_C \times LF_? - (E_P/(E_P + E_{C,Q})) \times AL_C \times BM_{C,Q} \times LF_?$

Methodology 3b: An alternative way to define the share of allowances for the producer would be not to consider the emissions, but to use the ratio of the amount of heat from the heat producer that is attributed to the activity of the heat consumer over the total amount of heat that attributed to that activity (see below; for use of carbon leakage factors see discussion of methodology 2).



Allocation to producer: $(Q_P/Q_T) \times AL_C \times BM_{C,Q} \times LF_?$

Allocation to consumer: $AL_C \times BM_C \times LF_? - (Q_P/Q_T) \times AL_C \times BM_{C,Q} \times LF_?$

Allocation methodology 3a leads to some undesired situations: if the producer would cause more emissions when producing the heat for the consumer (due to lower efficiency and a carbon intensive fuel mix), it would be allocated a larger share of the allowances than were allocated to the consumer based on a product benchmark. By the same reasoning, the producer would receive fewer allowances for the same amount of delivered heat if the consumer would cause more emissions in his production process (due to lower efficiency and fuel mix). Also in methodology 3b, the heat producer is influenced by the performance (i.e. with respect to heat consumption) of the consuming entity.

Another drawback of both methodology 3a and 3b is the potential need for data on a sub-installation level: in case the emissions are not only due to the generation of steam, it will be needed to be able to assess which part of the product benchmark accounts for steam production/consumption. Also, in case an installation produces more than one product, it will be needed to assess for every benchmarked product to what part of the steam was generated for its production. Because of these requirements, all heat flows in an installation will have to be known and understood, monitored and verified by competent authorities and/or third-party verifiers in order to come to an allocation. It is fair to say, however, that part of this information will also be required in case only part of the products of an installation are covered by a product benchmark with also some emissions (e.g. from the production of heat) covered via the heat production benchmark.

6.1.3 Remaining issues

The link to new entrant and closure rules

Regardless the final choice of the methodology to be applied, it is essential that the rules for new entrants in the EU ETS (Article 10a (7)) and the rules for installation that cease or partially cease operations (Article 10a (19) and (20)) are designed in a way consistent with the rules for free allocation. In case methodology 1 is chosen, it should for example be ensured that a new CHP installation delivering heat to an EU ETS installation that previously produced the heat in-house cannot receive free allocation from the new entrant reserve if the capacity of the installation on which the allocation is based (i.e. the capacity to produce a certain product in the case of product benchmarking) is not significantly expanded. The same holds for methodology 2c in case of increased outsourced heat supply from new CHP units. We do not in detail discuss new entrant and closure rules in detail in this study (Section 3.4.3). However, since the rules that formed the basis for the initial allocation to the system is known, it should always be possible to design the initial allocation and new entrant / closure rules in a way consistent with the allocation rules.

Heat producers outside the EU ETS

The situations above assume that the heat producer is an EU ETS installation. The majority of installations that supply heat to EU ETS installations will be part of the EU ETS (e.g. CHP plants, power plants, district heating networks etc.). However, there are situations in which the heat supplying installation is not part of the EU ETS:

- Installations for the incineration of hazardous or municipal waste
- Combustion installations that fall under the 20 MW threshold and are for this reason not included in the EU ETS
- Combustion installation that are excluded from the EU ETS via the opt-out provisions for small emitters.

In such cases, in the application of methodology 2b and 2c, the allocation to the producer of heat should not include the heat from installations that are not part of the EU ETS. For methodology 1, a mechanism would be necessary in which the total amount of allowances is reduced by an amount of allowances related to the heat coming from non EU ETS installations to avoid free distribution of allowances for emissions that are not part of the EU ETS.

Heat recovery from exothermic reactions

Heat can also be supplied from installations where heat is recovered from certain production processes (e.g. exothermic reactions). In case a product benchmark is developed for the product of this production process, the benchmark for this product will include a negative part for the emissions related to steam being exported from the production process. When this heat is delivered to another costumer, it receives allowances for this heat, as if the heat was produced with a boiler. The heat coming from this process will be treated the same as heat coming from the utility, so the allocation for heat is subject to the leakage factor of the consumer. The exporter will receive allowances for heat production, but as this is included a negative value in a benchmark, there will be no double allocation. The situation is different in case no product benchmark is developed for the exothermic process with heat recovery. In order not to disadvantage heat recovery, one could think of not correcting the allocation for heat coming from heat recovery in such cases. Alternatively, this heat could be excluded in the allocation rules (see also Section 4.4.1).

6.1.4 Conclusion

In the 2008 report (Ecofys/Fraunhofer-ISI, 2009) methodology 3 was chosen as the preferred allocation method. The main reason for this selection was the fact that it is the only option fully in line with the EU ETS design: the emitter receives allowances and, by definition, no negative allocations could be calculated. The choice was made in that report based on a simplified example where only heat related emissions occurred and only one product was produced by the consuming installation. Based on the results of practical case studies in which more complex situation occur, we no longer regard the methodology as feasible and desirable, because it results in practical problems regarding data availability and because the allocation to producers is influenced by the performance (i.e. with respect to heat consumption) of the consuming entity.

Of the remaining methodologies considered, methodology 1 is the most straightforward for flows between EU ETS installations: the allocation is irrespective of the heat flows between installations and does therefore not require any data and associated administrative burden. It is also offers advantages in relation to the need for changes in heat flows over time. However, it does result in the situation that for EU ETS installations with heat flows over the system boundary, there is no longer a direct relation between the allowance allocation and the emissions of the installation. As said, we leave it to the process following the publication of this report whether this is regarded acceptable. Furthermore, it requires that for each activity to which heat is supplied, the exposure to a significant risk of carbon leakage needs to be known including that of installations which are not part of the EU ETS.

In case the decision is made that the producer of the heat should receive allocation of allowances for the heat transferred to other EU ETS installation, the most consistent approach ensuring that the total amount of allowances for the same activity is not dependant on the ownership structure of heat supply is methodology 2c. The consumer and producer are in this option rewarded / punished for their efficiency of consumption and production, respectively and the application of the leakage factor of the consuming installations makes the allocation irrespective of the ownership structure of the heat producing and heat consuming installations. It also allows for free allocation related to heat delivered to activities that are exposed to a significant risk of carbon leakage, but that are not included in the EU ETS. Drawback of the method however is, that it can lead to negative allocation. It is not easy to judge in how many cases, negative allocations will occur. The most frequent occurrence of negative allocations is expected in industries where installations exist with a fully or almost fully outsourced heat supply. We propose to limit the allocation to a minimum of zero in order to avoid negative allocations. The negative part of the allocation can in such cased be subtracted from the heat producing installation. In such a way, the principle of equal amount of allowances regardless ownership structure is maintained. Another drawback, equal to methodology 1, is that for each activity the exposure to a significant risk of carbon leakage needs to be known. For reasons of simplicity, it could for this reason be decided to implement option 2b where the heat flow over the installation boundary is always regarded as not being exposed to a significant risk of carbon leakage.

We leave it open whether the legal text of the CIMs should include provisions to avoid that heat producers pass on the costs for the allowances received for free to the heat consuming installation in case methodologies 2b and 2c is chosen. Similarly, we leave it open whether such provisions are needed in case of methodology 1 in case consuming entities are not in the EU ETS. We further stress that the new entrant and closure rules are designed in a consistent way with the chosen allocation methodology.

6.1.5 Application of proposed allocation methodology

In order to study the feasibility of the allocation methodologies, the consortium worked together with the sector organization of the chemical industry (CEFIC), the paper industry (CEPI) and the organisations representing combined heat and power generation (COGEN Europe, Euro Heat and Power and EFIEES). Two sites were considered[49]. The heat flows of these sites are representative of the most complex that may occur in the ETS. Any methodology that would be workable for these sites was therefore deemed to be workable for other sites well.

One site, Chemelot (Geleen, The Netherlands), hosts various industries, Sabic and DSM being the largest. The site is listed as 1 ETS installation. The other site, Evonik Wesseling (Wesseling, Germany), the plants belong to the same group, but are organised in various legal entities. The Evonik site consists of multiple ETS installations. The activities that are carried out on these sites include amongst others: naphtha cracking to produce olefins, production of ammonia, nitric acid, hydrocyanic acid, melamine, acrolein, acrylonitrile, silica, sulphuric acid, caprolactam, methionine, cyanol chloride and the production of polymers and fibres.

[49] The consortium acknowledges the help of Evonik Industries (site Wesseling, Germany) and USG (utility organisation of site Chemelot, Sittard/Geleen, The Netherlands) in sharing details of the heat flows on their sites to provide a better insight in how the different allocation methodologies would work in actual industry situations.

On both sites, steam is centrally produced in CHP-units, as well as in boilers. Exothermal production processes – i.e. processes that produce heat – also provide steam. Steam pipes transporting steam at different pressures cross the sites. High pressure steam may be consumed in one installation unit, and a lower pressure steam may be returned and yet used in a second installation unit. Installation units not only have interrelations because of heat optimisation; the product of one unit may be raw material of the other.

Based on the situations encountered in the sites an example site was defined (Figure 8). At this site, 6 heat consuming plants (A-F) produce different products that, by incident have the same benchmark value. Each plant imports a fixed percentage of heat to cover its energy demand. The remaining percentage is produced in-house. The efficiency of the heat use varies between different plants, as well as the exposure of the activities to a significant risk of carbon leakage. A central heat generation facility – in this case a CHP unit – provides heat to all 6 plants. This generation facility produces the steam with a 10% lower efficiency than a generic heat benchmark. The utility also provides steam to non-ETS customers (G and H). One of the non-ETS customers is exposed to carbon leakage. The other is not.

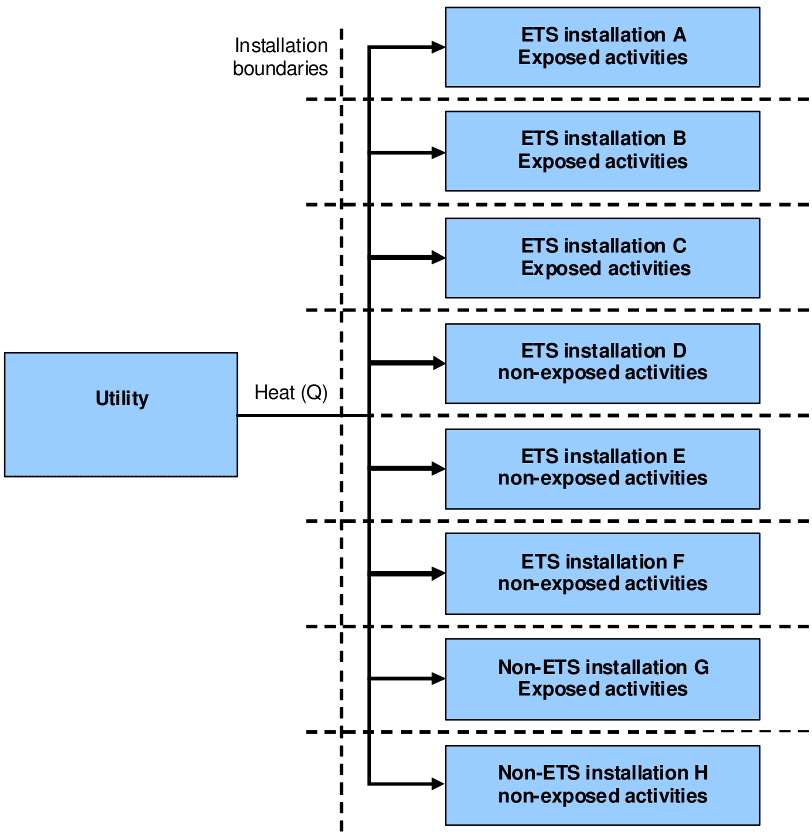


Figure 8 Example situation

Although in most countries at least some plants would be clustered into a single ETS installation, in this numerical example, all plants are separate ETS installations. We assume that production levels and the shares of outsourced versus in-house heat supply are identical to that in the reference year.

Table 10 and Table 11 provide overviews of the allocation resulting from the methodologies 2c and 3, respectively. The tables give the actual emissions, allocations and shortages, both for the installations A-F and the utility. For instance, in the row of A the columns "Installations A-H" indicate the emissions and allocation for installation A and the columns "Utility" indicate the emissions and allocation for the utility for the steam production for A. The total amount of allowances allocated to the utility, for the supply to all its consumers is indicated in the row "Total".

In the example, the utility produces heat less efficient than benchmark. A generic heat generation benchmark of 90% efficiency-gas fired was used, and the performance of the example utility is 10% below that benchmark. In the example, 75% of the utility's steam production is for ETS customers A-F, and 25% is for its non ETS customers. We consider the year 2013, hence the leakage factor for non-exposed sector is 80 percent.

Installation A performs better than the production benchmark and has a surplus of allowances, while the utility, which performs worse than the benchmark, has a shortage of allowances. The shortage for the utility increases upon decreasing end-use efficiency (from installation A to C and D to F), since the utility delivers an increasing amount of steam. For installations D-F, the same applies, but shortages are larger because of the lower leakage factor.

The shortage in allowances for the utility can in the case of methodology 2c be attributed solely to its worse-than-benchmark performance and the leakage factor of its consumer. For the heat production for consumers with the same leakage factor, the ratio of the shortage to heat production is the same for "ETS" and "non-ETS" production. The bottom row of the table shows the overall shortage for the utility.

In the case of methodology 3, the emissions for consumers that are part of the EU ETS are all with the consuming entity (Installation A – F) and only the allowances for heat delivery to non EU ETS costumers are given to the utility.

Table 10 Allocation for heat producer and heat consumers for methodology 2c

	Product benchmark (t CO_2/t product)	Performance with respect to benchmark	Specific emissions (tCO_2/t-product)	Activity level (t-product)	Leakage factor	Energy required for process (t-steam)	Heat supply by CHP (GJ steam)	Installations A to H			Utility			Total		
								Emission	Allocation	Shortage	Emission	Allocation	Shortage	Emission	Allocation	Shortage
Installation A	0.31	0.80	0.25	100	100%	400	200	12.5	18.7	-6.2	13.9	12.5	1.4	26.3	31.2	-4.8
Installation B	0.31	1.00	0.31	100	100%	500	250	15.6	15.6	0.0	17.3	15.6	1.7	32.9	31.2	1.7
Installation C	0.31	1.20	0.37	100	100%	600	300	18.7	12.5	6.2	20.8	18.7	2.1	39.5	31.2	8.3
Installation D	0.31	0.80	0.25	100	80%	400	200	12.5	15.0	-2.5	13.9	10.0	3.9	26.4	24.9	1.5
Installation E	0.31	1.00	0.31	100	80%	500	250	15.6	12.5	3.1	17.3	12.5	4.8	32.9	24.9	8.0
Installation F	0.31	1.20	0.37	100	80%	600	300	18.7	10.0	8.7	20.8	15.0	5.8	39.5	24.9	14.4
Installation G					100%		500				34.6	31.2	3.5	34.6	31.2	3.5
Installation H					80%		500				34.6	24.9	9.7	34.6	24.9	9.7
Total								93.5	84.2	9.4	173.1	140.3	32.9	266.6	224.4	42.2

Benchmark steam production efficiency:	90%
Utility steam production efficiency	81%
Emission factor of natural gas (kg CO_2/GJ)	56.1
Benchmark steam production (t CO_2/GJ-steam)	0.062
Utility specific emissions for steam production (t CO_2/GJ-steam)	0.069
Percentage of energy supply outsourced by installations A-F	50%
Energy benchmark installations A-F (GJ/t product)	5.0

Table 11 Allocation for heat producer and heat consumers for methodology 3

	Product benchmark (t CO_2/t product)	Performance with respect to benchmark	Specific emissions (tCO_2/t-product)	Activity level (t-product)	Leakage factor	Energy required for process (t-steam)	Heat supply by CHP (GJ steam)	Installations A to H: Emission	Installations A to H: Allocation	Installations A to H: Shortage	Utility: Emission	Utility: Allocation	Utility: Shortage	Total: Emission	Total: Allocation	Total: Shortage
Installation A	0.31	0.80	0.25	100	100%	400	200	12.5	31.2	-18.7	13.9	0	13.9	26.3	31.2	-4.8
Installation B	0.31	1.00	0.31	100	100%	500	250	15.6	31.2	-15.6	17.3	0	17.3	32.9	31.2	1.7
Installation C	0.31	1.20	0.37	100	100%	600	300	18.7	31.2	-12.5	20.8	0	20.8	39.5	31.2	8.3
Installation D	0.31	0.80	0.25	100	80%	400	200	12.5	24.9	-12.4	13.9	0	13.9	26.4	24.9	1.5
Installation E	0.31	1.00	0.31	100	80%	500	250	15.6	24.9	-9.3	17.3	0	17.3	32.9	24.9	8.0
Installation F	0.31	1.20	0.37	100	80%	600	300	18.7	24.9	-6.2	20.8	0	20.8	39.5	24.9	14.4
Installation G					100%		500				34.6	31.2	3.5	34.6	31.2	3.5
Installation H					80%		500				34.6	24.9	9.7	34.6	24.9	9.7
Total								93.5	168.3	-74.8	173.1	56.1	117.0	266.6	224.4	42.2

Benchmark steam production efficiency:	90%
Utility steam production efficiency	81%
Emission factor of natural gas (kg CO_2/GJ)	56.1
Benchmark steam production (t CO_2/GJ-steam)	0.062
Utility specific emissions for steam production (t CO_2/GJ-steam)	0.069
Percentage of energy supply outsourced by installations A-F	50%
Energy benchmark installations A-F (GJ/t product)	5.0

6.1.6 Stakeholder comments

The underlying principle that the total amount of allowances related to a certain heat end-use should be independent of the heat supply structure and that the carbon leakage factor should be based on the leakage factor of the consumer was shared by all industrial stakeholders.

Both CEPI[50] and CEFIC[51] expressed their preference for methodology 1 (allocation to consumer) in case of product benchmarks and challenge the opinion that option 1 would not be sufficiently in line with the overall architecture of the EU ETS. They regard allocation to the consumer to be in line with amended Directive text (Article 10a (12)) that stipulates free allocation to the level of the benchmark. If methodology 1 is deemed not feasible, CEPI prefers to have a have a heat production benchmark rather than a product benchmark.

CEFIC stressed that the allocation shall not negatively affect the incentive to reduce emissions and shall enable the heat consumer to change its sourcing of heat. Any allocation to the producer, also methodology 2, has, in their opinion, significant risks for some heat consumers. It might lead to windfall profits for the heat producer who might charge for allowance costs which he received for free. If the decision is made for methodology 2, CEFIC requests to address the potential risks through a legally binding implementation text, which would have to be approved in Comitology. They do not believe that these problems can in all cases be addressed on a contractual basis and therefore these issues should be ignored in the allocation system design. The legal text of the CIMs should address how to avoid windfall profits and that a consumer can at any time choose to change its heat sourcing with an automatic transfer of allowances to the new heat provider.

6.2 Carbon containing waste gases

A similar, albeit far from identical issue related to "emissions" crossing system boundaries across installations are carbon-containing waste gases in e.g. the iron and steel and chemical industries. The waste gases are a direct result of the production processes, but in itself also have an intrinsic value, because they can be used as fuel in other processes. As such, the waste gases have a relation to two different activities, i.e. the activity where the waste gas is produced and activity where the waste gas is consumed.

The underlying principles in dealing with this issue should in our opinion be that:

- The allocation approach to the producer of the waste gas and to the consumer of the waste gas should ensure that the emissions related to the waste gas are not double counted in the allocation
- The benchmark for the products where waste gases are produced should take into account the inherent production of these waste gases (with a given emission intensity) in the process, but also the potential of the process to export a gaseous fuel to other consumers.

[50] E-mail CEPI, 27 August, 2009

[51] E-mail CEFIC with attachments, 1 September 2009

- By analogy, the benchmark for the products where waste gases are consumed should take into account the fuel use related to the waste gas use, but should not reflect the difference in emission intensity between the waste gas and the default other fuel of choice for this process.

In the approach envisioned for the iron and steel industry in the study on allocation principles (Ecofys / Fraunhofer-ISI, 2009), these principles (although not made explicit there and not directly linked to the allocation for the consumer) were worked out by calculating the emission intensity of a production process for a product where waste gas is produced via the following formula:

Emission intensity waste gas producer = Direct Emissions of the installation[52] + Calorific value of waste gas exported * (emission factor waste gas – emission factor natural gas)

Equation 2

This is equal to the sum of emissions embodied in the waste gas produced, the emissions from fuels that are not a waste gas (if relevant) and the emissions from waste gases used using the emission factor of natural gas, corrected for the export of waste gas from the production process using the emission factor of natural gas.

This formula enables a proper performance comparison between different process configurations where waste gases are either used internally or used in other production units on the site outside the boundary of the production process, a choice which is often based on complex process optimization procedures.

To which extent the remaining allowances (i.e. the part related to the difference in emission intensity) will be allocated to the consumer of the gas depends on the allocation used in the consuming installation. If for the consuming installation, a product benchmark is calculated, the emission factor of natural gas should be used in the benchmark calculation for that installation (e.g. a coke producing installation using blast furnace gas). If the consumer falls under a heat production or fuel mix benchmark, allowances based on these benchmarks will be allocated.

If the reference for the consuming installations is auctioning (i.e. no free allocation, e.g. an electricity generator using blast furnace gas), in principle no additional allowance need to be allocated. One could argue, however, that the text in Article 10a (1) of the amended Directive on free allocation to electricity produced from waste gases implies that for electricity producers using the waste gas, the allocation should not be limited to the amount based on the emission intensity differences between the waste gas and natural gas as is proposed here, but that the total amount should be allocated. If so decided, this could be implemented by allocating to the electricity producer allowances based on the natural gas equivalent of the blast furnace gas used. It should be realized, however, that in doing so, the cost increase due

[52] Waste gases originating from other processes should be taken into account in this calculation with the emission factor of natural gas to create a consistent system.

to increased electricity prices is for waste gas producing sectors (partly) compensated via free allowances. This should be taken into account in the design of the financial compensation mechanism as outlined in Article 10a (6) of the Directive to prevent a double compensation if the waste gas producing sector is regarded eligible[53] for such financial compensation.

The method as proposed here (without free allocation to electricity generation) makes the possible financial compensation for increased electricity prices independent of the free allocation methodology and makes a fair and equal treatment of all operations possible via a EU-wide and non-installation specific methodology.

Since the basis for the allocation is known, the possible transfer of allowances between the consumer and producer not necessarily has to be regulated[54] and could be left to the two EU ETS installations.

It could also be that the waste gases are sold to costumers outside the EU ETS. In such cases, the emissions resulting from burning the waste gases are in principle no longer monitored and included within the EU ETS. In such cases, the allowances to the producers of the waste gas should be corrected to avoid allocation of allowances for emissions that are not accounted for in the EU ETS[55] [56]. It is expected that this will occur only in a very limited number of cases.

6.3 Substitutability between direct and indirect emissions

Certain products can be produced via production routes with differing shares of electricity (indirect emissions) versus fuel or heat use. Examples are:

- Electrical or fuel fired furnaces in the glass wool and rock wool industries
- Direct driven or electricity driven compressors in the chemical industry

Since the allocation will take place for the direct emissions only, this raises the following questions:

1. How to take the differences in electricity intensity into account in the benchmark?
2. How to allocate allowances to the different installations?

The following solutions can be thought of:

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[53] The question if sectors should get financial compensation for increased electricity prices and how many is not within the scope of this study.

[54] It is acknowledged that both production levels and the consumers of the waste gases can change over time. It is beyond the scope of this study to discuss in detail if and how this should be reflected in the number of allowances to be allocated over time and if the regulator should define rules for this. If such rules are developed, it is key that the initial allocation for the total system (i.e. for the producer and consumer together) is partly based on the activity of the producer of the waste gas producer (the difference in emission intensity between the waste gas and natural gas) and partly on the activity of the consumer of the waste gas consumer (the fact that a fuel is consumed).

[55] The correction should be downwards if the emission factor of the waste gas exceeds that of natural gas, (e.g. blast furnace gas) or upwards if the emission factor of the waste gas is lower than that of natural gas (e.g. coke oven gas).

[56] Again, whether changes during the trading should be reflected in the allocation and if the regulator should define rules for this is not further discussed in this study.

1. Not correcting for these differences and basing the benchmark for direct emissions on a curve including all installations. Electricity-intensive installations may in this case strongly determine the benchmark which in general would result in very low benchmark values.
2. Taking the indirect emissions into account in the curve via a uniform emission factor for electricity (e.g. the one used in the carbon leakage assessment, 0.465 t CO_2 / MWh) and base the benchmark on the primary emissions (i.e. including indirect emissions). For that purpose only the indirect emissions of those process steps in which fuel and electricity use are interchangeable should, in principle, be included. The resulting "primary" benchmark will be used for calculating the allocation for the direct emissions up to the level of the level of historic direct emissions to avoid giving a free allocation to electricity production. In developing rules for financial compensation for electricity consumers based on benchmarking, the same benchmark curve could form the basis to avoid double compensation of the CO_2 price signal in the electricity price.
3. Allowing technology-specific benchmarks in these cases by developing benchmark curves for the different product routes.
4. Automatically use a fall-back option for products where this problem occurs.

The first method is regarded as undesirable if the electricity-intensive route is from an overall greenhouse gas efficiency point of view not beneficial (which can only be assessed based on the emission intensity including the indirect emissions). The third method is difficult to apply when many different shares of electricity versus fuel use occur (rather than two or three very distinct process route with widely differing shares of electricity and fuel use).

The last methodology is undesired if the product is uniform and sufficient producers produce the product. Benchmarking is in such a case a feasible option. However, if the number of installations and emissions resulting from the electricity intensive route is very limited, it can be considered to exclude those installations from the benchmarking exercise and apply a fall-back for those specific installations. For the installations with direct emissions, a benchmark for direct emissions can be used.

For mineral wool, refineries and aluminium, we use the second methodology to come to an allocation, whereas for glass, steam cracking and ammonia production, a final choice between the 2^{nd} and 4^{th} methodology is made dependant on the data collection currently conducted by the sector. In Figure 9, we outline the 2^{nd} methodology in more detail.

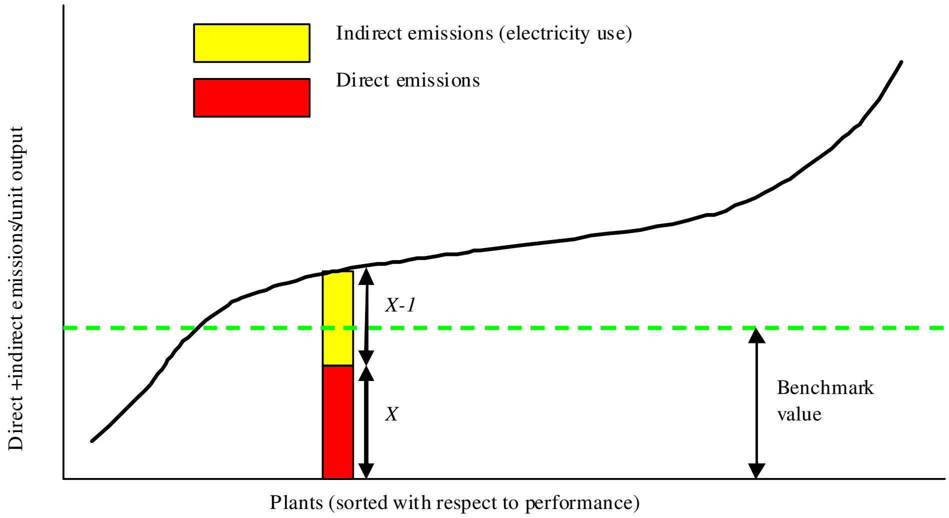


Figure 9 Benchmarking primary emissions with allocation for direct emissions only

The benchmark is set at the level of total (direct + indirect) emissions. For each plant the allocation is based on direct emissions only:

$$\text{Basic allocation} = \text{Benchmark}_{primary} * X_i * \text{Production}_i$$

Equation 3

for the reference year $_i$ on which the allocation is based with X_i being the share of direct emissions in the total emissions including those related to electricity consumption. Installations that perform worse than the primary benchmark never get more emission allowances than their historical direct emissions, which is in line with the objective to allocate only allowances for direct emissions.

7 Summary of sector reports

7.1 Summary of benchmarks from sector studies

In Table 12, we summarise the benchmarks as proposed in the sector reports and indicate the additional steps required to further improve / update the benchmark values as indicate. The sectors refer to the thirteen sectors for which a sector report is made (Section 4.3). The corresponding NACE codes are included in Appendix D. In the 2nd and 3rd column, the list of products for which a product benchmark is proposed is given together with the product classification that is proposed to identify the product. If "industry" is listed under classification, an industry-specific classification is required, because the product is not sufficiently defined by the PRODCOM list of products. The 4th column gives the estimated number of installations in the sector or producing the product that in 2013 will be included in the EU ETS. Norway and Iceland are excluded in these estimates unless stated otherwise. In the 5th column, the estimated amount of emissions in the sector or related to the products is given. The estimate is, unless otherwise given, based on 2008 emissions or emission allowances, corrected if relevant for installations that will be included in the EU ETS from 2013 onwards, but excluding Norway and Iceland. The 6th and 7th column list the indicative benchmark value as it proposed in the sector reports and the source (benchmark curve or literature value) on which the benchmark is based.

In the last column, we summarise further steps that could be made to improve the benchmark value as proposed in this study and the status of the efforts by the sector organizations. For this, we use the following categorization:

A Benchmark value according to proposed methodology not yet available, but expected to be available in time to be used in the final Commission decision

B Benchmark value based on benchmark curve, but improvements related to coverage and correct years required

C Benchmark value based on benchmark curve available, but methodological differences to be resolved

D Benchmark value based on benchmark curve according to proposed methodology not expected to become available in time to be used in the final Commission decision. Final benchmark value to be based on literature values combined with bottom-up verification

E Further product differentiation can be considered based on quantitative proof of emission intensity differences

F Benchmark covering direct emissions and emissions related to electricity consumption for process steps where electricity and fuel use is interchangeable

G Necessity for benchmark including electricity emissions to be considered based on quantitative proof of importance of indirect emissions

Table 12 Summary of proposed benchmarks (see text for explanation on the various columns). All values should be regarded as preliminary values that need further refinement.

1	**2**	**3**	**4**	**5**	**6**	**7**	**7**	**8**
Sector	**Product / fall-back**	**Classification**	**No. of installations**	**Estimated Emissions in Mt CO_2 – eq. (estimated electricity share)**	**Preliminary Benchmark values** [1]	**Spread in curve**[2]	**Source**	**Further steps**
Mineral oil refineries			147	155.9 (16%)	-	-	-	-
	CO_2 weighted t (CWT)	SOLOMON	147		*0.030 t CO_2 / CWT*[3]	-	Curve	A, C
	Steam cracking (High Value Chemicals)	PC	Unknown	Unknown	See under chemical industry	-	See under chemical industry	A, C
	Fall-back	-	-	Not required	-	-	-	-
Iron ore			4	0.6 (~0%)				
	Fall-back	-	4	0.6	-	-	-	-
Iron and steel industry		-	~1400	252.5 (unknown) [4,5]	-	-	-	-
	Coke	PC	43	23.0 [4]	0.090 t CO_2 / t	-	Literature	A
	Sinter	PC	32	32.0 [4]	0.119 t CO_2 / t	-	Literature	A
	Hot metal	Industry	41	175.0 [4]	1.286 t CO_2 / t	-	Literature	A
	EAF non-alloy, high alloy and other alloy steel	PC	~200	8.3 [4]	0.058 t CO_2 / t	-	Literature	A, E, G
	Fall-back	-	~1100	13.7 [4,5]	-	-	-	-

Continuation Table 12

1	2	3	4	5	6	7	7	8
Sector	**Product / fall-back**	**Classification**	**No. of installations**	**Estimated Emissions in Mt CO_2 – eq. (estimated electricity share)**	**Preliminary Benchmark values** [1]	**Spread in curve**[2]	**Source**	**Further steps**
Aluminium			91 [6]	13.5 (0%) [7,8]	-	-		
	Alumina	PC	8	4.2	0.390 t CO_2 / t	2.1	Curve	B
	Pre-baked anodes	Industry	18	0.9	0.330 t CO_2 / t	1.8	Curve	B
	Primary aluminium	PC	31	6.0	*1.570 t CO_2 - eq. / t* [9]	1.7	Curve	B, C, F
	Secondary aluminium	PC	30	1.8	*0.220 t CO_2 / t* [9]	4.0	Curve	B, C, F
	Fall-back		14	<1.0	-	-	-	-
Other non-ferrous metals			~40	~4 (unknown)	-	-	-	-
	Fall-back		~40	~4 (unknown)	-	-	-	-
Cement			268	157.9 (~0%)	-	-		
	Clinker	PC	268	157.9	*0.780 t CO_2 / t* [10]	1.5	Curve	B, C
	Fall-back (not required)			-	-	-	-	-
Lime			210	32.4 (~0%)	-		-	-
	Lime	PC	Unknown	28.8	0.985 t CO_2 / t	1.8	Curve	B
	Dolime	PC	Unknown	2.3	1.113 t CO_2 / t	1.7	Curve	B
	Fall-back	-		1.3	-	-	-	-

Continuation Table 12

1	2	3	4	5	6	7	7	8
Sector	**Product / fall-back**	**Classification**	**No. of installations**	**Estimated Emissions in Mt CO_2 – eq. (estimated electricity share)**	**Preliminary Benchmark values** [1]	**Spread in curve**[2]	**Source**	**Further steps**
Glass			309 [11]	19.3 [12]		-		
	Flat glass	PC	60	7.0	0.606 t CO_2 / t	-	Literature	D, E, G
	Hollow glass	PC	170	11.6	0.250 t CO_2 / t	-	Literature	D, E, G
	Continuous filament fibre	PC	16	0.7	1.003 t CO_2 / t	-	Literature	D, E, G
	Fall-back	-	Unknown	Unknown	-	-	-	-
Ceramic products	-	-	~2000	26.5 (~0 %)	-	-		
	Low density and High Density Clay blocks	PC + Industry	Unknown		*0.114 t CO_2 / t* [14]	2.4 [15]	Curve	B, C, E
	Facing bricks and pavers	PC + Industry	Unknown	8.0 [13]	*0.133 t CO_2 / t* [14]	2.0 [15]	Curve	B, C, E
	Roof tiles	PC + Industry			*0.151 t CO_2 / t* [14]	1.7 [15]	Curve	B, C, E
	Spray dried powder	PC + Industry	Unknown	2.9 [13]	0.055 t CO_2 / t		Literature	D
	Dry-pressed wall and floor tiles	PC + industry	Unknown	5.8 [13]	0.300 t CO_2 / t		Literature	D
	High heat resistant refractory products	PC + industry	40	0.3 [13]	0.335 t CO_2 / t	2.1	Curve	B
	Low heat resistant refractory products	PC + industry	20	0.6 [13]	0.225 t CO_2 / t	4.5	Curve	B
	Fall-back		-	8.9 [13]	-		-	-
Mineral wool			67 [15]	3.0 (~0%)		2.5		
	Mineral wool	PC			0.664 t CO_2 / t		Curve	B, F

Continuation Table 12

1	2	3	4	5	6	7	7	8
Sector	**Product / fall-back**	**Classification**	**No. of installations**	**Estimated Emissions in Mt CO_2 – eq. (estimated electricity share)**	**Preliminary Benchmark values [1]**	**Spread in curve[2]**	**Source**	**Further steps**
Gypsum[16]			50	0.7 (phase II)				
	Raw gypsum / land plaster	Industry			0.010 t CO_2 / t	-	Literature	D
	Plaster	PC			0.050 t CO_2 / t	-	Literature	D, E
	Gypsum blocks, plaster boards and coving	PC			0.080 t CO_2 / t	-	Literature	D, E
	Glass-fibre reinforced gypsum	PC			0.180 t CO_2 / t	-	Literature	D
Pulp and paper			932	37.8 (25%)	-	-	-	-
	Kraft pulp	PC	Unknown	Unknown	0.048 t CO_2 / t	-	Literature	D
	Sulphite pulp, (chemi-) thermo mechanical and mechanical pulp	PC	Unknown	Unknown	0.000 t CO_2 / t	-	Literature	D
	Recovered paper	Industry	Unknown	Unknown	0.019 t CO_2 / t	-	Literature	D
	Newsprint	PC	Unknown	Unknown	0.318 t CO_2 / t	-	Literature	D
	Uncoated fine paper	PC	Unknown	Unknown	0.405 t CO_2 / t	-	Literature	D
	Coated fine paper	PC	Unknown	Unknown	0.463 t CO_2 / t	-	Literature	D
	Tissue	PC	Unknown	Unknown	0.343 t CO_2 / t	-	Literature	D
	Containerboard	PC	Unknown	Unknown	0.368 t CO_2 / t	-	Literature	D
	Carton board	PC	Unknown	Unknown	0.418 t CO_2 / t	-	Literature	D
	Fall-back	-	Unknown	Unknown	-	-	-	-

Continuation Table 12

1	2	3	4	5	6	7	7	8
Sector	**Product / fall-back**	**Classification**	**No. of installations**	**Estimated Emissions in Mt CO_2 – eq. (estimated electricity share)**	**Preliminary Benchmark values** [1]	**Spread in curve**[2]	**Source**	**Further steps**
Chemical industry			Unknown	168 (Unknown)[17]				
	Nitric acid	PC	115	41.0	1.210 kg N_2O/ t	373	Curve	B, C
	Steam cracking (High Value Chemicals)	PC	45	35.0	Not yet available	-	Curve	A, C, G
	Ammonia	PC	55	30.0	1.460 t CO_2 / t	2.2	Curve	B, G
	Adipic acid	PC	5	13.0	5.600 t CO_2 – eq. / t	-	Literature	D
	Hydrogen / Synthesis gas	PC	Unknown	8.8 [18]	*0.030 t CO_2 / CWT (refinery approach)*[3]	-	Curve	A,C
	Soda ash	PC	16	10.0	0.730 t CO_2 / t	2.8	Curve	B
	Aromatics	PC	Unknown	6.6	*0.030 t CO_2 / CWT (refinery approach)*[3]	-	Curve	A, C
	Carbon black	PC	17	4.6	*2.620 t CO_2 / t* [20]	-	Literature	A, C
	Fall-back	-	Unknown	19.0 [19]	-	-	-	E

[1] Values in italics indicate that the value is based on a benchmark curve or a literature value that is not fully consistent with the methodology proposed in this study (i.e. with respect to how the emission intensity is calculated). Also the other values, which are methodologically in line with the method proposed in this study, are preliminary values that need further refinement (e.g. better coverage, more recent years, benchmark curve rather than literature values etc.)

[2] The specific emission intensity of the installation with the highest specific emission intensity divided by the specific emission intensity of the installation with the lowest specific emission intensity.

[3] Value should be regarded as preliminary, because it is unclear how specialty refineries have been treated and how the average of the 10% most efficient refineries have been exactly determined. For aromatics units, the CWT factors are 5.25 CWT (Aromatics Solvent Extraction, fresh freed as throughput parameter), 2.45 CWT (hydrodealkylation, fresh freed as throughput parameter), 1.85 CWT (toluene

disproportionation, toluene hydrodealkylation, fresh feed as throughput parameter), 3.00 CWT (cyclohexane, production as throughput parameter), 1.85 CWT (xylene isomer, fresh feed as throughput parameter), 6.40 (paraxylene, production as throughput parameter), 1.55 (ethylbenzene , production as throughput parameter) and 5.00 (cumene, production as throughput parameter). For hydrogen, the number of different units and the CWT factors for these units are still under discussion. See the reports for the refinery and chemical industry for more details.

[4] Bottom-up estimated emissions from the iron and steel product chain

[5] Some emissions from these downstream processes are outside the scope of the EU ETS.

[6] Including installations in Norway and Iceland. Installations for anode production and primary smelting operations counted as separate installations.

[7] Emission estimates exclude Norway and Iceland

[8] Bottom-up estimated emissions from the aluminium production chain

[9] Benchmarking including emissions from electricity calculated with an emission factor of 0.75 kg CO_2 / kWh instead of 0.465 kg CO_2 / kWh

[10] Values based on process emission factor of 538 kg CO_2 per t of clinker instead of 523 kg CO_2 per t of clinker which would be in line with the EU ETS monitoring and reporting guidelines.

[11] Excluding producers of speciality glass

[12] Bottom-up estimated emission from the glass production chain. Excluding emission from speciality glass production.

[13] Rough estimate based on estimated share of emissions in the total ceramics industry as provided by the sector organization.

[14] Benchmark value and spread based on linearization of the 10th to 90th percentile of installations

[15] EURIMA members only: approximately 88% of production and 91% of emissions.

[16] Given the limited amount of emissions, also a fall-back approach for the full sector could be considered

[17] Estimate for the total production of products mentioned in Annex I of the EU ETS Directive. Estimate for the total chemical industry is 190 Mt CO_2

[18] Excluding production for refineries and including production for methanol

[19] Products that are mentioned in Annex I of the EU ETS Directive.

[20] Value without deduction for calorific value of tail gas

The sectors studied have an estimated emission size of 873 Mt CO_2 in the third phase of the EU ETS. This estimate is based on 2008 emissions, but includes the new sectors and installations that will be added in phase III of the EU ETS (in particular most of the chemical sector and the non-ferrous metals). Between 785 and 823 Mt CO_2 (depending on the currently still unknown share of the pulp and paper industry covered by product benchmarks) is covered by the product benchmarks proposed. For the six sectors with annual emissions above 30 Mt CO_2, in total 23 benchmarks are proposed (thereby counting the refinery CWT approach as one). These sectors (iron and steel, chemical, cement, refineries, pulp and paper and lime) in total have annual emissions of around 805 Mt CO_2. For the seven other sectors, in total 19 benchmarks are currently proposed. These sectors (ceramics, glass, aluminium, non-ferrous metals, mineral wool, gypsum and iron ore) in total have annual emissions of 68 Mt CO_2.

All values included in the table should be seen as preliminary, needing further (methodological) refinements as is indicated in the footnotes below the table. Furthermore, for some of the sectors (iron and steel, chemicals, ceramics and glass) it can be considered to determine additional or more differentiated benchmarks once more data becomes available. This could enlarge the number of benchmarks to around 60. We briefly discuss the sectors below in the order of decreasing size of total annual emissions.

For iron and steel, the majority of emissions can be covered via four products, implying that the more diverse downstream activities will be covered via the fall-back approaches. Based on further data evidence, the EAF steel product could be further differentiated into separate groups.

For the chemical industry, six different product benchmarks are proposed and for two of the products (hydrogen / synthesis gas and aromatics), it is proposed to follow the CO_2 weighted t approach for refineries to ensure that the same products are treated the same regardless whether they are produced at refineries or in the chemical industry. By analogy, for steam crackers operated by refineries, the same methodology is foreseen as for those operated by the chemical industry. The eight products covered with a product benchmark cover the majority of the emissions of the products that are specified in the amended Directive.

For cement, a single clinker benchmark is proposed that covers (almost) all of the emissions of the cement sector. A benchmark for cement rather than clinker has been considered, but mainly in view of the principle to develop separate benchmarks for intermediate products to be able to determine an allocation for installations that trade the intermediate product, we propose to apply a clinker benchmark for the cement sector. An additional benchmark for cement making from clinker is then not necessary, because (almost) no direct emissions producing cement from clinker.

For refineries, the envisioned approach is based on the CO_2 weighted t approach in which the individual units at the refinery are combined into a single overall metric for the refinery as a whole. This approach enables a fair comparison of refineries differing widely in complexity with many intermediate products traded between installations and with highly integrated production processes.

For pulp and paper, individual benchmarks are determined for two different pulp groups, recovered paper processing and six different paper grades. The preliminary benchmarks are based on literature values. The benchmarks for the paper products are based on non-integrated paper mills. Currently, a bottom-up verification of these values is undertaken by the sector. Once the results of this analysis are available, it should also be assessed to which extent the chosen approach results in significant over-allocation of integrated pulp and paper mills. Based on this assessment, an appropriate solution for integrated pulp and paper mills should be found.

For the lime industry, two product benchmarks are proposed (one for lime and one for dolime) based on the same fuel use benchmark, but differing in the amount of process emissions.

For the much differentiated ceramics industry, in total 7 product benchmarks are proposed for the three main sub sectors in terms of emissions (bricks and roof tiles, floor and wall tiles and refractory products). Once further data becomes available, the three products distinguished for the bricks and tiles sector could be further differentiated.

For glass, currently three different benchmarks are proposed with the specialty glass sector being covered by the fall-back approaches. A more differentiated approach with in the order of 10 product benchmarks could be considered once more detailed quantitative information becomes available. It could then also be further considered to include electricity emissions in the benchmark curves (following the methodology outlined above) for some of the products. Alternatively, these furnaces could be treated with the fall-back approaches

For aluminium, similar to the iron and steel industry, four products cover the majority of the industry emissions. The more diverse downstream activities are covered via the fall-back approaches.

For the other non-ferrous metals industry, the relatively small size of the sector in combination with the limited number of installations producing individual products resulted in the proposal not to cover these sectors via product benchmarks, but to apply the fall-back approaches.

For mineral wool, a single benchmark, including indirect emissions from electricity consumption is determined based on a dataset covering the majority of relevant installations in the EU ETS.

For another relatively small sector, the gypsum industry, 4 benchmarks are proposed for the various (intermediate) products in the gypsum product chain. The data basis for this sector is still very weak. In view of the small size of the sector, also the fall-back approach might be a sensible option.

For the iron ore sector, given the relatively small size of the sector in combination with the limited number of installations, the fall-back approach is proposed.

8 Rule book and data flows

8.1 Overview of current data structure the EU ETS

Below, we give the current important documents and related data flows in the current EU ETS system, divided into the permitting and allocation phase and the execution phase of the EU ETS. In Appendix G, we describe in more detail the content, level of detail and the key responsibilities of the actors involved.

Permitting and allocation

1. EU ETS directive
2. Guidelines for the NAP (Based on the criteria in Annex III of the original EU ETS Directive)
3. Monitoring and reporting guidelines (Based on the principles in Annex IV of the original EU ETS Directive)
4. Monitoring plan (each installation)
5. GHG permit (each installation)
6. Background data gathering for NAP (each MS)
7. NAP and list of installations with allowance allocation (each MS)
8. Application and issuance of allowances (each MS)

Execution phase

9. Annual emission reports (each installation)
10. National registries (each MS)
11. CITL database

8.2 Changes due to the amended directive

As a direct result of the adoption of the amended Directive, the data structure of the EU ETS will change considerably. The revised data structure is summarised below in Table 13. In Table 14, we summarise the additional / revised data in each of the revised documents as listed in the table including the key actors involved and the timing.

Article 9, 9a and 10a (5) of the amended Directive determine the total emission cap available for free allocation. The methodology for allocating the free allowances to installations, however, changes between the first two phases of the EU ETS and the third phase. The main difference between is that the allocation methodology is harmonised across the EU via the Community wide Implementing Measures (CIMs). These CIMs contain the allocation rules to be applied at the MS level in the National Implementation Measures (NIMs). Contrary to the guidance for the National Allocation Plans (EC, 2005), the CIMs will contain in detail the allocation methodology that has to be applied by the MS at the installation level to determine the allocation. The CIMs will contain the list of products for which a product benchmark forms the basic allocation methodology and emission benchmark values for these products. In addition, the CIMs will describe how emissions for which no product benchmark is developed, have to be treated. It is envisioned that with the CIMs several guidance documents will be published (discussed in more detail in the next chapter) to ensure maximum harmonization in the application of the CIMs by the various MS.

The CIMs will be applied by the MS in the NIMs that will contain the final list of EU ETS installations with their allocations. The NIMs will be prepared by the MS in 2011. A cross-sectoral correction factor is foreseen to ensure that the total amount of free allocation remains within the available cap for free allocation, (Section 3.4.1). This implies that at least two submission rounds will be required before final NIMs can be agreed on. First, a basic allocation calculation is required by the MS, which is then applied by the European Commission to calculate a cross-sectoral emission factor (if required). In a second round, the final allocation, including the cross-sectoral factor, is determined.

The amended Directive is not conclusive on the envisioned content of the revised monitoring and reporting guidelines. According to Article 14 of the amended Directive, the Commission shall adopt by 31 December 2011, a regulation for the monitoring and reporting of emissions and, where relevant, activity data, from the activities listed in Annex I. These revised monitoring and reporting guidelines should include guidelines for monitoring and reporting of emissions from the new activities and greenhouse gases that will be included in the EU ETS after 2013, but the necessity to include also provisions for monitoring activity data is less clear. Activity data are required to apply the CIMs to determine an allocation for each installation, but are not necessarily required during the trading period itself.

For the following reasons, we still recommend to include all data (including also activity data) required to come to an allocation at the installation level also as an integral part of the revised monitoring and reporting guidelines and, as a consequence of this, also in monitoring plans and emission reports[57]:

- Depending on the exact rules that will be determined for new entrants and closures, activity data might play a role the application of these rules. If so, monitored and verified data following uniform monitoring and reporting guidelines are desirable.
- Obviously, no decision has been made whatsoever on the allocation methodologies (if any) that will be applied after 2020. If methodologies comparable to the period 2013 – 2020 will be used, activity data will play a role in the allocation. Monitored and verified data following uniform monitoring and reporting guidelines are in this case desirable.

[57] In many cases, activity data already form part of the monitoring plan and emission report as part of the supporting documentation used by verifiers in the verification process.

Table 13 Changes in data structure between EU ETS Phase I/II and III

EU ETS phase I and I	**EU ETS Phase III**
1 EU ETS directive	1 Amended Directive
2 Guidelines for NAP	2 Community wide and fully harmonised implementing measures
3 Monitoring and reporting guidelines	3 Revised monitoring and reporting guidelines
4 Monitoring Plan	*Unchanged*[1]
5 GHG permit	*Unchanged*
6 Background data for National Allocation Plans	6 Background data for National Implementation Measures
7 National Allocation Plan	7 National Implementation Measures
8 Application and issuance of allowances	*Unchanged*
9 Annual emission reports	*Unchanged*[1]
10 National registries	*Unchanged*
11 CITL database	*Unchanged*

[1]As discussed in the text, it can be worthwhile considering including also activity data as integral and obligated part of the revised monitoring and reporting guidelines. If included, the monitoring plan and emission reports could change accordingly.

Table 14 Data requirements

No.	Data	Background / Guidelines	Actor	Timing
Directly based on amended EU ETS Directive				
1	Community wide quantity of allowances	Article 9 of the amended Directive	EC	Publication by 30 June 2010
2	Adjustment for opt-ins	Article 9a (1) of the amended Directive	EC	
3	Adjustment for new sectors and gases	Article 9a (2) of the amended Directive based	MS	Delivered to the EC by 30 June 2010
4	Adjusted quantity of allowances	Article 9a (3) of the amended Directive	EC	Published on 30 September 2010
5	Adjustment for excluded installations	Article 9a (4) of the amended Directive	EC	After 2011
6	Maximum amount of allowances	Article 10a (5) of the amended Directive	EC	Published on 30 September 2010
7	Cross-sectoral emission factor	Article 10a (5) of the amended Directive	EC	2011
Community-wide and fully harmonised allocation rules				
8	List of products with product benchmarks and value for these benchmarks	Based on work by consultants, including stakeholder consultation.	EC	Adoption on 30 December 2010
9	Description of fall-back approaches for emissions not covered by product benchmarks	Based on work by consultants, including stakeholder consultation. No "formal" data collection process	EC	Adoption on 30 December 2010
10	Carbon leakage factors		EC	Adoption on 31 December 2009
Monitoring and reporting guidelines				
10	Updated monitoring and reporting guidelines	Guidelines for new sectors and gases. Inclusion of activity data?	EC	Adoption on 31 December 2011
National implementing measures				
11	Relevant activity data to apply allocation based on product benchmarks	Based on harmonised allocation rules and revised monitoring guidelines	MS	2011
12	Relevant data to apply fall-back approaches	Based on data in emission reports	MS	2011

8.3 Flow diagram for the NIMs based on the CIMs

Chapter 4, 5, 6 and 7 describe a methodology to determine the allocation for each installation eligible for free allocation of emission allowances. In Figure 10, we give the four steps that are required to calculate the basic allocation before the (possible) application of the linear reduction factor and the possible cross-sectoral correction factor as discussed in Section 3.4.1 and the application of correction factors for allowances that are calculated based on a fall-back approach as described in Section 5.4.2.

STEP 1: Basic data
STEP 2: Allocation based on product benchmarks
STEP 3: Allocation based on fall-back approaches
STEP 4: Correction for cross-boundary heat flows

8.3.1 Step 1: Basic data

It is envisioned that for all products for which a product benchmark is the allocation methodology, it is also determined whether the products are exposed to a significant risk of carbon leakage (see Section 4.3), independent of the NACE classification of the installation in which the product is produced. For the allocation via the heat production and fuel mix benchmarks, however, the NACE code the remaining activities of the installation is an important variable in the allocation formula. It is therefore recommended to collect as an integral part of preparing the NIMs, the NACE 4-digit classification of all activities undertaken by the EU ETS installation[58]. The classification of installations into Annex I activities is not directly influencing the allocation. Still, to improve the transparency of e.g. the national register and CITL, it is recommended to standardize the categorization of installations into the various Annex I activities. In Section 4.2.1, such standardization is proposed, which could be included in the CIMs and subsequently applied in the NIMs.

8.3.2 Step 2: Allocation based on product benchmarks

The second step is to find out for each installation which of the products for which a product benchmark is included in the CIMs, is produced by the installation. For the reference period on which the allocation is based (Section 4.5), the production volume for these products is required. Multiplication of this production volume with the relevant benchmark value yields the basic allocation based on the product benchmarks.

For those processes where a benchmark is proposed including (part of) the electricity consumption, because fuel use and electricity use in the production process can be used interchangeable (Section 6.3), the share of direct fuel and steam related emissions in the total emissions including electricity is required to correct the total allocation based on the benchmark that includes electricity emissions for the part related to direct (i.e. fuel and steam)

[58] The easiest way to determine the activities undertaken by the installation is probably to ask for the full list of products (with the PRODCOM classification number) which is directly linked to the NACE classification.

emissions (Equation 2 in Section 6.3)[59] [60]. Obviously, the CIMs and associated guidance papers should clearly indicate the relevant methodologies (e.g. system boundaries, emission factors etc.) for this correction.

8.3.3 Step3: Allocation based on fall-back approaches

For some installations (e.g. in refineries, clinker manufacture, lime manufacture), the product benchmarks will cover all relevant emission of the EU ETS installation. For these installations, the basic allocation determined via the product benchmarks as explained above is sufficient for calculating the emission allowances for the installation. In the majority of installations, however, some of the emissions are related to processes and activities for which no product benchmarks are developed. In Chapter 5, the following three approaches have been proposed for these emissions:

1. Grandfathering for small amounts of non fossil fuel related process emissions
2. Heat production benchmark for processes where a secondary energy carriers is produced
3. Fuel mix benchmark for other combustion processes

For the first fall-back approach, the historical non fossil fuel related process emissions in the reference year on which the allocation is based, are required.

For the third fall-back approach, first the relevant combustion units need to be identified. In a second step, the calorific value of the fuels used in these units needs to be known. Thirdly, the calorific value of these fuels (e.g. in GJ) needs to be multiplied with the relevant fuel mix benchmark (e.g. in t CO_2 / GJ) to determine the basic allocation.

The second fall-back approach is relatively easy for installations where the total heat output of the heat producing installation is consumed in processes without a product benchmark. In this situation, the total amount of heat consumed in the reference year needs to be combined with the heat production benchmark to determine the basic allocation.

The most complicated is the situation where the heat output of the heat producing installation is consumed partly by production processes with a product benchmark and partly by production processes without such a product benchmark. This situation will for example occur in EU ETS installations in the chemical industry where interconnected steam networks supply a wide variety of production processes. In such situations, detailed information at the installation level (emission reports and more detailed operational data) will be required to determine the share of heat from the heat producing installation that is consumed by production processes without a product benchmark. Based on the work with industrial stakeholders on cross-boundary heat flows (Chapter 6.1), we conclude that the operational data required for determining the basic allocation is in many cases available, but also that competent authorities, verifiers and operations should be guided by clear guidance documents

[59] For readability reasons, the additional data requirement for determining the share of electricity versus fuel use is not separately included in Figure 10

[60] For refineries, the correction for electricity use is an integral part of the CO_2 weighted t approach.

in which issues such as system boundaries (e.g. how to measure steam consumption and at which point), estimation methodologies (e.g. if data are not or insufficiently available) are unambiguously described.

Also the guidance for CHP units where both electricity (not eligible for free allocation) and heat (eligible for free allocation) are produced needs to be unambiguous and clear.

8.3.4 Step 4: Cross-boundary heat flows

The basic allocation as calculated in Step 2 and 3 was based on product benchmarks and on consumed heat with a heat production benchmark[61]. In this last step, a correction is required in cases where part of the heat for which the basic allocation is calculated is not produced within the installation, but outside the system boundary of the installation or where the EU ETS installation is also or only producing heat that is sold to costumers outside the system boundary of the EU ETS installation. The options for this are described in Section 6.1, in Figure 10, we summarize the situation in which option 2c for cross-boundary heat flows is chosen (i.e. correction for cross-boundary heat flows with heat production benchmark and carbon leakage factor of the consuming entity).

8.3.5 Step 5: Total basic allocation

The sum of the basic allocation based on product benchmarks and fall-back approaches corrected for cross-boundary heat flows gives the basic allocation to the installation. Depending on the decisions made regarding correction factors for the fall-back approaches (Section 5.4.2) and regarding the linear and cross-sectoral reduction factors (Section 3.4.1), this basis allocation should be multiplied with additional factors to come to the final allocation of the installation.

[61] In addition, allocations based on grandfathering and fuel mix benchmarks have been discussed, but since these "emissions" do not cross the system boundary of installations, we do not further discuss these here. In the case of waste gases, the basic methodology as outlined in Section 6.2 avoids the necessity to correct the allocation for the flow of waste gases over the system boundaries of installations.

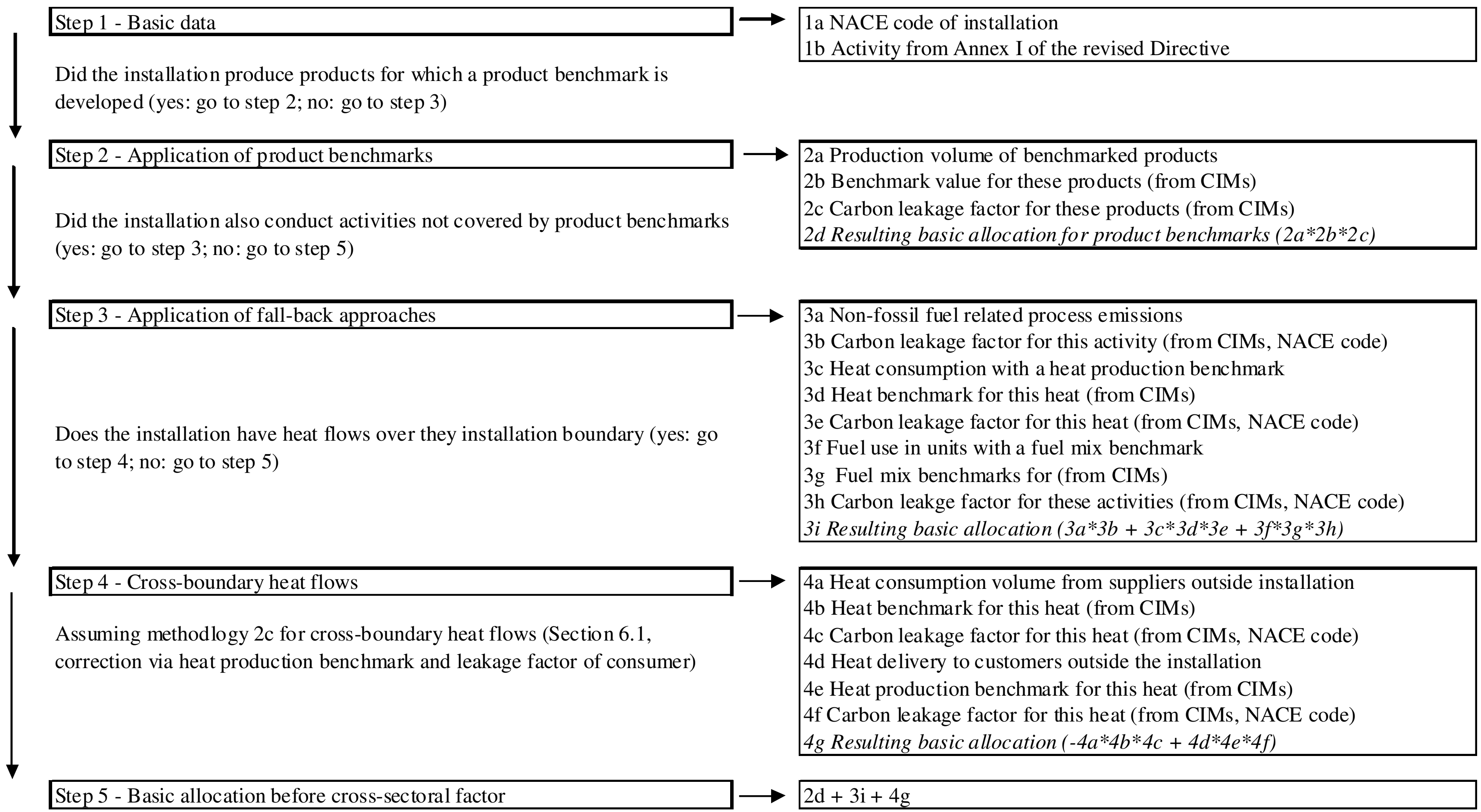


Figure 10 Flow diagram to determine the basic allocation at installation level (i.e. without linear reduction factor, correction factors and the cross-sectoral reduction factor)

9 Next steps

As explained in the introduction to this report, this study aimed to prepare a first blueprint for a methodology to allocate emission allowances to installations eligible for free allocation in the third trading phase of the EU ETS. The methodologies as described in the various sector reports and the summarizing rule book given in the previous chapter allow the calculation of a basic allocation for each EU ETS installation.

Yet, several steps need to be made to come to a harmonised allocation methodology which can unambiguously be applied by the MS for the calculation of an allocation to each installation. In this chapter, we summarise the most important steps, grouped into three categories:

- Further work on finalization of benchmark values
- Further methodological refinements to the allocation methodology
- Guidance documents for the preparation of the NIMs

9.1 Further work on finalization of benchmark values

- The benchmark values as proposed in this study are often based on preliminary results from benchmark studies conducted by the industrial stakeholders or are based on literature values, because no results from the benchmark studies conducted by the stakeholders are yet available. The values are therefore often not based on the right years (2007 – 2008 as prescribed in the amended Directive) or contain only a selection of the relevant installations. It is recommended to decide as soon as possible on a process for including new information from the industrial stakeholders in the process to come to adopted CIMs, including clear deadlines and the approach regarding data verification (next point). In each of the sector reports, the further steps required are described. It is recommended to discuss additional steps required bilaterally with the sectors concerned.
- In this study, industrial stakeholders have been asked to collect and present data based on methodologies according to the principles as described in this study. Verification of the data has not been part of this study and in some cases, small differences exist between the methodologies proposed in this study and the methodologies used by the stakeholders. Also the applied system boundary of production processes (i.e. which steps to include in the production process) have not always been discussed in all details (see next paragraph). It is recommended to decide as soon as possible on a process for verifying the benchmark values as proposed in this study, both with respect to the methodologies applied for determining the benchmark values and with respect to the correctness of the data used.

9.2 Further methodological refinements

- The CIMs not only need to include benchmark values for the various products with a product benchmark, but should also sufficiently describe the system boundaries of the production processes for this product. This is for example required to unambiguously determine whether an emission source is covered by the production benchmark or should be covered by one of the fall-back approaches. The sector reports describe in general terms the system boundaries of the various production processes, but it is recommended to further specify these system boundaries in the CIMs, in close consultation with the industrial stakeholders, thereby ensuring consistency between these system boundaries and the benchmark values as adopted.
- For some sectors, the possibility of distinguishing additional product groups with a separate benchmark was left to further quantitative proof on the difference in emission intensity between the product groups and the availability of product classification to distinguish between the product groups. As part of the process to come to adopted CIMs, it is recommended to clearly define the process to come to a decision on this point.
- The three fall-back options (grandfathering, heat production benchmark, fuel mix benchmark) have been described at a conceptual level in this report. Yet, a number of choices have to be made like the necessity to apply additional correction factors and the exact values for these benchmarks. This also holds for the definition of process versus fuel emissions in the definition of these fall-back approaches.
- As explained in Section 4.3, this study focused on product benchmarks for sectors included in the EU ETS via a product or production process definition. For the sectors included in the EU ETS via the combustion of fuel activity, the fall-back approaches are proposed, but it was indicated that for some of these sectors, additional product benchmarks might be considered if the sectors produce sufficiently homogenous products and if the majority of the sector is included in the EU ETS. It is recommended to decide as soon as possible on a process to decide on the possible inclusion in the CIMs of additional product benchmarks for these sectors, including clear deadlines and guidance on the methodologies to be applied.
- An issue not discussed in detail in this study it the choice of the reference year(s) for determining the allocation and the approach for activity levels for new entrants. Given the importance of this choice for the final allocation, it is recommended starting stakeholder consultation on this issue as soon as possible.

9.3 Guidance documents for the NIMs

- Although the fall-back approaches described in this study are conceptually clear, further guidance will be required for e.g. a uniform definition of heat and a uniform approach to measure and monitor heat production (e.g. how to deal with e.g. condensate return etc.). It is recommended preparing a guidance document associated with CIMs on these issues.
- As explained in the previous chapter, the application of the fall-back approaches will require for some heat producing installations to determine the share of the heat consumed in production processes with a product benchmark and to production

processes covered via the fall-back approach. Also on this issue, further guidance will be required, possibly in the form of a guidance document.

- The allocation methodology as proposed in this study is rather cumbersome and data-intensive. It cannot yet fully be foreseen which methodological approaches will result in exactly which questions when applied at the individual installation level. Also questions on data availability can only be resolved when the MS start applying the NIMs to come to an allocation at the individual installation level. It is recommended to start as soon as possible a pilot in a number of MS to test the feasibility of the approaches envisioned in this study. Based on the experiences in this pilot, additional guidance documents can be suggested to ensure maximal harmonization across MS in applying the CIMs.

10 References

Ecofys / Fraunhofer-ISI (2009) *Developing benchmarking criteria for CO_2 emissions,* Ecofys Netherlands / Fraunhofer Institute for Systems and Innovation research, February 2009

Ecofys / Öko Institute (2008) *Pilot on Benchmarking in the EU ETS,* report for the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Dutch ministry of Economic Affairs, Berlin / Utrecht, October 2008

EC (2005) *Communication from the Commission on further guidance on allocation plans for the 2008 – 2012 trading period of the EU Emission Trading Scheme, COM(2005) 703 final,* 22.12.2005

EC (2007) *Commission decision of 21 December 2006 establishing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council, Official* Journal of the European Union 6.2.2007

EC (2008) *Proposal for Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community,* 23.01.2008

EU (2003) *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emissions allowance trading within the Community and amending Council Directive 96/61/EC,* Official Journal of the European Union, 25.10.2003

EU (2004*) Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC,* Official Journal of the European Union, 21.2.2004

EU (2009) *Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2008 amending Directive 2003/87/EC as to improved and extend the greenhouse gas emission allowance trading scheme of the Community,* Official Journal of the European Union, 5.6.2009

EUROSTAT/IEA/UN (2008) Electricity and Heat – Annual Questionnaire 2007 and Historical Revisions. Joint questionnaire for compilation of energy statistics used by Eurostat, IEA and United Nations.

IEA (2008a) *Extended energy balances of OECD and non-OECD countries, 2008 version,* International Energy Agency, Paris

IEA (2008b) *CO_2 emission from fuel combustion, 2008 version,* International Energy Agency, Paris

List of abbreviations

CAA	European Starch Industry Association
CAEF	European Foundry Association
CEFIC	European Chemical Industry Council
CEFS	Comité Européen des Fabricants de sucre
CEMBUREAU	Representative organisation of the cement industry in Europe
CEPS	Centre for European Policy Studies
CERAME-UNIE	European ceramics industries association
CHP	Combined heat and power
CIAA	Confederation of the food and drink industry in the EU
CIMs	Community wide implementing measures
CITL	Community Independent Transaction Log
CN	Combined Nomenclature, a European classification of goods used for foreign trade
CONCAWE	The oil companies' European association for environment, health and safety in refining and distribution
CPA	European Classification of Products by Activity
CPC	Central Product Classification of the United Nations
CPIV	Standing committee of the European glass industries
CWT	CO_2 weighted tonne
EAA	European Aluminium Association
eBIO	European Bio ethanol fuel association
EC	European Commission
ECCP	European Climate Change Program
ECF	European Coffee Federation
EDA	European Diary Association
EFMA	European Fertilizer Manufactures Association
EPF	European Panel Federation
EPPSA	European Power Plant Suppliers Association
ESIA	European Semiconductor Industry Association
ETRMA	European Tyre and Rubber Manufacturers Association
EU	European Union
EU ETS	EU Emission Trading Scheme
EULA	European Lime Association
EURIMA	European Mineral wool Manufacturers Association
EUROFER	European confederation of iron and steel industries
EUROGYPSUM	European federation of national associations of gypsum products manufacturers
EUROMETAUX	EU Association of the non-ferrous metals industry
Euromalt	Represents the interests of the malting industry in the European Union
EUROMINES	European association of mining industries

EUROPIA	A non-profit organisation that represents the downstream sector (refining and marketing) of Europe's oil industry
EUSalt	European Salt Producers' Association
EWPA	European Whey Products Association
FEDIOL	EU oil and protein meal industry
GHG	Greenhouse Gas
HS	Harmonised commodity description and coding system
ISIC	United Nations International Standard Industrial Classification of all Economic activities
kt	Kilotonne
MS	Member States
MS TWG	Member States Technical Working Group on benchmarks
Mt	Megatonne
NACE	Classification of Economic Activities in the European Community
NAP	National Allocation Plan
NGO	Non-governmental organisation
NIMs	National Implementation Measures
PRODCOM	Production Communautaire. Classification of goods used for statistics on industrial production in the EU
SWA	Scotch Whisky Association
t	Tonne

Appendices

Appendix A: Issues discussed with industrial stakeholders
Appendix B: Questionnaire to Member States
Appendix C: Detailed description of Annex I activities
Appendix D: Emissions per Annex I activity
Appendix E: Sector and product classifications
Appendix F: NACE codes of installations in the "combustion of fuels" activity
Appendix G: Data flows in the EU ETS

Appendix A: Issues discussed with industrial stakeholders

In the initial contacts with industrial stakeholders, the list of issues as given in Box 3 was used.

Box 3 List of issues discussion with industrial stakeholders

General issues

1. Number of installations in the ETS
2. 2005 – 2007 emissions of those installations
3. 2008 – 2012 allowances of those installations
4. The NACE (version 2 or version 1.1) code (s) of the sector
5. The main activity from the original Annex I into which the installations are classified
6. The main activity from the amended Annex I into which the installations are classified

Starting points

7. Sector informal opinions on starting points formulated in 2008 study

Product differentiation

8. Intermediate products that need a separate benchmark
9. Reasonable amount of products to distinguish taken into account
10. Differences in downstream activities between installations
11. Usability of PRODCOM list. If not usable, are there other product classifications
12. Electricity and CHP installations operated in the sector and how many
13. Sold heat to other sectors

Actual benchmark values

14. Key parameters (energy efficiency / fuel mix) determining specific emission from the installations considered
15. Ongoing sector work in determining benchmarks and availability of this material
16. Difficulties in determining benchmarks (CHP, allocation issues between products etc.)
17. Expected difference between top 10% level and top 90% level of installations and the top 0% level and the 100% level (the shape of the curve

Activity indicators

18. Confidentiality of 2005 – 2007 production figures
19. Availability of 2005 – 2007 production figures
20. Capacity utilization estimates for new installations

Appendix B: Questionnaire to Member States

A questionnaire was sent to all MS and Norway to in order to:

- Develop a comprehensive overview of installations grouped to the Annex I activities in the amended Directive. Such and overview was needed to help assessing how many installations would be covered by certain benchmarks. To obtain the overview, MS were requested to provide the Annex I activity from the amended Directive for each installation.
- Develop an overview of the type of activities included in the ETS because they perform Annex I activity "combustion of fuels". Such an overview was needed to support the development of fall-back approaches for sectors / products for which a benchmark is difficult to develop. To obtain the overview, MS were requested to provide the sector each installation is in, as defined by a 4-digit code in the NACE classification of economic activities.
- Develop an overview of electricity producers, electricity producers that also produce heat, and electricity generators as defined by Art. 3(u). Such an overview was needed because the amended Directive foresees, with some exceptions, auctioning of allowances for emissions from electricity production and (partial) free allocation for other emissions. To obtain the overview, MS were requested to indicate for each installation if it produces electricity, produces electricity and heat, and if it is an electricity generator as defined by Art. 3(u).
- Develop an overview of heat producing installations that export part of their heat to an external user and to develop overview of the type of activities that consume heat provided by an external producer. These overviews were needed to get a clear view on cross-boundary heat flows where the boundaries are defined by the GHG emission permits. To obtain the overview, MS were requested to indicate for each installation if it exports heat and if yes, to which sector(s) the heat is delivered, as defined by a 4-digit code in the NACE classification of economic activities.

The questionnaire consisted of excel files that were prepared specifically for each country. The basis of this excel file was an extract from the CITL register downloaded in April 2009 listing all installations included in the ETS at that time. An example of a questionnaire in shown in Figure 11. Member states were requested to fill in the red cells. Some cells in the example are filled for the purpose of illustration.

All returned questionnaires were incorporated in a single excel file. This file contains the input from all MS (except for Cyprus and Malta) and Norway. Returned data was modified in the following ways:

- The status of the installations and 2007 verified emissions were updated using CITL data from 11 May 2009. After doing so, the 2007 verified emissions per Annex I activity according to the questionnaire were compared with aggregated data from the

CITL viewer[62]. Only relatively small differences were observed. Total differences amounted to 2.5 Mt CO_2-eq.

- If the question: Does the installation produce electricity and heat?" was answered with 'yes', then the answer to the question "Does the installation produce electricity?" was made to be 'yes' as well.

Figure 11 Example of questionnaire

General Information: Account Identifier	General Information: Installation Numb	General Information: Account Stat	Installation General Information : Installation Name	Installation General Information : Permit Numbe	Installation Address Information : Main Activity	Revised Annex I activity	NACE code of installation	Electricity production	Electricity producers also producing heat	Electricity generator as defined by Art. 3(u)	Heat to external users	NACE code of heat consuming sector	Remarks
ES120.19.0	1	open	ES011408000001	ES01140800	8-Installations for the	13. Ceramics	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
20	2	open	ES014106000002	ES01410600	6-Installations for the	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
29	11	open	ES010406000011	ES0104060	6-Installations for the	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES120.119.0	101	open	ES012308000111	ES0123080	8-Installations for the	13. Ceramics	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1111-0	1040	open	Bahía de Bizkaia Gas, S.L. - Pl	ES19480100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1112-0	1041	open	Bridgestone Hispania, S.A. - Pl	ES19480100	1-Combustion installa	Unknown	40.30	Yes	No	Yes	No	No	
ES-120-1114-0	1043	open	DaimlerChrysler España, S.A. -	ES19010100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1115-0	1044	open	Elyo Arrasate, A.I.E.	ES19200100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1116-0	1045	open	Guipasa, S.A.	ES19200100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1117-0	1046	open	Kosorkuntza, A.I.E - Instalación	ES19480100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1118-0	1047	open	Kosorkuntza, A.I.E - Instalación	ES19200100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1119-0	1048	open	Michelín España Portugal, S.A	ES19010100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1120-0	1049	open	Michelín España Portugal, S.A	ES19200100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1121-0	1050	open	Unilever Foods España, S.A.	ES19480100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES120.120.0	102	open	ES011808000112	ES01180800	8-Installations for the	13. Ceramics	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	
ES-120-1122-0	1051	open	Pamesa Cerámica, S.A.	ES10120100	1-Combustion installa	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	

Results of the questionnaire:

- The Annex I activity from the amended Directive was reported for 9837 installations with open accounts (87% of all open accounts in EU ETS (CITL, 11 May 2009)) accounting for 2014 Mt CO_2-eq (94% of 2007 verified emissions all of open accounts in EU ETS (CITL, 11 May 2009))
- NACE code was reported for 10625 installations with open accounts (93% of open accounts in EU ETS (11 May 2009)) accounting for 2083 Mt CO_2-eq (97% of 2007 verified emissions of open accounts in EU ETS (CITL, 11 May 2009)).
- For 8539 installations with open accounts (75% of all open accounts in EU ETS (CITL, 11 May 2009)) accounting for 1871 Mt CO_2-eq (87% of 2007 verified emissions of all open accounts in EU ETS (CITL, 11 May 2009)) it was reported whether the installations produces electricity or electricity and heat.
- For 8122 installations with open accounts (71% of all open accounts in EU ETS (CITL, 11 May 2009)) accounting for 1795 Mt CO_2-eq (83% of 2007 verified emissions of all open accounts in EU ETS (CITL, 11 May 2009)) it was reported that the installation is an electricity generators as defined by Art. 3(u).
- For 8160 installations with open accounts (72% of all open accounts in EU ETS (CITL, 11 May 2009)) accounting for 1766 Mt CO_2-eq (82% of 2007 verified emissions of all open accounts in EU ETS (CITL, 11 May 2009)) it was reported whether the installation exports heat.
- The heat consuming sector was reported for 68% of installations that were reported to export heat.

[62] http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=473

Appendix C: Detailed descriptions of Annex I activities

Activities included in the EU ETS are listed in Annex I of the Directive. In the table below, these activities have been linked to the NACE Rev. 1.1 classification of economic activities. The match between NACE codes and Annex I activities is not always straightforward. NACE codes may cover more activities than the Annex I activities that they are linked to and vice versa.

No.	Annex I activity in amended Directive	NACE Rev. 1.1 code	Description of NACE Rev. 1.1
1	Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except installations for the incineration of hazardous or municipal waste)	Many NACE codes	
2	Refining of mineral oil	23.20	Manufacture of refined petroleum products
3	Production of coke	23.10	Manufacture of coke oven products
4	Metal ore (including sulphide ore) roasting or sintering, including pelletisation)	13.10	Mining of iron ores
5	The production of pig iron or steel (primary or secondary fusion)	27.10	Manufacture of basic iron and steel and ferro-alloys
6	Production and processing of ferrous metals (including ferro-alloys) where combustion installations 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.	27.10	Manufacture of basic iron and steel and ferro-alloys
		27.21	Manufacture of cast iron tubes
		27.22	Manufacture of steel tubes
		27.31	Cold drawing
		27.32	Cold rolling of narrow strip
		27.33	Cold forming or folding
		27.34	Wire drawing
		27.51	Casting of iron
		27.52	Casting of steel
		28.40	Forging, pressing, stamping and roll forming of metal; powder metallurgy
		28.51	Treatment and coating of metals
7	Production of primary aluminium	27.42	Aluminium production
8	Production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated	27.42	Aluminium production

Continuation

No.	**Annex I activity in amended Directive**	**NACE Rev. 1.1 code**	**Description of NACE Rev. 1.1**
9	Production and 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.	27.41	Precious metals production
		27.43	Lead, zinc and tin production
		27.44	Copper production
		27.45	Other non-ferrous metal production
		27.53	Casting of light metals
		27.54	Casting of other non-ferrous metals
10	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	26.51	Manufacture of cement
11	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	14.12	Quarrying of limestone, gypsum and chalk
		14.50	Other mining or quarrying
		26.52	Manufacture of lime
12	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day	26.11	Manufacture of flat glass
		26.12	Shaping and processing of flat glass
		26.13	Manufacture of hollow glass
		26.14	Manufacture of glass fibres
		26.15	Manufacture and processing of other glass, including technical glassware
13	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	26.21	Manufacture of ceramic household and ornamental articles
		26.22	Manufacture of ceramic sanitary fixtures
		26.23	Manufacture of ceramic insulators and insulating fittings
		26.24	Manufacture of other technical ceramic products
		26.25	Manufacture of other ceramic products
		26.26	Manufacture of refractory ceramic products
		26.30	Manufacture of ceramic tiles and flags
		26.40	Manufacture of bricks, tiles and construction products, in baked clay
14	Manufacture of mineral wool insulation materials using glass, rock or slag with a melting capacity exceeding 20 tonnes per day	26.14	Manufacture of glass fibres
		26.82	Manufacture of other non-metallic mineral products, not elsewhere classified

Continuation

No.	Annex I activity in amended Directive	NACE Rev. 1.1 code	Description of NACE Rev. 1.1
15	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a rated thermal input exceeding 20 MW are operated.	14.12 26.53 26.62 26.64 26.66	Quarrying of limestone, gypsum and chalk Manufacture of plaster Manufacture of plaster products for construction purposes Manufacture of mortars Manufacture of other articles of concrete, plaster and cement
16	Production of pulp from timber or other fibrous materials	21.11	Manufacture of pulp
17	Production of paper and card board with a production capacity exceeding 20 tonnes per day	21.12	Manufacture of paper and paperboard
18	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	24.13	Manufacture of other inorganic basic chemicals
19	Production of nitric acid	24.15	Manufacture of fertilisers and nitrogen compounds
20	Production of adipic acid	24.14	Manufacture of other organic basic chemicals
21	Production of glyoxal and glyoxilic acid	24.14	Manufacture of other organic basic chemicals
22	Production of ammonia	24.15	Manufacture of fertilisers and nitrogen compounds
23	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	24.14 24.16 24.17	Manufacture of other organic basic chemicals Manufacture of plastics in primary forms Manufacture of synthetic rubber in primary forms
24	Production of hydrogen (H_2) and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tonnes per day	24.11	Manufacture of industrial gases
25	Production of soda ash (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$)	24.13	Manufacture of other inorganic basic chemicals

Appendix D: Emissions per Annex I activity

Table 15 Number of installations and 2007 verified emissions of those installations per activity as defined in the original Annex I (CITL data, 11 May, 2009).

Activities in original Annex I	No. of installations[1]	2007 Verified emissions[2] (Mt CO_2-eq)
1. Combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations)	7415	1535
2. Mineral oil refineries	148	152
3. Coke ovens	21	22
4. Metal ore (including sulphide ore) roasting or sintering installations	31	25
5. Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2.5 tonnes per hour	242	132
6. Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day	565	200
7. Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day	440	21
8. 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 4 m^3 and with a setting density per kiln exceeding 300 kg/m^3	1100	14
9. Industrial plants fro the production of (a) pulp from timber or other fibrous materials (b) paper and card board with a production capacity exceeding 20 tonnes per day	844	29
99. Other activity opted-in	558	23
Total	**11364**	**2154**

[1] Only account that were open according to CITL (11 May 2009); includes installations in Norway.
[2] Excludes Norwegian emissions.

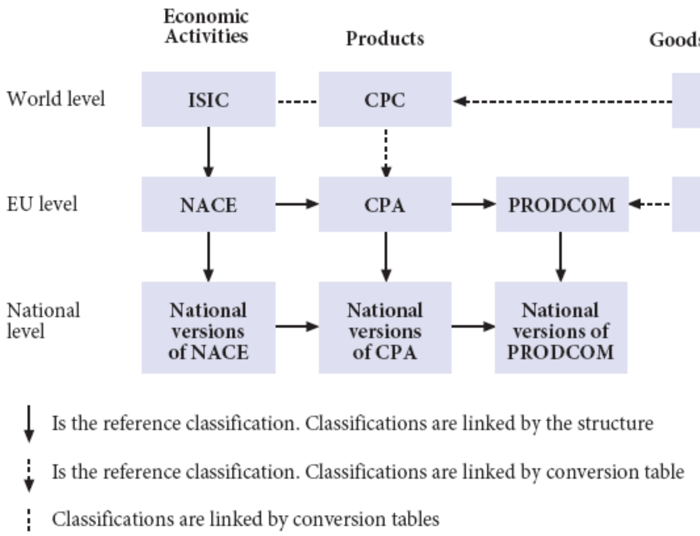
Table 16 Number of installations and 2007 verified emissions of installations with their classification in Annex I activities from amended Directive (CITL data download 11 May, 2009, MS responses to questionnaire)

Activities in Annex I of amended Directive[1]	No. of open accounts[2]	2007 Verified emissions (Mt CO_2-eq)[2,3]
1. Combustion of fuel	5971	1414.6
2. Refining of mineral oil	149	148.4
3. Production of coke	26	8.5
4. Metal ore	17	14.4
5. Pig iron or steel	257	159.0
6. Ferrous metals	42	2.4
7. Primary aluminium	5	3.4
8. Secondary aluminium	6	0.2
9. Non-ferrous metals	6	0.2
10. Cement clinker	238	153.9
11. Lime, dolomite and magnesite	283	27.6
12. Glass	403	19.9
13. Ceramics	1082	14.3
14. Mineral wool insulation materials	27	0.6
15. Gypsum	17	0.3
16. Pulp	83	4.0
17. Paper and card board	638	23.1
18. Carbon black	9	0.0
19. Nitric acid	6	2.6
20. Adipic acid	0	0.0
21. Glyoxal and glyoxilic acid	0	0.0
22. Ammonia	10	2.2
23. Bulk organic chemicals	63	11.6
24. Hydrogen and synthesis gas	0	0.0
25. Soda ash and sodium bicarbonate	1	0.2
99. Other activity opted-in	498	3.2
Unknown	1497	134.7
Total	**11334**	**2148.9**

[1] See Appendix 3 for full description of Annex I activities in amended Directive.
[2] Data is representative for 85% of open accounts and 99% of emissions. For other open accounts, categorization into Annex I activity unknown or questionnaire not received back
[3] No quality check has been performed to this data. The data given here directly relate to the classification as provided by the MS.

Appendix E: Sector and product classifications

The figure below shows an integrated system of statistical classifications for economic activities that are important from the European point of view:



For the purpose of this study, the European classifications (NACE, CPA, PRODCOM, and CN) are important, briefly described below:

NACE - Classification of Economic Activities in the European Community

NACE ("Nomenclature générale des Activités économiques dans les Communautés Européennes" – Statistical classification of economic activities in the European Communities) is the acronym used to designate the various statistical classifications of economic activities developed since 1970 in the European Union. It is the European standard classification of productive economic activities. NACE presents the universe of economic activities partitioned in such a way that a NACE code can be associated with a statistical unit carrying them out. NACE provides the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic statistics (e.g. production, employment, national accounts) and in other statistical domains.

NACE is derived from ISIC (United Nations' International Standard Industrial Classification of all Economic activities) in the sense that it is more detailed than ISIC. ISIC and NACE have exactly the same items at the highest levels, where NACE is more detailed at lower levels. The use of NACE is mandatory within the European Statistical System.

The most recent version of NACE is NACE Rev. 2 which has been created based on ISIC Rev. 4

Structure:

Level 1: 21 sections identified by alphabetical letters A to U;
Level 2: 88 divisions identified by two-digit numerical codes (01 to 99);
Level 3: 272 groups identified by three-digit numerical codes (01.1 to 9.0);
Level 4: 615 classes identified by four-digit numerical codes (01.11 to 99.00).

For more information the reader is referred to: http://epp.eurostat.ec.europa.eu/

CPA - European Classification of Products by Activity.
The CPA is the official product classification by activity of the European Union.

CPA classifies products by their physical characteristics as goods or by their intrinsic nature as services and by originating activity. Originating activities are those defined by NACE.

It is the European version of the CPC (the Central Product Classification of the United Nations), and the purposes it serves are in line with those of the CPC. Whilst the CPC is merely a recommended classification, however, the CPA is legally binding in the European Community. In addition, the specific survey classifications were and are linked to the CPA unless the CPA is itself used as a survey classification.

Although the CPA is the European counterpart of the CPC, it differs from the latter not only in that it is more detailed but also as regards its structuring. The view at European level was that a central product classification should be structured according to the criterion of economic origin, with the framework (and thus the definition of the economic activities) being based, naturally enough, on NACE. This recourse to NACE with respect to the definitions of economic activity means that the CPA's structure corresponds at all levels to that of NACE.

Since the elements of the CPA are based on those of the CPC, links between the CPA and the HS exist in the same way as those between the CPC and the HS which have been referred to above. The same also applies as regards the Explanatory Notes to the CPA.

Most recent version is CPA 2008

Structure:

Level 1: 21 sections identified by an alphabetical code (A to U);
Level 2: 88 divisions identified by a two-digit numerical code;
Level 3: 261 groups identified by a three-digit numerical code;
Level 4: 575 classes identified by a four-digit numerical code;
Level 5: 1342 categories identified by a five-digit numerical codes;
Level 6: 3142 sub-categories identified by a six-digit numerical code.

For more information the reader is referred to:
http://epp.eurostat.ec.europa.eu/

CN - Combined Nomenclature, a European classification of goods used for foreign trade
The Combined Nomenclature (CN) is the classification used within the European Union for collecting and processing foreign trade data. It was introduced in 1988. Annual revisions of the CN are produced and adopted as a legal text and published in the Official Journal of the European Communities. This classification further breakdown of the Harmonised commodity description and coding system (HS) which covers all products that can be the subject of an international transaction and simultaneously have a physical dimension.

Revised annually, most recent version: CN 2009

Structure: about 15000 headings (of which about 9500 CN subheadings) organized in five hierarchical levels:

Level 1: sections coded by Roman numerals;
Level 2: chapters identified by two-digit numerical codes;
Level 3: headings identified by four-digit numerical codes;
Level 4: HS subheadings identified by six-digit numerical codes;
Level 5: CN subheadings identified by eight-digit numerical codes.

For more information the reader is referred to:
http://epp.eurostat.ec.europa.eu/

A conversion table exist between PRODCOM (see below) and the CN.

PRODCOM - classification of goods used for statistics on industrial production in the EU
PRODCOM aims at giving data of the production of industrial products produced by companies of the Member States. It is based on the Council Regulation (EEC) No 3924/91 of 19 December 1991 on the establishment on a Community survey of industrial production. The title comes from the French "PRODuction COMmunautaire", community production.

Revised annually, most recent version Prodcom list 2009.

Structure:

Level 1: 237 headings (corresponding to NACE Rev. 2 codes);
Level 2: 1,489 headings (corresponding to CPA 2008 codes);
Level 3: 3,915 PRODCOM headings.

For more information the reader is referred to:
http://epp.eurostat.ec.europa.eu/

Appendix F: NACE codes of installations in the "combustion of fuels" activity

The table below shows the number of installations and 2007 verified emissions of those installations for sectors that are included in the ETS because they perform Annex I activity 'combustion of fuels' from the amended Directive. The data is presented as reported by the MS and Norway; no quality checks were performed. Only account that were open according to CITL (11 May 2009) were considered. The emissions in the right column exclude Norwegian emissions. NACE code was obtained for 99% of open accounts (11 May 2009) and 99.9% of 2007 emissions categorized in Annex I activity 'combustion of fuels'.

Table 17 Number of installations and 2007 verified emissions of those installations for sectors in Annex I category of activities 'combustion of fuels'

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
1.11	Growing of cereals and other crops n.e.c.	2	15379
1.12	Growing of vegetables, horticultural specialities and nursery products	112	479786
1.24	Farming of poultry	1	43835
5.02	Fish farming	3	83502
10.1	Mining and agglomeration of hard coal	7	170941
10.3	Extraction and agglomeration of peat	2	114639
11.1	Extraction of crude petroleum and natural gas	178	14228975
11.2	Service activities incidental to oil and gas extraction, excluding surveying	12	230353
12	Mining of uranium and thorium ores	1	6596
13.1	Mining of iron ores	2	34388
14.1	Quarrying of stone	1	11359
14.22	Mining of clays and kaolin	3	132891
14.3	Mining of chemical and fertilizer minerals	2	164901
14.4	Production of salt	5	169282
14.5	Other mining and quarrying n.e.c.	3	38933
15	Manufacture of food products and beverages	14	154074
15.1	Production, processing and preserving of meat and meat products	2	8796
15.11	Production and preserving of meat	26	352353
15.12	Production and preserving of poultrymeat	2	19881
15.13	Production of meat and poultrymeat products	17	131240
15.2	Processing and preserving of fish and fish products	6	94070
15.3	Processing and preserving of fruit and vegetables	7	68192
15.31	Processing and preserving of potatoes	13	203730
15.32	Manufacture of fruit and vegetable juice	17	312808
15.33	Processing and preserving of fruit and vegetables n.e.c.	55	623037
15.4	Manufacture of vegetable and animal oils and fats	1	6793
15.41	Manufacture of crude oils and fats	25	427012
15.42	Manufacture of refined oils and fats	29	1073902
15.43	Manufacture of margarine and similar edible fats	5	62785

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
15.5	Manufacture of dairy products	1	4698
15.51	Operation of dairies and cheese making	90	2119412
15.61	Manufacture of grain mill products	6	108062
15.62	Manufacture of starches and starch products	34	1737722
15.71	Manufacture of prepared feeds for farm animals	15	143128
15.72	Manufacture of prepared pet foods	5	46625
15.81	Manufacture of bread; manufacture of fresh pastry goods and cakes	1	7382
15.82	Manufacture of rusks and biscuits; manufacture of pre-served pastry goods and cakes	1	12357
15.83	Manufacture of sugar	151	8948217
15.84	Manufacture of cocoa; chocolate and sugar confectionery	14	118070
15.85	Manufacture of macaroni, noodles, couscous and similar farinaceous products	5	77061
15.86	Processing of tea and coffee	11	176493
15.87	Manufacture of condiments and seasonings	2	19721
15.88	Manufacture of homogenized food preparations and die-tetic food	7	121624
15.89	Manufacture of other food products n.e.c.	20	321688
15.9	Manufacture of beverages	4	32200
15.91	Manufacture of distilled potable alcoholic beverages	17	199014
15.92	Production of ethyl alcohol from fermented materials	6	443851
15.93	Manufacture of wines	1	108004
15.94	Manufacture of cider and other fruit wines	1	3915
15.95	Manufacture of other non-distilled fermented beverages	2	11519
15.96	Manufacture of beer	72	857907
15.97	Manufacture of malt	7	79594
15.98	Production of mineral waters and soft drinks	6	42315
16	Manufacture of tobacco products	6	65788
17	Manufacture of textiles	2	12557
17.1	Preparation and spinning of textile fibres	5	44761
17.11	Preparation and spinning of cotton-type fibres	3	38550
17.13	Preparation and spinning of worsted-type fibres	1	53893
17.14	Preparation and spinning of flax-type fibres	1	3360
17.17	Preparation and spinning of other textile fibres	1	8609
17.2	Textile weaving	5	72164
17.21	Cotton-type weaving	4	53806
17.23	Worsted-type weaving	1	5108
17.24	Silk-type weaving	2	26711
17.25	Other textile weaving	2	24078
17.3	Finishing of textiles	27	331946
17.4	Manufacture of made-up textile articles, except apparel	4	33998
17.5	Manufacture of other textiles	2	40923
17.51	Manufacture of carpets and rugs	5	30183
17.53	Manufacture of non-wovens and articles made from non-wovens, except apparel	2	58351
17.54	Manufacture of other textiles n.e.c.	4	23230
17.6	Manufacture of knitted and crocheted fabrics	1	4882
17.72	Manufacture of knitted and crocheted pullovers, cardi-gans and similar articles	2	10323
18.22	Manufacture of other outerwear	3	8781

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
19.1	Tanning and dressing of leather	2	7479
20.1	Sawmilling and planing of wood; impregnation of wood	19	215108
20.2	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	92	1978710
20.3	Manufacture of builders' carpentry and joinery	6	64892
20.41	NACE code does not exist	2	61522
20.5	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1	0
20.51	Manufacture of other products of wood	4	120648
20.52	Manufacture of articles of cork, straw and plaiting materials	1	3402
21.1	Manufacture of pulp, paper and paperboard	1	11611
21.11	Manufacture of pulp	1	137063
21.12	Manufacture of paper and paperboard	21	1621306
21.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	6	263633
21.22	Manufacture of household and sanitary goods and of toilet requisites	5	120549
21.25	Manufacture of other articles of paper and paperboard n.e.c.	1	190
22.13	Publishing of journals and periodicals	2	38192
22.21	Printing of newspapers	1	11396
22.22	Printing n.e.c.	8	187572
23.1	Manufacture of coke oven products	3	658870
23.2	Manufacture of refined petroleum products	22	787352
23.3	Processing of nuclear fuel	3	59790
24	Manufacture of chemicals and chemical products	1	0
24.1	Manufacture of basic chemicals	5	940379
24.11	Manufacture of industrial gases	3	484098
24.12	Manufacture of dyes and pigments	6	551200
24.13	Manufacture of other inorganic basic chemicals	36	4798232
24.14	Manufacture of other organic basic chemicals	81	10769424
24.15	Manufacture of fertilizers and nitrogen compounds	27	3682877
24.16	Manufacture of plastics in primary forms	24	1241678
24.17	Manufacture of synthetic rubber in primary forms	1	0
24.2	Manufacture of pesticides and other agro-chemical products	5	104162
24.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2	15008
24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	1	6019
24.41	Manufacture of basic pharmaceutical products	32	444417
24.42	Manufacture of pharmaceutical preparations	39	683292
24.5	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	1	15326
24.51	Manufacture of soap and detergents, cleaning and polishing preparations	7	451735
24.52	Manufacture of perfumes and toilet preparations	2	53695
24.61	Manufacture of explosives	3	56292
24.62	Manufacture of glues and gelatines	7	113685
24.64	Manufacture of photographic chemical material	1	48080

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
24.65	Manufacture of prepared unrecorded media	1	2772
24.66	Manufacture of other chemical products n.e.c.	21	671407
24.7	Manufacture of man-made fibres	17	1114865
25.1	Manufacture of basic chemicals	2	4795
25.11	Manufacture of rubber tyres and tubes	25	969351
25.12	Retreading and rebuilding of rubber tyres	1	48160
25.13	Manufacture of other rubber products	7	141312
25.2	Manufacture of pesticides and other agro-chemical products	2	31081
25.21	Manufacture of plastic plates, sheets, tubes and profiles	7	109743
25.22	Manufacture of plastic packing goods	6	210391
25.23	Manufacture of builders' ware of plastic	1	4631
25.24	Manufacture of other plastic products	5	49874
26.12	Shaping and processing of flat glass	1	12184
26.13	Manufacture of hollow glass	1	17815
26.14	Manufacture of glass fibres	1	35413
26.22	Manufacture of ceramic sanitary fixtures	1	23623
26.23	Manufacture of ceramic insulators and insulating fittings	1	7682
26.25	Manufacture of other ceramic products	2	11271
26.26	Manufacture of refractory ceramic products	3	454
26.4	Manufacture of bricks, tiles and construction products, in baked clay	1	3299
26.51	Manufacture of cement	1	2473
26.61	Manufacture of concrete products for construction purposes	2	9829
26.7	Cutting, shaping and finishing of ornamental and building stone	1	8775
26.81	Production of abrasive products	1	3021
26.82	Manufacture of other non-metallic mineral products n.e.c.	35	2995482
27.1	Manufacture of basic iron and steel and of ferro-alloys	38	18622588
27.22	Manufacture of steel tubes	5	5227
27.32	Cold rolling of narrow strip	1	33336
27.34	Wire drawing	1	7253
27.42	Aluminium production	9	313841
27.43	Lead, zinc and tin production	2	26021
27.44	Copper production	1	9653
27.45	Other non-ferrous metal production	1	1446979
27.51	Casting of iron	3	60569
27.54	Casting of other non-ferrous metals	1	13617
28.11	Manufacture of metal structures and parts of structures	2	14261
28.22	Manufacture of central heating radiators and boilers	1	47510
28.3	Manufacture of steam generators, except central heating hot water boilers	4	16186
28.4	Forging, pressing, stamping and roll forming of metal; powder metallurgy	4	63540
28.51	Treatment and coating of metals	4	15491
28.63	Manufacture of locks and hinges (the emissions of one of 4 installations is disproportionally large suggesting that it is wrongly classified)	4	4618609
28.7	Manufacture of other fabricated metal products	3	15876

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
28.75	Manufacture of other fabricated metal products n.e.c.	2	78430
29.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	7	38657
29.13	Manufacture of taps and valves	2	23824
29.14	Manufacture of bearings, gears, gearing and driving elements	3	36666
29.2	Manufacture of other general purpose machinery	3	11138
29.22	Manufacture of lifting and handling equipment	3	47390
29.23	Manufacture of non-domestic cooling and ventilation equipment	1	20884
29.24	Manufacture of other general purpose machinery n.e.c.	3	17175
29.31	Manufacture of agricultural tractors	1	9590
29.32	Manufacture of other agricultural and forestry machinery	2	6666
29.5	Manufacture of other special purpose machinery	1	27951
29.52	Manufacture of machinery for mining, quarrying and construction	4	16186
29.54	Manufacture of machinery for textile, apparel and leather production	1	28316
29.6	Manufacture of weapons and ammunition	11	165321
29.7	Manufacture of domestic appliances n.e.c.	1	6051
29.71	Manufacture of electric domestic appliances	4	32586
30.02	Manufacture of computers and other information processing equipment	1	3021
31.1	Manufacture of electric motors, generators and transformers	3	73032
31.2	Manufacture of electricity distribution and control apparatus	4	15099
31.3	Manufacture of insulated wire and cable	3	18180
31.5	Manufacture of lighting equipment and electric lamps	1	7204
31.6	Manufacture of electrical equipment n.e.c.	1	6030
31.61	Manufacture of electrical equipment for engines and vehicles n.e.c.	3	35324
31.62	Manufacture of other electrical equipment n.e.c.	2	3134
32.1	Manufacture of electronic valves and tubes and other electronic components	8	162459
32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	2	6567
34.1	Manufacture of motor vehicles	64	1329004
34.2	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2	26917
34.3	Manufacture of parts and accessories for motor vehicles and their engines	18	178264
35	Manufacture of other transport equipment	1	2578
35.11	Building and repairing of ships	5	15732
35.2	Manufacture of railway and tramway locomotives and rolling stock	11	112886
35.3	Manufacture of aircraft and spacecraft	21	157281
35.41	Manufacture of motorcycles	2	21278
35.5	Manufacture of other transport equipment n.e.c.	1	5058
36.4	Manufacture of sports goods	1	2907
36.6	Miscellaneous manufacturing n.e.c.	1	0

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
36.63	Other manufacturing n.e.c.	2	21719
37.2	Recycling of non-metal waste and scrap	1	10210
40	Electricity, gas, steam and hot water supply	145	53321630
40.1	Production and distribution of electricity	184	62248967
40.11	Production of electricity	990	1059446622
40.12	Transmission of electricity	1	52602
40.13	Distribution and trade of electricity	6	347464
40.2	Manufacture of gas; distribution of gaseous fuels through mains	2	71406
40.21	Manufacture of gas	39	1089599
40.22	Distribution and trade of gaseous fuels through mains	62	2017781
40.3	Steam and hot water supply	2192	129359714
41	Collection, purification and distribution of water	7	43646
45.21	General construction of buildings and civil engineering works	1	0
45.23	Construction of motorways, roads, airfields and sport fa-cilities	5	12477
45.25	Other construction work involving special trades	3	8104
45.34	Other building installation	1	3950
51.34	Wholesale of alcoholic and other beverages	1	4216
51.51	Wholesale of solid, liquid and gaseous fuels and related products	1	0
51.52	Wholesale of metals and metal ores	1	0
51.53	Wholesale of wood, construction materials and sanitary equipment	1	117118
51.9	Other wholesale	1	12259
55.1	Hotels	1	2252
60.1	Transport via railways	4	33310
60.22	Taxi operation	1	16173
60.3	Transport via pipelines	42	849083
62.1	Scheduled air transport	3	29473
63.1	Cargo handling and storage	1	26783
63.11	Cargo handling	1	3736
63.12	Storage and warehousing	8	37032
63.23	Other supporting air transport activities	8	141931
65.12	Other monetary intermediation	2	781
65.23	Other financial intermediation n.e.c.	1	801
67.13	Activities auxiliary to financial intermediation n.e.c.	1	517
70.11	Development and selling of real estate	1	38883
70.2	Letting of own property	4	26486
70.32	Management of real estate on a fee or contract basis	11	207330
73.1	Research and experimental development on natural sci-ences and engineering	2	18884
74.11	Legal activities	1	0
74.8	Miscellaneous business activities n.e.c.	2	0
74.82	Miscellaneous business activities n.e.c.	1	36951
74.87	Other business activities n.e.c.	3	34249
75.12	Regulation of the activities of agencies that provide health care, education, cultural services and other social services, excluding social security	2	43855
75.22	Defence activities	9	90703

Continuation Table 17

NACE Rev. 1.1 code	Description of NACE code	No. of installa-tions	2007 Verified emissions (t CO_2-eq)
80.3	Higher education	16	296759
85.11	Hospital activities	78	845112
90.01	Collection and treatment of sewage	5	44054
90.02	Collection and treatment of other waste	8	239676
91.31	Activities of religious organizations	1	9498
92.2	Radio and television activities	2	6142

Appendix G: Data flows in the EU ETS

Table 18 Permitting and Allocation

No.	Product	Content	Level of detail	Party Involved	Tasks
1/2	EU ETS Directive	Total and MS caps - How much?		EU Commission	Propose directive and be active in negotiations
		Definitions, scope, boundaries - What?		MS governments, EU parliament and other stakeholders	Discuss and vote
		Allowed allocation methodologies - How to's, Do's and Do nots			
3	Monitoring Guidelines	Which data from which installations under which conditions?		EU Commission	Preparation of Monitoring and Reporting Guidelines

Table continues on the next page

Continuation Table 18

No.	Product	Content	Level of detail	Party Involved	Tasks
4	Monitoring Plan	Individual monitoring requirements, processes and instruments for each installation - Which data from installation X will be monitored, calculated, estimated, reported?	• Responsibilities for monitoring and reporting • the fuel and material streams to be monitored • the choice of tiers for all elements of the emission calculation • a description of metering devices (location, technology, uncertainty) • a detailed description of emission measurement systems (if applicable) • QA/QC procedures for monitoring and reporting, e.g. for the processes of data collection and emission calculation	Operators	Set up monitoring plan
			country-specific and depending on monitoring plan, see above	Verifiers	Verify / Validate that monitoring plan is in line with MRGs
			country-specific and depending on monitoring plan, see above	Competent Authority	Approve/Accept monitoring plan
5	GHG Permit	Specification of type of installation, including boundaries	Minimum requirements: • description of installation • activities • technology used • emissive raw and auxiliary materials • measures planned in accordance with MRG	Operators	Apply for GHG permit
			• name and address of operator • description of activities and emissions from the installation • monitoring requirements • reporting requirements • obligation to surrender allowances	Competent Authority	Grant GHG permit

Continuation Table 18

No.	Product	Content	Level of detail	Party Involved	Tasks
6	Preliminary data gathering	Emissions (and production) data of covered installation	Country-specific, but can include: • Emissions in specified period of years • Production in specified period of years • Installation changes in specified period of years	MS governments	Set up legal and organisational basis for data gathering
				Operators	Internal data gathering and submission
7	NAP and resulting list of installations with allowances	Total and sectoral caps	• Amount of allocated allowances per sector • Allocation method per sector • JI/CDM share per sector • Treatment of Non-CO2-gases	MS governments	Preparation of NAP
			based on 12 criteria (quantitative and qualitative as well as mandatory and optional) laid down in Annex III to the Emission Trading Directive	European Commission	Assess the NAPs
		List of installations	Name (and identification code?) of covered installation	Verifiers	By some MS used to verify data
		Total allowances per installation	Name (and identification code?) and allocated amount per covered installation		

Continuation Table 18

No.	Product	Content	Level of detail	Party Involved	Tasks
8		Application and issuance of allowances	Application with technical and production data, depending on allocation method. Application for whole trading period received for the entire trading period.	Operators	The application for allowances is necessary to receive an allocation of free of charge allowances.
			country-specific and depending on application procedure, see above	Verifiers	
			country-specific and depending on application procedure, see above	Competent authority	Decides upon the total quantity of allowances to be allocated to the operators of the various installations, based on the information provided in the application and according to the allocation rules laid down in NAP.
9	Annual emission reports	Detailed emission (and perhaps production) data per individual emission source	• Identification of installation • chosen approach (measurement or calculation) • chosen tiers and method (if applicable) and temporal or permanent changes • activity data • emission and oxidation factors • total emissions and uncertainty for each activity for which emissions are calculated, or total emissions • information on the reliability of measurement methods and uncertainty • memo items	Operators	Internal data gathering and reporting
			country-specific and depending on monitoring plan, see above	Verifiers	Verify emission reports
			country-specific and depending on monitoring plan, see above	Competent authorities	Approve / Accept emission reports

Continuation Table 18

No.	Product	Content	Level of detail	Party Involved	Tasks
10	National Registries	Operators and traders identification data	• decisions relating to the allocation of allowances • information on emissions reports as required under the GHG emissions permit	Competent authorities or special institution	Administration, processing and publication of data from permits, allocation plans, emission reports and trading actions
		Installation data, Operators account balances and status	• decisions relating to the allocation of allowances • information on emissions reports as required under the GHG emissions permit • Quantity of issuance 2005-2007/2008-2012 • issuance of force majeure allowances • Verified emissions • Total units surrendered • Surrendered allowances 2005-2007 • Surrendered allowances 2008-2012 • Surrendered ERUs (AAU) • Surrendered CERs • Compliance status		
11	CITL database	Operators and traders identification data	Publicly available only contact data, and information on activity type.	European Commission	Collect data from national registries
		Installation data	Publicly available only contact data, and information on activity type.		Administration, processing and publication of data from JI and CDM
		Operators account balances and status	The Community Independent Transaction Log (CITL) records the issuance, transfer, cancellation, retirement and banking of allowances that take place in the registry.		