Carbon leakage and the future of the EU ETS market

Impact of recent developments in the EU ETS on the list of sectors deemed to be exposed to carbon leakage

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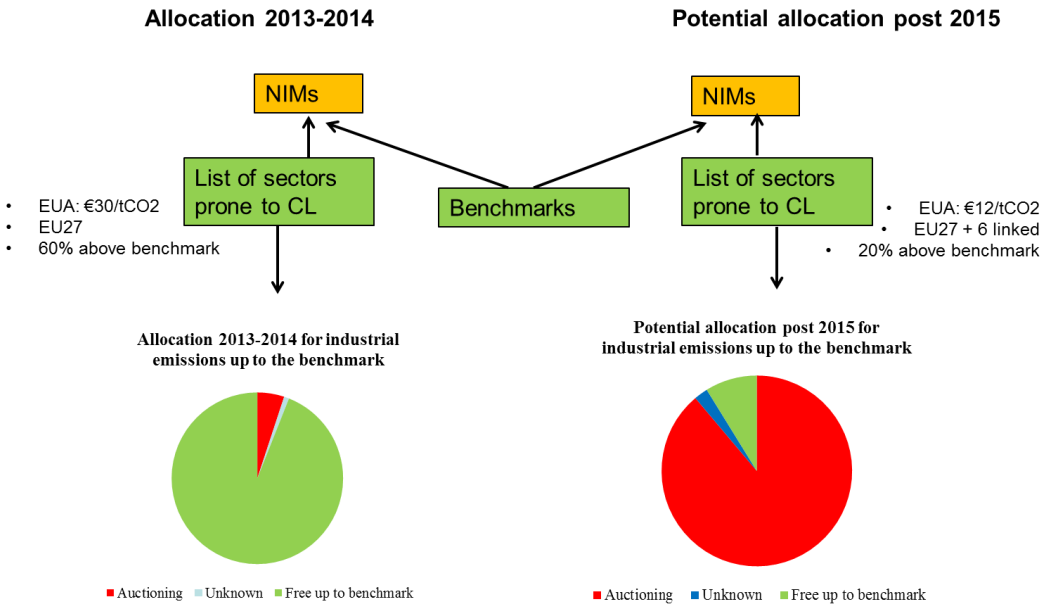
Political Brief

Carbon leakage has been an important argument in the design of the Third Phase of the EU ETS. By giving free allowances to industries prone to carbon leakage, the EU ETS tried to combine a restrictive climate policy with the goal of shielding energy-intensive industry from high carbon costs that would affect their competitiveness. As we approach the Mid-Term Review of the carbon leakage list in 2014, it appears that many of the core assumptions used to define the current list of sectors receiving free allowances are outdated. The 2009 assessment assumed:

- a carbon price of € 30 by 2020, although it is now unlikely to exceed € 12;
- exposed sectors would exceed their benchmarked free allowances by 60%. Although as yet uncertain, a figure of 20% now seems more likely;
- non-EU countries were not part of the EU ETS. However, currently Croatia, Iceland, Norway and Liechtenstein participate, with planned linkages with Australia and Switzerland by 2015.

This study shows that applying more realistic assumptions regarding price, supply and trade conditions would imply a drastic reduction of the number of sectors eligible for additional free allowances. A revised assessment indicates that if the 2009 allocation had been based on more realistic assumptions, the sectors deemed at risk of carbon leakage would have fallen from the current 60% of sectors, representing 95% of industrial emissions, to a mere 33% of sectors, accounting for only 10% of emissions (see figure below). This is a conservative estimate in which other relevant factors such as cost-pass-through, cheaper abatement opportunities available (e.g. offsets) and the presence of comparable carbon pricing policies elsewhere have not been quantified.



These results can be linked to current attempts to reform the EU ETS. If such reforms fail and carbon prices remain very low, the threat of carbon leakage logically becomes much smaller. Ideally, the trade-off between carbon leakage and reform of the EU ETS should be reflected in the Mid-Term Review. Politically, this may require a new impact assessment of the current state of the ETS to be used in the Mid-Term Review.

Summary

The EU ETS is in crisis, as the oversupply of emission allowances has become apparent to all participants in the market. In 2012 demand for allowances fell short of supply by over 10% and the price of allowances fell to an all-time low of € 3/tCO_2 in January 2013. Analysts assume that oversupply will remain a feature of the EU ETS for most of Phase 3 of the scheme, which lasts until 2020. With prices so low, the ETS is failing to provide any incentive for implementing carbon-saving measures and greening the economy, its stated objective.

In its *Carbon Market Report* the European Commission has identified six options for structural measures to strengthen the EU ETS during Phase 3 and render it more effective. However, measures to restructure the ETS and support the price of allowances have met with severe political and societal opposition. An often forgotten element in this discussion is the impact the coming Mid-Term Review (MTR) will have at the end of 2014. The MTR will re-evaluate the basis of allocation in the ETS and decide which sectors are deemed to be exposed to a significant risk of carbon leakage and would thus receive free allowances for the years 2015-2019. The purpose of the present study is to indicate the estimated impact on the allocation of allowances if the MTR proceeds from a realistic analysis of the current state of the EU ETS.

The factors on which sectors are considered to be exposed to carbon leakage were set out in the revised ETS Directive. This Directive presented two criteria to be used to assess whether a sector is exposed to carbon leakage:
(i) additional carbon costs, and (ii) trade intensity. Thus, sectors with qualified high additional carbon costs and/or exposure to the world market through international trade would continue to receive free allocation of allowances up to community-wide established efficiency benchmarks.

Which sectors would be eligible for free allocation was determined through comitology in 2009 by quantifying these criteria for all sectors of the manufacturing and mining industries. By the end of 2009 it became apparent that 60% of the sectors, representing 95% of emissions, were deemed to be exposed to a significant risk of carbon leakage according to these two criteria. This served as the basis for allocation in the years 2013 and 2014.

The present study argues that many of the assumptions underlying the quantitative analysis in 2009 are now obsolete and thus can no longer be used to determine which sectors are deemed to be exposed to carbon leakage. Three of these assumptions were selected for further scrutiny in this study:

1. Impact of the price. The 2009 quantitative analysis undertaken as part of the comitology process forecast that EU ETS prices would stabilize at € 30/tCO_2. Clearly, the current low prices show that this assumption no longer holds. After reviewing various price forecasts, we take the approach that prices in 2020 will be € 12/tCO_2 at most.
2. In 2009 the EC assumed that even for sectors deemed to be exposed to carbon leakage, 60% of emissions would be above the benchmarks and therefore would still be auctioned. While it is not yet possible to determine the exact level of auctioning, it has become clear that this figure of 60% is very unlikely and we therefore adopt a more realistic figure of 20%.

3. In 2009 the analysis assumed that the ETS would be limited to the EU 27 only, with the trade intensity criterion determined on the basis of 'trade with non-EU countries'. However, the EU ETS has been steadily integrated with installations in other countries (e.g. Croatia, Norway, Liechtenstein and Iceland) and linkages with emissions trading schemes in Switzerland (2014) and Australia (2015) are planned. This implies that the EU 27 can no longer be regarded as the appropriate entity for assessing the relevance of carbon leakage. Carbon leakage to countries included in or linked to the EU ETS is by definition impossible and such countries should be excluded when quantifying the trade intensity criterion.

We quantify the impact of these assumptions using the same data used in the 2009 comitology process. The results show that the number of sectors receiving free allowances on the grounds of carbon leakage would have been reduced to only 1/3. In terms of emissions the impact is even more drastic: only 10% of industrial emissions would still have been eligible for free allowances up to the benchmark. Nearly all the carbon-intensive sectors in the EU ETS - notably refineries, cement production, iron and steel and paper production - would be faced with a regime in which part of the emissions up to the benchmark were auctioned (see Table 1). It is therefore to be expected that an updated MTR with more realistic assumptions regarding price, benchmarks and geographical coverage of the ETS should conclude that a much smaller share of allowances should be given away for free under the argument of 'carbon leakage'.

Table 1 **Top industrial sectors, their present allocation and impact of revised assumptions on future allocation**

#	Industrial sector	% ^	Current situation	Revised assumptions
1	Manufacture of refined petroleum	25%	Free	Part-auctioning
2	Manufacture of cement	25%	Free	Part-auctioning
3	Manufacture of basic iron and steel	14%	Free	Part-auctioning
4	Manufacture of paper and paperboard	6%	Free	Part-auctioning
5	Manufacture of lime	4%	Free	Part-auctioning
6	Extraction of crude petroleum and nat. gas	2%	Free	Free

Note: ^ refers to percentage of verified emissions in the EU ETS of industrial installations (excluding public power plants) .

This analysis does not come as a surprise. Clearly, distortive competitive price disadvantages ensuing from the EU ETS will by definition be smaller if the EUA price is low and the ETS system is integrated with or linked to more countries. The quantitative analysis undertaken here reflects these circumstances, with carbon leakage posing far less of an issue until such time as the ETS is capable of providing a strong price signal to curb emissions. Other arguments as to why carbon leakage may be less of an issue after 2015 relate to recent evidence of cost-pass-through, lower carbon cost price differentials with major trading partners and the widescale use of CDM. However, these have not been quantified in the present study, although they could arguably be taken into account in the upcoming MTR.

These results can be linked with current attempts to reform the EU ETS. If such reforms fail and carbon prices remain very low, the threat of carbon leakage logically becomes much smaller. Ideally, the trade-off between carbon leakage and reform of the EU ETS should be reflected in the quantitative analysis of the Mid-Term Review. The current Impact Assessment that guided the determination of the carbon leakage list in 2009 has been rendered obsolete. Politically, it may be useful to accompany the upcoming review of the carbon leakage list with a new Impact Assessment in which options for structural reform of the EU ETS are also addressed.

1 Introduction

1.1 Introduction

The third phase of the EU ETS, operating since January 2013, has had a difficult start. As the oversupply of CERs and transferred EUAs of Phase 2 became apparent, the already low prices were dropping even further to below the € 3/tCO_2 in January. At the end of 2012, demand for allowances fell short of supply by more than 10% (EC, 2012). The only reason for a positive price is that the market still expects that some action will be undertaken by the Commission to re-establish scarcity on the ETS market.

However, such actions require political decision making at the EU level that is cumbersome in a period that is dominated by economic and financial concerns because of the economic crisis. The Carbon Market Report (EC, 2012) identified six options for structural measures to strengthen the EU ETS during Phase 3 and to make it more effective. The least opposed option of 'back-loading', through which a number of auctioned allowances will be withheld from entering the market at present and brought back to the market during 2018-2020, is currently under political decision making.
The expectation is that this could give a temporary price increase of at least 25%, albeit at the expense of a decrease of the EUA price in later years. Nevertheless, with present prices ranging between € 3-5/tCO_2, the impact of this option will be limited. At best, it could buy the EC time to come up with more structural reforms at a later stage.

An often overlooked item in the present discussion about reforms of the EU ETS is the expected Mid-Term Review at the end of 2014. The revised EU ETS Directive announced that, at least every five years, the greenhouse gas emissions permit allocation will be reviewed and appropriate amendments will be made. This process is called the 'Mid-Term Review' and will be abbreviated as MTR in this paper. The MTR reconsiders the decision of sectors that were 'deemed to be exposed to a significant risk of carbon leakage' which receive free allocation of allowances up to the community-wide based benchmarks in 2013 and 2014. The present study gives an indication of what changes can be expected from the MTR with respect to the allocation of allowances in the years 2015-2019.

1.2 Purpose of this study

For the third phase of the EU ETS auctioning has been stated as the principle allocation mechanism for emission allowances. However, a major exemption has been formulated for sectors that are 'deemed to be exposed to a significant risk of carbon leakage'. These sectors receive free allocation up to community-wide established benchmarks at least until 2020.

The two criteria that were presented in the revised Directive (2009/29/EC) to assess whether a sector was exposed to carbon leakage were related to (i) **the additional carbon costs**, and (ii) **the trade intensity**. In short, sectors with substantially high additional carbon costs and/or highly exposed to the world market through international trade would receive continued free allocation of

allowances from 2013-2020 up to community-wide established efficiency benchmarks.

The exact determination which sectors would be eligible for free allocation was part of comitology.[1] By the end of 2009 it became apparent that the comitology process identified a large number of sectors (representing the major share of industrial emissions) as deemed to be exposed a significant risk of carbon leakage according to these two criteria. The main allocation principle of auctioning was, in the end, severely compromised for emissions from industrial installations.[2]

The quantitative analysis undertaken in the comitology process used an expected forecast of the EU ETS market in which prices would stabilize at € 30/tCO_2. In addition, the comitology assumed that the ETS would be limited to the EU 27 only. In fact, none of these assumptions have been justified by reality. The price of an emission allowance was dropping to an all time low of below the € 3/tCO_2 at the end of January 2013 – hence only 1/10th of the price that was assumed in the comitology process. In addition, the EU ETS has been steadily integrated with installations in other countries (e.g. Croatia, Norway, Liechtenstein and Iceland) and planned linkages with the ETS systems in Switzerland (2014) and Australia (2015) are underway.
This implies that the EU 27 cannot be regarded as the proper entity when assessing the relevance of carbon leakage. We remark that carbon leakage to countries that are included, or linked to, the EU ETS cannot happen by definition, since these share a common carbon price (and in some cases a common target).

For these reasons it is insightful to investigate how these recent developments will impact on the decision whether a sector is deemed to be exposed to carbon leakage. The purpose of this paper is therefore to illustrate what the impact of recent developments in the EU ETS will be for the allocation of allowances in the EU ETS in the period 2015-2019. We will do that by means of qualitative and quantitative analysis.

1.3 Outline of this paper

In Chapter 2, we will give details on the criteria that were used to establish the list of sectors that were exposed to carbon leakage in 2009. We will describe in more detail the legal framework, and the choices that have been made in the comitology process in 2009 and following years. The results of that analysis will be given in the end of Chapter 2. In Chapter 3 we will identify differences that can be expected during the Mid-Term Review.
In Chapter 4 we present the outcome of the quantitative analysis and investigate how these differences impact on the allocation of allowances for the period 2015-2019. Chapter 5 presents conclusions and links the outcome of this study to wider developments in the EU ETS, such as back-loading and price developments.

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1 Comitology (or 'committee procedure') refers to the procedures under which the European Commission executes its implementing powers with the assistance of so called 'comitology committees' consisting of Member State representatives.

2 However, electricity production was still subject to auctioning with some exceptions for new member state).

2 Carbon leakage and the EU ETS

2.1 The EU ETS, carbon leakage and allocation of allowances

Since 2005 large emitters of GHG emissions are part of the European Emission Trading System (EU ETS). Currently the third phase of the EU ETS is in operation (2013-2020) in which more than 11,000 installations in 31 countries[3] are obliged to monitor and report their CO_2 emissions and cover them with EU emission allowances (EUA). These emission allowances are partly auctioned and partly distributed to the installations of the EU ETS for free each year according to a complicated set of rules. Although complicated, allocation in the third phase is generally considered as an improvement over previous phases, mainly because of the harmonized rules of allocation at the EU level and the larger share of allowances that are to be auctioned.

The rules governing the allocation of allowances in the third phase are laid down in the revised EU ETS Directive from 2009 (2009/29/EC), adopted by the Council and the European Parliament. This Directive lists auctioning as a principal method of allocation in the third phase. However, considerable exemptions to this generalized rule have been made, amongst others, through the provision of free allocation of sectors that are deemed to be exposed to 'carbon leakage'. Carbon leakage is a phenomenon that occurs when the decrease in GHG emissions in one country because of stringent climate policies result in an undesired increase in emissions in other countries that have no climate policies in place (see Box1). According to the Guidance document on carbon leakage published by the European Commission (EC, 2011), sectors deemed exposed to a significant risk of carbon leakage are defined as: "*those sectors that may suffer a material competitive disadvantage against competitors located in areas outside the EU which do not have similar emission reduction commitments, which could in turn lead to an increase in greenhouse gas emissions*".

The revised EU ETS Directive views free allocation as a principle way to reduce the risk of carbon leakage (see Box 2 for a discussion). Sectors that were classified as being 'deemed exposed to carbon leakage' through the comitology process would receive free allowances each year up to a specified benchmark up to 2020. Sectors that were not being classified as being exposed to carbon leakage, would receive 80% of their allowances for free in 2013 and further diminishing every year in small steps to only 30% in 2020. The rest of their required allowances they would have to buy on the ETS market or on one of the regularly organized auctions for new allowances. Therefore the decision whether a sector would be qualified as 'exposed to carbon leakage' has substantial financial consequences for the firms involved in the EU ETS. This put some pressure on the comitology process in 2009. At the end of 2009, the Carbon Leakage Decision was adopted (Commission Decision 2010/2/EU) which established a list of sectors and subsectors that are deemed exposed to a significant risk of carbon leakage. A total of 151 sectors at NACE 4 level were identified as being exposed to carbon leakage, receiving free allocation up to the later established benchmarks for the years 2013 and 2014.

[3] All 27 EU member states plus Croatia, Iceland, Norway, and Liechtenstein.

Box 1: Carbon leakage in the EU ETS

Carbon leakage refers to the situation where activities that are currently under EU ETS are transferred to areas where they do not fall under climate change policies. In this way, global emissions will be higher than in the situation without carbon leakage. It is not necessary that the new installations will be less efficient, the fact that emissions move from a location where an emission cap exists to a location where emissions are not capped is enough for carbon leakage to occur. If, for example, steel manufacturing will be relocated from the UK to India, this will always result in higher emissions worldwide, as the overall emission target for the UK is still equivalent to -20% compared to 1990 levels, whereas the emission of India will now increase irrespective the efficiency of the new installation.

Carbon leakage occurs in essence because of the impact of climate change policies on existing markets where goods and capital are freely mobile. Three types of leakage are distinguished in the literature (see e.g. AEA/CE Delft, 2012). First there is leakage through product markets where EU competitors may face a competitive disadvantage because carbon costs are being incorporated in the price of the products. Products outside the EU get a larger market share so that production that is not under an emission ceiling is being augmented. Second, there is leakage through capital markets where investments are being done in countries that do not have climate policies in place because such investments may have higher yields because of the absence of carbon costs. The third is leakage through the energy market where the reduced energy demand in the EU leads to a lower price of fossil fuels worldwide, which stimulates consumption in the other countries. Modelling exercises (see Kuik, 2005, for an overview) show that the impact through energy markets is in general the most important element of carbon leakage. The impacts through products- and capital markets are much less important.

Box 2: Is free allocation an effective measure to combat carbon leakage?

The literature provides a wide range of views on mitigations options to reduce carbon leakage that could be considered. One of these options has been free allocation and easy access to international credits (see e.g. EC, 2010). The idea is that, by giving EUAs for free, companies would not be faced with additional carbon costs so that no cost price differentials would exist between EU 27 industries and competitors from countries that do not have climate policies in place. However, as noticed in the literature (see e.g. CE Delft, 2010b; Sijm *et al.*, 2012), at the margin the costs of CO_2 would be still equivalent to the EUA, even if allowances were given for free. If firms engaged in marginal cost pricing (and economic theory predicts they would), free allocation would not alleviate the competitive disadvantage of participants to the EU ETS because prices of products would still rise with the costs of EUAs. Empirical evidence that product prices do contain CO_2 cost components even if allowances were given for free were produced in a number of studies for many industrial products and electricity (see Annex C).

One of the problems is that alternatives for free allocation are not very attractive. Sectoral agreements (see e.g. Carbon Trust, 2010) are plagued by the same type of international coordination problems that have hampered international climate negotiations. Border tax adjustments (import tariffs and/or export rebates, see e.g. CPB, 2008) do not come without economic costs either and can be problematic because of the chance of retaliation.

In addition, the Commission has the possibility every year to add sectors to the carbon leakage list if the criteria in the revised ETS Directive can be shown to be met. This has already occurred in 2011, with the addition of several sectors[4], and in 2012, with the addition of the glass fibres and mineral wool sector.

[4] Production of salt; production of cocoa paste, cocoa butter and cocoa powder; manufacture of bricks, tiles and construction products in baked clay.

The Carbon Leakage List in its present form contains 154 sectors at NACE 4 level and 16 subsectors that would receive free allowances up to the benchmarks in 2013 and 2014. This list is currently being used in the preparation of the NIMs (the National Implementation Measures) prepared by each Member State to establish the free allocation for Phase 3 of the EU ETS (as of 2013) in line with the harmonised rules.[5]

2.2 The formal criteria that were used in the Revised EU ETS Directive

The rules and procedures to decide whether a sector is deemed to be exposed to carbon leakage were listed in the revised Directive. They are based on two indicators:

1. The **additional production costs** defined as the sum of direct and indirect carbon costs divided by the Gross Value Added of a sector.
2. The **trade intensity** of this sector with countries that are not part of the EU ETS, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the Community (annual turnover plus total imports from third countries).

Aricle 10a, pars.15-17 of the revised ETS Directive outline when a sector or subsector is deemed to be exposed to a significant risk of carbon leakage. Four criteria were given, if a sector would qualify for one of these, it would obtain free allocation of allowances.

1. The additional production costs > 5% **and** the intensity of trade > 10%.
2. The additional production costs > 30%.
3. The trade intensity > 30%.
4. For sectors that would not qualify under one of the above situations, a provision has been made for more detailed analysis at a more desaggregated level (NACE 6 and beyond) and/or a qualitative assessment if trade intensities and/or increase in production costs were close to the threshold levels in which the required investments, market characteristics and profit margins would flourish as alternative indicators.

The revised EU ETS Directive states furthermore that every year sectors can be *added* to the list based on the fourth criterium (but not deleted). A structural revision of the Carbon Leakage List is foreseen for every five years by the Commission (starting in 2009)[6]. During this structural revision, (sub)sectors can be added to or removed from the list. The first of such revisions needs to be completed by the end 2014, to be used for the allocation in 2015-2019.

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5 Section 2.4 of this report gives a table which identifies the sectors that would qualify for free allowances up to the benchmark at the present moment.

6 Art. 10a(13) of the revised ETS Directive.

2.3 The informal criteria used by the comitology process in 2009

The comitology process in 2009 was used to actually quantify the indicators of additional production costs and trade intensity that were presented in the revised EU ETS Directive and to determine whether sectors would be placed on the carbon leakage list or not. However, things were not that straightforward, because a number of methodological decisions had to be made, related to:

1. The definition of a 'sector'.
2. The way the additional carbon costs were to be quantified.
3. The way the trade intensity indicator was to be quantified.
4. the data sources that were being used to undertake the quantitative analysis.

These will be discussed below and the appropriateness of the choices made in 2009 related to the current state of the EU ETS and available data will be discussed.

2.3.1 Definition of a sector

The revised EU ETS Directive states that: "*The carbon leakage risk in these sectors or subsectors should be assessed, as a starting point, at a 3-digit level (NACE 3 code) or, where appropriate and where the relevant data are available, at a 4-digit level (NACE 4 code).*"

The comitology process showed that data were available at the 4-digit level and finally defined a sector as a combination of NACE 4 (NACE Rev.1.1) level and, for a few sectors, an analysis beyond NACE 4. The choice for NACE 4 was justified as being the most detailed level for which Eurostat data was available. However, for some sectors this may have resulted in a too generalized picture, especially if a few installations are very different from other installations in terms of carbon costs and/or trade intensities. Therefore, a few numbers of sectors were included to be analysed in more detail. The Commission emphasized that not for all sectors a full analysis at NACE 6 could be undertaken. In the end, sixteen sectors were given free allocation of allowances up to the benchmark based on an analysis at NACE 6 and beyond level.

We do not expect that this will change. NACE 4 is still the most detailed level for which data are available. However, there will be stronger pressure from installations to undertake an analysis at NACE 6 level since this was proven to be successful to apply for free allocation in a number of instances.

Another aspect that will change is the update from NACE Rev.1.1 to Rev.2.0. Economic activities since 2008 will be monitored in a new sectoral classification. This may have an impact for some sectors. The manufacturing section of NACE Rev.2 knows 230 sectors at the 4-digit level compared to 242 sectors that were classified under Rev. 1. Hence, the total number of sectors will be smaller. This may have an impact especially on the additional carbon costs. The general rule is that a more detailed sectoral classification shows higher additional carbon costs (see e.g. CE Delft, 2008). However, we would expect that sectors that were identified as 'carbon leakage' under Rev. 1.1., but would not qualify for carbon leakage under Rev. 2.0 any more, would be eligible for more detailed analysis.

2.3.2 Additional carbon costs for the carbon cost criterion

The question what type of costs would be eligible for the carbon cost criteria is fuzzy. In general, one can distinguish between[7]:

1. Gross or net costs, where gross costs refer to the costs of buying EU allowances, while net costs include the cheaper options that companies have including abatement, the use of CERs and taking into account the pass-through of carbon costs into product prices.
2. Marginal or average costs, where marginal costs refer to the costs that the most carbon intensive sectors would face under the ETS, while average costs would be an average for the while sector.
3. Absolute or relative costs, where absolute costs refer to costs EU industry makes for EU ETS, while relative costs refer to the costs EU industry makes in comparison with carbon costs for major competitors.

Unfortunately the revised EU ETS Directive is not very clear what kind of costs would be eligible for calculation of the ***additional carbon* costs** criterion. Article 10a, Par.12 states that "*the Commission shall assess, at Community level, the extent to which it is possible for the sector or subsector concerned, at the relevant level of disaggregation, to pass on the direct cost of the required allowances and the indirect costs from higher electricity prices resulting from the implementation of this Directive into product prices without significant loss of market share to less carbon efficient installations outside the Community. These assessments shall be based on an average carbon price according to the Commission's impact assessment accompanying the package of implementation measures for the EU's objectives on climate change and renewable energy for 2020...*". In Par.15 of the same Article, the Directive states that the relevant costs relate to the "additional costs induced by the implementation of this Directive". Both references hint at the use of **net** costs as real, tangible costs. However, the comitology process in 2009 fully neglects this issue, starting from a gross concept without any further discussion. It is clear, however, that data needs for the net cost concept would be much more awkward than for the gross cost concept.

The document accompanying the Comitology process contains a discussion related to the use of average costs or marginal costs, but concludes that they would use 'average costs'. There is no discussion whether absolute or relative costs would be needed. The additional carbon costs are finally calculated according to the following formula:

$$Additional\ costs = \frac{(DCO2 * AF + ICO2) * €EUA}{GVA} \qquad (1)$$

Where for each sector

- DCO2 = the direct emissions of CO_2, these were selected from the CITL and information from member states.
- AF = the amount of emissions that fall under auctioning (75% was chosen as the most likely option describing the expected reality in 2013 and 2014).
- ICO2 = the indirect emissions of CO_2. For this an average factor of 0.465tCO_2/MWh was used. Data for electricity consumption by sectors was obtained from member states.
- EUA = the expected emission price in 2020, which was taken as being equivalent to € 30/tCO_2 based on the Impact Assessment of 2008.
- GVA = the gross value added at factor costs, taken from Eurostat (SBS).

[7] This distinction is a bit arbitrary. In some cases in the literature, the concept used here of net costs are being referred to as 'average costs'.

The most critical elements for discussion are here the AF factor, which is actually not giving a representative picture of the actual situation in 2013, and the EUA prices, which are currently way below the € 30/tCO_2. In Chapter 3 we will discuss both indicators.

2.3.3 Quantification of the trade intensity criterion

Article 10a, Pars 15 and 16, define the trade intensity criterion as: "*the intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the Community (annual turnover plus total imports from third countries)*".

In formula, this would yield:

$$Trade\ intensity = \frac{Imports+Exports}{Production+Imports} \qquad (2)$$

This definition, although more clear than the additional carbon cost criterion, still lacks a proper definition of the concept of 'third countries'. During the comitology process, without much discussion, third countries were defined as extra-EU 27 (all the countries that are not part of the EU 27). However, this is not a logical definition in the context of EU ETS, as the EU ETS is larger than the EU 27 and includes installations from Norway, Iceland, Croatia, and Liechtenstein and planned linkages with Switzerland and Australia.

The trade intensity criterion was established in the light of the discussion of potential carbon leakage. However, carbon leakage to countries that are included in the ETS cannot occur by definition. Therefore, the concept of third countries should be: 'countries not included in the EU ETS'. Also the planned linkage with other ETS implies that prices will equalize on these markets, and one cannot speak about carbon leakage. Therefore, all countries that are included in the ETS or linked to the ETS cannot be regarded as 'third countries' but are part of the ETS. Trade to those countries should not be included in the trade intensity criterion.

2.3.4 Data used and data sources

The revised ETS Directive states that "*if available, trade, production and value added data from the three most recent years for each sector or subsector*" will be used. In the comitology process in 2009, this implied that data for the years 2005-2006 for emissions and 2005-2007 for economic data were used.

The MTR, to be finished in 2014, will therefore most likely have the time horizon of 2010-2012. Because of the economic crisis, it can be expected that the numerical value of both indicators will be different than in 2009. However, since both indicators are ratios, and both the numerator and denominator are affected by the economic crisis, it is expected that this impact will be relatively small.

The revised EU ETS Directive does not specify which data sources are to be used in the quantitative assessment of sectors that would be 'carbon leakage'. The comitology process in 2009 used data from Eurostat, the CITL and member states to draw up the carbon leakage list.[8] These data sources are still available. Therefore no major changes regarding the use of data sources will be expected.

[8] In several cases these data were confidential.

2.4 Outcome of the comitology process in 2009

As we have seen, countries could be placed on the carbon leakage list if one of these four criteria would have been met:
Four criteria were given, if a sector would qualify for one of these, it would obtain free allocation of allowances.

1. The additional carbon costs > 5% **and** the trade intensity > 10%.
2. The additional carbon costs > 30%.
3. The trade intensity > 30%.
4. A qualitative assessment if trade intensities and/or increase in production costs were close to the threshold levels in which the required investments, market characteristics and profit margins would be used as alternative indicators.

The quantitative and qualitative analyses has been performed at NACE 4 digit level though for some sectors an additional NACE 6 digit analysis has been undertaken. At NACE 4 level, 154 sectors out of 258 were finally placed on the carbon leakage list. In addition, for eight sectors[9] some production processes were on the carbon leakage list based on an analysis of the criteria at NACE 6 and beyond. In sheer numbers, one could say that about 60% of the analysed sectors would be placed on the carbon leakage list. However, in terms of emissions, these sectors constitute 95% of industrial emissions. In Phase 3, only 5% of industrial emissions would not be qualified as 'carbon leakage' and hence be subject to 20% auctioning in 2013, gradually growing to 70% in 2020.

Table 2 gives the summarized outcome of the comitology process using the data that were used at that time (for emissions the average of 2005-2006, and for economic data the average of 2005-2007).

Table 2 Outcome of the comitology process in 2009 including additions in 2010-2012

	Total	Carbon leakage list
Number of sectors	258	154+8*
As percentage of industrial emissions in 2005 and 2006	100%	95%

Source: CITL, own calculations.

* In total sixteen subsectors qualified for free emissions, belonging to eight sectors at NACE 4 level.

Table 3 gives the number and percentage of emissions in 2005 and 2006 identified as deemed to be exposed to a significant risk of carbon leakage according to the four situations depicted above.

It appears that the first criterion (carbon costs > 5% and trade intensity > 10%) is the reason for including most of the emissions under the ETS on the carbon leakage list. In terms of total number of sectors, the third criterion (trade intensity > 30%) can be regarded as most important.

[9] Eight sectors at NACE 4 level containing sixteen subsectors at level NACE 6 and beyond.

Table 3 **Percentage of industrial emissions obtaining free allocation up to the benchmarks and the criteria that were used to justify free allocation, present situations**

Total emissions	No. of sectors	Verified emissions^	In % of industrial emissions
Criterion 1	13	219,302,751	36%
Criterion 2	2	177,572,917	29%
Criterion 3*	133	157,232,891	26%
Criterion 4	6	14,435,748	2%
NACE 6 and beyond**	8	Max.5,778,713	Max 1%
Total industrial emissions	258	604,954,753	

Source: CITL, own calculations.

^ Average of 2005 and 2006 verified emissions

* Sixteen sectors that fall under Criterion 3 would also qualify for Criterion 1.

** In total sixteen subsectors qualified for free emissions, belonging to eight sectors at NACE 4 level. We cannot assess precisely how much free allocation these sectors received, but we give a maximum level here, which is equivalent to the verified emissions for the eight NACE 4 sectors to which these sixteen subsectors belong.

Table 4 lists the top 20 sectors with respect to their size of verified emissions (expressed as the average of 2005 and 2006 compared to the total verified emissions of industrial installations under the ETS for this sector) and the allocation decision of this sector.[10]

Table 4 **Top 20 sectors and their allocation method in 2013 according to the comitology process**

#	NACE 4	Short description	% of CO_2*	Situation 2013 for allocation up to benchmark	Crit.
1	2320	Manufacture of refined petroleum	25%	Free	S1
2	2651	Manufacture of cement	25%	Free	S2
3	2710	Manufacture of basic iron and steel	14%	Free	S1/S3
4	2112	Manufacture of paper and paperboard	6%	Free	S1
5	2652	Manufacture of lime	4%	Free	S2
6	1110	Extraction of crude petroleum and natural gas	2%	Free	S3
7	2414	Manufacture of other organic basic chemicals	2%	Free	S1/S3
8	2613	Manufacture of hollow glass	2%	Free	S1
9	2310	Manufacture of coke oven products	1%	Free	S1/S3
10	1583	Manufacture of sugar	1%	Free	S1
11	1020	Mining and agglomeration of lignite	1%	20% auctioning	-
12	2413	Manufacture of other inorganic basic chemicals	1%	Free	S1/S3

[10] One should notice that the sectoral classification was undertaken on the basis of the CITL data. Some sectors have argued that there are mistakes in the sectoral classification of the CITL data (see e.g. Ecofys, 2009). In general one could argue that the share of emissions in industrial emissions has a margin of error of about 5-10%. For the sector Iron and Steel, freely given allowances for electricity production from waste gasses is included in the sectoral estimate.

#	NACE 4	Short description	% of CO_2*	Situation 2013 for allocation up to benchmark	Crit.
13	3410	Manufacture of motor vehicles	1%	20% auctioning	-
14	2416	Manufacture of plastics in primary forms	1%	Free	S4
15	2611	Manufacture of flat glass	1%	Free	S1
16	2661	Manufacture of concrete products for construction	1%	20% auctioning	-
17	2640	Manufacture of bricks, tiles and construction products, in baked clay	1%	Free	S4
18	1562	Manufacture of starches and starch products	1%	Free	S1
19	2742	Aluminium production	1%	Free	S1/S3
20	2466	Manufacture of other chemical products	1%	Free	S3

Source: CITL, own calculation.

* % refers to the share of these sectors in the total verified emissions for industrial installations (excluding public power and heat plants) under the EU ETS in 2005 and 2006.

From this table it becomes apparent that the top 10 sectors would all receive free allocation. The sector 'mining and agglomeration of lignite' is at place 11 the first sector that would not receive 100% free allowances up to the benchmarks in 2013.

3 Impacts of changes in the ETS on the carbon leakage list

3.1 Updated methodology

The carbon leakage list must be determined based on the quantitative and qualitative criteria laid down in the ETS Directive. The Commission established the general methodology for the application of those criteria while determining the first carbon leakage list. For the Mid-Term Review (MTR), the EC will update the methodology that has been used in 2009 and use more recent data. At this moment it is unclear how the methodology will be adapted. We will argue in this chapter that two major revisions, compared to the 2009 methodology, would be desirable in the light of recent developments in the EU ETS, and we will sketch the impact of these revisions on the carbon leakage list.

In this chapter we will distinguish between methodological improvement of the additional carbon cost criterion in Section 3.2, and the adjustment to the trade intensity criterion in Section 3.3. From this discussion we will select in Section 3.4 the elements that we take into our quantitative analysis in Chapter 4.

3.2 Methodological adjustments related to carbon costs

Compared to 2009, the ETS market has drastically changed. The most observable change relates to the carbon price. While the comitology process in 2009 used an estimated price of EUA of € 30/tCO_2, prices have fallen by almost 90% compared to that estimate. However, the additional carbon costs (given by formula 1) are not only made up by the price of EUA, but also by other factors. In short these factors are:

1. The price of EUA on the market.
2. The Auctioning Factor that was used.
3. Other factors such as the costs that are passed through to customers and relative versus absolute cost structures.

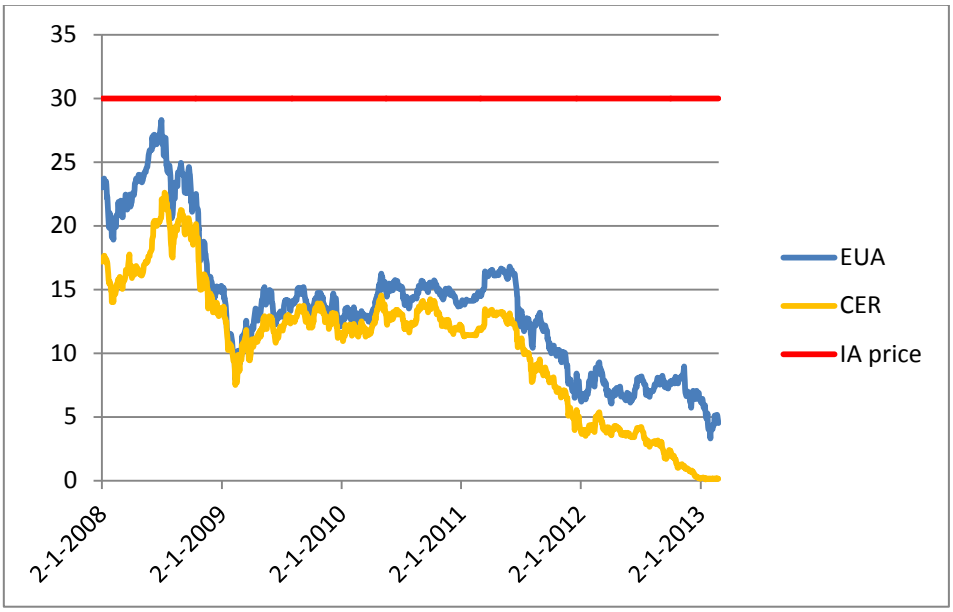
Below these will be discussed in more detail.

3.2.1 Carbon price developments

Article 10a of the revised EU ETS Directive states that the assessment of the risk of carbon leakage should be based on an average carbon price according to the Commission's impact assessment accompanying the package. Although in this impact assessment nowhere an average price can be found, the comitology process in 2009 took € 30/tCO_2 as the average price of EUA as the average over the period 2013-2020.

In the light of price developments in 2008, this price was nowhere disputed. Prices varied between € 15-28 in 2008, and the expectation was that growing scarcity would drive prices up in the years to come. However, the real price development has been completely different than could be seen in 2008. Between 2009 and 2011, prices fluctuated between the € 10 and € 16 but falling towards € 5-10 in 2012 and below the € 5 in 2013.

Figure 1 **Price development in the EU ETS since 2008**



The historically very low price can be explained by the oversupply of allowances. The EC (2012b) and many market analysts now regard the EU ETS market as being saturated with allowances and the only reason for a non-zero price lays in the expectation that the EC will do something to fix the market (set-asides or moving to a more ambitious target) which would imply that the allowances will get more value in the future.[11] At present the oversupply is being estimated to be above 1,000 Mt CO_2 (EC, 2012a).

Even if the economy would recover soon, it can be expected that the oversupply of allowances will saturate the market during the largest part of Phase 3. In addition to the economic crisis there are two other reasons why the price developments predicted in the Impact Assessment from 2008 are not correctly done.

1. The IA from 2008 does not correctly specify the impact of auxiliary policies to combat climate change such as the Renewable Energy Directive (RED), energy saving measures, many local initiatives at the area of municipalities, etc. Obviously such auxiliary policies reduce CO_2 emissions as well and many of these emissions are covered by the EU ETS (especially with respect to RED). Obviously this reduced demand for allowances and hence puts a downward pressure on the prices.

[11] The carbon market report (EC, 2012b) states that: *"With the start of the second trading period it was expected that the ETS Phase 2 cap would be ambitious. But the crisis unfolding as of 2008 has radically altered the picture and the ETS has since experienced a surplus of allowances and international credits compared to emissions […]. The number of allowances that were put in circulation has been increasing every year, as well as the supply and use of international credits, most notably in 2011. By the end of 2011, 8,171 million allowances had been put into circulation and 549 million international credits had been used for compliance, in total adding up to 8,720 million units that were available for compliance over the period 2008-2011. In contrast, verified emissions in the period 2008-2011 were only 7,765 million tonnes CO_2 eq.*

2. The IA does not take properly into account the large opportunities to use offsets and transferability of the surplus of allowances from Phase 2 to Phase 3. About 1/3 of the total demand for allowances created in Phase 3 can be met by CERs and oversupplied allowances from Phase 2. This creates a downward pressure on the prices much stronger than anticipated in 2008.

Therefore, many market analysis expect that prices will not be restored fully, even if the economy soon recovers, or recovering measures like back-loading or set-asides are to be implemented (Öko-Institut, 2012).

Clearly, the IA from 2008 is not a proper document to assess the risk of carbon leakage. An average price of € 30/tCO_2 from 2012-2020 as predicted in the IA, is not according to the reality. Therefore this price cannot be taken as a guiding principle to guide the decision about sectors that are prone to carbon leakage.

The question is then what price levels can be expected if the EC uses options as back-loading to restore price levels at the moment. Recently, a draft of the impact assessment of different back-loading options has been published (EC, 2012b). Different back-loading options and carbon price forecasts by private sector market analysts are given for the case that back-loading is implemented. In Table 5 the respective EUA price forecasts are given for different volumes of allowances to be back-loaded. A price range thereby reflects projections from different analysts. Note that the analysts do assume different timings regarding the back-loading, which makes the forecasts not directly comparable.

Table 5 **EUA price forecasts for different back-loading scenarios (in €/t CO_2 nominal prices)**

EUA price Back-loading	2013	2014	2015	2016	2017	2018	2019	2020
400 Mt	6-7.3	5.5-8.6	6-11	5	4.5-6	5-7	7-9	10-11
500 Mt	9.75	19*	-	-	-	-	-	-
700 Mt	7.5	10	11	8	7	7	8	10
800 Mt	10	-	-	-	-	-	-	-
900 Mt	8.6-13	12-23.5*	11-20	5	5	6	6	8
1,200 Mt	9-13	14	13-20	7-13	5-9	5-7	6-10	8-10

Source: EC, 2012b.

* Average of first two quarters of 2014.

Notice that these are nominal prices, whereas the used price forecast of € 30/tCO_2 are (most likely) in constant 2005, or 2008 prices.[12] If we would deflate these prices to 2005 levels, they would be even lower (see Annex B).

A forecast that has not been taken into account in the summary of price forecasts in EC (2012b) is a forecast from IHS as presented in October 2012 (IHS, 2012). Several back-loading options (400 Mt-1,200 Mt), under the assumption that an EU ETS Phase 4 will be realised, are considered here as well. The 2020 EUA price does not vary much between the different back-loading scenarios (14-16 €$_{2011}$/t CO_2 or 12-14 €$_{2008}$/t CO_2). Regarding the EUA price path it holds that the higher the volume of allowances back-loaded, the

[12] The exact price level cannot be discerned directly from the IA.

higher the price in the period 2013-2019 and the lower the price in the period after 2019.

The Öko-Institut (2012) comes to the conclusion that a stand-alone approach for a set aside which will be fully reintroduced to the market before 2020 will have negligible price effects. The EUA price would remain at a level of less than 8 €/EUA in 2013 and approx. 14 €/EUA in 2020.[13]

Very recently Reuters has carried out a poll among fourteen analysts that has been published beginning of December 2012 (Point Carbon, 2012).
The forecasted EUA (nominal) prices for Phase 3 thereby range from 3.9 to 14.9 €/t CO_2 with an average price of 11.34 €/t CO_2 .This is in line with the expectation from EC (2012b) and Öko-Institut. Bloomberg New Energy Finance (2013) expects higher prices in 2020 (€ 30/tCO_2 without back-loading) under the condition that a Phase 4 with annual reductions in the cap of 40Mt/yr will be formulated. Bloomberg expects that only in 2026 the market in the ETS will fall short. They state that without a Phase 4 the price of the EUA would approach zero all over Phase 3. In Annex B more forecasts are given.

The question if the MTR can contain a different carbon price than € 30/tCO_2 can be answered only politically. A new impact assessment of the EU ETS has not been undertaken, despite that it was announced in 2011. Clearly, such an impact assessment would show that an average price level of € 30/tCO_2 would be nowhere attainable anymore. In its impact assessment of the energy efficiency directive in 2011, the EC assumes that the price level of EAU in 2020 will be € 14.2/tCO_2 if full compliance at RED is achieved.

We would suggest using in the analysis of the MTR an average carbon price of € 12 – which is on the high side of the various forecasts shown in this paragraph.

3.2.2 Auctioning Factor

Another factor relevant for the additional carbon costs is the auctioning factor. The auctioning factor can be interpreted as the amount of allowances that companies have to buy on the ETS market to cover their verified emissions *if they were not being classified as prone to carbon leakage*. Clearly, industry, when not being placed on the carbon leakage list, will not have to buy all their allowances, but would receive a certain amount of auctions still for free. For (sub-)sectors that are not deemed vulnerable to carbon leakage, free allocation is available for a transitional period. In practice, this means that the free allocation for non-carbon leakage sector is reduced annually by a so-called Carbon Leakage Exposure Factor (CLEF), linearly reducing the amount of free allowances from 80% of the benchmark value in 2013 to 30% in 2020[14] For sectors that are vulnerable to carbon leakage, the CLEF equals 1, and is not reduced over time.

[13] It cannot be discerned if these are nominal or real prices.

[14] With the intention to reach a level of no free allocation in 2027, as formulated in the revised ETS Directive. The intentional declaration means the 0% level in 2027 does not yet have a legal status.

The auctioning factor is then determined by the following formula[15].

$$Auctioning\ factor\ = (1 - CLEF) + BM * CLEF + \text{LR(2013)}$$

Where BM is the benchmark value (representing the share of emissions that would be above the benchmark) and LR gives the cumulative lineair reduction factor compared to 2013. Table 6 gives the evolvement of the CLEF factor over time.

Table 6 Evolvement of the CLEF over time

	2013	2014	2015	2016	2017	2018	2019	2020
CL EF for non-CL sectors	0.8	0.729	0.657	0.586	0.514	0.443	0.371	0.3
CL EF for CL sectors	1	1	1	1	1	1	1	1

In the comitology process of 2009, the average CLEF of 0.76 was taken as average value for 2013 and 2014 (see Table 6). In addition, the BM has been estimated at 0.6, implying that the benchmarks would be very strict leading to 60% of industrial emissions being above the benchmark. In 2014, a linear reduction factor of 0.0174 has been used, implying that the reduction of emissions would have to be realized through the purchase of emission allowances.[16] Together these three variables determined an auctioning factor of nearly 75%.[17] This auctioning factor was used as a factor in the cost calculations for industry.

We used in this study the same methodology but with adapted information on CLEF and the BM and the linear reduction factor. For 2015 to 2019, the average CLEF would be 0.51 according to Table 6. It is at the moment not possible to estimate the impact of the benchmarks on the share of auctioning for non-carbon leakage sectors as by our knowledge no study has estimated the amount of allowances put into auction due to existence of benchmarks. However, it is clear that the assumption that 60% of industrial emissions would be above the benchmark is overshooting the real impact of the benchmarks. First, because the confrontation of the benchmark values chosen by the Commission and the benchmark sector reports show that the share of emissions that would fall under the benchmark is actually larger than the share of emissions that would be above the benchmark.[18] Second, because technological progress is not fixed but contributes over time to more efficient installations. Therefore, we assume that the actual benchmark value will be much smaller. We assumed in this study a benchmark value of 0.2. Under a BM-value of 0.2, the auctioning factor between 2015-2019 would become 0.68.[19] We would therefore propose to use this value.

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[15] When either fuel or electricity can be used in the production process, indirect emissions have been taken into account in the determination of the benchmark value. As allocation is only based on direct emissions, a ratio of direct and total emissions is used in the allocation formula. This has not been taken into account here.

[16] We notice here that this is a bit unrealistic, because not all companies can buy allowances to reduce their carbon emissions – or the price would become infinite. Therefore, some companies must reduce their emissions.

[17] In the formula this implies: AF = (1-0.76) + 0.76*0.6 + 2* 0.0174 = 0,73

[18] See: http://ec.europa.eu/clima/policies/ets/cap/allocation/studies_en.htm

[19] In the formula this implies: AF= (1-0,51) + 0,51*0,2 + 5* 0.0174 = 0,68.

3.2.3 Other factors

There are other reasons to assume lower carbon costs than in the 2009 comitology process. First, the EU ETS Directive hints at the additional costs for industry from the implementation of the Directive, taking into account the possibility of cost-pass-through of allowances in product prices. There is ample empirical ex-post evidence that such a cost-pass-through has occurred in prices of gasoline, diesel, cement, steel, chemicals and numerous other materials (glass, bricks, etc.). Annex C gives an overview of empirical studies.

Second, the cost price differential between many trading partners is not just equivalent to the EUA price. In many countries, some forms of climate policies are in place and industry is being faced with implicit carbon costs.
This even applies to the US and China, countries that have not formally adopted nation-wide climate policies. However, in the US, at the level of federal governments there are numerous instances where climate policies have been installed. Also in China, many initiatives are taken to curb down carbon emissions. These all have an implicit cost attached to them (see Section 3.3.3 for more detail).

Although we find both arguments compelling arguments to take into account in the construction of the MTR, we do admit that the empirical basis of studies regarding cost-pass-through and cost price differentials with other countries is still premature. We therefore decided not to take them into account in this study.

Another point is that the additional carbon costs are actually lower for companies since they can make use of CERs for about 1/3 of their emission reductions and prices of CER have been fallen to below the € 1. Hence, the actual financial burden for companies falling under an auctioning regime would be much lower than the anticipated EUA price since they can buy credits cheaper through the use of CERs. It is unclear why the EC did not take into account this in determining the additional carbon costs for companies – probably because they observe that the price of CERs follows that of EUAs. Still, it would be better to include the possibilities to use CERs to lower the carbon costs for companies. However, we will not attempt to do this here either for reasons of remaining as close to the Commission Decisions in 2009. We only notice that by not including these in the determination of the carbon costs, the average price of € 12 can be regarded as an upper limit.

3.3 Adjustment to the trade intensity criterion

Not only the additional carbon cost criteria may result in changes in the way it is calculated, also the trade intensity criterion is prone to changes.
Three changes will be discussed below:

1. The impact of other countries being included in the ETS.
2. The impact of linkages with ETS systems in other countries.
3. The impact of climate policies in other countries.

3.3.1 Impact of enlarging the ETS system

In Phase 1 of the EU ETS, only the EU 27 member states participated in the emissions trading system. One of the goals of the system, however, was that it would serve as a platform that would be linked with other emission trading systems in other countries and incorporates other countries as well.

The second phase of the ETS (2008–12) expanded the coverage of the system both in terms of number of installations and number of countries. Three non-EU members, Norway, Iceland, and Liechtenstein joined the scheme in 2007 to participate in the second phase. Ahead of its accession to the EU, Croatia joined the ETS at the start of Phase 3 on January 1, 2013.

The greater geographical scope of the ETS has implications for the calculation of the trade intensity criterion. Clearly trade to countries that are included in the ETS cannot be regarded as 'carbon leakage'. The revised ETS Directive very clearly mentions 'third countries' as the relative entity for the trade intensity criterion, and not 'non-EU countries'. Therefore, the trade intensities calculated in the comitology process of 2009, as EU 27 trade intensities, will not be relevant anymore for the MTR.

3.3.2 Impact of linkages to the EU ETS.

A related discussion is on the linkage of the ETS system to other ETS systems. Currently planned linkages are underway between the EU ETS, Switzerland and Australia. In October 2012 the third round of negotiations between the EU Commission and Switzerland regarding the linkage of the two emissions trading systems has taken place. It has thereby been agreed on a roadmap for the following steps. According tot his roadmap the negotiations between the leaders of the delegations can be finalized in 2013. It is expected that Switzerland will join the EU ETS in 2014.

In August 2012 the European Commission and Australia agreed on a pathway for linking the EU ETS and the Australian emissions trading scheme. According to this pathway, an interim link will be established in July 2015, giving the Australian business the opportunity to use EU allowances to comply with the Australian trading scheme. A full link between the two trading systems is to be established no later than July 2018 – in this way EU business can also buy allowances on the Australian market to comply with the EU ETs regulations.

When the ETS is linked with other emission trading systems, there can be no carbon leakage through trade. If a steel manufacturer would close its operations in the EU 27 and continue in Switzerland, it will still fall under climate policies using the same price as in the EU 27. Carbon leakage cannot occur by definition to countries that are linked with the EU ETS. Therefore trade with these countries should also be excluded from the trade intensity criterion.

The proper definition of third countries is therefore the countries that are not included in, or linked with the EU ETS.

3.3.3 Impact of trade with countries that do impose carbon costs to their industries

Carbon costs of electricity

Direct carbon costs are the result of a carbon tax or the costs of an emission trading system on energy. Such legislation produces an explicit carbon price for energy users as costs are being passed on to them. In Europe, both Norway and Switzerland have implemented a carbon tax on the productive use of fossil fuels. It is appended by a tax on the extraction of oil and gas in Norway which can be passed on to end-users. Swiss industries have the option to exempt themselves from paying the tax if they participate in a cap-and-trade system.

There is no national carbon legislation in place in the US and Canada, but some states and provinces do have a carbon tax. Several Northeastern states in the

US and Eastern provinces in Canada have been cooperating in the Regional Greenhouse Gases Initiative (RGGI), which includes a cap-and-trade system for power plants. The highly publicized initiative for an ETS in California has fallen foul of legally binding procedures.

The New Zealand Emissions Trading Scheme has been in place since 2008. Australia has introduced a carbon tax in 2012, which is set to transition into a cap-and-trade system by 2015. The New Zealand ETS and proposed Australian ETS do entail free allocation of allowances to carbon-intense sectors.
The governments of several East Asian countries (i.e. China, Japan, South Korea and Taiwan) have committed themselves to a carbon tax, although the actual implementation of the tax may take some time.

While most competitors are lagging behind in the implementation of carbon legislation, excepting perhaps Norway and Switzerland, it would be wrong to conclude that industries in non-EU countries do not face carbon costs in the use of energy. Other policies, such as subsidies, feed-in tariffs or minimum obligations for renewable generation, all impact on the price of energy as an input to production. The costs that the use of renewable energy imposes on the production of electricity are passed on to manufacturers.

The implicit carbon price of electricity generation has been estimated in a report contracted by Climate Strategies for six major economies (Vivid Economics, 2010). The costs of the use of renewable energy as opposed to conventional coal or oil can be converted into an implicit carbon price, if the matching reduction in emissions is also known. This exercise results in ex-post estimates for the implicit carbon price of electricity in the year 2010.
Vivid Economics' estimates have been converted from 2010 USD into 2010 Euro's in Table 7. Results tell that carbon costs in non-EU countries range from next to nothing (South Korea) to about one-third of UK carbon costs (China and the RGGI states in the US).
The estimates exclude the impact of energy efficiency schemes, as they do not increase the price of electricity, but they include the impact of renewable energy generation. The latter impact is responsible for the non-zero carbon price in the non-RGGI states of the US.

China's estimate is mainly the result of restrictions on existing coal use and mandating of coal technology. Australia's estimate excludes the impact of the carbon tax as this measure was not in effect in 2010. Japan is the only country with a sizeable coal tax; most other countries mainly subsidize fossil fuels hereby lowering carbon costs. The larger part of carbon costs in the UK was due this country's energy sector participating in the EU ETS. The carbon price used is the average spot price for allowances in the scheme in 2009/2010 of € 13.6/tCO_2.

Table 7 **Implicit carbon price of electricity in 2010 Euro's**

Country	Market exchange rate
Australia	1.75
China	6.05
Japan	3.16
South Korea	0.38
US	3.78
US-RGGI states	7.13
UK	21.30

Source: Vivid Economics, 2010.

Carbon costs of industrial sectors

Carbon costs of electricity are indirect costs to manufacturers if the costs are passed on in the energy price. Manufacturers in some countries further endure direct carbon costs mainly due to participation in the EU ETS. ICF International estimated the ex-post direct and indirect costs of energy and climate change policies in eleven countries for 2011, en ex-ante costs for 2015 and 2020 in a report commissioned by the U.K. Department for Business Innovation & Skills (ICF International, 2012).

Investigated sectors include manufacturing of Iron and steel (NACE-codes 2.71, 2.72 and 2.73), Aluminum (2.742), Cement (2.651), Chlor alkali (embedded in 2.413), Fertilizer (2.415) and Industrial gases (2.411) on the carbon leakage list. Countries investigated include China, India, Japan, Russia, Turkey and the US as Non-EU Countries and Denmark, France, Germany, Italy and the UK as EU countries. We have excluded direct cost estimates for the EU countries, as the ICF estimates were based on the implicit subsidy created by free allocation of allowances in the ETS.

Table 8 presents the estimates of the ex-post direct and indirect carbon costs for 2010. The indirect carbon costs were on average higher in the EU than in China, but not by a very large margin. This cannot be said of US, Russia and India, where few efforts have been made to curb emissions in the industrial sectors.

Table 8 **Carbon costs in 2010 euro's per tonne of production**

	Steel		Aluminum		Cement		Chlor-Alkali		Fertilizer		Industrial gases	
Country	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct
China	3.0	0.0	7.0	0.0	2.2	0.0	4.0	0.0	1.3	0.0	6.0	0.0
India	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Japan	0.8	0.0	2.3	0.0	0.7	0.0	1.3	0.0	0.3	0.0	1.8	0.0
Russia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	1.7	0.0	1.7	0.0	0.3	0.0	1.0	0.0	0.0	0.0	1.3	0.0
US	0.0	-0.3	0.0	-0.2	0.0	-0.3	0.0	-0.3	0.0	0.0	0.0	-0.3
EU-avg.	3.5	0.0	5.0	0.0	1.8	0.0	5.6	0.0	0.8	0.0	4.5	0.0

Source: ICF International, adapted by CE Delft. EU average calculated as average of 5 countries (Denmark, France, Germany, Italy, and UK) weighted by the relative size of the manufacturing industry (source: Eurostat).

3.4 Conclusions

This chapter has reviewed many recent changes in the ETS market and studies that have analysed the ETS market. Table 9 gives an overview of these changes and indicates what changes we will take onto our quantitative analysis in Chapter 4.

Table 9 **Desirable changes in the methodology for the assessment of sectors with significant risk on carbon leakage**

Arguments	Included in our analysis?
Additional carbon costs	
More realistic carbon price	Yes
More realistic auctioning factor	Yes
Recognizing cost-pass-through	No, not enough data
Taking into account cost price differentials other major economies	No, not enough data
The EU ETS can make a larger use of CERs than anticipated	No
Trade intensity criterion	
Including all countries in the ETS	Yes
Including countries linked to the ETS in 2015-2019	Yes
Including countries with comparable climate policies	No, not enough data

As from this table becomes apparent, we have only made a modest selection of changes that are likely to undertake when a good assessment is being made of the new carbon leakage list in the MTR. In Chapter 4 we will present the outcome of the analysis.

4 Quantitative analysis of sectors with risk of carbon leakage

4.1 Introduction

From the discussion in Chapter 3, we have seen that the methods employed to determine which sectors have a risk to be exposed to carbon leakage need to be updated. From the various possible updates we have selected three important updates:

1. Taking into account a realistic carbon price based on recent forecasts and impact assessments. As we have argued, a EUA price of € 12/tCO_2 seems to be in the upper range of potential future forecasts.
2. Taking into account a realistic factor reflecting the amount of allowances that will be auctioned if a sector is not being exposed to carbon leakage. As we have argued, an auctioning factor of 0.68 seems to be appropriate in this case.
3. Taking into account that trade to countries that are included in, or linked with the EU ETS, cannot be regarded as relevant for carbon leakage. By definition no carbon leakage can occur to these countries, so they should be excluded from the trade intensity criterion.

In this paragraph we will sketch the impact of these changes on the list of sectors that are deemed to be exposed to carbon leakage.

4.2 Methodology employed

4.2.1 Method for quantitative analysis

The MTR will update the data that have been used, using the most recently available data between 2010-2012. Due to confidentially of data, and the fact that most of the data have been delivered by MS to the EC, we cannot assess in this report the newest data that are available. Basically this is a task that the Commission, together with consultants and Eurostat, will undertake during 2013 and 2014. In this report we will instead, investigate how the improved methodology would work out for the data that were gathered in the first Comitology process in 2009.

We have used the same data and data sources that the Commission has used during their comitology process in 2009. Starting point was the outcome of the quantitative analysis the Commission has published in their Draft Commission Staff Document (EC, 2009). The Table in the Annex provides detailed data on additional carbon costs over GVA and the trade intensities. In many cases, however, the information is masked by ranges making a precise recalculation impossible.

By collecting the data from the same sources as being described in EC, 2009, we have been able to recollect data for a major part of the 258 sectors. In the end, we were able to reconstruct the quantitative analysis for 247 sectors at the NACE 4 level, leaving out only five sectors of the analysis (an additional six sectors were given free allowances based on qualitative criteria, see below).

Eight sectors at NACE 4 (containing sixteen subsectors at NACE 6 and beyond) have been granted free allowances based on a quantitative analysis beyond NACE 6. Unfortunately we have not been able to reproduce these results in this study. However, since they represent only 1% of industrial emissions in the ETS, the impact is not large.

4.2.2 Qualitative assessments

The qualitative assessments cannot be evaluated against the same criteria as the quantitative assessments. The EC documents related to the qualitative assessments were scanned and the arguments that were put forward to put the sectors on the list were analysed.[20] In general one could say that arguments that the additional CO_2 costs were close to the threshold level of 5% (for situation 1), or that additional CO_2 costs would eat out more than 1/3 of profit margins, were compelling arguments for the EC to regard the sector as having a risk to carbon leakage, thereby granting them free allowances up to the benchmark.

We used this to analyse the potential impact of taking a lower EUA price of € 12/tCO_2 as central value for the 2015-2020 period. The outcome of this analysis is given in Table 10.

Table 10 Analysis of the sectors which were granted free allowances up to the benchmark based on a qualitative assessment

NACE 4	Sector name	Why it was added	Based on	With € 30		With € 12		Future decision
				CO_2/GVA	CO_2 costs/ profit	CO_2/GVA	CO_2 costs/profit	
1730	Finishing of textiles	No trade data available	Trade exposure of subgroups > 60%	1,40%	No profit	0,6%		CL
2020	Manufacture of veneer sheets manufacture of plywood, laminboard	Costs close to 5%	Costs	4,20%	35,80%	1,7%	14,3%	Not CL
2416	Manufacture of plastics in primary form	Costs close to 5%	Costs	3-5%	Unknown	1,2-2%	Unknown	Not CL
2640	Manufacture of bricks, roof tiles and construction products	Substantial costs	Costs	9,80%	45%	3,9%	18,0%	Not CL
2751	Casting of iron	High costs and trade exposure close to the threshold	Trade, costs		>50%		>20%	Uncertain
2753	Casting of light metals	High share of costs in profit margins	Costs	<5%	>100%		>40%	CL

[20] See: http://ec.europa.eu/clima/policies/ets/cap/leakage/documentation_en.htm

We see that with a lower carbon cost price, only the sector 1730 (Finishing of Textiles) and 2753 (Casting of Light Metals) would still be granted free allowances and the decision for the sector 'casting of iron' would be uncertain. In all other cases, the relevant criteria (mostly the CO_2 costs) are less urgently pressing on the sector with a lower CO_2 price. Therefore we have included these sectors as being no longer eligible for free allocation on the basis of a future qualitative assessment. One should bear in mind, however, that not only the CO_2 costs, but most likely also the profit margins have been decreasing in recent years, which might form another argument for including them again on the carbon leakage list.

4.3 Outcome of the analysis

Using the same criteria as stated in the Revised EU ETS Directive (see Section 2.4) we have re-analysed the impact of the three changes on the decision whether a sector would be deemed to a significant risk of carbon leakage.

The results of this analysis are given in Table 11.

Table 11 Percentage of industrial emissions obtaining free allocation up to the benchmarks and comparing this to the comitology process in 2009

	New outcome			*Comitology 2009*	
Total emissions	**Number of sectors**	**Verified emissions**	**In perc. of total emissions**	***Number of sectors***	***In perc. of total emissions***
Criterion 1	1	2,791,654	0,5%	*13*	*36,3%*
Criterion 2	0	0	0,0%	*2*	*29,4%*
Criterion 3*	79	48,935,716	8,1%	*133*	*26,0%*
Criterion 4	3	1,596,167	0,3%	*6*	*2,4%*
Unknown**	13	14,219,509	2,4%	*8*	*1,0%*
Auctioning	163	537,411,708	88,8%	*104*	*5,1%*
Total EU ETS	258	604,954,753			

Note: * Many of the installations receiving free allowances because of Criterion 1.

From this analysis it appears that the three applied changes to the calculation of the criteria of the revised EU ETS Directive evaporate the free allocation to sectors. Whereas in the Comitology process 95% of industrial emissions would obtain free allocation, this is reduced to 9-11% in the new situation. 89-91% of industrial emissions will be subject to auctioning when these changes are being implemented.

The top 20 sectors from the 2005-2006 ETS registry can again be given and their outcome using the updated methodology can be compared with the initial decision during the Comitology process in 2009. Table 12 gives the results.

Table 12 **Top 20 sectors and their likely allocation method in 2015 in comparison with 2013 according to the updated methodology**

NACE 4	Short description	%of CO_2^	Criterion 2015*	Criterion 2013
2320	Manufacture of refined petroleum	25%	34%auct.	Free(S1)
2651	Manufacture of cement	25%	34%auct.	Free(S2)
2710	Manufacture of basic iron and steel	14%	34%auct.	Free(S1/S3)
2112	Manufacture of paper and paperboard	6%	34%auct.	Free(S1)
2652	Manufacture of lime	4%	34%auct.	Free(S2)
1110	Extraction of crude petroleum and natural gas	2%	Free(S3)	Free(S3)
2414	Manufacture of other organic basic chemicals	2%	Free(S3)	Free(S1/S3)
2613	Manufacture of hollow glass	2%	34%auct.	Free(S1)
2310	Manufacture of coke oven products	1%	NA	Free(S1/S3)
1583	Manufacture of sugar	1%	34%auct.	Free(S1)
1020	Mining and agglomeration of lignite	1%	34%auct.	20%auct.
2413	Manufacture of other inorganic basic chemicals	1%	34%auct.	Free(S1/S3)
3410	Manufacture of motor vehicles	1%	34%auct.	20%auct
2416	Manufacture of plastics in primary forms	1%	34%auct.	Free(S4)
2611	Manufacture of flat glass	1%	34%auct.	Free(S1)
2661	Manufacture of concrete products for construction	1%	34%auct.	Free()
2640	Manufacture of bricks, tiles and construction prod.	1%	34%auct.	Free(S4)
1562	Manufacture of starches and starch products	1%	34%auct.	Free(S1)
2742	Aluminium production	1%	34%auct.	Free(S1/S3)
2466	Manufacture of other chemical products nec	1%	Free(S3)	Free(S3)

Note: * Allocation in 2015 was based in this study on the data 2005-2007 using the three moderated assumptions underlying the calculations as given in Paragraph 4.1. The actual allocation will be based on data 2010-2012 and may therefore show small changes compared to this table.

^ % of emissions of CO_2 in the ETS as an average of 2005 and 2006 for industrial installations (excluding public power plants).

It appears that the top 5 contributors to the EU ETS now would all fall under an auctioning regime. Only three sectors in the top 20 most carbon intensive sectors would still be granted free allocation up to the benchmarks.

5 Conclusions and implications

5.1 General conclusions

The EU ETS is in crisis, as the oversupply of emission allowances has become apparent to all participants in the market. In 2012 demand for allowances fell short of supply by over 10% and the price of allowances fell to an all-time low of € 3/tCO_2 in January 2013. Analysts assume that oversupply will remain a feature of the EU ETS for most of Phase 3 of the scheme, which lasts until 2020. With prices so low, the ETS is failing to provide any incentive for implementing carbon-saving measures and greening the economy.

While the EC tries to recover the EU ETS by political decision making concerning back-loading of auctioned emission allowances, analysts assume that this will not have much impact on the low carbon prices in the ETS. An often overlooked instrument for restoring the ETS is the forthcoming Mid-Term Review (MTR) at the end of 2014. The MTR will re-evaluate the basis of allocation in the ETS and decide which sectors are deemed to be exposed to a significant risk of carbon leakage. The present study has analysed the comitology process that has resulted in 2009 in the list of sectors that were considered to have a significant risk of carbon leakage. This study showed that nearly 60% of the sectors, responsible for over 95% of industrial emissions in the EU ETS were granted free allowances up to the benchmark based on the criteria laid down in the revised EU ETS Directive.

However, the quantitative analysis that was performed in 2009 is no longer representative of the current state of the ETS. Carbon prices are much lower than anticipated, benchmarks have been less stringent than expected and the scope of the ETS has been widening to include other countries and providing links to other ETS systems. A re-assessment of the comitology process in 2009 using more realistic scenarios regarding carbon price, benchmarks and geographical coverage of the ETS resulted in the insight that free allowances will not be a rule anymore for industrial installations in the ETS. The number of free allowances will be reduced drastically to only about 10%.

This analysis has been performed using the data from 2005-2007. It illustrates how crucial the underlying assumptions are for the determination of the carbon leakage list. Recent developments and studies on the functioning of the EU ETS have put serious doubts about several of the assumptions underlying the MTR. Table 13 gives an overview of these developments. As can be seen, we included here only four out of eight arguments to change the methodologies underpinning the MTR.

Table 13 **Assumptions in the comitology process regarding sectors prone to carbon leakage and the reason why these assumptions should be updated**

Assumptions in the Comitology	Reason for update of assumption	Included in this study
Carbon price is € 30/tCO_2	Carbon prices are now below the € 5	**Carbon price of € 12/tCO_2**
60% of industrial emissions are above the benchmark	This figure is unlikely and disregarding technological progress regarding energy savings, even though no empirical evidence has been gathered yet	**20% of industrial emissions are above the benchmarks**
Industrial installations cannot pass through the costs	Many studies have empirically shown that cost-pass-through is likely for a wide range of industrial products	Not included in this study
Other countries do not impose carbon costs on electricity sector and industry	Several studies have shown that, especially for electricity generation, other countries have also imposed costs to their power producers implying higher electricity prices for industry	Not included in this study
The EU ETS can make a larger use of CERs than anticipated	About 1/3 of the required emissions reductions can be covered with CERs and these CERs cost at the moment only € 0,15/tCO_2	Not included in this study
The EU ETS is limited to EU 27	Croatia, Liechtenstein, Norway and Iceland are currently under the EU ETS	**Yes, impacting on the trade intensity criterion**
The EU ETS is not linked to other ETS	Switzerland (2014) and Australia (2015) are being linked with the EU ETS	**Yes, impacting on the trade intensity criterion**
No countries have similar climate policies in place	The EU is no longer a frontrunner on climate change policies. Various countries have comparable policies in place	Not included in this study

5.2 Implication for the EU ETS market, governments and industry

In a well-functioning market the method of allocation would not matter for the price, because it is the relation between the demand for allowances and the sheer quantity of allowances issued that impact on the price. However, enabling a larger share of auctioning would diminish the current trend of oversupply of allowances for industry as they would use their banked allowances to cover their verified emissions first. Therefore, it can be expected that some moderate price impacts may occur, especially if the EU decides to further implement back-loading or set-aside allowances. The decision to use back-loading or set-asides may also be facilitated if a larger amount of allowances will be auctioned.

A larger share of auctioned allowances will have positive impact for state budgets of the countries engaged in the EU ETS. It may therefore provide a fiscal stimulus to restore balance in the state budgets of these countries that now show severe deficits.

Industry can be faced with much higher shares of auctioning than they experienced until now. Since a larger share of carbon emissions will be priced, the ETS may provide more incentives for the transition towards a green economy and stimulate the uptake of measures to reduce carbon emissions, albeit at a lower carbon price than anticipated. However, it also shows the interrelation between the carbon market report of the EC and their strategic position in the ETS. If industry and certain member states keep opposing more structural reforms of the ETS (such as set-asides or price floors) that would give a permanent boost in the price of allowances, they are likely to be bitten in their own hands because of the inherent allocation mechanism in the ETS. The inclusion on the carbon leakage list is not a 'right' and should be evaluated against the expected additional carbon costs, and it is clear that these costs nowadays are considerably lower than expected in 2009. The analysis undertaken here shows that there is potential room for a 'silent bargain' where industry and certain member states would give up resistance against structural measures in order to secure continued free allowances. A higher marginal EUA price would also stimulate innovation more than a high 'average price', because marginal prices tend to be more decisive for inclusion of carbon saving measures than average prices, at least according to economic theory.

5.3 Policy implications

The Mid-Term Review (MTR) will not automatically lead to results as depicted in this study. It should involve strong commitment of politicians that want to take a realistic perspective on deciding whether sectors are prone to carbon leakage or not.

Especially the carbon price that is included in the revision of the carbon leakage list is crucial – in our analysis it is the most important factor. However, the revised EU ETS Directive (Article 10a, par.12) stated that: "*the Commission shall assess, at Community level, the extent to which it is possible for the sector or subsector concerned, at the relevant level of disaggregation, to pass on the direct cost of the required allowances and the indirect costs from higher electricity prices resulting from the implementation of this Directive into product prices without significant loss of market share to less carbon efficient installations outside the Community. These assessments shall be based on an average carbon price according to the Commission's impact assessment accompanying the package of implementation measures for the EU's objectives on climate change and renewable energy for 2020…*".

It is clear that the impact assessment from 2008 cannot be a guiding document anymore for deciding on the carbon leakage between 2015 and 2019. The EC had announced a new impact assessment of the EU ETS (to be finished in 2011), but this has never been published. We believe that a new impact assessment of the EU ETS, including the chance of carbon leakage, should accompany the MTR at the end of 2014. This will provide a realistic picture on the price of EUA and the associated risk of carbon leakage.

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Annex A Outcome of the 2009 Comitology process at NACE 4 level

Table 14 Outcome of the 2009 Comitology process at NACE 4 level

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
1010	Mining and agglomeration of hard coal	>5% and < 30%	-0,40%	>5% and < 30%	53,40%	YES
1020	Mining and agglomeration of lignite	>5% and < 30%	5,80%	>5% and < 30%	0,90%	NO
1030	Extraction and agglomeration of peat	<5%	0,20%	<5%	< 10%	NO
1110	Extraction of crude petroleum and natural gas	0,70%	0,20%	0,80%	60,20%	YES
1120	Service activities incidental to oil and gas extraction, excluding surveying	<5%	0,10%	<5%	<5%	NO
1200	Mining of uranium and thorium ores	<5%	<5%	<5%	<5%	NO
1310	Mining of iron ores	<5%	<5%	<5%	84,90%	YES
1320	Mining of non-ferrous metal ores, except uranium and thorium ores	0,30%	1,50%	1,80%	86,20%	YES
1411	Quarrying of stone for construction	0,80%	1,20%	2,00%	44,20%	YES
1412	Quarrying of limestone, gypsum and chalk	>5% and < 30%	2,20%	>5% and < 30%	4,40%	NO
1413	Quarrying of slate	<5%	<5%	<5%	6,40%	NO
1421	Operation of gravel and sand pits	<5%	0,90%	<5%	3,70%	NO
1422	Mining of clays and kaolin	0,60%	2,80%	3,30%	49,00%	YES
1430	Mining of chemical and fertilizer	>5% and < 30%	6,60%	>5% and < 30%	61,10%	YES
1440	Production of salt	<5%	1,70%	<5%	12,50%	YES
1450	Other mining and quarrying nec	1,30%	2,30%	3,60%	182,00%	YES
1511	Production and preserving of meat	0,10%	0,80%	0,90%	11,10%	NO
1512	Production and preserving of poultry meat	0,10%	1,10%	1,20%	6,30%	NO
1513	Production of meat and poultry meat products	0,00%	0,60%	0,70%	3,30%	NO
1520	Processing and preserving of fish and fish products	0,40%	0,80%	1,20%	49,70%	YES
1531	Processing and preserving of potatoes	0,50%	0,70%	1,20%	5,90%	NO
1532	Manufacture of fruit and vegetable juice	0,40%	0,80%	1,20%	19,00%	NO
1533	Processing and preserving of fruit and vegetables nec	0,30%	0,70%	1,00%	21,60%	PART
1541	Manufacture of crude oils and fats	1,90%	0,80%	2,70%	49,40%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
1542	Manufacture of refined oils and fats	1,20%	1,20%	2,40%	19,40%	NO
1543	Manufacture of margarine and similar edible fats	0,50%	0,30%	0,80%	7,80%	NO
1551	Operation of dairies and cheese making	0,30%	1,00%	1,30%	7,60%	PART
1552	Manufacture of ice cream	<5%	1,30%	<5%	2,80%	NO
1561	Manufacture of grain mill products	0,10%	1,10%	1,30%	7,90%	NO
1562	Manufacture of starches and starch products	5,20%	1,90%	7,10%	14,50%	YES
1571	Manufacture of prepared feeds for farm animals	0,30%	1,30%	1,50%	2,80%	NO
1572	Manufacture of prepared pet foods	0,20%	0,40%	0,60%	9,90%	NO
1581	Manufacture of bread manufacture of fresh pastry goods and cakes	0,00%	0,40%	0,40%	0,90%	NO
1582	Manufacture of rusks and biscuits manufacture of preserved pastry goods	<5%	0,50%	<5%	6,10%	NO
1583	Manufacture of sugar	4,80%	0,60%	5,40%	19,50%	YES
1584	Manufacture of cocoa chocolate and sugar confectionery	0,10%	0,50%	0,60%	12,50%	PART
1585	Manufacture of macaroni, noodles, couscous and similar farinaceous products	<5%	0,80%	<5%	10,60%	NO
1586	Processing of tea and coffee	0,20%	0,30%	0,50%	12,40%	NO
1587	Manufacture of condiments and seasonings	<5%	0,40%	<5%	10,00%	NO
1588	Manufacture of homogenized food preparations and dietetic food	0,40%	0,70%	1,20%	25,10%	NO
1589	Manufacture of other food products nec	0,10%	0,40%	0,60%	22,20%	PART
1591	Manufacture of distilled potable alcoholic beverages	0,40%	0,20%	0,50%	53,60%	YES
1592	Production of ethyl alcohol from fermented materials	5,30%	0,40%	5,70%	17,00%	YES
1593	Manufacture of wines	<5%	0,30%	<5%	31,50%	YES
1594	Manufacture of cider and other fruit wines	<5%	0,10%	<5%	3,60%	NO
1595	Manufacture of other non-distilled fermented beverages	<5%	<5%	>5% and < 30%	25,40%	YES
1596	Manufacture of beer	0,20%	0,40%	0,70%	7,20%	NO
1597	Manufacture of malt	2,50%	3,50%	5,90%	30,90%	YES
1598	Production of mineral waters and soft drinks	0,00%	0,60%	0,60%	6,30%	NO
1600	Manufacture of tobacco products	0,00%	0,20%	0,30%	12,00%	NO
1711	Preparation and spinning of cotton-type fibres	1,00%	4,00%	5,00%	40,50%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
1712	Preparation and spinning of woollen-type fibres	<5%	<5%	<5%	40,50%	YES
1713	Preparation and spinning of worsted-type fibres	<5%	2,60%	<5%	40,50%	YES
1714	Preparation and spinning of flax-type fibres	<5%	<5%	<5%	40,50%	YES
1715	Throwing and preparation of silk, including from noils, and	<5%	2,40%	<5%	40,50%	YES
1716	Manufacture of sewing threads	<5%	<5%	<5%	40,50%	YES
1717	Preparation and spinning of other textile fibres	<5%	<5%	<5%	40,50%	YES
1721	Cotton-type weaving	0,20%	1,00%	1,20%	58,30%	YES
1722	Woollen-type weaving	<5%	2,30%	<5%	58,30%	YES
1723	Worsted-type weaving	<5%	<5%	<5%	58,30%	YES
1724	Silk-type weaving	<5%	1,90%	<5%	58,30%	YES
1725	Other textile weaving	<5%	1,10%	<5%	58,30%	YES
1730	Finishing of textiles	0,40%	1,00%	1,40%	1,50%	YES
1740	Manufacture of made-up textile articles, except apparel	0,10%	0,40%	0,50%	46,70%	YES
1751	Manufacture of carpets and rugs	0,20%	0,60%	0,80%	31,20%	YES
1752	Manufacture of cordage, rope, twine and netting	0,20%	0,80%	1,00%	34,10%	YES
1753	Manufacture of non-wovens and articles made from non-wovens	<5%	1,80%	<5%	30,90%	YES
1754	Manufacture of other textiles nec	0,10%	0,70%	0,80%	37,40%	YES
1760	Manufacture of knitted and crocheted fabrics	<5%	0,80%	<5%	47,70%	YES
1771	Manufacture of knitted and crocheted hosiery	<5%	0,70%	<5%	39,30%	YES
1772	Manufacture of knitted and crocheted pullovers, cardigans and similar articles	<5%	0,50%	<5%	63,90%	YES
1810	Manufacture of leather clothes	>5% and < 30%	>5% and < 30%	>5% and < 30%	52,10%	YES
1821	Manufacture of workwear	<5%	0,30%	<5%	44,70%	YES
1822	Manufacture of other outerwear	0,00%	0,20%	0,20%	70,60%	YES
1823	Manufacture of underwear	<5%	0,30%	<5%	75,60%	YES
1824	Manufacture of other wearing apparel and accessories n.	0,20%	0,20%	0,40%	99,40%	YES
1830	Dressing and dyeing of fur manufacture of articles of fur	0,20%	0,20%	0,30%	101,90%	YES
1910	Tanning and dressing of leather	<5%	1,10%	<5%	47,50%	YES
1920	Manufacture of luggage, handbags and the like, saddlery and harness	0,10%	0,20%	0,20%	87,50%	YES
1930	Manufacture of footwear	0,10%	0,30%	0,40%	59,70%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
2010	Sawmilling and planing of wood impregnation of wood	0,00%	1,00%	1,60%	30,80%	YES
2020	Manufacture of veneer sheets manufacture of plywood, llaminboard	1,10%	2,60%	3,70%	23,80%	YES
2030	Manufacture of builders' carpentry and joinery	<5%	0,40%	<5%	9,00%	NO
2040	Manufacture of wooden containers	<5%	0,50%	<5%	7,40%	NO
2051	Manufacture of other products of wood	<5%	0,40%	<5%	26,00%	NO
2052	Manufacture of articles of cork, straw and plaiting material	<5%	<5%	<5%	36,50%	YES
2111	Manufacture of pulp	2,90%	<5%	<5%	46,10%	YES
2112	Manufacture of paper and paperboard	5,30%	4,80%	10,20%	25,70%	YES
2121	Manufacture of corrugated paper and paperboard and of containers of paper	0,10%	1,60%	1,70%	5,20%	NO
2122	Manufacture of household and sanitary goods and of toilet requisites	0,50%	2,90%	3,40%	12,80%	NO
2123	Manufacture of paper stationery	<5%	0,70%	<5%	9,40%	NO
2124	Manufacture of wallpaper	<5%	0,90%	<5%	38,70%	YES
2125	Manufacture of other articles of paper and paperboard nec	0,10%	0,60%	0,70%	13,60%	NO
2211	Publishing of books	<5%	0,10%	<5%	17,40%	NO
2212	Publishing of newspapers	<5%	0,20%	<5%	0,20%	NO
2213	Publishing of journals and periodicals	0,20%	<5%	<5%	2,90%	NO
2214	Publishing of sound recordings	<5%	<5%	<5%	24,30%	NO
2215	Other publishing	<5%	<5%	<5%	37,20%	YES
2221	Printing of newspapers	<5%	0,70%	<5%	3,30%	NO
2222	Printing nec	0,00%	0,50%	0,50%	3,70%	NO
2223	Bookbinding and finishing	<5%	0,50%	<5%	3,30%	NO
2224	Composition and plate-making	<5%	<5%	<5%	6,40%	NO
2225	Other activities related to printing	<5%	<5%	<5%	3,30%	NO
2231	Reproduction of sound recording	<5%	0,90%	<5%	n.a.	NO
2232	Reproduction of video recording	<5%	0,70%	<5%	n.a.	NO
2233	Reproduction of computer media	<5%	<5%	<5%	n.a.	NO
2310	Manufacture of coke oven products	36,80%	4,60%	41,40%	> 30%	YES
2320	Manufacture of refined petroleum products	10,50%	1,20%	11,70%	16,10%	YES
2330	Processing of nuclear fuel	<5%	<5%	<5%	44,30%	YES
2411	Manufacture of industrial gases	1,40%	7,50%	8,90%	4,20%	PART

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
2412	Manufacture of dyes and pigments	0,70%	1,40%	3,20%	43,10%	YES
2413	Manufacture of other inorganic basic chemicals	4,80%	6,00%	11,90%	31,70%	YES
2414	Manufacture of other organic basic chemicals	2,50%	2,20%	5,40%	46,30%	YES
2415	Manufacture of fertilizers and nitrogen compounds	14,00%	3,70%	70,20%	27,40%	YES
2416	Manufacture of plastics in primary forms	1,40%	1,70%	3,00%	27,10%	YES
2417	Manufacture of synthetic rubber in primary forms	>5% and < 30%	<5%	>5% and < 30%	38,10%	YES
2420	Manufacture of pesticides and other agro-chemical products	1,20%	0,40%	1,60%	41,10%	YES
2430	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	<5%	0,40%	<5%	20,80%	PART
2441	Manufacture of basic pharmaceutical products	0,40%	0,90%	1,30%	85,80%	YES
2442	Manufacture of harmaceutical preparations	0,00%	0,20%	0,30%	58,60%	YES
2451	Manufacture of soap and detergents, cleaning and polishing preparations	<5%	0,40%	<5%	23,10%	NO
2452	Manufacture of perfumes and toilet preparations	<5%	0,30%	<5%	45,30%	YES
2461	Manufacture of explosives	<5%	0,30%	<5%	15,90%	NO
2462	Manufacture of glues and gelatines	0,30%	0,60%	0,90%	25,90%	PART
2463	Manufacture of essential oils	<5%	0,30%	<5%	77,00%	YES
2464	Manufacture of photographic chemical material	0,30%	1,10%	1,40%	65,70%	YES
2465	Manufacture of prepared unrecorded media	<5%	<5%	<5%	105,10%	YES
2466	Manufacture of other chemical products nec	1,00%	0,80%	1,80%	49,60%	YES
2470	Manufacture of man-made fibres	1,50%	2,80%	4,30%	32,80%	YES
2511	Manufacture of rubber tyres and tubes	0,50%	0,90%	1,40%	37,10%	YES
2512	Retreading and rebuilding of rubber tyres	<5%	0,70%	<5%	7,10%	NO
2513	Manufacture of other rubber products	0,10%	0,90%	0,90%	26,50%	NO
2521	Manufacture of plastic plates, sheets, tubes and profiles	0,10%	1,30%	1,40%	20,40%	NO
2522	Manufacture of plastic packing goods	0,10%	1,90%	2,00%	14,00%	NO
2523	Manufacture of builders' ware of plastic	0,10%	0,50%	0,60%	9,40%	NO
2524	Manufacture of other plastic products	0,00%	0,80%	0,80%	20,00%	NO

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
2611	Manufacture of flat glass	6,20%	1,80%	8,00%	21,00%	YES
2612	Shaping and processing of flat glass	<5%	0,80%	<5%	13,50%	NO
2613	Manufacture of hollow glass	4,70%	2,60%	7,30%	24,30%	YES
2614	Manufacture of glass fibres	0,80%	2,10%	3,60%	23,40%	YES
2615	Manufacture and processing of other glass, including technical glassware	0,80%	1,60%	2,40%	49,10%	YES
2621	Manufacture of ceramic household and ornamental article	1,20%	0,70%	1,80%	57,00%	YES
2622	Manufacture of ceramic sanitary fixtures	0,90%	0,50%	1,40%	30,20%	YES
2623	Manufacture of ceramic insulators and insulating fittings	1,40%	1,00%	2,40%	34,50%	YES
2624	Manufacture of other technical ceramic products	0,70%	0,40%	1,20%	54,60%	YES
2625	Manufacture of other ceramic products	0,90%	0,60%	1,50%	49,10%	YES
2626	Manufacture of refractory ceramic products	1,90%	1,00%	2,80%	37,20%	YES
2630	Manufacture of ceramic tiles and flags	>5%	1,50%	>5% and < 30%	28,60%	YES
2640	Manufacture of bricks, tiles and construction products, in baked clay	8,00%	1,70%	9,80%	2,70%	YES
2651	Manufacture of cement	41,10%	4,40%	45,50%	6,80%	YES
2652	Manufacture of lime	62,30%	2,80%	65,20%	2,60%	YES
2653	Manufacture of plaster	>5% and < 30%	3,10%	>5% and < 30%	6,50%	NO
2661	Manufacture of concrete products for construction purpos	<5%	0,40%	<5%	1,50%	NO
2662	Manufacture of plaster products for construction purpose	2,70%	1,00%	3,20%	5,70%	NO
2663	Manufacture of ready-mixed concrete <	<5%	0,40%	<5%	0,10%	NO
2664	Manufacture of mortars	1,80%	0,60%	2,40%	2,10%	NO
2665	Manufacture of fibre cement	<5%	0,80%	<5%	7,70%	NO
2666	Manufacture of other articles of concrete, plaster and cem	<5%	0,20%	<5%	17,70%	NO
2670	Cutting, shaping and finishing of stone	<5%	0,20%	<5%	27,60%	NO
2681	Production of abrasive products	<5%	0,50%	<5%	40,50%	YES
2682	Manufacture of other non-metallic mineral products nec	0,50%	1,20%	1,70%	17,90%	PART
2710	Manufacture of basic iron and steel and of ferro-alloys (ECSC)20)	6,50%	3,60%	10,60%	32,30%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
2721	Manufacture of cast iron tubes	>5% and < 30%	1,30%	>5% and < 30%	28,00%	YES
2722	Manufacture of steel tubes	0,60%	0,70%	0,90%	45,20%	YES
2731	Cold drawing	>5% and < 30%	<5%	>5% and < 30%	32,70%	YES
2732	Cold rolling of narrow strip	<5%	1,10%	<5%	19,70%	NO
2733	Cold forming or folding	0,10%	0,30%	0,40%	4,90%	NO
2734	Wire drawing	0,50%	1,40%	1,90%	21,90%	NO
2741	Precious metals production	<5%	<5%	<5%	73,90%	YES
2742	Aluminium production	1,70%	10,30%	14,00%	35,90%	YES
2743	Lead, zinc and tin production	1,30%	6,00%	7,40%	26,80%	YES
2744	Copper production	2,10%	3,40%	5,50%	34,60%	YES
2745	Other non-ferrous metal production	<5%	2,00%	>5% and < 30%	73,80%	YES
2751	Casting of iron	<5%	3,60%	>5% and < 30%	n.a.	YES
2752	Casting of steel	0,60%	1,40%	2,00%	n.a.	NO
2753	Casting of light metals	<5%	1,10%	<5%	n.a.	YES
2754	Casting of other non-ferrous metals	<5%	1,40%	<5%	n.a.	NO
2811	Manufacture of metal structures and parts of structures	<5%	0,20%	<5%	8,40%	NO
2812	Manufacture of builders' carpentry and joinery of metal	0,10%	0,10%	0,20%	3,30%	NO
2821	Manufacture of tanks, reservoirs and containers of metal	<5%	0,30%	<5%	14,50%	NO
2822	Manufacture of central heating radiators and boilers	<5%	0,30%	<5%	15,30%	NO
2830	Manufacture of steam generators, except central heating	0,60%	0,20%	0,80%	12,60%	NO
2840	Forging, pressing, stamping and roll forming of metal powder metallurgy	0,20%	0,80%	0,80%	n.a.	NO
2851	Treatment and coating of metals	<5%	0,80%	<5%	n.a.	NO
2852	General mechanical engineering	<5%	0,30%	<5%	n.a.	NO
2861	Manufacture of cutlery	0,10%	<5%	<5%	64,60%	YES
2862	Manufacture of tools	0,10%	0,30%	0,40%	42,50%	YES
2863	Manufacture of locks and hinges	<5%	<5%	<5%	29,80%	NO
2871	Manufacture of steel drums and similar containers	<5%	0,40%	<5%	17,80%	NO
2872	Manufacture of light metal packaging	<5%	1,00%	<5%	11,10%	NO
2873	Manufacture of wire products	0,20%	0,80%	1,00%	21,00%	NO
2874	Manufacture of fasteners, screw machine products, chain and springs	<5%	0,50%	<5%	36,20%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
2875	Manufacture of other fabricated metal products nec	<5%	0,30%	<5%	37,10%	YES
2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	0,30%	0,30%	0,60%	51,00%	YES
2912	Manufacture of pumps and compressors	<5%	0,30%	<5%	47,40%	YES
2913	Manufacture of taps and valves	<5%	0,30%	<5%	47,20%	YES
2914	Manufacture of bearings, gears, gearing and driving elements	0,00%	0,50%	0,50%	39,00%	YES
2921	Manufacture of furnaces and furnace burners	<5%	0,20%	<5%	56,80%	YES
2922	Manufacture of lifting and handling equipment	<5%	0,20%	<5%	26,60%	NO
2923	Manufacture of non-domestic cooling and ventilation equipment	0,00%	0,10%	0,20%	34,50%	YES
2924	Manufacture of other general purpose machinery nec	<5%	0,20%	<5%	46,40%	YES
2931	Manufacture of agricultural tractors	>5% and < 30%	0,30%	>5% and < 30%	31,10%	YES
2932	Manufacture of other agricultural and forestry machinery	<5%	0,20%	<5%	31,10%	YES
2941	Manufacture of machine-tools	<5%	0,20%	<5%	73,40%	YES
2942	Manufacture of machine-tools	<5%	0,20%	<5%	48,50%	YES
2943	Manufacture of machine-tools	<5%	0,20%	<5%	48,10%	YES
2951	Manufacture of machinery for metallurgy	<5%	0,30%	<5%	42,10%	YES
2952	Manufacture of machinery for mining, quarrying and cons	0,10%	0,20%	0,30%	63,00%	YES
2953	Manufacture of machinery for food, beverage and tobacco processing	0,10%	0,10%	0,20%	43,60%	YES
2954	Manufacture of machinery for textile, apparel and leather production	<5%	<5%	<5%	71,70%	YES
2955	Manufacture of machinery for paper and paperboard production	<5%	0,20%	<5%	46,60%	YES
2956	Manufacture of other special purpose machinery nec	0,00%	0,10%	0,10%	48,70%	YES
2960	Manufacture of weapons and ammunition	0,20%	0,30%	0,50%	33,60%	YES
2971	Manufacture of electric domestic appliances	<5%	0,30%	<5%	40,70%	YES
2972	Manufacture of non-electric domestic appliances	<5%	0,20%	<5%	28,20%	NO
3001	Manufacture of office machinery	0,30%	0,30%	0,90%	87,80%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
3002	Manufacture of computers and other information processing equipment	0,10%	0,20%	0,30%	83,50%	YES
3110	Manufacture of electric motors, generators and transformers	<5%	0,30%	<5%	43,50%	YES
3120	Manufacture of electricity distribution and control apparatus	<5%	0,20%	<5%	39,30%	YES
3130	Manufacture of insulated wire and cable	0,10%	0,90%	1,00%	32,60%	YES
3140	Manufacture of accumulators, primary cells and primary b	0,50%	1,40%	1,90%	54,30%	YES
3150	Manufacture of lighting equipment and electric lamps	<5%	0,30%	<5%	41,30%	YES
3161	Manufacture of electrical equipment for engines and vehicles nec	<5%	0,40%	<5%	21,20%	NO
3162	Manufacture of other electrical equipment nec	0,10%	0,40%	0,50%	44,80%	YES
3210	Manufacture of electronic valves and tubes and other electronic components	0,00%	0,70%	0,80%	81,40%	YES
3220	Manufacture of television and radio transmitters and apparatus	0,00%	0,20%	0,20%	76,80%	YES
3230	Manufacture of television and radio receivers, sound or video	<5%	0,20%	<5%	70,50%	YES
3310	Manufacture of medical and surgical equipment and orthopaedic appliances	0,00%	0,10%	0,20%	72,70%	YES
3320	Manufacture of instruments and appliances for measuring, checking	0,10%	0,20%	0,20%	59,60%	YES
3330	Manufacture of industrial process control equipment	<5%	0,10%	<5%	n.a.	NO
3340	Manufacture of optical instruments and photographic equipment	0,10%	0,30%	0,40%	66,10%	YES
3350	Manufacture of watches and clocks	<5%	0,20%	<5%	107,40%	YES
3410	Manufacture of motor vehicles	0,20%	0,40%	0,50%	28,90%	NO
3420	Manufacture of bodies (coachwork) for motor vehicles manufacture of trailers	0,00%	0,20%	0,20%	10,30%	NO
3430	Manufacture of parts and accessories for motor vehicles and their engines	0,00%	0,60%	0,60%	24,80%	NO
3511	Building and repairing of ships	<5%	0,60%	<5%	69,60%	YES
3512	Building and repairing of pleasure and sporting boats	0,10%	0,20%	0,30%	62,00%	YES

NACE 4 code	Sector	Direct costs/GVA	Indirect costs/GVA	Total costs/GVA	Trade	Significant risk of CL
3520	Manufacture of railway and tramway locomotives and roll	0,10%	0,30%	0,30%	16,40%	NO
3530	Manufacture of aircraft and spacecraft	0,00%	0,20%	0,30%	79,70%	YES
3541	Manufacture of motorcycles	<5%	<5%	<5%	52,70%	YES
3542	Manufacture of bicycles	<5%	0,30%	<5%	50,40%	YES
3543	Manufacture of invalid carriages	<5%	0,20%	<5%	35,00%	YES
3550	Manufacture of other transport equipment nec	<5%	0,40%	<5%	36,60%	YES
3611	Manufacture of chairs and seats	<5%	0,30%	<5%	20,40%	NO
3612	Manufacture of other office and shop furniture	<5%	0,30%	<5%	10,60%	NO
3613	Manufacture of other kitchen furniture	<5%	0,40%	<5%	7,30%	NO
3614	Manufacture of other furniture	0,00%	0,50%	0,50%	28,50%	NO
3615	Manufacture of mattresses	<5%	0,20%	<5%	8,30%	NO
3621	Striking of coins and medals	<5%	<5%	<5%	49,40%	YES
3622	Manufacture of jewellery and related articles nec	<5%	<5%	<5%	102,60%	YES
3630	Manufacture of musical instruments	<5%	0,10%	<5%	78,20%	YES
3640	Manufacture of sports goods	<5%	0,40%	<5%	66,60%	YES
3650	Manufacture of games and toys	0,10%	0,40%	0,40%	76,10%	YES
3661	Manufacture of imitation jewellery	<5%	<5%	<5%	88,20%	YES
3662	Manufacture of brooms and brushes	<5%	0,50%	<5%	43,30%	YES
3663	Other manufacturing nec	0,30%	0,80%	1,10%	60,40%	YES
3710	Recycling of metal waste and scrap	<5%	0,70%	<5%	n.a.	NO
3720	Recycling of non-metal waste and scrap	<5%	1,30%	<5%	n.a.	NO

Annex B CO_2 price forecasts

B.1 Introduction

In this Annex we present our findings from a literature review regarding the EUA price that is expected for 2020.

In July 2012 the European Commission announced to probably postpone ('back-load') some auction volume from 2013-2015 towards the end of Phase 3 of EU ETS (i.e. 2013-2020) in order to tackle the oversupply of allowances in the market (EC, 2011c). Although the decision making process has not been finalized yet (in February 2013), it seems that the EP will agree with back-loading as a mechanism to restore the EU ETS market. However, for reason of clarity we differentiate between price expectations that do take back-loading scenarios into account and those that do not.

Back-loading is seen by some as a first step towards a more structural reform. Various of these structural reforms have been investigated by the Carbon Market Report (EC, 2012a). If more structural reforms, like set-asides or price floors, would be accepted, prices analysed here will most likely change. Findings from the literature

B.1.1 Expected 2020 EUA price – no back-loading

PRIMES is a partial equilibrium model for the European Union energy markets. It can be used for forecasting, scenario construction and policy impact analyses and is often used in studies carried out for the European Commission. In 2010 the updated reference scenario of the PRIMES model has been presented (E3MLab, 2010). In this scenario the policies are incorporated that had been implemented in spring 2009 and the scenario reflects the effect of the first economic crisis. In the 2009 PRIMES reference scenario the 2020 EUA price amounts to 16.5 $€_{2008}$/t CO_2.

In 2010 the European Commission has carried out an assessment of different options to move beyond a 20% GHG emission reduction (EC, 2010). In this study it is being assumed that the economic crisis has long lasting effects, leading to a permanent loss of GDP. It is being differentiated between a baseline scenario and a reference scenario. In the reference scenario the Climate and Energy package is assumed to be nationally fully implemented and that non-ETS and renewable energy targets are being reached in 2020. The baseline scenario 2020 EUA prices amounts to 25 $€_{2008}$/t CO_2 whereas to 16 $€_{2008}$/t CO_2 in the reference scenario.

The Energy Efficiency Directive has been assessed by the European Commission (EC, 2011a). Different policy stringencies and different compensation options (e.g. income tax increase to compensate energy suppliers/distributors) have thereby been analysed. The EUA prices that have been derived in this study using the E3ME model are given in Table 15.

Table 15 **Expected EUA prices derived with E3ME-model depending on policy stringency and compensation measure**

		Option B1	Option B3	Option B4
EUA price	2010	11.1 €$_{2008}$/t CO_2		
	2015	19.9 €$_{2008}$/t CO_2	7.9-10.3 €$_{2008}$/t CO_2	0.8-4.7 €$_{2008}$/t CO_2
	2020	28.7 €$_{2008}$/t CO_2	7.7-10.4 €$_{2008}$/t CO_2	4.9-12 €$_{2008}$/t CO_2

Source: EC, 2011.

Options B1, B3, and B4 thereby represent different policy stringencies as follows:

- Option B1: Current approach is retained (limited encouragement in the Energy Services Directive);
- Option B3: All MS are required to introduce energy saving obligations while leaving their design for determination by MS;
- Option B4: As B3 but with harmonisation of key design features.

The price ranges reflect the different compensation measures.

In the assessment it is pointed out that the EUA price becomes zero in the long run in the E3ME forecast. This is due to the modelling approach chosen: the efficiency improvement is induced by a rise of energy prices in the model, leading to an endogenous decline of the EUA price.

Therefore the PRIMES 20% energy efficiencies scenarios are looked at as well. Under the assumptions that ETS continues until 2050, that unlimited banking is allowed from Phase 2 until 2050, and that full compliance with renewable energy targets is given for 2020, the 2020 EUA price amounts to 14.2 €$_{2008}$/t CO_2.

In the impact assessment of the Energy Roadmap 2050 of the European Commission (EC, 2011b) the expected EUA prices for 2020 amounts to 15 €$_{2008}$/t CO_2, assuming that the then current policy initiatives are being implemented. Other scenarios have been analysed as well. The according expected 2020 EUA prices are given in Table 16.

Table 16 **2020 EUA prices as expected in assessment of EC's Energy Roadmap 2050**

Scenario	2020 EUA price
Reference	18 €$_{2008}$/t CO_2
Current Policy Initiatives (updated reference scenario)	**15 €$_{2008}$/t CO_2**
High Energy Efficiency	15 €$_{2008}$/t CO_2
Diversified (Energy) Supply Technologies	25 €$_{2008}$/t CO_2
High RES (Renewable Energy Sources)	25 €$_{2008}$/t CO_2
Delayed CCS	25 €$_{2008}$/t CO_2
Low nuclear	20 €$_{2008}$/t CO_2

Source: EC, 2011b.

For a detailed description of the scenarios please see EC (2011b) on pages 26-27.

Very recently, in November 2012, a draft of the impact assessment of different back-loading options has been published (EC, 2012b). Here a review of recent carbon price forecasts by a number of private sector market analysts is given.

In Table 17 these price forecasts are given for the case that no back-loading is carried out.

Table 17 **EUA price forecasts for the case that there is no back-loading (in €/t CO_2 nominal prices)**

	2013	2014	2015	2016	2017	2018	2019	2020
Barcleys	5.5	5	4.5	4.5	4.5	5	7	10
Thomson Reuters Point Carbon	4	4	5	6	8	9	10	12
Tschach Solutions	4.5	8*	-	-	-	-	-	-
Bloomberg New Energy Finance	6.3	6.2	6.7	7.8	9.0	19.5	24.2	29.2

Source: EC, 2012b.

* Average of first two quarters of 2014.

Note that the forecasts given in Table 17 are in nominal prices. For the sake of comparison with the EUA prices presented so far, we converted these nominal prices into 2008 Euro (see Table 18).

Table 18 **EUA price forecasts for the case that there is no back-loading (in $€_{2008}$/t CO_2; rounded to 0.5)**

	2013	2014	2015	2016	2017	2018	2019	2020
Barcleys	5	4.5	4	4	4	4	5.5	9
Thomson Reuters Point Carbon	3.5	3.5	4.5	5	6.5	7.5	8	9.5
Tschach Solutions	4	7*	-	-	-	-	-	-
Bloomberg New Energy Finance	5.5	5.5	6	6.5	7.5	16	19.5	23.5

Source: Own calculations based on EC, 2012b.

* Average of first two quarters of 2014.

B.1.2 Expected 2020 EUA price consindering back-loading

In the above mentioned impact assessment of different back-loading options (EC, 2012b) carbon price forecasts by private sector market analysts are also given for the case that back-loading is implemented. In Table 19 the respective EUA price forecasts are given for different volumes of allowances to be back-loaded. A price range thereby reflects projections from different analysts. Note that the analysts do assume different timings regarding the back-loading, which makes the forecasts not directly comparable.

Table 19 **EUA price forecasts for different back-loading scenarios (in €/t CO_2 nominal prices)**

EUA price Back-loading	2013	2014	2015	2016	2017	2018	2019	2020
400 Mt	6-7.3	5.5-8.6	6-11	5	4.5-6	5-7	7-9	10-11
500 Mt	9.75	19*	-	-	-	-	-	-
700 Mt	7.5	10	11	8	7	7	8	10
800 Mt	10	-	-	-	-	-	-	-
900 Mt	8.6-13	12-23.5*	11-20	5	5	6	6	8
1,200 Mt	9-13	14	13-20	7-13	5-9	5-7	6-10	8-10

Source: EC, 2012b.

* Average of first two quarters of 2014.

Note also that the forecasts given in Table 19 are in nominal prices. For the sake of comparison with the EUA prices presented so far, we converted these nominal prices into 2008 Euro (see Table 20).

Table 20 EUA price forecasts for different back-loading scenarios (in $€_{2008}$/t CO_2; rounded to 0.5)

EUA price Back-loading	2013	2014	2015	2016	2017	2018	2019	2020
400 Mt	5.5-6.5	5-7.5	5-9.5	4.5	4-5	4-6	5.5-7.5	8-9
500 Mt	9	17*	-	-	-	-	-	-
700 Mt	7	9	9.5	7	6	6	6.5	8
800 Mt	9	-	-	-	-	-	-	-
900 Mt	7.5-11.5	10.5-21*	9.5-17.5	4.5	4	5	5	6.5
1,200 Mt	8-11.5	12.5	11.5-17.5	6-11	4-7.5	4-6	5-8	6.5-8

Source: Based on EC, 2012b; own calculations.

* Average of first two quarters of 2014.

A forecast that has not been taken into account here (EC, 2012b) is a forecast from IHS as presented in October 2012 (IHS, 2012). Several back-loading options (400-1,200 Mt), under the assumption that a EU ETS Phase 4 will be realised, are considered here as well. The 2020 EUA price does not vary much between the different back-loading scenarios (14-16 $€_{2011}$/t CO_2 or 12-14 $€_{2008}$/ t CO_2). Regarding the EUA price path it holds that the higher the volume of allowances back-loaded, the higher the price in the period 2013-2019 and the lower the price in the period after 2019.

The Öko-Institut (2012) comes to the conclusion that a stand-alone approach for a set aside which will be fully reintroduced to the market before 2020 will have negligible price effects. The EUA price would remain at a level of less than 8 €/EUA in 2013 and approx. 14 €/EUA in 2020.

Very recently Reuters has carried out a poll among 14 analysts that has been published beginning of December 2012 (Point Carbon, 2012). The forecasted EUA (nominal) prices for Phase 3 thereby range from 3.9 to 14.9 €/t CO_2 with an average price of 11.34 €/t CO_2 which corresponds to 3.5-13 $€_{2008}$/t CO_2. Unfortunately it is not clear to us inasmuch back-loading is accounted for in this forecast; we therefore do not consider the study in our conclusions.

Annex C Cost-pass-through for industrial products

Table 21 gives an overview of the cost-pass-through rates that ex-post empirically have been observed for a range of products from various sectors. It shows a wide range of ex-post cost-pass-through estimates. This is mostly due to the methods that have been used to determine the empirical cost-pass-through rates. More simple econometric methods were being used by Walker (2006), while the studies by Alexeevi-Talebi (2010); Oberndorfer *et al.* (2010) and CE Delft (2010) contained more advanced econometric time-series analysis.

From a methodological point of view one may distinguish between the input cost-approach where various cost components are being regressed on the output price and the significance of the CO_2 parameter is being observed, with the markets methods where price developments between markets with and without climate policies are being analysed. The markets method, as used in CE Delft (2010a) seems to have resulted in an estimate of higher cost-pass-through rates than the methods based on input costs (all the other studies listed in the Table 21). However, as explained in the literature cost-pass-through rates of above 100% could emerge in competitive markets if supply and demand exhibit certain characteristics (Sijm *et al.*, 2012).

Table 21 Overview of empirical studies finding cost-pass-through in various products

Study	Product	Country	Method	Cost-pass-through*
Refineries				
Oberndorfer, 2010	Diesel	UK	Costs	50%
Oberndorfer, 2010	Gasoline	"	Costs	75%
CE Delft, 2010a	Gasoline	EU	Markets	500%
CE Delft, 2010a	Diesel	EU	Markets	350%
Chemicals				
Oberndorfer, 2010	LPDE	"	Costs	100%
Oberndorfer, 2010	Ammonium	"	Costs	50%
CE Delft, 2010a	PE		Markets	100%
CE Delft, 2010a	PS		Markets	33%
CE Delft, 2010a	PVC		Markets	100%
Alexeeva-Talebi, 2010	Dyes and pigments	"	Costs	37%
Alexeeva-Talebi, 2010	Other basic inorganic chemicals	"	Costs	10%
Alexeeva-Talebi, 2010	Fertilizers and nitrogen compounds	"	Costs	16%
Alexeeva-Talebi, 2010	Plastics in primary forms	"	Costs	42%
Alexeeva-Talebi, 2010	Perfumes and toilet preparations	"	Costs	0%
Alexeeva-Talebi, 2010	Other rubber products	"	Costs	75%
Paper				
Alexeeva-Talebi, 2010	Paper and paperboard	Germany	Costs	0%
Alexeeva-Talebi, 2010	Household and toilet paper	"	Costs	38%
Glass				
Alexeeva-Talebi, 2010	Hollow glass	"	Costs	60%
Alexeeva-Talebi, 2010	Glass fibres	"	Costs	27%
Alexeeva-Talebi, 2010	Other glass, processed	"	Costs	24%
Oberndorfer, 2010	Hollow glass	"	Costs	20-25%
Oberndorfer, 2010	Container glass	"	Costs	0

Study	Product	Country	Method	Cost-pass-through*
Cement				
Alexeeva-Talebi, 2010	Cement, lime and plaster	"	Costs	73%
Walker, 2006	Cement	France	Costs	<30%
Walker, 2006	Cement	Germany	Costs	<30%
Walker, 2006	Cement	Italy	Costs	<10%
Walker, 2006	Cement	UK	Costs	<31%
Walker, 2006	Cement	Greek	Costs	<11%
Walker, 2006	Cement	Portugal	Costs	0
Walker, 2006	Cement	Spain	Costs	<37%
Steel				
CE Delft, 2010a	Hot rolled coil	EU	Markets	120%
CE Delft, 2010a	Cold rolled coil		Markets	110%
Ceramics				
Oberndorfer, 2010	Ceramic goods	"	Costs	>100%
Oberndorfer, 2010	Ceramic bricks	"	Costs	30-40%