Trade Exposure of Energy Intensive Sectors

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Author(s):
Marisa Korteland
Dagmar Nelissen
Sander de Bruyn

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Marisa Korteland, Dagmar Nelissen, Sander de Bruyn
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Further information on this study can be obtained from the contact person Marisa Korteland.

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Contents

Summary

In this report we analysed the origin and destinations of trade flows between EU and non-EU countries with respect to eight industrial sectors. In addition we looked at the political pledges made during the Copenhagen negotiations last December. If we combine these two types of insights, we get an idea of the risk of carbon leakage due to EU climate policies. Our analysis shows that the EU often trades with countries that have climate policy in place. As these major trading partners of the EU can be expected to adopt similar stringent climate policies, CO_2 might get a price in these markets as well and the risk of carbon leakage is reduced/absent. Trade intensities should be corrected for that.

In case the EU will adopt a -30% emission reduction target, trade with Australia, New Zealand, Japan, Switzerland, Brazil and Mexico, need to be excluded from the calculation of trade intensities since those countries will adopt comparable climate policies. The average downward correction on trade intensities is 3%. If the EU eventually decides to adopt a -20% reduction scenario, trade flows with Russia, Canada and the USA should also be excluded. Those countries will then have policies of similar stringency. The average correction on trade intensities is then -8,5%.

These findings have direct consequences on the allocation mechanism for some sectors, which will no longer receive free emission rights as they do not qualify as 'exposed' to international competition anymore. These sectors are listed in Table 4 (-30% scenario) and Table 5 (-20% scenario) on page 31. Yet, those sectors that are expected to face large cost increases (>5%) due to EU ETS, will still receive free allocation.

1 Introduction

1.1 Background

The EU emissions trading scheme (ETS) was launched in 2005 to cap CO_2 emissions from large industrial facilities and electricity producers. On December, 17, 2008 the European Parliament and the Council reached agreement on the design of EU ETS post 2012. One of the main issues is the allocation mechanism. Auctioning of emission rights is the main principle. Auctioning in general assures a greater deal of efficiency compared to (certain types of) free allocation, lowers the administrative costs and prevents eventual windfall profits.

However, auctioning also implies a potential loss of competitiveness for industry. If ultimately no significant international agreement on future climate policies is reached and non-EU countries commit to less strict climate policies, firms may not be able to pass on the higher costs to their customers and may be faced with a loss in profitability and the threat of import substitution. In any emission trading scheme with an absolute cap, a relocation of production that is not covered by CO_2 targets implies an increase in global CO_2 emissions. This phenomenon has been labelled as 'carbon leakage'. To prevent carbon leakage, 'exposed' sectors or subsectors are exempted from auctioning and receive free allocation of rights on the basis of a benchmark.

According to the legislative text (EC, 2009a), a sector or subsector is deemed to be exposed to a significant risk of carbon leakage if[1]:

- The sum of direct and indirect additional costs due to EU ETS is over 5% of Gross Value Added and the intensity of trade with third countries is above 10%. Or
- The sum of direct and indirect additional costs is at least 30% of GVA. Or
- The intensity of trade with third countries is above 30%.

Crucial parameters in the analysis of potential carbon leakage are thus trade patterns. If substantial imports and exports flow to countries that have no comparable climate change policy, there might indeed be a risk of carbon leakage[2]. If, on the other hand, trade is mainly within Europe of with countries that do impose climate policies on their firms, sector may be reduced at risk.
Therefore, in this analysis we will investigate the trade intensities of eight sectors and, given current pledged of countries for the international climate negotiations, their implication for the risk of carbon leakage.

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1 Although the list of sectors constructed on the basis of quantitative assessment of cost increases and trade intensities may be supplemented after completion of a qualitative assessment.

2 Other aspects such as market structure and the existence of trade barriers like transport costs and product differenciation also need to be considered in order to estimate the risk of carbon leakage.

1.2 General approach

The analysis consists of three steps:

- Description of political context; what is the expected strictness of climate policies in non-EU countries? Evaluation is based on the pledges countries in Copenhagen.
- Determination of trade intensities between countries of the European Economic Area (EEA) and non-EEA countries. The group of EEA countries consists of the EU-27 member states together with the EEA EFTA states Norway, Iceland, and Lichtenstein[3]. The following eight sectors are covered:
  - Cement.
  - Chlorine.
  - Polyvinyl chloride (PVC).
  - Iron & Steel.
  - Paper.
  - Copper.
  - Zinc.
  - Refineries
- Interpretation of results and correction of the Commission proposal on exposed sectors. The trade intensities published by the Commission are corrected for the trade with countries with similar climate policies.

1.3 Methodology trade intensities

Trade intensities are measured between EEA and non-EEA countries according to the formulas in box 1.

Box 1
Measuring trade intensities

1. $$\frac{\text{Import}_{\text{EEA countries from non-EEA country}}}{\left(\text{Import}_{\text{EEA countries from non-EEA countries}} + \text{Production}_{\text{EEA countries}}\right)}$$

2. $$\frac{\text{Export}_{\text{EEA countries to non-EEA country}}}{\left(\text{Import}_{\text{EEA countries from non-EEA countries}} + \text{Production}_{\text{EEA countries}}\right)}$$

That is, the sum of:

- The total value of the import of the respective goods of the EEA countries from non-EEA countries. And
- The total value of production of the respective goods of the EEA countries.

Is related to:

- The value of the import of all the EEA countries from a specific non-EEA country (formula 1).
- The value of the export of all the EEA countries to a specific non-EEA country (formula 2).

[3] For simplicity we use EU and non- EU distinction in the remainder of this report.

For all sectors except the refineries, import and export data are extracted from the Eurostat Comext database on external trade (Comext, 2009) while the data on production is taken from the Eurostat Prodcom database for manufactured goods (Prodcom, 2009).

Comext trade data is provided according to the Standard International Trade Classification (SITC Rev. 3), whereas Prodcom data is set up according to the Nomenclature statistique des activités économique dans la Communauté Européenne (NACE Rev. 1.1). In order to calculate the trade intensities, the Comext data has been converted to match the NACE classification. Only those SITC subsectors have been taken into account for which a corresponding NACE subsector does exist. As a consequence, confidential trade data has not been taken into account. Please note that the value of exports is underestimated to some extend since particularly export data is classified to be confidential. Trade intensities are related to the year 2007.

Due to a lack of data on the refinery sector in these databases, an alternative data source had to be used. Trade and production data has been extracted from the OECD STAN database[4] and have 2006 as base year (OECD, 2009). The shortcoming of this data is that import and production of Bulgaria, Estonia, Latvia, Lithuania, Malta, Romania and Slovenia are not included, nor does it incorporate the EEA EFTA states. In general, it should be noted that all databases report zero trade in cases where no data is available. This means that trade between countries for which no trade information is provided falls in the lowest category (<100).

Since trade intensities are determined for individual countries, presenting them in the unit 'per cent' will yield very small figures. Therefore we convert them to 'per million' (e.g. compare % to ‰).

1.4 Structure

The structure of this report is as follows. Chapter 2 will broadly outline the political context on climate change. It will reveal the degree of comparability of efforts between EU and non EU countries. In chapter 3 trade intensities of the eight sectors are provided. Chapter 4 forms the conclusion.

[4] For the sector "Manufacture of coke, refined petroleum products and nuclear fuel"

2 Political context

In order to interpret the trade flow data, the degree to which other countries commit themselves to EU-comparable emission reductions needs to be assessed. If main trading partners of the EEA countries will implement similar climate policies, carbon also gets a price in those regions and the risk of carbon leakage decreases. Information on the pledges of Annex I respectively non-Annex I countries in the international climate change negotiations in Copenhagen are illustrative for the political context. Besides, the eventual EU target will also depend on what other countries are putting forward as targets in the international climate negotiations.

2.1 Annex I countries

PBL (2009) compares countries' pledges[5] with the targets resulting from modelling using various effort-sharing approaches. Such a comparison allows taking some conclusions regarding the question if the specific countries do commit to comparable effort sharing or not. Table 1 and Figure 1 below give a summary of findings from this modelling exercise.[6]

Table 1 **Countries' pledges in climate negotiations versus targets resulting from modelling**

Country	Pledge	Conclusions from modelling
Australia	5-25% reduction by 2020 as compared to 2000.	Significant pledge, especially the higher limit.
Canada	17% reduction by 2020 as compared to 2005.	In most approaches, the pledge of Canada is below the reduction targets resulting from modelling.
Japan	25% reduction by 2020 as compared to 1990, conditional on international agreement.	The pledge of Japan is on the ambitious end of the results of modelling.
New Zealand	10-20% reduction by 2020 as compared to 1990.	The pledge of New Zealand is on the ambitious end of the results of modelling.
Norway	30% reduction by 2020 as compared to 1990, 40% conditional on international agreement.	The pledge of Norway is without doubt the most ambitious of all countries and above results of modelling for all approaches.
Russia	25% reduction by 2020 as compared to 1990 conditioned on international agreement.	The pledge of Russia is not ambitious as compared to the results of modelling. All effort-sharing approaches suggest higher targets.
Switzer-land	20-30% reduction by 2020 as compared to 1990.	The pledge of Switzerland, and especially the higher end, is in line with the targets resulting from modelling.

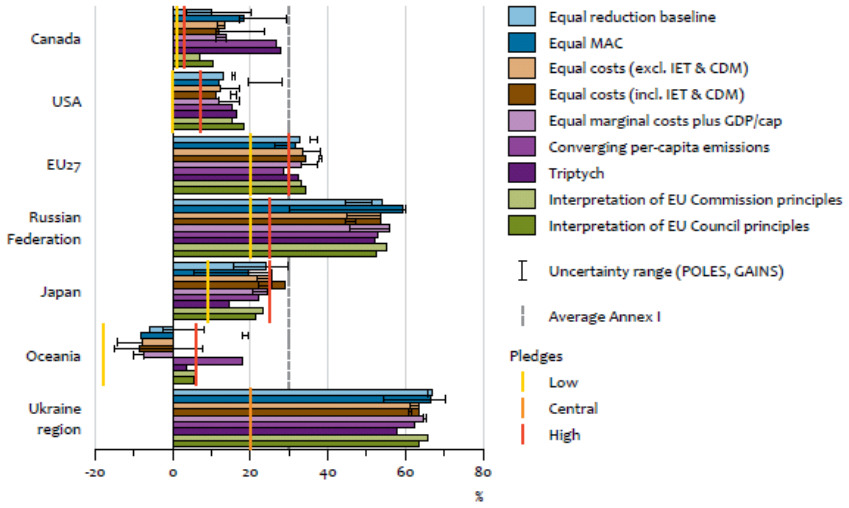
5 Countries' pledges as reported in PBL (2009) have been updated and verified against the pledges published in UNFCCC (2010). Note that the results are highly dependent on the definition of the rules for LULUCF.

6 Please note that the selection of countries included in the table and in the graph is slightly different, which is due to the fact that not all countries presented in the table are included in the FAIR model used by PBL (2009).

Country	Pledge	Conclusions from modelling
USA	No official pledge; president Obama has stated that the USA could remove emissions to 1990 levels; planned legislation is taken as the more ambitious target in the range of 17% reduction by 2020 as compared with 2005 level.	The current version of the legislation is less ambitious than the reduction range calculated in the model unless financing of reducing emissions from deforestation in developing countries is included.

Source: Based on PBL (2009) and UNEP (2010).

Figure 1 GHG emission reduction targets 1990-2020, Annex I countries and regions



From Table 1 and Figure 1 it becomes evident that, according to this model (PBL, 2009), the current pledge of 20% reduction in the EU would be similar to the highest pledges from Canada, Ukraine, Russia and the USA[7]. However, this should not fully restrict the EU from accepting higher targets as the higher range of pledges from Japan and Australia/New Zealand (as well as Norway and Switzerland) would be in line with the EU -30% target. So the question is in essence here: who does the EU want to follow: the disappointing climate policies of the USA and Russia, or the more ambitious proposals of Australia, New Zealand and Japan along with the non-EU European countries?

2.2 Emerging non-Annex I counties

Current positions of emerging economies on GHG reduction are much more difficult to assess than the positions of countries representing more developed economies. Ecofys (2009) provides such a preliminary evaluation.[8] The evaluation is performed by comparing the current and projected performance of a given country with the target of 15-30% reduction below a reference scenario, which is consistent with the scenario of keeping global warming below 2° C increase in temperature while Annex I countries reduce in total 30%

7 Based on all comparable effort-sharing approaches except for converging per-capita emissions.

8 The evaluation of Ecofys has been updated and verified using the data from UNEP (2010).

of emissions (in 2020 as compared to 1990). The main findings of this analysis are summarised in Table 2.

Table 2 **Current pledges of the selected emerging economies and their evaluation regarding comparable effort-sharing**

Country	Pledge	Evaluation
China	40-45% reduction by 2020 as compared with 2005.	No quantitative emission target has been proposed. China's domestic plans include targets and policies which are ambitious and would rate as moderate to sufficient.
India	No overall quantitative target has been announced. The announced endeavour is to reduce emissions intensity of GDP by 20-25% by 2020 as compared to the level of 2005.	India's goals stated in a national climate plan are rated medium.
Brazil	36-39% as compared to reference emissions projected for 2020, which would approximate 1994 emission levels.	Ambitious target. The most important measure planned is to reduce the deforestation rate in the Amazon region by 80% between 2005 and 2020.
South Africa	34% below a reference scenario for 2020.	Ambitious target although it is not clear what measures will be implemented.
Mexico	21% below a reference scenario in 2020 and -30% with international financing.	Ambitious goals and a detailed climate plan. However the reductions after 2012 are conditional on external financing.
South Korea	30% below reference emissions in 2020, which is 4% below 2005 level.	Relatively ambitious target however the comparable effort ranges would require more ambitious reductions due to the relatively high level of development.

Source: Based on Ecofys (2009) and UNEP (2010).

The differences in the ambition level between the countries in this group are large. Brazil ranks high, Mexico and Korea are in the middle of the range, while the targets of China and India are at the moment impossible to assess in qualitative terms.

2.3 Conclusion

By comparing the pledges of the various countries in Copenhagen, one may arrive at the conclusion that a -20% target is disappointing and more or less comparable to what the USA, Canada and Russia have suggested. However many countries have put forward more ambitious reduction targets, like Australia/New Zealand, Japan, Norway, Switzerland and most non-Annex I countries. This means the risk of carbon leakage to these counties is low, even if the EU feels pressurised to increase its target to -30% at least.

3 Trade intensities

After a brief introduction per sector, trade intensities between EU countries and non-EU countries are provided in this chapter, based on the analysis of import and export flows.

3.1 Chemical sector

3.1.1 Introduction

Chemicals is a complex sector that comprises of 20 subsectors with various types of production processes and outputs. Subsequently, CO_2 emissions and the successive impact of EU ETS may vary widely.

The EU basic chemical production is dominated by a few countries. Germany is on top, followed by, France, UK, the Netherlands, Belgium and Ireland (NERI et al., 2007a). In terms of turnover, the subsectors other organic chemicals and plastics in primary form are most important.

While it is believed that fertilizers may have had problems with passing through the costs of their freely obtained allowances so far, relatively little is known on the organic and inorganic chemical sectors. These sectors are in essence characterised by a two-stage production technology in which first liquid bulk inputs that are dangerous to transport (chlorine, ethylene, styrene, etc.) are transformed into intermediate products (PVC, PS, PE, PP) that can be at relatively low costs transported. The chemical sector claims that this phenomenon assures that, given the international trade in the end-products, possibilities of cost-pass through are absent, even though chlorine itself is hardly being traded.

In order to shed some light on this statement, trade flows of both chlorine and PVC are considered. Chlorine is a product from the inorganic chemical industry, whose production is highly electricity intensive[9]. Chlorine is produced by electrolysis using three main technologies: mercury, membrane and diaphragm[10]. The chief application of chlorine is in the manufacturing of PVC[11].

[9] Energy consumption is about 3,440 KWh per ton of chlorine.

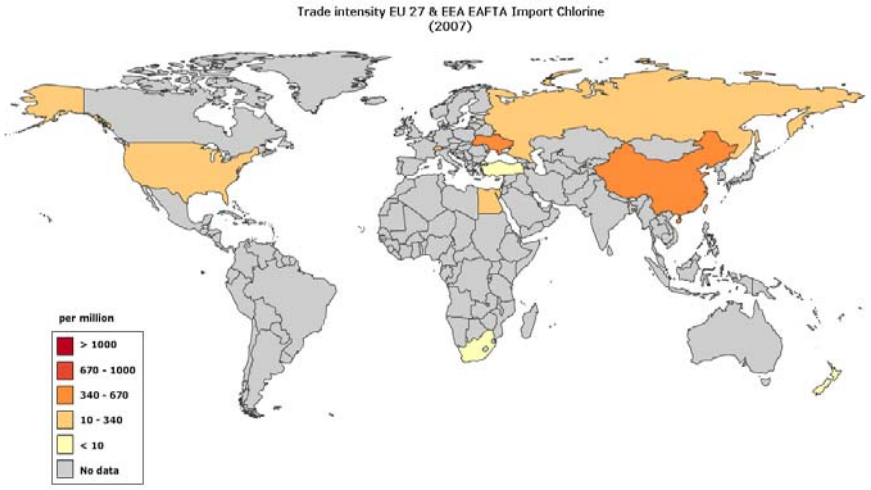
[10] Mercury has been the principal process in the EU, representing 43% of production capacity in 2006. In the future, the industry is expected to move towards mercury free technologies (in response to safety and environmental concerns), particularly to the more energy efficient membrane process (Euro Chlor, 2007).

[11] With the production of chlorine, caustic soda is also produced. This co-product also has a wide range of applications, among which the production of pulp and paper.

3.1.2 Trade flows chlorine

Chlorine trade between the EU and non-EU regions appears to be limited. High risks associated with transports of substances like chlorine translate into relatively low non-EU trade intensities for those chemical sectors (Climate Strategies, 2007). In addition, transport costs might be substantial for products with chemical inputs that require temperature to be controlled (NERI et al., 2007b). Chlorine is mainly used at the site where it is produced in a variety of downstream units such as those for PVC (Euro Chlor, 2009).
It is therefore not surprising that the non-EU trade intensity of chlorine is very low. In 2007 the non-EU trade of chlorine was slightly above the 1%[12]. There is hardly any import, with the limited imports originating mainly from China and the Ukraine. Those countries both accounting for about 30% of non-EU imports to the EU, see Figure 2.

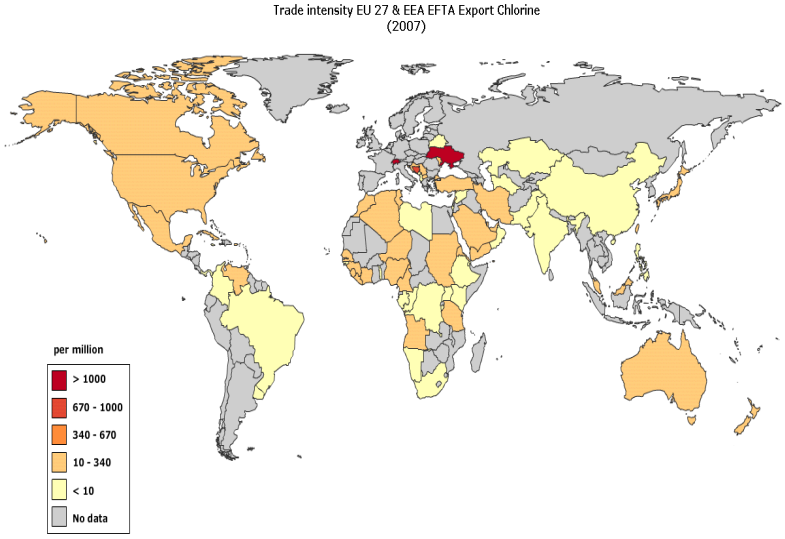
Figure 2 Trade intensities imports of chlorine (per million)



Although the amount of exports is also limited, the EU is a net exporter of chlorine. Exports are about six times higher than imports. Switzerland, Ukraine, Turkey and Northern America seem to be the main export markets of European chlorine produced, see Figure 3. Exports to Switzerland cover 30% of total non-EU exports.

[12] In calculating the non-EU trade intensities we include countries participating in EU ETS as EU countries. It deals here with Norway, Liechtenstein and Iceland.

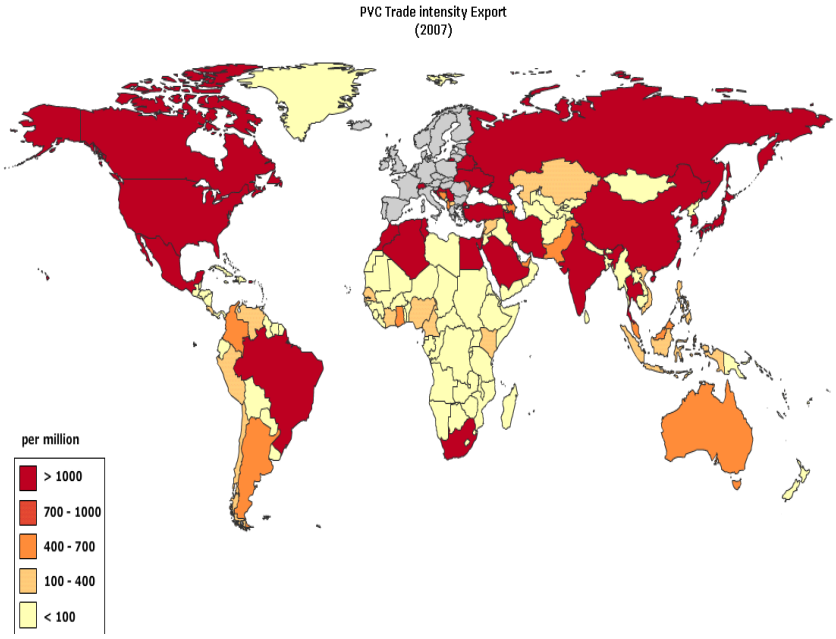
Figure 3 **Trade intensities exports of chlorine produced in EU 27+3 (per million)**



3.1.3 Trade flows PVC

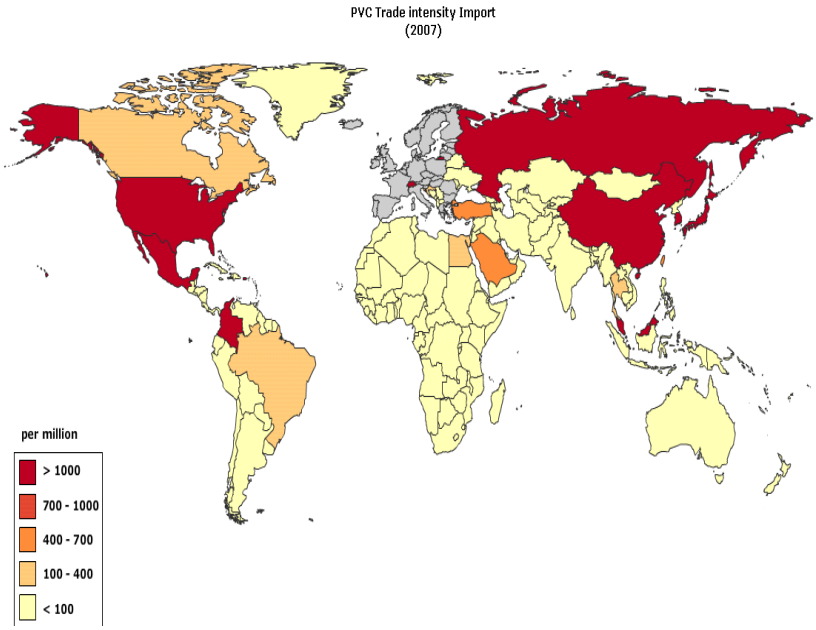
The EU-27 is mainly an exporter of PVC around the globe, as is illustrated by Figure 4. There are hardly any economies of importance to which the EU does not ship substantial deliveries of PVC.

Figure 4 **Trade intensities exports of PVC (per million)**



On the European market itself, import competition mainly comes from a limited number of countries, see Figure 5. In the East, these are Russia, China, Korea, and Japan. In the West, imports originate from the USA, Mexico and Columbia. The USA accounts for nearly 40% of the total imports.

Figure 5 Trade intensities imports of PVC (per million)



3.2 Refinery sector

3.2.1 Introduction

Refineries are very large complex industrial plants converting crude oil to a large range of products, from asphalt to fuel gas based on various crude oil grades (IEA, 2005b). The refinery sector consists of all refinery sites that take in the oil and produce finished products, such as gasoline.

The refining process varies in complexity but all techniques do follow a similar production pattern. The refining sector has been responsible for nearly 3.5% of EU-25 CO_2 emissions (Climate Strategies, 2007). These are particularly direct emissions, thus created during the refinery route (McKinsey, 2006).

Within the EU, Northern European countries tend to produce relatively high valued products, such as automotive fuels or inputs for the chemical industry. Southern Europe generates a large proportion of fuel and gas oils, although this is slowly changing as industrialists and power generators in this region are switching to natural gas as a heat or power source (IEA, 2005b).

3.2.2 Trade flows

The world refinery industry can be characterised by its regional character. Refinery capacity is dominated by the Middle East, Eastern Europe and South America, which together account for almost two thirds of global refineries (IEA, 2005b). There are some trade flows in and out of the European Union, but these would involve selected products. This trade can be considered as structural (McKinsey, 2006). Apart from this structural trade, however, refineries are traded at local/regional markets.

Figure 6 and Figure 7 give the import and export countries relevant in the refineries sector. The highest import intensity is reached with Russia, covering 40% of total imports. Other major trading partners are Northern America, Turkey and India. Exports of the EU 27+3 are mainly to the United States, accounting for 30% of total exports, followed by Mexico, Switzerland and Turkey.

Figure 6 **Trade intensities imports of refinery products (per million)**

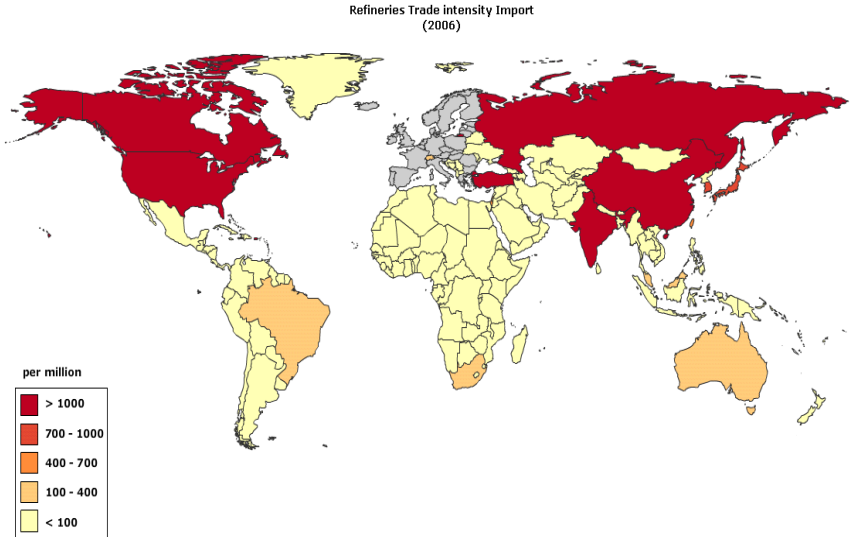
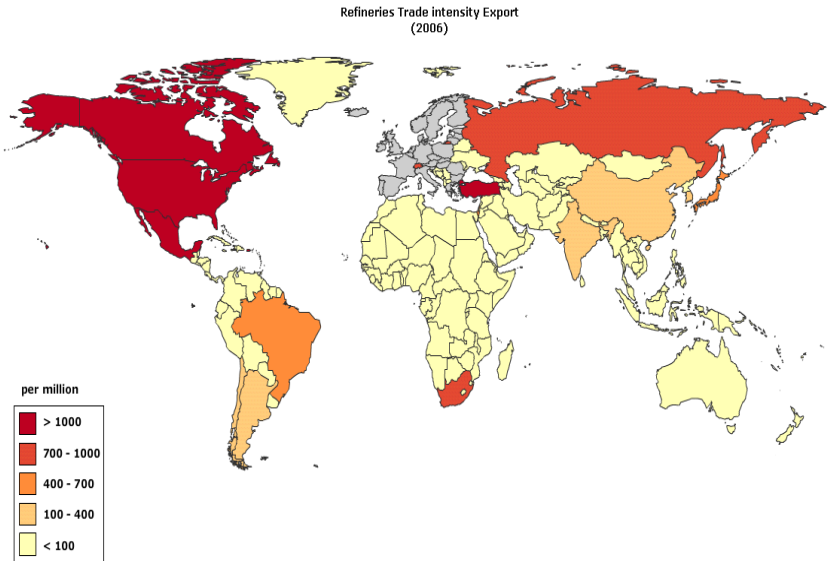


Figure 7 **Trade intensities exports of refinery products (per million)**



3.3 Steel sector

3.3.1 Introduction

In steelmaking, two main production routes can be distinguished. Primary steelmaking comprises the smelting of primary materials as iron ore and coal coke. It is performed in large scale integrated facilities (3-15 Mt), mainly involving basic oxygen furnace (BOF) (Hatch Beddows, 2007). The majority of the final products that emerge from this production process are so called flat products[13]. These are often specialties with a relative high value, especially used in the automotive industry (McKinsey, 2006; Climate Strategies, 2007). Secondary steel is created by remelting the scrap that arises from downstream manufacturing processes and consumer goods. It is performed in relatively smaller mills, generally involving electric arc furnaces (EAF) (Hatch Beddows, 2007). The largest part of the production is focused on long products. These are mostly commodities, used in for example the housing sector (McKinsey, 2006; Climate Strategies, 2007).

The production of steel (and iron) is one of the most energy intensive manufacturing sectors and accounts for an estimated 5.2% of total global greenhouse gas emissions (OECD, 2005). The BOF production process used much more energy than the EAF process; it would be, on average, be 4.5 times more emission intensive (OECD, 2005a). BOF plants would therefore bear most of the cost increase from carbon pricing. Total steel production in the EU-25 region was about 184 million tons in 2003, whereby the greatest part, about 62%, originates from BOF processes (McKinsey, 2006). Various empirical studies investigated the risk of carbon leakage in the steel sector[14]. These studies reveal leakage rates of 35 to 60%.

3.3.2 Trade flows

Steel is indeed a heavily traded good; about 40% of worldwide production is being traded. and Figure 8 confirm this. Exports of the EU flow mainly to the United States, Turkey, Switzerland and China. The largest import flows originate from China and Russia. Although India and the Ukraine are other important steel producers worldwide, they do not ship large amounts of steel (measured in monetary terms) to the EU. They cover only 5 respectively 8% of total non-EU imports.

The non-EU steel import ratios are low given the difference in operating costs observed throughout the world. The average BOF western EU plant has 40% higher operating costs than Brazil and Russia. This gap falls to around 20% for India and China (Climate Strategies, 2007)[15]. The European steel market seems to be somewhat protected from these foreign imports through trade barriers such as product and service differentiation and transport cost (see IEA, 2005a).

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[13] In the EU, 75% of the steel products from BOF plants are flat end-products, 25% are long end-products (McKinsey, 2006).

[14] Under the assumption that the competitiveness impact of an emissions trading scheme would be identical to that of a homogenous carbon tax. Estimates depend on the tax rate (Gielen and Moriguchi, 2002; OECD, 2002 in Climate Strategies, 2007).

[15] Concerning the EAF plants, operating costs vary much less among regions (Climate Strategies, 2007), so low trade intensities are not striking as far as cost differences are concerned.

Figure 8 Trade intensities exports of steel (per million)

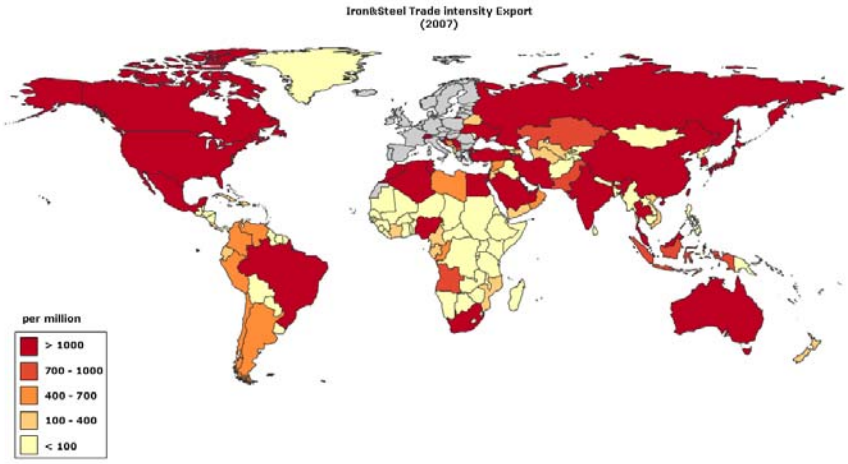
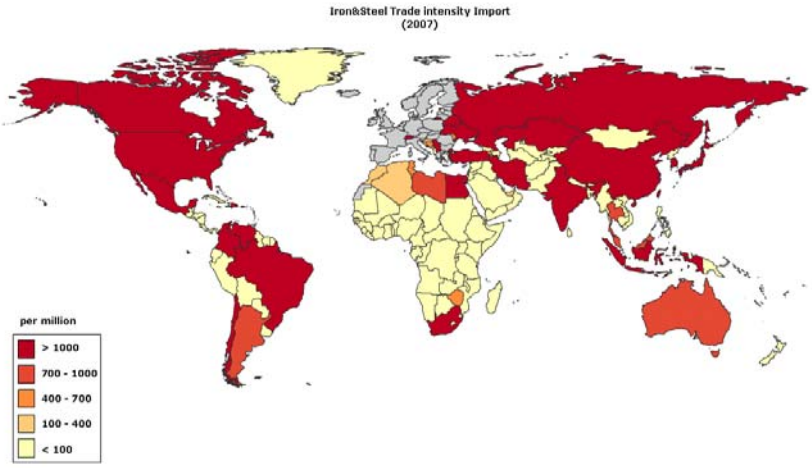


Figure 9 Trade intensities imports of steel (per million)



3.4 Cement sector

3.4.1 Introduction

Cement is a relatively homogenous product, whose production is a highly energy intensive activity. Cement manufacturing contributes to about 5% of the global anthropogenic emissions CO_2 (WBCSD, 2009). Three types of production methods can be distinguished: dry, semi-dry and wet processes. In the EU-25, dry production process represents 95% of the total production, only 5% is accounted for by wet processes (McKinsey, 2006). Production is highest in large EU countries and in the Mediterranean area (Spain, Italy and Germany) (NERI et al., 2007a).

3.4.2 Trade flows

There is a global market of cement with a total production of 2.55 billon ton in 2006 (USGS, 2008). China is the main player on the market, accounting for 67% of world production. As Figure 10 shows, it is also the largest importer to the EU, covering over 40% of non-EU imports, followed at great distance by Turkey, Thailand, Egypt and Croatia. Non-EU exports mainly flow to the United States and Russia, as Figure 11 reveals.

Nevertheless, trade intensities between Europe and non-EU regions remain relatively low (about 7%). Cement is produced in virtually all countries, due to the fact that (1) cement is an important construction material and (2) the raw material (limestone) needed for cement production is geographically abundant (IEA, 2005a).

An issue that is not captured by the analysis, is that the impact of emission trading might be different for individual EU member states, dependent on geographical location. In areas close to seaports and near (southern) EU borders, such as Greece, Italy, southern France and Spain, the risk of import substitution is highest (Climate Strategies, 2007). Several export capacities are available in the countries' neighborhood (NERI et al., 2007b). For other countries, such as the Netherlands and Germany, international pressure seems to be limited or even absent at the moment. Producers are protected by high transport costs and some other trade barriers (Climate Strategies, 2007).

Figure 10 Trade intensities imports of cement (per million)

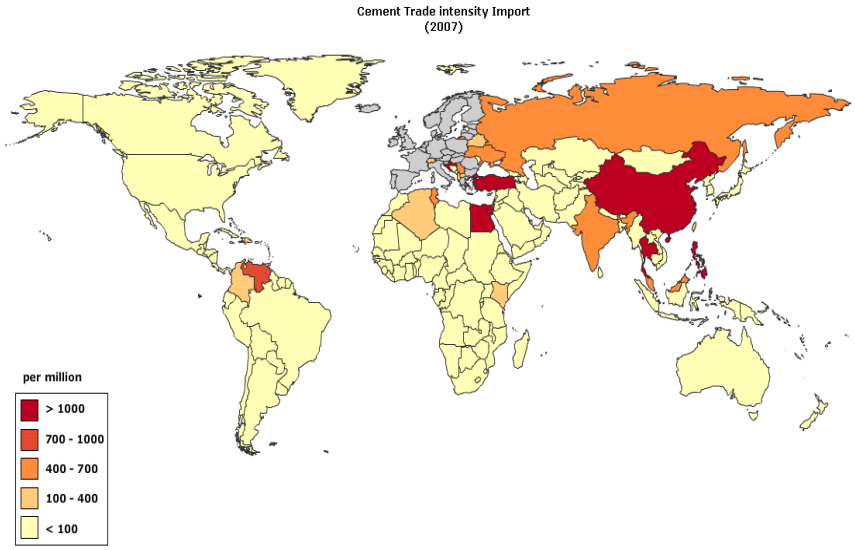
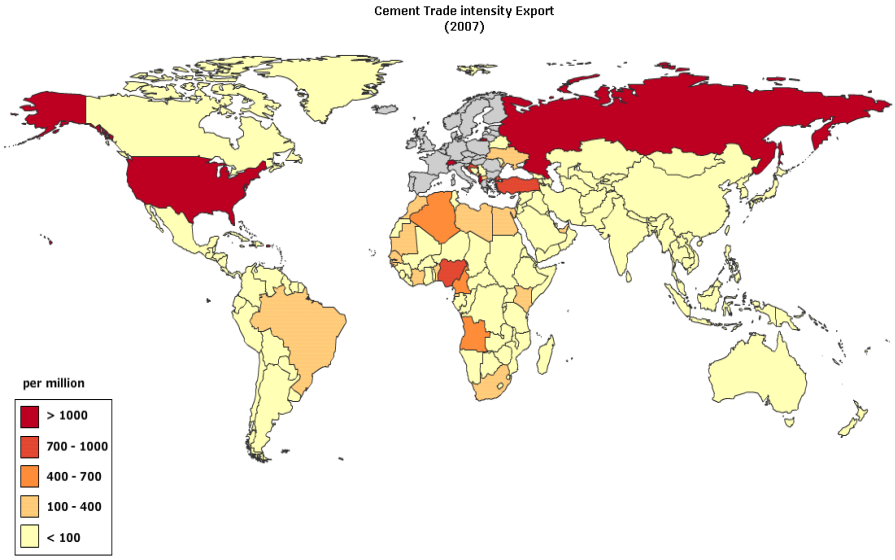


Figure 11 Trade intensities exports of cement (per million)



3.5 Paper and pulp sector

3.5.1 Introduction

The market for paper and pulp is international, competitive and at the same time highly diversified. There are various base materials, production methods and applications, varying from printing paper to packaging.

Europe represents a quarter of world paper production and consumption. Its paper industry produces over 90 million tons of paper and board and about 84 million tons of pulp per year (McKinsey, 2006). This pulp production is almost equally split between production from recovered fibre, i.e. secondary pulp, and production from wood, the so-called primary pulp (McKinsey, 2006). The production of primary pulp is dominated by chemical pulping (30%), which is the least energy consuming process compared to mechanical (6%) and thermo mechanical (12% of production) pulping. Nevertheless, in 2002 the pulp and paper sector represented 5 % of European CO_2 emissions (IEA, 2005a).

Within the EU, Germany, Finland and Sweden are the major players, which individual production over 12 million tons (EIPPCB, 2001; VNP, 2007).

3.5.2 Trade flows paper

Figure 12 and Figure 13 show the import and export countries relevant in the paper sector. With respect to exports, the main destination is Russia followed by the United States and Switzerland. At the same time, imports also mainly originate from latter countries. Europe is a net importer of paper products from the USA and Switzerland. It should be noticed that trade flows in and out of the region might involve different types of products.

Figure 12 Trade intensities exports of paper (per million)

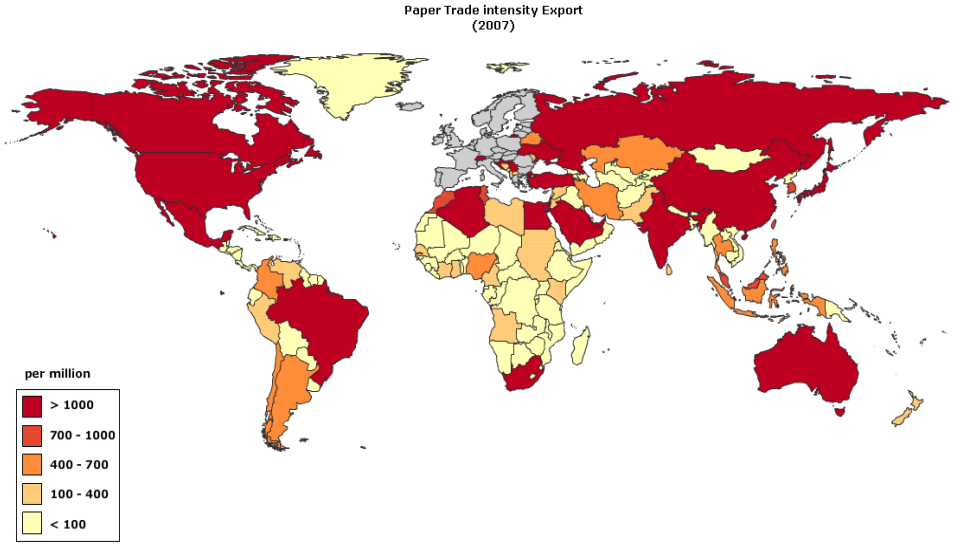
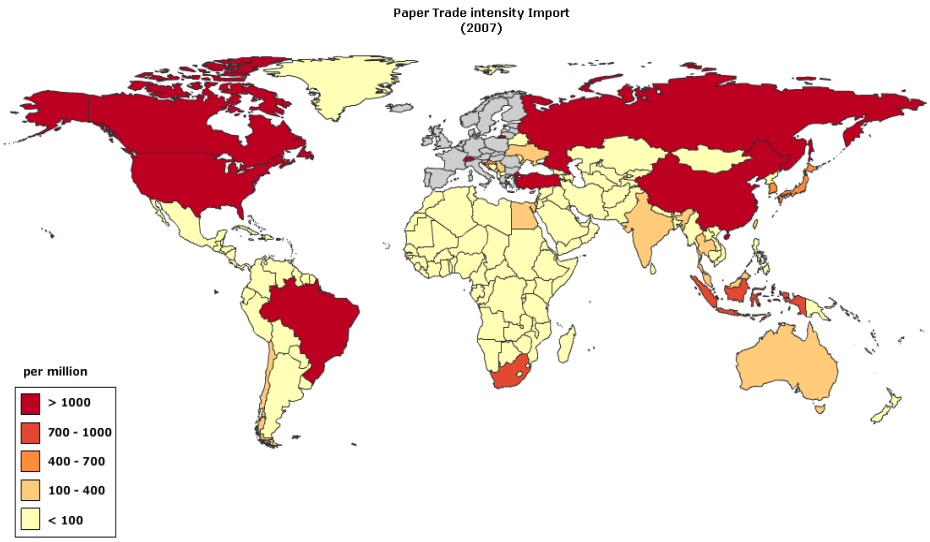


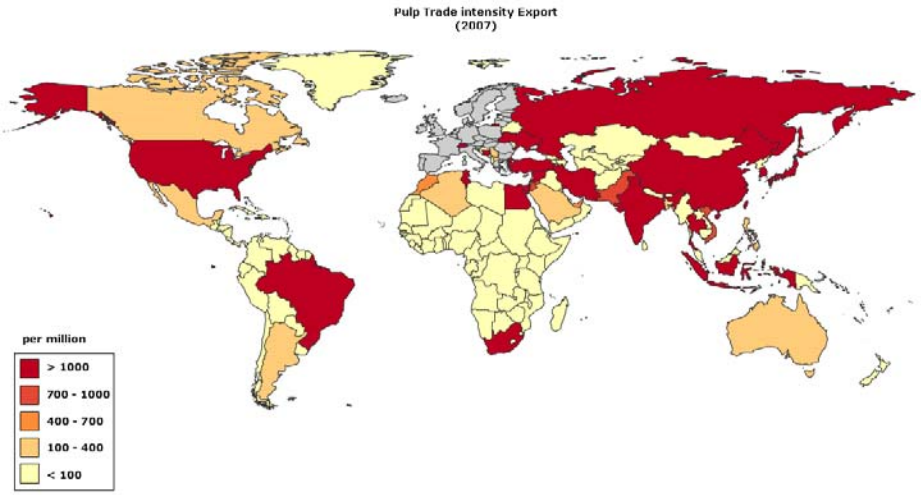
Figure 13 Trade intensities imports of paper (per million)



3.5.3 Trade flows pulp

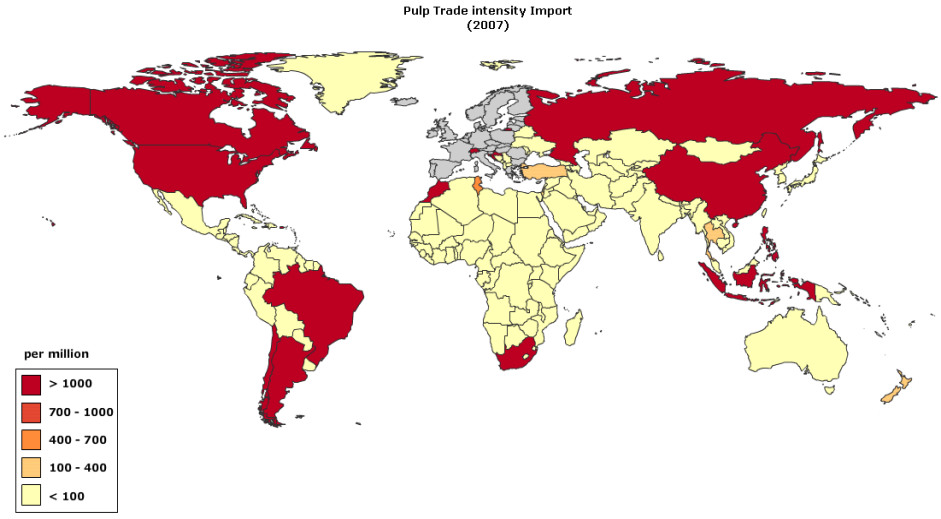
As Figure 14 and Figure 15 show, trade in pulp[16] is more concentrated that trade in paper, which involves numerous countries. Export of pulp mainly go to China, Switzerland and Turkey.

Figure 14 Trade intensities exports of pulp (per million)



Non-EU imports originate mostly from woody areas such as Brazil (33% of imports), USA, Canada, Russia and Indonesia. Intra-EU imports show a similar pattern; these are dominated by Sweden and Finland.

Figure 15 Trade intensities imports of pulp (per million)



16 Please note that not all subsectors are covered in the figures due to the conversion in classification codes that had to be made, see section 1.3.

3.6 Non-ferrous metals sector

3.6.1 Introduction

The non-ferrous metals sector covers numerous metals other than iron and alloys that do not contain an appreciable amount of iron. Examples are aluminium, copper, nickel, tin, zinc and lead.

Much analysis has been conducted on the costs of EU ETS for the aluminium industry, the largest subsector. It is believed that aluminium producers have limited opportunity to pass through costs of climate policy on to customers. It has a relatively homogeneous product and faces international competition and price setting through the London Metal Exchange and Shanghai Futures exchange. Relatively little is said about the other non-ferrous metals, such as copper, zinc and lead.

Primary zinc is produced via two different routes, namely 'Roasting–Leaching–Electrolysis' (RLE) and the Imperial Smelting Furnace (ISF). Only two ISF installations are left in Europe. There are 11 installations under EU ETS, causing 519 kton CO_2 emissions (Ecofys et al., 2009).

Copper is produced via the primary as well as the secondary production route. Primary copper production starts from concentrates with a copper content of up to 30 %, which are roasted, melted, converted and refined to copper with a copper content of 98 to 99,9%. Pure copper scrap for secondary production can directly be melt into billets, cakes and slabs. Less pure scrap with a copper content between 1 and 99 % is transformed to anodes by different treatments, depending on the scrap quality. There are nearly 40 installations with copper activities under the EU ETS. They represent about 2.25 Mt of CO_2 (average 2005-2007) (Ecofys et al., 2009).

3.6.2 Trade flows copper

Exports of copper are highest to Switzerland and the USA, although countries as Turkey, Tunisia and Morocco are also relevant destinations, see Figure 16. Europe is a net importer. Copper metal (cathodes) and concentrates are mainly imported from Chile, accounting for nearly 50% of non-EU imports. Other import countries are shown in Figure 17.

Figure 16 Trade intensities exports of copper (per million)

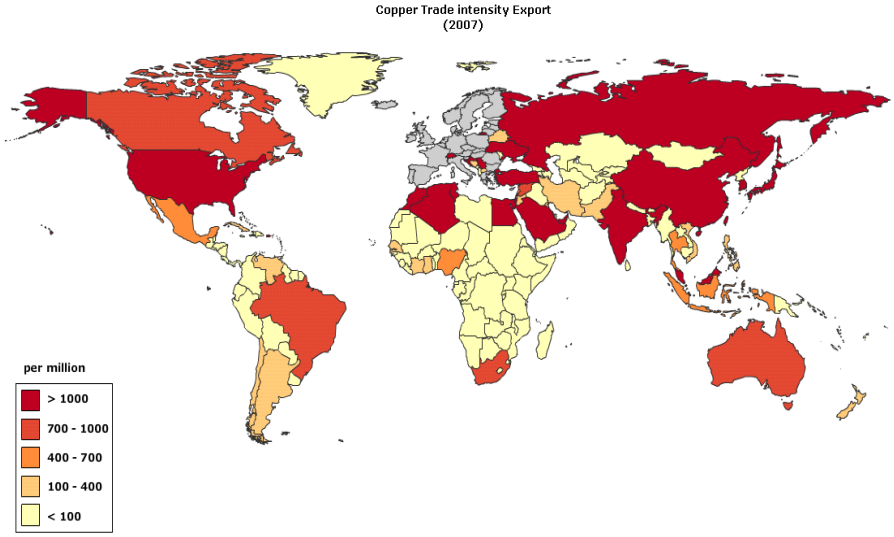
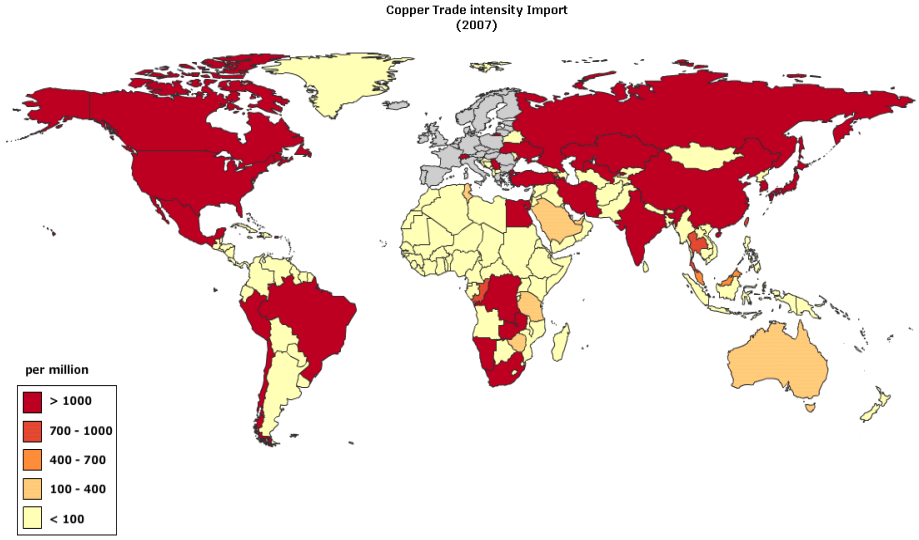


Figure 17 Trade intensities imports of copper (per million)



3.6.3 Zinc

Figure 19 and Figure 18 show the main non-EU trading partners of the zinc sector in Europe. It exports a major part of its production to Turkey (almost 40% of total non-EU exports). Other countries are the USA, Saudi Arabia, Malaysia and China. Europe is also a net importer of zinc. Most imports originate from Kazakhstan, Namibia, India, Mexico and China.

Figure 18 Trade intensities exports of copper (per million)

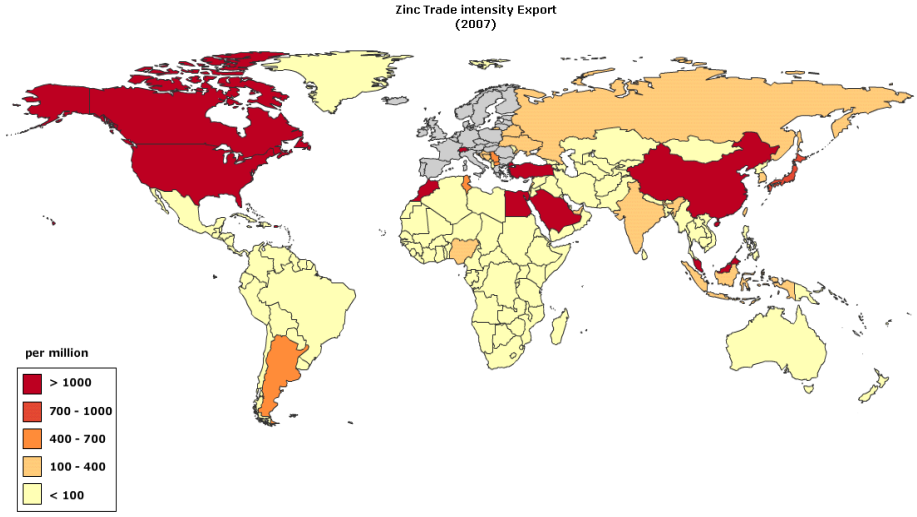
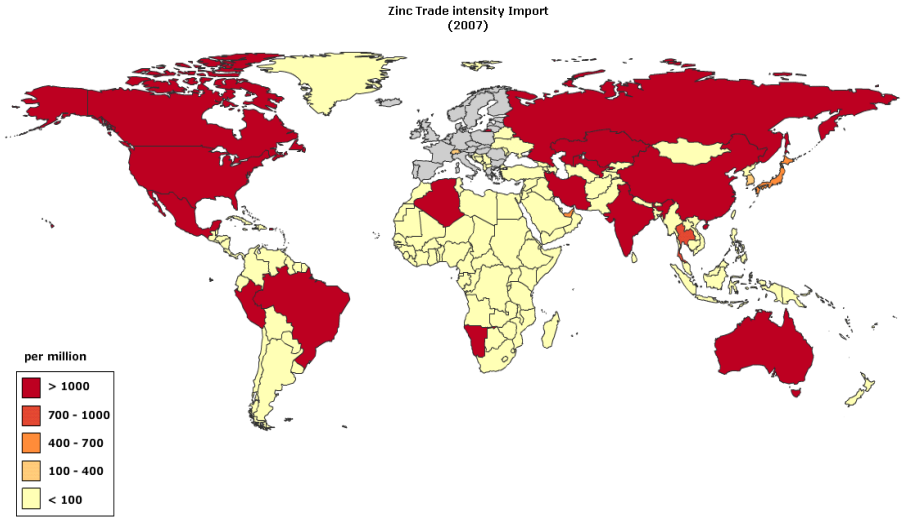


Figure 19 Trade intensities imports of copper (per million)



4 Conclusions

4.1 Main conclusion

In chapter 2 we analysed the political pledges of non-EU countries and in chapter 3 we revealed the origin and destinations of main trade flows. If we combine these two insights, we get an idea of the risk of carbon leakage due to EU climate policies. Our analysis shows that the EU often trades with countries that have climate policy in place. As these major trading partners of the EU can be expected to adopt similar stringent climate policies, CO_2 might get a price in these markets as well and the risk of carbon leakage is reduced/absent. Trade intensities should be corrected for that.

In the case of a -30% reduction, trade with Australia, New Zealand, Japan, Switzerland, Brazil and Mexico, need to be excluded from the calculation of trade intensities since those countries will adopt comparable climate policies. The average downward correction on trade intensities is 3%[17]. If the EU eventually decides to adopt a -20% reduction scenario, trade flows with Russia, Canada and the USA should also be excluded. Those countries will then have policies of similar stringency. The average correction on trade intensity is then -8,5%.

4.2 Impact on list of 'exposed' sectors

Table 3 reveals per sector to what extent the trade intensity estimates proposed by the European Commission can be corrected if we exclude countries with similar policy ambition from the trade data. Under the scenario in which the EU adopts a -30% target, trade intensities have been reduced by 3%. When Europe commits to a -20% target, trade intensities have been reduced by 8,5%. Especially in the pulp and paper sector, trade intensities drop significantly (24-25%) under latter scenario. The reason is that Europe imports a lot of pulp and wallpaper (SBI 2124) from countries such as Russia, Canada and the USA.

[17] Average determined on the basis of the eight evaluated sectors.

Table 3 Trade intensities per sector and proposed correction for two EU reduction target scenario's[18]

(Sub)sector		Overall trade intensity			Total cost increase
Name	*SBI-code*	*Figure European Commission (EC)*	*Correction -30% scenario*	*Correction -20% scenario*	*Figure EC*
Refineries	2320[19]	16.10%	-1.29%	-8.42%	15.2%
Cement	2651	6.80%	-0.17%	-0.66%	59.2%
PVC	2743	26.80%	-3.51%	-10.15%	7.8%
Copper	2744	34.60%	-2.82%	-8.01%	6.2%
Steel	2710	32.30%	-3.68%	-9.36%	12.7%
	2721	28.00%	-3.90%	-6.75%	>5% and <30%
	2722	45.20%	-3.62%	-12.39%	1.5%
	2731	32.70%	-5.57%	-17.36%	>5% and <30%
	2732	19.70%	-4.36%	-4.36%	<5%
	2733	4.90%	-1.99%	-4.35%	0.4%
	2734	21.90%	-4.25%	-7.69%	2.0%
Paper	2112	25.70%	-4.66%	-11.39%	11.9%
	2121	5.20%	-1.32%	-1.32%	1.8%
	2122	12.80%	-2.78%	-6.41%	3.6%
	2123	9.40%	-1.73%	-2.35%	<5%
	2124	38.70%	-0.97%	-24.46%	<5%
	2125	13.60%	-1.65%	-4.03%	0.7%
	2222	3.70%	-0.14%	-0.30%	0.5%
Pulp	2111	46.10%	-9.69%	-25.66%	<5%
Zink	2743	26.80%	-3.34%	-5.46%	7.8%

Subsequently, the question is whether this correction would actually make a difference, in the sense that sectors that are currently on the list of exposed sectors and qualify for free allocation would be excluded. This happens if, due to the correction (see section 1.1.):

- The trade intensity will be lower than 30% while the total cost increase is expected to be less than 5%.
- The trade intensity is lower than 10% whereas the total cost increase is estimated to be higher than 5%.

This is not the case for the eight evaluated sectors, if we use the quantitative assessment of the European Commission (EC, 2009b) as starting point. These sectors have been identified as sectors that will face relatively high cost increases due to EU ETS[20].

If we look at the complete list of sectors whose trade intensity and cost increase have been evaluated by the commission (2009b), the sectors mentioned in Table 4 (-30% scenario) and Table 5 (-20% scenario) would no longer receive free allocation. Given the climate policies of main non-EU

[18] Chlorine is not included in this table. The Commission considers the sector at NACE 4 level (2413), whereas chlorine is a subsector on 8 digit level (23131111). Latter trade intensity lies, according to our calculations on 1.5%, whereas the Commission reports 31.70% for the whole sector.

[19] This is the largest sector within the category 'Coke refined petroleum and nuclear fuel'.

[20] It should be noted that the European Commission reports marginal costs, while there are reasons to look at average cost figures instead. These are usually lower than marginal cost estimates.

trading partners, their 'exposure' to international competition turns out to be limited.

Table 4 Sectors that will no longer receive free allocation of emission rights (-30% scenario)

SBI code	Name of sector
1593	Manufacture of wines
1595	Manufacture of other non-distilled fermented …
1751	Manufacture of carpets and rugs
1753	Manufacture of non-wovens and articles made …
2010	Sawmilling and planing of wood; impregnation …
2470	Manufacture of man-made fibres
2622	Manufacture of ceramic sanitary fixtures
2932	Manufacture of other agricultural and forestry …
3130	Manufacture of insulated wire and cable

Table 5 Sectors that will no longer receive free allocation of emission rights (-20% scenario)

SBI code	Name of sector
1562	Manufacture of starches and starch products
1592	Production of ethyl alcohol from fermented …
1593	Manufacture of wines
1595	Manufacture of other non-distilled fermented …
1751	Manufacture of carpets and rugs
1752	Manufacture of cordage, rope, twine and netting
1753	Manufacture of non-wovens and articles made …
1754	Manufacture of other textiles n.e.c.
2010	Sawmilling and planing of wood; impregnation …
2052	Manufacture of articles of cork, straw and plaitin
2215	Other publishing
2320	Manufacture of refined petroleum products
2470	Manufacture of man-made fibres
2511	Manufacture of rubber tyres and tubes
2622	Manufacture of ceramic sanitary fixtures
2623	Manufacture of ceramic insulators and …
2626	Manufacture of refractory ceramic products
2874	Manufacture of fasteners, screw machine …
2875	Manufacture of other fabricated metal products
2923	Manufacture of non-domestic cooling and …
2932	Manufacture of other agricultural and forestry …
2960	Manufacture of weapons and ammunition
3130	Manufacture of insulated wire and cable
3543	Manufacture of invalid carriages
3550	Manufacture of other transport equipment n.e.c.

References

Climate Strategies, 2007
Jean-Charles Hourcade, Damien Demaill, Karsten Neuhoff, Misato Sato, (Contributing Autors), Michael Grubb, Felix Matthes, Verena Graichen
Climate Strategies Report : Differentiation and Dynamics of EU ETS Industrial competitiveness impacts
S.l. : Climate Strategies, 2007

Comext, 2009
Eurostat : external trade data
http://epp.eurostat.ec.europa.eu/portal/page/portal/external_trade/data/database
Attended: August 2009

EC, 2009a
Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.
In : Official Journal of the European Union L140 (2009); p.63-87

EC, 2009b
European Commission
Results of the quantitative assessment of sectors at NACE 4 level (state of 01/07/09)
At: http://ec.europa.eu/environment/climat/emission/pdf/20090701_list_sectors.pdf

Ecofys, 2009
N. Hohne, E. Holdaway, N. Graus, G. Reece, K. Klomp
Possible future reduction targets for the EU
Utrecht : Ecofys, 2009

Ecofys et al., 2009
Ecofys, Fraunhofer Institute for Systems and Innovation Research, Öko-Institut
Methodology for the free allocation of emission allowances in the EU ETS post 2012 : Sector report for the non-ferrous metals industry
S.l. : Ecofys, 2009

EIPPCB, 2001
Integrated Pollution Prevention and Control (IPPC) : Reference Document on Best Available Techniques in the Pulp and Paper Industry
Seville : European Integrated Pollution Prevention and Control Bureau (EIPPCB), 2001

Euro Chlor, 2007
Chlorine Industry Review 2006-2007 : Well-earned reputation rests on renewed sustainability efforts
Brussels : Euro Chlor, 2007

Euro Chlor, 2009
Information on the European chlorine industry (09/2009)
At: http://www.eurochlor.org/europeanchlorineindustry
Attended : March 2010

Hatch Beddows, 2007
EU ETS Competitiveness Impacts on the European Steel Industry
London : Hatch Beddows, 2007

IEA, 2005a
J. Reinaud
Industrial Competitiveness under the European Union Emissions Trading Scheme
Paris : International Energy Agency (IEA), 2005
http://www.iea.org/textbase/papers/2005/Industrial_Competitiveness.pdf

IEA, 2005b
J. Reinaud
The European Refinery Industry under the EU Emissions Trading Scheme : Competitiveness, trade flows and investment implications
Paris : International Energy Agency (IEA), 2005

McKinsey/Ecofys, 2006
McKinsey ; Ecofys
EU ETS Review : Report on International Competitiveness
Brussels : European Commission, DG Environment, 2006

NERI et al., 2007a
Mikael Skou Andersen, Terry Barker, Edward Christie, Paul Ekins, John Fitz Gerald, Jirina Jilkova, Sudhir Junankar, Michael Landesmann, Hector Pollitt, Roger Salmons, Sue Scott, Stefan Speck (eds.)
Competitiveness Effects of Environmental Tax Reforms : Final report for the European Commission, DG Research and DG Taxation and Customs Union (Summary report)
Aarhus : NERI, University of Aarhus (Denmark); Cambridge Econometrics (UK); ESRI (Ireland); IEEP, Univ. of Economics (Czech Republic); PSI (UK) and WIIW (Austria), 2007

NERI et al., 2007b
Mikael Skou Andersen, Terry Barker, Edward Christie, Paul Ekins, John Fitz Gerald, Jirina Jilkova, Sudhir Junankar, Michael Landesmann, Hector Pollitt, Roger Salmons, Sue Scott, Stefan Speck (eds.)
Competitiveness Effects of Environmental Tax Reforms : Annex to final report for the European Commission, DG Research and DG Taxation and Customs Union
Aarhus: NERI, University of Aarhus (Denmark); Cambridge Econometrics (UK); ESRI (Ireland);IEEP, Univ. of Economics (Czech Republic); PSI (UK) and WIIW (Austria), 2007

OECD, 2005
D. Demailly, Ph. Quirion
The competitiveness impact of CO_2 emissions reduction in the cement sector
Paris: Organisation for Economic Co-operation and Development (OECD), Environment directorate centre for tax policy and administration, 2005

OECD, 2009
Eurostat : STAN Bilateral Trade
http://stats.oecd.org/Index.aspx?DatasetCode=BTDNEW&lang=en
Attended: November 2009

PBL, 2009
M.G.J. den Elzen, N. Hohne, M. Hagemann, J. Vliet, D.P.van Vuuren
Sharing developed countries' post-2012 greenhouse gas emission reductions based on comparable efforts
Bilthoven : Planbureau voor de Leefomgeving (PBL), 2009

Prodcom, 2009
Excel file Prodcom Annual Data 2007
http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/introduction
Attended: November 2009

UNEP, 2010
UNEP climate pledges site
http://www.unep.org/climatepledges/#
Accessed on 4 March 2010

UNFCCC, 2010
Quantified economy-wide emissions targets for 2020
http://unfccc.int/home/items/5264.php
Accessed on 4 March 2010

USGS, 2008
See: WBCSD/IEA, 2009

VNP, 2007
Koninklijke Vereniging van Nederlandse Papier- en kartonfabrieken (VNP) : Jaarverslag 2006
Hoofddorp : VNP, 2007

WBCSD/IEA, 2009 (is nog WBCSD, 2009 in tekst)
Cement Technology Roadmap 2009 : Carbon emissions reductions up to 2050
S.l. ; Paris : World Business Council on Sustainable Development (WBCSD); International Energy Agency (IEA), 2009