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STUDY

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Economic and Scientific Policy

Competitive distortions and leakage in a world of different carbon prices

Trade, competitiveness and employment challenges when meeting the post-2012 climate commitments in the European Union

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Executive Summary

Effective climate policy in Europe requires early commitment to ambitious emission reduction targets, with tight emission caps and rapid shifts towards auctioning of emissions. This guides a transition to a low carbon economy, provides growth opportunities for innovative sectors and technologies, and demonstrates leadership to drive international climate policy. Whether or not an agreement is reached at the Copenhagen COP in 2009, it is very unlikely that a single global price for carbon will prevail. A frequently voiced concern is that states with stringent climate policies will place domestic industries at a disadvantage relative to competitors in states with less ambitious climate efforts.

This study compilation is an attempt to present the policy options available in this possible future situation of different levels of ambitions in climate policies. It asks the question whether competitive distortions and leakage present a realistic danger in a world of different carbon prices. The prevailing assumption is that a considerable (and possibly growing) part of allowances in EU-ETS are auctioned as of 2013.

Chapter 1 presents the content of the study, clarifies the questions and summarizes the main arguments and results of the authors. The further study is a compilation of 4 contributions in chapters 2-5. They are all written by recognized experts in the field. The diversification of authorship across chapters allows further to include different points of views as well as to have both economic and legal approaches to the problem.

Karsten Neuhoff from Cambridge University argues in chapter 2 that only a few industrial sectors of the economy, accounting for 1-2% of total GDP would face significant cost increases through the higher carbon price. They can be individually assessed to see whether long-term carbon price differences would contribute to relocation of industrial activity and thus leakage of emissions. If it becomes necessary in 2010/2011, state aid, continued free allowance allocation or border adjustments can be implemented to address these leakage concerns.

Three authors from the Ecologic Institute take a more legal approach in chapter 3. They argue that the relationship between climate policy and international trade is complex, characterised by a wide spectrum of interactions that range from synergy to conflict. A multilateral solution would be the first best option, a view shared by all other contributors to this study compilation. Among the unilateral policy measures available, border adjustments to offset the regulatory burden of climate policies are not ruled out in principle by the pertinent rules of international trade law. Border adjustments should affect domestic and foreign producers in a non-discriminatory manner, and be justified on environmental, not competitive, grounds. However, legal uncertainties remain and the particular design of the adjustments is important.

Chapter 4 is a closer scrutiny of the implementation challenges of border adjustments. In their contribution, the authors Philippe Quirion and Stéphanie Monjon assume that the implementation of border adjustments is decided and discuss the main design options and their capacity to fulfil the ambition of countering leakage caused by higher production costs in the EU. Out of their discussion on the mechanism design, a particular form of BAs arises as the most viable, containing the lowest costs of enforcement and administration.

In chapter 5, Ulrike Lehr and Christian Lutz from GWS analyze the employment impacts of broader climate change policies in a literature survey. They find that the net employment impacts are very small. Carbon leakage is expected to be rather small in most studies and can be offset by technology spill-over. Employment losses due to carbon leakage will be concentrated in a few processes and facilities. Renewable energy and other policies outside the ETS are reported to be rather positive for the labour market.

1. Introduction[1]

1.1 The Rationale for this Study

The present study compilation was requested by the European Parliament's Temporary Committee on Climate Change (CLIM) for its 7th Thematic Session, addressing "Competitiveness, Trade, Financing and Sustainable Employment". While the Thematic Session, held on 29 May 2008 in Brussels, discussed all the various issues in its title, for the sake of thematic coherence it seemed wise to deal with competitiveness, trade and employment in one study, leaving the issue of financing to a separate study.

As regards international trade aspects of climate change, it should be noted that colleagues from the Policy Department External Policies of the European Parliament published a study in July 2007 titled "*What contribution can trade policy make towards combating climate change*" (European Parliament, 2008), which analyzed in more detail the various trade policy aspects relating to climate change. The study found that climate impacts of trade are substantial and that key mechanisms exist that could help deal with these impacts, although full realisation of these mechanisms requires the establishment of clear international institutional and legal frameworks. The executive summary of the study is replicated in Annex 1 to this study compilation.

Since relatively little has changed in the last 12 months in international trade law or practice, this study compilation concentrates on competitiveness issues, addressing most notably the related notion of "(carbon) leakage", i.e. the potential relocation of carbon intensive production outside the EU in response to unilateral carbon pricing policies. The terminology and the concepts are further clarified later in these introductory remarks (see below 1.2). In general, trade is undoubtedly an integral part of competitiveness (and vice versa), and therefore it will remain an aspect throughout this study. However, it is in itself not in the centre of the analysis. For a closer analysis of trade measures and trade flows as such, readers are invited to refer to the above mentioned study.

1.2 Channels of competitiveness and leakage

When talking about competitiveness and leakage, it is important to define the terminology.

Competitiveness is a rather difficult concept when applied to entire economies (Krugman 1994)[2], where it is an abstract concept difficult to fill with meaning. It is important to keep in mind that in general the companies in a country can be competitive or uncompetitive depending on their productivity. Continuously uncompetitive companies go bankrupt. Countries, or economic areas, by definition cannot go bankrupt in analogy to a firm. The incentives that apply on a micro level to companies and to industry do not translate onto the level of the macroeconomy. In line with this, this compilation will mainly take a micro-founded sector by sector view on competitiveness which is then only very carefully interpreted on the macro-level.

The main concern about leakage is whether production from plants based in Europe would be relocated to other parts of the world in response to unilateral and stringent climate policy in Europe. As a result, emissions would also be located in other areas, and no longer covered under the European cap. Subsequently, there would be space for other emissions that could be taken up by other sectors.

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[1] We would like to thank all authors of subsequent chapters as well as Julia Reinaud, Christine Bahr, Camilla Bursi and Yanne Goossens for very helpful comments on earlier versions of the introductory chapter.

[2] Krugman, Paul (1994): Competitiveness, A Dangerous Obsession, Foreign Affairs March/April 1994.

Furthermore, the production in the new facilities outside Europe could be more carbon intensive, thus further increasing total emissions. This second effect might be less relevant, or even negative, as most new investment tends to be efficient. However, whatever the case, for so long as emissions are displaced as a result of the asymmetric climate policy, this is still defined as carbon leakage (Reinaud, forthcoming).

If policies attempt avoiding the risk of leakage of emissions, they avoid the risk that individual companies reduce production or relocate in response to stringent climate policy that is implemented unilaterally. This form of leakage which happens in response to carbon-price induced increases of production costs of European companies vis-à-vis their non-European competitors can be called "industry specific leakage". The cost increase can happen either directly over the cost of carbon, or indirectly over the increased cost of energy.[3] This form of leakage would qualify as leakage in the sense employed in this study compilation.

A second channel for leakage of emissions is discussed in the academic literature. As discussed by Monjon and Quirion in chapter 4, (carbon) leakage can also occur through the prices of fossil fuels, most notably through the oil price but to some extent also gas and coal (e.g. Felder and Rutherford 1993). This "fossil fuel channel"[4] of leakage is at work when ambitious climate policies within the EU decrease the aggregate world demand for these commodities, thus reducing their relative *world* price and increasing their use in the rest of the world. With decreasing demand in the EU and inelastic supply, all adjustment would go through prices and would be partially offset by increased demand elsewhere (Burniaux and Martins (2000)). Indeed, the supply elasticities of oil, gas and coal with regard to carbon pricing present a major challenge and bear the potential to undermine ambitious policy efforts for stringent climate policies.

The channel of fossil fuel prices cannot be studied in detail here due to the scope of this compilation. However, many uncertainties remain with regard to the effective working of this channel. Firstly, the (future) elasticity of supply cannot be estimated with sufficient certainty. Therefore it could well be that following lower demand in Europe, the net world demand for fossil fuels would finally effectively be decreasing rather than being constant. It is also not clear how decreased oil demand in the EU will affect investment in oil exploration. Moreover, any negative leakage effect via the fossil channel might be off-set by a positive leakage from (long-term) technology spill-overs. Energy efficiency and low carbon technologies developed under stringent climate policy frameworks diffuse to other countries and reduce their carbon emissions (Gerlagh and Kuik 2007).

1.3 The Content of the Study

Popular fears about the post 2012 regime of EU-ETS (EU-Emissions Trading Scheme) can be simplified and summarized into two elements, one being the fear of "carbon leakage" and the other the fear of "job leakage". This study compilation addresses both these issues.

This study compilation assumes that the EU is envisaging to develop the EU-ETS in the direction proposed by the European Commission on 23 January 2008[5], where a certain (and possibly growing) number of sectors are included in an auctioning (rather than free allocation) of emissions.[6] Should the rest of the world not immediately follow the EU in adopting stringent carbon pricing policies, this would create asymmetries in global carbon prices.

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[3] Such as an increased electricity price in production, but only that part which can be attributed to the CO_2 cost.

[4] In chapter 4 this channel is called "energy price channel".

[5] See European Commission Communication COM (2008)16.

[6] Article 10a(8) of the Draft Directive 2008/0013/COD, which the Commission proposes to insert into Directive 2003/87/EC.

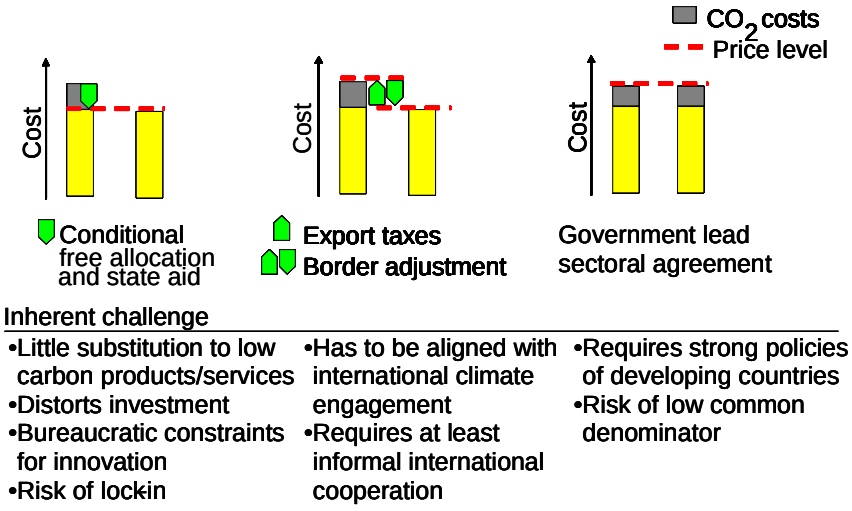
This study compilation then asks what happens to competitiveness of European industry, and whether carbon leakage is a justified concern if carbon allowances are auctioned and prices within the EU are for many years higher than in the rest of the world. If, where and when this is found to be a concern, concrete policy measures are presented to counter this loss in competitiveness and the associated danger of leakage.

The compilation is a selection of four briefing papers from renowned experts in the field. The argument in chapters 2 to 4 proceeds in the following simplified sequence: 1) economic analysis, 2) legal analysis and 3) challenges of implementation. Chapter 5 finishes with a literature review of the employment impacts. This study compilation diversifies the contributions to different authors in order to be able to provide the best possible expertise in every different aspect from different points of views (e.g. more economic (chapters 2 and 4) and more legal analysis (chapter 3)). Furthermore, chapter 5 on the impacts on employment differs from the rest of the approaches in that it is more of a literature review. Moreover, in the spirit of this diversity, the content of the contributions was at no point streamlined to reflect a particular view. Therefore, repetitions and contradictions on certain details may be found between chapters in this compilation. This, it is our hope, will not be confusing for the reader but can be seen as healthy grounds for further discussions on these subjects, which will undoubtedly follow.

In **chapter 2**, Karsten Neuhoff from Cambridge University introduces options to counter leakage from a sector by sector perspective. He shows how leakage concerns are only a potential concern in a few carbon intensive sectors that are internationally competitive with a total contribution to GDP of 1%-2% . Analyzing the carbon intensity and competitiveness of individual industry sectors, the possible extent and nature of carbon leakage is analyzed.

There are different ways to deal with leakage, but they all have in common the objective to level the playing field between companies within and outside the European Union. Policies to level the playing field for companies include about four basic options. These options follow three different mechanisms of levelling the playing field, presented in Figure 1.1:

Figure 1.1: Policy options to address leakage concerns



Source: Neuhoff, Karsten: Tackling Carbon – how to price carbon for climate policy

The left hand column of Figure 1.1 shows how free allowance allocation and state aid can mitigate the carbon price impact. Thus the cost increase is prevented, and all producers compete at the cost level similar to a world without carbon pricing.

The centre column of Figure 1.1 presents how some form of border adjustment for higher carbon prices (or export taxes implemented by countries with lower carbon prices) could adjust carbon cost differential if products are traded between countries with different carbon price levels and reestablish a level playing field. The right hand column of Figure 1.1 illustrates how government-led sectoral agreements could create the same carbon price for all competing firms. This is similar to a global carbon price, but might be only focused on specific sectors. All three options ensure that all firms face comparable carbon costs, and thus create a level playing field with regard to the carbon price.[7]

The term "sectoral approach" (right hand column in Fig. 1.1) can encompass a range of ideas, from sharing of best practices to benchmarking across regions and countries, to technological R&D (as outlined in the Bali Action Plan), to binding international policy coordination. Combinations and cross-fertilisation of the above can also be envisioned. (Baron et al 2007, Reinaud forthcoming).

Karsten Neuhoff argues in chapter 2 that international sectoral agreements have many undisputed benefits (including the above mentioned) and should therefore be fostered. However, none of the currently discussed approaches address leakage concerns. Neuhoff argues that leakage concerns only occur where industry faces the full carbon price, e.g. from a carbon tax or auctioning from CO_2 allowances, which is not envisaged in any of the currently discussed schemes for sectoral agreements. Therefore these schemes would also not address leakage and competitiveness and leakage could be taken off the objectives when discussing sectoral approaches. This could simplify the discussion of sectoral approaches, allow them to focus on real emission reductions as well as make them quicker and more effective.[8]

In the light of the arguments and given the negative side effects associated with all measures, Neuhoff does not favour any of the measures in particular but advises to keep all options on the table and to explore in international discussions how to minimise their negative side effects. Should an instrument be required, this can be selected in 2010/2011.

As becomes evident already in Figure 1.1, there are different measures to deal with leakage, but in an international free trade environment some of them will have significant legal implications. In order to address this, **chapter 3** is written by three legal experts from the Ecologic - Institute of International and European Environmental Policy[9]. It is an update of parts of the above mentioned study by our colleagues from the Policy Department External Policies in so far as it analyses the WTO compatibility of proposed measures in some detail, as well as some more fundamental issues with regard to international trade and environment regimes.[10]

The chapter adds to a large selection of literature which has analyzed the case for different measures vis-à-vis international law (for a selection see references in the chapter). The main conclusion is that while e.g. border adjustments would "stand a good chance of being found admissible" in terms of their WTO-compatibility, some general legal uncertainty remains as many difficult questions at stake are untested terrain in the arena of international law.

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[7] Figure 1.1 as well as this explanatory section were kindly provided by Karsten Neuhoff.

[8] However, other authors argue that there could also be a case for sectoral agreements in addressing leakage - whether or not they alleviate concerns about carbon leakage will depend on their actual design and concrete implementation details (see e.g. Reinaud, Julia forthcoming).

[9] The authors are Michael Mehling, Nils Meyer-Ohlendorf and Ralph Czarnecki.

[10] Specifically, chapter 3 presents an update to the chapter 5.2 in the above mentioned study by Policy Department External Policies.

As a bottom line, any unilateral measure should be introduced only after all efforts have been exhausted to make the climate policies as multilateral as possible. If a unilateral solution such as the implementation of a BA has to be attempted, it is of great importance that these are introduced for environmental rather than competitiveness reasons. Although the chances of WTO compatibility are high, the final word would rest with the judicial bodies of the WTO.

Chapter 4 features a contribution by Philippe Quirion and Stéphanie Monjon from CIRED-SMASH[11], who were asked to select one of the measures, border adjustments (BA), and take a closer look at some of the challenges of a possible implementation of BAs for the European Union.[12] It seemed sensible to bring forward alternatives to the method of free allocation, as envisaged by the European Commission, and put those alternatives under closer scrutiny. The literature on free allocation and different options available therein is already extensive (see special references on p. 8). However, the virtues of free allocation are far from clear. Therefore, alternatives, while certainly imperfect as well, clearly deserve closer scrutiny. In this context this compilation makes the explicit but unprejudiced choice to analyze border adjustments in more detail.

On a theoretical level, the contribution by Monjon and Quirion in chapter 4 is not reinventing the wheel in terms of analysis of border adjustments. Various authors have recently looked into BAs (e.g. Goh (2004), Ismer and Neuhoff (2007), de Cendra (2006), Ashiabor/OECD (2005), Demailly and Quirion (2008)). The main thrust of the literature is that the economic argument behind BAs is relatively unproblematic, and even the legal compatibility is mostly positively assessed. The main problems relate to the "politics" of BAs, as emphasised also by Karsten Neuhoff in chapter 2.

Furthermore, one should distinguish between border adjustments (BA) and border *tax* adjustments (BTA), as both terms have been mentioned in the literature. A border adjustment can be a tax, much along the lines of international VAT, but it does not (strictly) have to be. It could also work in the form of an obligation to importers within the EU to surrender emission allowances. The latter has various benefits, the most important being that there is no tax rate to be set as the emissions market determines the price of the allowances to be surrendered. Indeed, this seems to be the mechanism design favoured by the authors of chapter 4.

According to WTO rules, the case for border (tax) adjustments would be relatively simple, were the "tax base", i.e. the object to be taxed physically incorporated in the product. WTO rules quite clearly allow for adjustment for indirect taxes on products "physically incorporated" in the final product, provided they are applied in a non-discriminatory manner (see also chapter 3.4). However, much of the remaining complexities in the case of BAs stem from the fact that they relate to production processes and the energy input, rather than the product itself, or a substance incorporated in the product.

Border adjustments have already been implemented (unilaterally) in the US in the cases of the US Ozone Depleting Substances Tax or the Superfund Tax.[13] The US cases could be seen as encouraging as they provide a precedent at some level, albeit they are not entirely comparable in terms the targeted products or processes.

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[11] CIRED - Centre International de Recherche sur l'Environnement et le Développement; SMASH - Société de mathématiques appliquées aux sciences humaines.

[12] They authors do so by hypothetically assuming that the decision for BAs had already been taken, therefore not questioning the rationale of BAs as such. It has to be stressed that the choice to scrutinize BAs in more detail is neither an explicit choice by the authors of that chapter, nor is this study compilation in general meant to explicitly advocate BAs or any other of the measures.

[13] However, these cases differ in as far as the substances in question can be deemed to be "physically incorporated" in the product. For a general description and discussion of these cases see e.g. OECD (2006), Chapter 5 "The Sectoral Competitiveness Issue - Border Tax Adjustments", p.100, or Ashiabor (2005).

Moreover, in late 2007, Senators John Warner and Joseph Lieberman[14] introduced a bill in the US Senate requiring US-importers of carbon-intensive goods from certain countries to purchase greenhouse gas emission allowances as a condition for importing these goods. This bill has most recently been defeated on the Senate floor. However, the political signal sent by its introduction alone is significant in its own right as it is evidence of readiness on a high political level to impose some kind of adjustment mechanisms.

To conclude, the politics of BAs remain very difficult and too little research has analyzed the challenges of their actual implementation, including the targeted products, the form of the adjustment, but especially also the adjustment base, the countries covered, the enforcement and the administration costs. This is what Philippe Quirion and Stéphanie Monjon analyze in chapter 4.

The final **chapter 5** on the employment impacts of climate policies takes a broader scope in looking at the potential social costs of combating climate change. It starts with a careful analysis of the economic effects of the measures suggested in the Climate Change package and shows how these measures impact economic growth and, ultimately, employment and competitiveness. In a second step, the literature on employment effects of the various measures is reviewed. While net employment effects of policy measures require a somewhat macro-perspective approach, most of the work considered includes analyses on the sectoral levels which are the basis of most of the arguments before. The results of the measures considered (carbon trade, renewable energy targets) differ distinctly. The bulk of the analyzed studies on carbon trade shows only a small net employment impact, which Ulrike Lehr and Christian Lutz deem as encouraging in the light of the ambitious climate policy targets in the EU.

As for the employment effects of carbon leakage, the authors observe that leakage is expected to be rather small in most studies and can be offset by technology spill-over. Employment losses due to carbon leakage will be concentrated in a few processes and facilities, a conclusion very much in line with the implications of previous chapters.

The most promising results are found in studies on the employment effects of the renewable energy target. The authors refer to single country studies – Germany with its large market shares in renewable energy sources (RES) capacities installed being a prominent example – as well as studies on the European level. Overall employment effects of the RES target are non-negative and they are largely positive for the market leaders, though the authors caution about very high positive and negative numbers. They may be a result of a partial analysis (e.g. how many people are working directly and indirectly in the RES industry) that does not (intend to) take into account interdependencies such as the negative budget effect. High net employment impacts, either negative or positive, can in most cases be traced back to missing inter-linkages or simplified assumptions in the models, i.e. they are no net effects in the definition of the contribution of Ulrike Lehr and Christian Lutz. The net effects are gained by comparing different scenarios in comprehensive and complex models. High gross employment in the field of RES may also be delusive. The more public money is put into any specific sector, the more direct jobs will be created. Net employment, the authors conclude, is something completely different. All this is discussed in detail in the final chapter.

[14] Senate Bill S.2191, introduced by the independent Senator Joseph I. Lieberman (I-CT) and the republican Senator John W. Warner (R-VA) on 18 October 2007, in the version of the Boxer-Lieberman-Warner Substitute of 21 May 2008 ("Lieberman/Warner Climate Security Act of 2008", hereinafter ACSA 2008), available at http://lieberman.senate.gov/documents/amendment.pdf.

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2. The Political Economy of a World with Different Carbon Prices[15]

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Executive Summary

Effective climate policy in Europe requires early commitment to ambitious emission reduction targets, with tight emission caps and rapid shifts towards auctioning of emissions. This guides a transition to a low carbon economy, provides growth opportunities for innovative sectors and technologies, and demonstrates leadership to drive international climate policy. What would happen, if other countries will not agree to implement similarly stringent climate policy in 2009/2010?

Only a few industrial sectors of the economy, accounting for 1-2% of total GDP would face significant cost increases through the higher carbon price. They can be individually assessed to see if long-term carbon price differences would contribute to relocation of industrial activity and thus leakage of emissions. If it becomes necessary in 2010/2011, State Aid, continued free allowance allocation or border adjustments can be implemented to address these leakage concerns. All three instruments have negative side effects, and should thus not be decided on prematurely in 2008. These measures need to be prepared, and discussed internationally to be readily available. At the same time, industry can be confident that they will be implemented – if necessary – because the environmental objective to avoid leakage coincides with the labour and industry objective to avoid relocation of production. Therefore, investment security is provided.

One political challenge of climate policy lies in the fact that it involves changing relative prices, to make carbon emissions and carbon-intensive products more expensive through emissions trading – so as to incentivise efficiency and substitution to innovative lower carbon products. These price increases might include some production cost increases, but reflect mainly the cost of CO_2 emission certificates. If auctioned, the revenue can be used to compensate final consumers for price increases and to reduce labour and industry taxes to support the economy. However, if allocated for free, specific sectors benefit. This creates strong incentives to lobby for continued free allowance allocation, as this increases profits albeit at the cost of effectiveness of European economic and climate policy. Thus it will be difficult to identify authentic leakage concerns in the political process and it would be preferable to use an expert group that can make a better informed decision based on detailed information about each sector. This ensures that concerns of all sectors will be considered, and avoids a non-transparent bargaining process that would emerge if provisions were to be implemented by the political decision-making bodies alone in response to concerns presented by individual sectors.

[15] This work builds on research of the European network Climate Strategies and research funded by UK research council grant TSEC. Contact details: Faculty of Economics, University of Cambridge, Sidgwick Avenue, Cambridge CB3 9DE. I am grateful for comments on earlier drafts to Emmanuel Guerin, Roland Ismer, Sarah Lester, Arttu Makipaa, Felix Matthes and Julia Reinaud.

2.1. Introduction

A robust climate policy framework is necessary to encourage companies to pursue low-carbon strategies in investment, operation and innovation. For companies to have confidence that their low-carbon strategy is viable, the framework must be able to endure unfavourable circumstances. For example, after a collapse of oil prices, carbon prices would have to rise to ensure that investment in energy efficiency and low-carbon technologies remained profitable.

Given that the policy framework delivers high carbon prices, this is of little concern for industry, provided they are applied globally.[16] To illustrate this fact, it is calculated that the current increase of oil prices from $60 to $120 per barrel corresponds to a carbon price of 150$/t CO_2 put on oil consumption, far in excess of any carbon price currently discussed. Therefore the industry can deal with high carbon prices, as long as they are relatively homogeneous around the world. It is however not yet clear whether international climate negotiations will decide on a global deal in Copenhagen in 2009 that results in similar carbon prices for all countries. Some countries might not yet be prepared to sign a deal at the required level of stringency. Even if all countries pursue climate policies at similar levels of stringency, they might prefer to put different emphasis on the role of carbon pricing in their climate policy mix. Thus, during the initial years, we might see carbon prices that differ across regions – and in this case only in the long-term similar technologies and policies would move carbon prices to similar levels across regions.

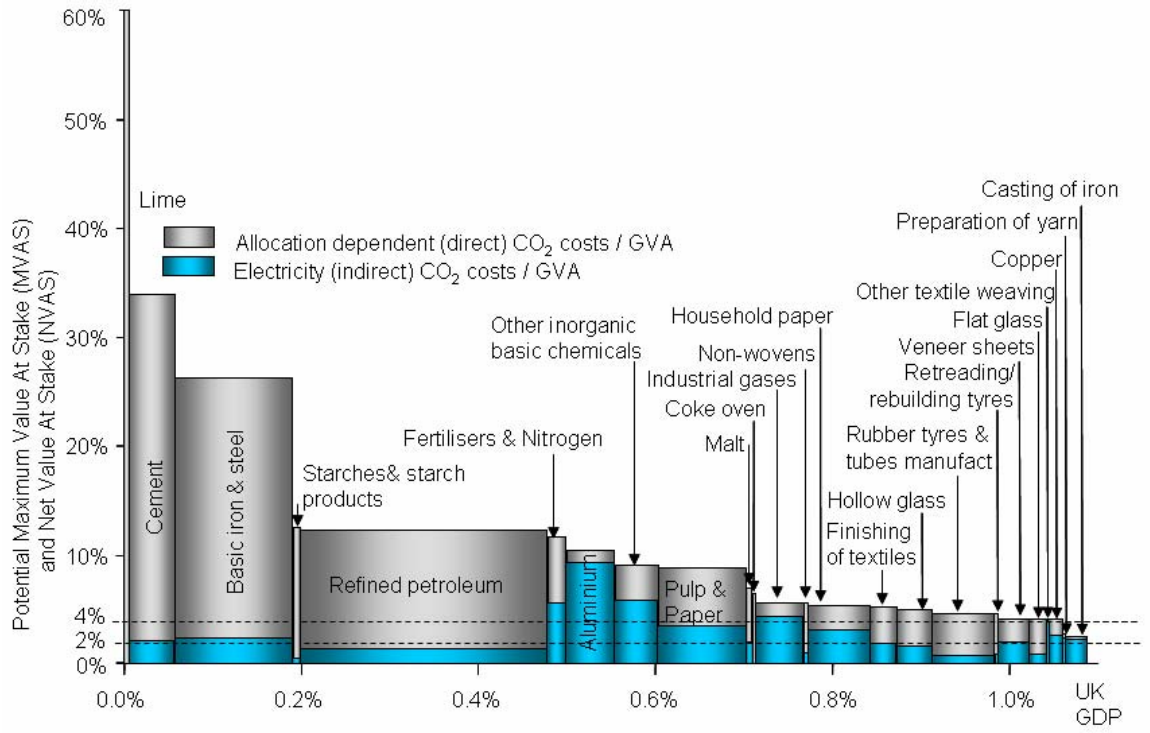
This raises the question of what are the impacts on production and trade, if carbon prices differ between countries or regions for several years, perhaps over the period 2012 to 2020? Econometric analysis of the impact of environmental taxes imposed in some European countries over the last two decades shows no negative impact of carbon taxes on industrial activity.[17] Similarly, also countries with high energy tax levels are economically successful.[18] This shows that asymmetric high carbon prices are unlikely to create competitiveness concerns for the overall economy. However, most of the carbon tax and energy tax schemes provided for some exemptions for very carbon intensive products. Therefore the specific effect on these products has to be analysed separately – after all the European Emissions Trading Scheme (EU ETS) aims to target in particular these carbon intensive products and should therefore not exclude their participation ex-ante.

[16] A shift to a low carbon economy requires a substitution of some high carbon products with lower carbon alternatives. A robust policy framework creates clarity that allows preparation for this change.

[17] Andersen, M.S., Barker, T., Christie, E., Ekins, P., Fitz Gerald, J., Jilkova, J., Junankar, J., Landesmann, M., Pollitt, H., Salmons, R., Scott, S. & Speck, S. (2007): Competitiveness Effects of Environmental Tax Reforms (COMETR). Final report to the European Commission, DG Research and DG TAXUD. National Environmental Research Institute, University of Aarhus.

[18] See e.g. Newbery, D. M. (2003). "Sectoral dimensions of sustainable development: energy and transport." Economic Survey of Europe 2(73-93).

Figure 2.1: Industrial activities with the highest cost increase from carbon pricing, and their contribution to UK GDP, assumed carbon price of 20 €/tCO_2, electricity price increase 10 €/MWh.



A sector by sector analysis is required

Figure 2.1 shows the results of a Climate Strategies study (2008).[19] Analysis of 164 industrial activities shows the activities with the highest "value at stake" from both electricity cost increases and from direct carbon emissions. Value at stake measures how much of the value added created in a sector would be lost if it could not pass-through the cost of carbon. Sorting activities by their total value at stake, the horizontal axis depicts the contribution of the sectors to the GDP of the UK. The contribution of individual industrial activities to UK emissions is proportional to the area covered by the rectangle that represents the activity. In the UK only 1%, and in a similar study for Germany less than 2% of all economic activities face significant cost increases relative to their value added.[20]

Will asymmetric carbon prices result in carbon leakage among these activities? Leakage may occur if higher carbon prices in one region drive a shift of investment and production to regions with a lower carbon price and cause a relocation of emissions. A sector by sector analysis has to consider transport costs, trade barriers, demand trends and the cost structure of the specific carbon intensive production processes.[21]

[19] Hourcade, J.C., Neuhoff, K., Demailly, D., Sato, M. (2008). Differentiation and Dynamics of EU ETS Competitiveness Impacts. Climate Strategies report. < http://www.climate-strategies.org/uploads/1_ClimateStrategies_competitiveness_final_report_140108.pdf >

[20] Forthcoming with www.oeko.de.

[21] Reinaud (2005) Industrial competitiveness under the European Union Emissions Trading Scheme" International Energy Agency; McKinsey & Company and Ecofys (2006). EU ETS Review: Report on International Competitiveness.

Initial results suggest the risk of carbon leakage is concentrated in a few industrial activities like blast furnace steel, and cement. But not all sectors listed in Figure 2.1 are affected. For example profit margins in the refining industry are sufficiently large to continue production and finance upgrading of existing facilities even in the worst-case scenario that carbon cost can not be passed through to product prices. Given pipeline infrastructure and transport costs, some pass-through of carbon cost is likely to happen but was not quantified so far.

The problem of potential carbon leakage is not necessarily the economic impact, after all only a small share of total gross value added (GVA) and therefore employment and tax revenues in developed countries are related to the production of carbon intensive basic commodities and only a fraction of these would be affected. The environmental impact gives rise to concerns, as relocation of emissions undermines the goal to mitigate emissions. If ambitious climate policy is seen to result in relocation rather than reduction of emissions, it loses domestic and international support not only because of its failure to deliver environmental objectives, but also because any relocation creates local job losses. Nevertheless, in the same vein, the measures to address leakage need to be carefully handled as they could be seen as protectionist and thus undermine international efforts to pursue climate policy.

Addressing potential carbon leakage is also necessary to enable a long-term and credible carbon price. If leakage results in relocation of production and therefore an uncertain market size for domestic production in these sectors, it reduces incentives to make fundamental innovations and investments in less carbon intensive technologies. Also, where leakage results in emissions reductions from European installations, it is more difficult to predict the need for real emissions reductions, and therefore to predict the market for low-carbon products and services that can deliver real emissions reductions. Both effects would reduce the incentives for companies to pursue low-carbon strategies and investments.

Four policy measures are discussed to address leakage in the sectors potentially at risk of carbon leakage:

- Free allowance allocation to emitters that is conditional on continued operation or production volumes;
- Support of investment and re-investment with State Aid;
- Government-led sectoral agreements that create a similar carbon price for installations in all countries;
- Border adjustment for the carbon costs of production at the carbon level of best available technology.

All four approaches are discussed in more detail in this document, and together offer a viable portfolio of options to address leakage concerns. However, all approaches have some side effects, and therefore should only be applied in a very restrictive and targeted manner to minimise inefficiencies.

Free allowance allocation related to production capacity, activity or production volume and State Aid to support investment and reinvestment with carbon benefits create an early action problem – reducing the incentive for early investment in efficiency. More importantly, the subsidies shield producers of carbon intensive products from the cost of carbon and limit the price increase of the carbon intensive commodity. The product price increase is an important signal to use these products more efficiently and to encourage development and diffusion of less carbon intensive substitutes.

Sectoral agreements and approaches aim to broaden the participation in the post 2012 climate regime and engage industries and governments in sharing of best practice and pursuing low carbon research, investments and policies.[22] Sometimes they are also discussed as a mechanism to address leakage. Leakage concerns can only arise if companies are exposed to the full carbon price and have to buy all allowances. But current discussions do not envisage implementing a sectoral agreement with full carbon prices signal, only with incentives to improve production efficiency. Therefore the sectoral agreements neither face nor address leakage concerns. If sectoral agreements are not listed as instruments to address leakage, then they are relieved of the difficult objective to address leakage concerns among competitors. Thus they can be more effective in delivering their core objectives and will indirectly address some of the leakage concerns – by accelerating the pace of international climate policy.

Border adjustment approaches allow for the full carbon price to feed through the economy. If for a specific basic commodity the cost increase from full auctioning of allowances were to result in leakage, then imports would be exposed and exports compensated for a similar cost increase. This adjustment would be pursued at the costs for carbon allowances a producer would face using best available technology. This ensures that foreign producers are not discriminated against by a move to full auctioning with border adjustment. Border adjustments can however be perceived as an instrument of protectionism. To create trust they would need to be carefully discussed in an international setting and are best anchored in an international agreement that limits the scale and scope of border adjustment.

Table 2.1: Main options to address leakage if concerns remain

	State Aid + Auction	Conditional free allocation (benchmark)	Border adjustment + Auction
Efficiency in production	+	+	+
Innovation of substitutes	+		+
Incentive for efficient use of the product			+
Avoid leakage	+	+	+
International coordination	To limit use, so as to avoid subsidy debate	To avoid lock-in to poor policy choices	To limit use and build trust with developing countries

State Aid, conditional free allowance allocation, and border adjustments offer three viable and practical solutions to address leakage concerns. Governments and the commission have strong incentives to implement the most suitable solution for each sector if there is a clear need in 2010/11. This is a robust basis for investment decisions in Europe.

[22] IEA(2007) Sectoral Approaches to Greenhouse Gas Mitigation- Exploring Issues for Heavy Industry; WRI (2007) Slicing the Pie: Sector-based Approaches to International Climate Agreements.

An earlier commitment to continued use of free allowance allocation to address leakage concerns, as is sometimes suggested, is not necessary and would stop international efforts to discuss less distorting approaches like border adjustment or harmonised sunset clauses for free allocation. If carbon intensive industries succeed in shielding their production from effective climate policy with continued free allocation in Europe, then this sets a bad example for other countries and regions and undermines global efforts to pursue effective climate policy.

Some industrial groups argue that for their investment decisions they require a commitment to free allowance allocation already as part of the proposals amending Directive 2003/87/EC. It is difficult to find the economic rationale behind this argumentation. Assume a carbon intensive company pursues an investment plan that is viable in an international setting with ambitious climate policy. Consequently, assume further that no international framework materialises by 2009/2010 and competitors in some countries of the world do not face the full carbon price. If this were the reason for a firm to locate the investment in another country, then this would constitute leakage and would trigger the use of instruments to address leakage. The firm would receive state aid, free allowances or the cost differences would be compensated with border adjustment. Thus the initial investment remains viable even in the absence of a global deal. This shows that an early commitment to free allowance allocation is not necessary for investment projects that are compatible with climate policy objectives.

2.2 Classification of leakage concerns

Leakage is defined as the emission increase abroad caused by unilateral climate policy measures (ETS, carbon pricing) at home (EU). It results from a shift of emissions from the sector to production facilities in other regions.[23] Two additional mechanisms for leakage are not discussed in this essay. First, carbon leakage can occur where stringent climate policy in some countries reduces fossil fuel demand and thus fossil fuel prices. This could induce demand and thus emissions increases in other countries, thus partially offsetting the emission reductions. Second, low-carbon technologies developed under a stringent climate policy regime can be applied also in other regions and reduce emissions in these regions, thus increasing the effectiveness of unilateral climate policy.

Table 2.1 identifies four types of company decisions that could be significantly altered by the effect of asymmetric carbon prices on direct emissions and electricity prices. These decisions would result in some movement of carbon intensive production from installations covered by EU ETS to other regions. Thus European emissions reductions would not be genuine reductions, but reflect leakage of emissions. We will subsequently refer to these four categories as leakage channels:

– **New investment:** For products with increasing production volume in a scenario with asymmetric climate policies, the plant investment could be shifted to regions with lower carbon prices in a scenario of asymmetric carbon prices. This is the decision that is probably most sensitive to carbon price differentials. However, with stringent climate policy few carbon intensive commodities will be required at larger volume and little new investment is required for their production.

[23] Definition from IPCC. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (eds Metz, B., Davidson, O. R., Bosch, P. R., Dave, R. & Meyer, L. A.) (Cambridge Univ. Press, Cambridge and New York, 2007).

– **Reinvestment:** Even with constant or declining production volumes, plants require ongoing investment, maintenance and upgrading to match evolving product and environmental requirements. If these investments are not pursued, then it is more likely that production of a plant will be reduced or even phased out. This is of concern where reinvestment requirements are high relative to the cost of greenfield investments and where there are limited technical links with related manufacturing activities.
– **Reduced production with potential closure:** If carbon costs of production are large relative to annual fixed costs of an installation, then firms gradually reduce production volumes where they face increasing import volumes.
– **Closure of plant:** If carbon costs of production and fixed annual costs are large, then producers typically face the decision of full production or closure of an installation rather than gradual adjustment of output.

Table 2.2 lists three carbon intensive production processes that might exhibit leakage concerns. They serve as an example to show how production process could be exposed to different leakage channels and to assess which policy instruments might be most suitable to address these concerns.

Table 2.2: Potential leakage channels illustrated at the example of some potentially effected commodities

	Investment	Re-investment	Reduction/ Closure	Direct closure
Steel production (BOF)		**X**		**X**
Clinker (Cement)			**X**	
Steam reformers (Chemicals)	**X**			

2.3 State Aid or free allowance allocation to subsidise carbon intensive production

Governments can shield carbon intensive production from the full carbon price. Free allowance allocation can be used to subsidise production or investment in sectors with direct carbon emissions.[24] State Aid can be used to subsidise investments and re-investments in sectors that are facing either high costs from carbon emissions or significant cost increases from electricity price increases.

For steel production, the fixed costs of operating are high. Therefore producers have to decide whether or not to operate an installation, but do not have the choice of gradual reduced output. Thus free allowance allocation can be linked to total production capacity with some benchmark value. Allocation has to be conditional on continued operation to create the necessary incentives, but does not require a link to the precise production volume. The implementation of similar provisions in the first two national allocation plans suggests that firms can choose the timing of closure of installations so as to retain continued allocation for almost two years after closure. This reduces the incentive for continued operation of plants.

Alternatively, State Aid could be used to support reinvestment decisions of firms. Further analysis is required to assess (i) whether the re-investment volume, and thus the benefit from State Aid is sufficiently large for State Aid to have a material impact on addressing leakage, and (ii) to what extent such re-investment can be separated from operational costs that would not be covered by State Aid.

[24] Böhringer, C. and A. Lange (2005). "On the design of optimal grandfathering schemes for emissions allowances." European Economic Review 49(8): 2041-2055

The situation differs for **clinker** (the carbon intensive input material for cement). The relative costs of CO_2 are high. Therefore allocation based on a capacity benchmark could result in reduced production volumes even if conditionality requirements require a minimum output of a plant. Thus capacity related benchmarks would not address leakage concerns. Free allocation proportional to some recent production volume of clinker would be required to address leakage concerns in this sector with domestic subsidies.

This will, however, dampen the product price increase of clinker and throughout the cement value chain. Hence it dampens the incentives to reduce the clinker content of cement, the amount of cement in concrete, and the amount of concrete in buildings. Thus free allowance allocation proportional to recent production volumes forgoes much of the desired incentive for substitution towards lower carbon materials for constriction.

The allocation of allowances can also be made proportional to the output of cement production rather than output of clinker production in order to retain the incentive to reduce the amount of clinker in cement. This would not address emissions leakage as cement producers can import the carbon-intensive intermediate product clinker. [25] Constraints to prevent this might be difficult to justify under WTO rules. [26]

The allocation of allowances based on benchmarks requires a precise definition of the production process and qualifying products. If, for example, the specifications of clinker are not clearly defined, it could create incentives for producers to add clay to clinker production. This would increase the volume of 'clinker' and thus the amount of free allowances that are allocated proportional to the volume of clinker produced. If instead, the processes and product is very narrowly defined, then the flexibility of operation, investment and exploration of substitutes is reduced, thus increasing overall costs of emissions reductions.

Finally, **steam reformers** are part of large chemical installations. Existing steam reformers are therefore likely to continue their operation as part of the overall facility. State Aid could support new investment and large-scale reinvestment, should a detailed analysis demonstrate that they are at risk of relocation in a world of asymmetric carbon prices.

The following table 2.3 summarises which approach seems most suitable for different sectors.

	Benchmark on capacity	Benchmark on production	State Aid
Steel production (BOF)	**X**		**?**
Clinker (for cement)		**X**	
Steam reformers (Chemicals)	**?**		**X**

All three policies have unintended negative side effects. They create **administrative processes** that link allocation of subsidies to carbon emissions of a plant. This will undoubtedly create an early action problem – where agents expect their actions today can allow them to capture future benefits from public subsidy rather than from emissions reductions – this will distract and possibly distort investment and operational choices.[27]

[25] Demailly D. and Quirion P. (2006) CO2 abatement, competitiveness and leakage in the European cement industry under the EU ETS: grandfathering versus output-based allocation. Climate Policy (6) 93-113.

[26] Such requirements might be perceived as a trade barrier under rules of the World Trade Organisation, see discussions on labelling or efficiency standards to support the use of low-carbon products (Charnovitz, S. (2004). Trade and Climate: Potential Conflicts and Synergies. Beyond Kyoto: Advancing the international effort against climate change, PEW Center on Global Climate Change).

[27] Ellerman, D. (2006). New Entrant and Closure Provisions: How do they distort? Massachusetts Institute of Technology: Center for Energy and Environmental Policy Research.

Subsidies to carbon intensive production also reduce product prices and thus the economic incentive to shift towards lower carbon production technologies and/or product substitution. To compensate for this, the carbon price increases and additional mitigation efforts are pursued in other sectors. This deviation from the first best distribution of mitigation efforts increases the costs of climate policy.

From an international perspective, the continued use of subsidies, and particularly the use of free allowance allocation, might lead to a lock-in to inefficient policies. Countries decide sequentially on their allocation plans for allowances. Once all countries have implemented such provisions, extensive coordination is required to phase out subsidies. Perhaps early international cooperation can ensure sun-set clauses are in place to facilitate the move to an efficient carbon pricing scheme in the long-run.

Subsidies can address leakage – but at a high cost. They limit incentives for emissions reductions and innovation in the sector where they are applied. Therefore the cost of delivering emissions reductions has to be bourn by other sectors of the economy. It reduces the incentive for industry to develop low cost options for emissions reductions that can be replicated in developed countries.

2.4 Sectoral agreements to address leakage

Activities on sectoral agreements can be observed in the steel, cement, aluminium and some initiatives in the power sector, and typically involve voluntary agreements on sharing of best practice and collection of information for this purpose.[28] Such sectoral cooperation can play an important part in accelerating the response of industry to climate change policies.[29]

Sectoral agreements to deliver full carbon price

One could envisage that governments want to focus their negotiations on a specific sector, for example to demonstrate the viability of carbon pricing. What could be the shape of a successful sectoral agreement for a specific sector that allows for a full carbon price and avoids leakage concerns?

Such an agreement would require a commitment of all participants to impose the full carbon price, i.e. prohibiting subsidises for domestic industry for example using State Aid or free allowance allocation. This commitment has to be credible not only for the high commodity prices of current times, but has to endure periods of potential excess capacity when some producers might face the risk of bankruptcy.

This raises the question: how would the carbon price be defined under such an agreement? A trading scheme could be implemented for all installations covered by the sector in participating countries. It would imply that the sector would no longer be covered by the national/regional trading scheme – an option that only addresses direct CO_2 emissions and even there has not received any support at European and member state level.

Matthes, F., V. Graichen and J. Repenning (2005). The environmental effectiveness and economic efficiency of the European Union Emissions Trading Scheme: Structural aspects of allocation.WWF, Oeko Institute.

[28] Philibert, C. (2004). Technology Innovation, Development and Diffusion. OECD and IEA Information Paper, COM/ENV/EPOC/IEA/SLT or IISI (2007) " A policy to reduce steel-related greenhouse gas emissions" IISI Policy Statement http://www.worldsteel.org

[29] See work of Baron, R., et al. (2007). Sectoral Approached to Greenhouse Gas Mitigation: Exploring Issues for Heavy Industry. IEA/OECD.

The approach would also not allow for smoothing of uncertainty about production volumes and technology innovation that is possible with trading schemes across sectors. [30] Therefore the agreement could focus on explicit carbon prices and set a fixed carbon price for all installations in the sector. It is difficult to see how an international discussion among governments and their national champions could set such price at an appropriate level.

Alternatively, an international agreement could determine the minimum carbon price that would have to be set for installations in the sector, thus allowing individual countries to retain these sectors in their larger domestic trading scheme as long as the national scheme exceeds this price levle. Implementation of either of these approaches on a global scale would likely be an ambitious enterprise.

Sectoral agreements have to be government-led if they aim to address leakage. Even if big companies cover most of the emissions in a sector, the experience of India and China illustrated the ability of smaller firms grow rapidly – thus undermining any agreement among big companies. The national government is required for the implementation of a consistent policy that covers all installations.

Sometimes it is suggested by industry that trading schemes could be developed that reward installations in developing countries for lowering emissions and create incentives for voluntary participation. However, this would imply that old, inefficient plants in developed countries would fund investment in new and efficient plants in developing countries. An unlikely scenario for products that are traded internationally.

Sectoral agreements based on benchmarks are not necessary to address leakage. Most proposals for government-led sectoral agreements envisage that a benchmark emissions rate will be determined. Companies with emissions per unit of product that exceed this benchmark have to buy allowances to cover the additional emissions. If an installation produces fewer carbon emissions per unit of production than the benchmark, then it receives allowances for this difference and can sell the allowances. This creates the desired incentives for efficiency improvements in production. However, like free allowance allocation based on benchmarks, the approach creates administrative constraints that restrict flexibility for operation and investment. Also, the approach reduces the production costs of efficient installations and only creates carbon costs for the inefficiency of installations, not for the full carbon externality. As a result, it will not drive consumers to explore substitutes or use carbon intensive commodities more efficiently.

If the policy does not result in a price increase for the carbon intensive commodity, then it does not create any leakage concern. But if there is no leakage concern, then no international approach is necessary to pursue the policy. Therefore again the sectoral approach can equally be pursued with the objective of cooperation to enhance emissions reductions, and be relieved from the poisoned pill to negotiate among industry a solution that avoids leakage.

[30] With a trading scheme for one sector, all installations would likely use similar technology and more importantly, would depend on a similar technology innovation to reduce emissions. Success of any one innovation is always uncertain, and therefore the sectoral target would have to be set rather leniently to ensure viability of the trading scheme even if innovation is delayed. Also, with sectoral trading the main benefit of emissions trading schemes is thus lost: combining uncertainties of innovation and growth rates of many sectors to reduce the uncertainty about the aggregate emissions reduction opportunities. Obviously the sectoral scheme could be linked to an outside carbon market, often the CDM market is mentioned in this context. But if there is an expectation that such a market will provide a credible price signal that is widely shared, then this raises the question why there would be the need for a specific sectoral trading scheme.

In summary we can say that concerns about leakage only arise in carbon pricing schemes where producers pay the full price of carbon. Sectoral agreements are only required to address leakage if there is the ambition to impose the full carbon price as part of the agreement. However, there is little indication that this is the ambition of any of the schemes. Therefore it might be preferable to remove the objective of avoiding leakage from the discussions of sectoral approaches. This will increase their effectiveness in engaging a wider set of countries in pursuing climate policy.

2.5 Border adjustments

The **economics of border adjustment** are simple. If leakage occurs because producers face higher carbon prices, then leakage can be avoided when imports and exports are adjusted for the carbon price difference. Thus the full carbon price signal remains intact and creates incentives for innovation in new production processes, products and services and supports the substitution towards lower carbon options.

The idea is already widely applied in schemes of value added taxes: for a car sold in Germany the sales price includes the value added tax that was accrued over the various production steps. A private resident of Switzerland who buys a car in Germany initially bears the German value added tax, but gets a full refund when exporting it from Germany. The Swiss customs office will levy value added tax at the Swiss level when the car is imported. Thus all cars competing for consumers in Germany include the German value added tax in their sales price. Where they compete for Swiss consumers, the sales price includes value added tax at the Swiss level. Thus competition is not distorted despite the differing levels of value added tax across countries.

The **WTO compatibility** of border adjustment can be ensured through careful implementation.[31] For this, the scheme may not differentiate between like products by foreign and domestic producers without due justification. This requirement is met when charges levied at the border for imports or reimbursed for exports do not exceed the carbon costs of producing with best available technology. Also, border adjustment can only be applied to the extent that installations pay for their allowances. Border adjustment is not possible to the extent installations receive free allowances or State Aid.

[31] See Zhang, Z. X. (1998). "Greenhouse Gas Emissions Trading and the World Trading System." Journal of World Trade **32**(5): 219-239. For description of implementation at level of best available technology and discussion of WTO compatibility see Ismer, R. and K. Neuhoff (2007). "Border Tax Adjustments: A feasible way to support stringent emissions trading." European Journal of Law and Economics **24**: 137–164., For simulation results in the cement case see Demailly, D. and P. Quirion (2006). Leakage from climate policies and border tax adjustment: Lessons from a geographic model of the cement industry, CIRED.

The **politics of border adjustment** are more challenging. Developing countries have experienced a long history of border provisions with adverse impact on their economic development. This situation was not simplified by various proposals to use border measures as a stick to enforce participation in climate policy.[32] Therefore, the clear anchoring in the general rules of the WTO is important to prevent such proliferation. This can involve international cooperation that clearly limits the scale and scope of border adjustment on carbon prices.

Indeed, rather than creating barriers between countries, border adjustment for carbon price differentials could support international cooperation on climate policy e.g. by using net revenues to support climate policies in developing countries. More importantly, border adjustments allow countries to implement carbon pricing schemes with higher carbon prices so as to increase their decarbonisation effort which is beneficial for all countries.

The political sensitivities associated with border adjustments require that they are discussed and implemented in close international cooperation. This creates trust and shared understanding among all parties about the objectives and constraints of border adjustment. Border adjustments are not required before 2012. This gives sufficient time for their international discussion. The EU can engage in these discussions open mindedly, because it retains the alternative options of state aid or using free allowance allocation for exposed sectors.

For the **implementation of border adjustments,** governments can choose whether the adjustment is done in allowances or in money. In the first case, importers have to acquire allowances in the market or in auctions to cover the emissions associated with the production of their goods at the adjustment level while exporters are compensated with allowances. Alternatively the adjustment rate can be multiplied with the market price for carbon allowances to determine the import levy or export refund.

[32] Some proposals aim to compensate for average carbon intensities, or to differentiate based on the climate policy implemented by the trade partner. This would however discriminate against some foreign producers. Proponents argue that their approaches could be exempt from stringent WTO requirements if they are presented as a component of an international environmental agreement. While this is in theory possible, it is uncertain how a WTO panel would rule. The approach would therefore not offer the certainty required for investment choices. Also, if carbon prices continue to differ across regions, the leakage might not necessarily occur along the lines of signatures of the international environmental agreement, but along the lines of carbon price differentials. This illustrates that border adjustment is an economic, not a political instrument and should therefore also be implemented within the boundaries of economic rational defined by general WTO rules.

It also has to be decided how far down the supply chain border adjustment is applied.[33] For example in cement production the carbon-intensive commodity is clinker. Adjustments are applied to clinker at the level of carbon intensity of producing clinker with the best available technology. As a result clinker costs and prices increase. This increases the costs of cement production and might result in some relocation unless border adjustment is also applied to the clinker content of cement. It is, however, not necessary to apply adjustments to products further down the supply chain. The cost increase for concrete products due to higher clinker and cement prices are low relative to transport and other trade costs.

The examples illustrate that the adjustment would be limited to a small number of specific, carbon intensive commodities (i.e. clinker and cement, not concrete; the steel content of refined steel, not of cars). This adjustment process could probably be pursued based on existing customs law and its product categories, and would therefore not require significant additional administrative procedures or costs for governments or private sector.

Border adjustment is politically contentious, but might well be implemented effectively – if pursued in an international framework that engages all countries. This would clearly limit the scale and scope of adjustment to ensure it addresses leakage. Thus ambitious countries could pursue stringent emissions reductions.

2.6 Conclusions

Effective climate policy to deliver the 2020 emissions reduction targets requires a robust policy framework. With the Climate Package the European Parliament can make a credible commitment to facilitate private sector investments in low-carbon and energy efficiency projects and technologies.

This raises the question what would happen, should international negotiations not result in similar ambitious policies including carbon pricing for other regions of the world in the period 2013-2020. Analysis on a sub-sector level shows that production of a few carbon intensive commodities could be affected in the period. High carbon prices could contribute to a shift of production and investment and therefore result in partial relocation of emissions rather than full emissions reductions.

[33] In the steel production, again the majority of emissions are associated with the initial production stage (basic oxygen furnace). Border adjustment would have to be applied to semi-finished steel. Subsequent production stages face significant cost increases from the higher costs of semi-finished steel, and therefore border adjustment would have to be applied also to pipes, and half forms. These subsequent production steps are not very carbon or energy intensive by themselves, and therefore it suffices to apply border adjustment for the carbon emissions associated with the initial production of steel. Therefore, the adjustment is only pursued based on the weight of the steel in the product. By the time the steel has been included into a car, the impact of the cost increase from carbon emissions will be insignificant, and therefore no further adjustment would be required. Steel can also be produced with electric arc furnaces at significantly lower carbon intensity. However, in this case the input is recycled steel rather than iron ore. As border adjustment also applied to recycled steel, the production costs with electric arc furnaces increase with the carbon price. Thus no discrimination occurs and no differentiation according to the production process is necessary.

For each of these commodities, policy makers can choose for the period post 2012 to use conditional free allowance allocation, provide state aid, or implement border adjustment. While these instruments effectively address leakage, they have negative side effects that have to be carefully balanced. Conditional free allowance allocation and state aid distort incentives and create administrative constraints that significantly reduce the effectiveness of carbon pricing for the specific sector, reduce emissions reductions in this sector and increase overall costs of climate policy. Border adjustment, if pursued unilaterally, risks repercussions for international cooperation on climate policy.

Therefore the policy instrument should only be implemented, if the international setting and sector specific analysis points in 2010/2011 to a clear risk of leakage. This offers the opportunity to actively discuss and coordinate internationally how to pursue the different policy instruments before that. Investors can be confident that the most suitable instrument will then be implemented, if necessary. After all, in the objective to address leakage the interests of industrial and environmental interest groups coincide.

A fourth approach to address leakage has been discussed for many years – international sectoral agreements. If they are to be both effective in reducing emissions and to address leakage concerns, they would be very complex to negotiate and implement. I think sectoral approaches should be alleviated from the objective to address leakage. Then they can make use of the opportunities that emerge where public and private sector expertise and initiative are combined and contribute to best practice sharing and accelerate international cooperation towards a global deal.

3. International trade policy in a world of different carbon prices

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3.1 Introduction: Climate Policy and International Trade

The relationship between climate policy and international trade is complex, characterised by a wide spectrum of interactions that range from synergy to conflict.[35] Attention has lately shifted to the expected and potential impacts of domestic and regional climate policies on international trade flows, notably as they affect the competitiveness of carbon-intensive industries in global markets.[36] A frequently voiced concern is that states with stringent climate policies will place domestic industries at a disadvantage relative to competitors in states with less ambitious climate efforts. Not only could this affect the economic prospects of these industries, critics fear, with unwanted consequences including loss of jobs and a deteriorating trade balance, it could also undermine the effectiveness of underlying climate policies by causing "leakage" – a relocation of manufacturing capacities (and thus greenhouse gas emissions) to states with more relaxed environmental standards.

Unsurprisingly, these fears have translated into active consideration of measures to help avert such undesired effects. Although a variety of measures have been proposed, the most prominent suggestions all incur some form of restriction on international trade. Historically, the notion of applying trade measures to offset competitive disadvantages, prevent leakage and compel foreign states to adopt stricter climate efforts has its origins in Europe, where various actors have repeatedly proposed the introduction of a tax or similar border adjustment on carbon-intensive imports.[37] In the meantime, this idea has also found its way across the Atlantic, where several legislative bills under consideration in the U.S. Congress embrace measures relevant to international trade.[38] Any restriction on international trade, however, has to be measured against applicable free trade disciplines, including the regime administered by the World Trade Organisation.

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[35] Expanding trade flows tend to incur rising greenhouse gas emissions, although larger, more competitive markets can spur innovation and ensuing welfare gains can improve the prospects for adoption of stringent climate policies, see Steve Charnovitz, "Trade and Climate: Potential Conflicts and Synergies", in Joseph Aldy *et al., Beyond Kyoto: Advancing the International Effort against Climate Change* (Washington, D.C.: Pew Center on Global Climate Change, 2005), 141-170.

[36] See, most recently, Trevor Houser *et al., Leveling the Carbon Playing Field* (Washington, D.C.: Peterson Institute/World Resources Institute, 2008); World Bank, *International Trade and Climate Change: Economic, Legal and Institutional Perspectives* (Washington, D.C.: World Bank, 2008).

[37] See European Parliament Resolution on "Winning the Battle Against Global Climate Change" (2005/2049(INI)) of 16 November 2005, Parl. Doc. P6_TA(2005)0433, para 37; "France Proposes Carbon Tax on EU Imports", ENDS Europe DAILY Nr. 2204 of 14 November 2006.

[38] See *infra*, Section 2.2; concern in the United States is largely geared towards manufacturing industries and the competition they face from transition economies such as China.

Accordingly, the discussion has recently extended to a careful assessment of the admissibility of border adjustments and other trade measures adopted to offset negative impacts of climate policies.[39] In Europe, decision makers are aware of the need to implement any trade-related measure in a manner which is compliant with international trade rules.[40] A similar debate has also been launched in the United States, where the compatibility of current legislative bills has been subjected to ample scrutiny.[41] In the long run, however, there is a clear need to move beyond isolated trade measures, and instead promote better coordination between the international trade and climate regimes. Here, a series of proposals to amend existing or introduce new trade rules have been made. This briefing paper assesses the adoption of restrictive trade measures, particularly border adjustments, from a legal point of view.

3.2. Solving Leakage Unilaterally: Border Adjustments and Other Trade-related Measures (TREMs)

3.2.1 TREMs to Address Leakages

A number of trade-related measures are conceivable to reduce the risk of leakage and address competitive distortions which may follow from the introduction of domestic or regional climate policies. Political interest has largely centred on border tax adjustments (BTAs), the introduction of which has been threatened by government officials or demanded by industry and labour representatives as a way of levelling the "competitive playing field". Conceptually, BTAs can be imposed on imports as "any fiscal measures which ... enable … imported products sold to consumers to be charged with some or all of the tax charged in the importing country in respect of similar domestic products."[42] Conversely, border adjustments may also be applied to products destined for export, most commonly through some form of tax relief.[43] A similar effect can be achieved by awarding subsidies or other economic benefits to affected domestic producers, with the benefit calculated to offset any competitive disadvantages resulting from domestic climate policies.[44]

One option that is lately attracting increased attention, moreover, is the extension of domestic or regional emissions trading schemes to imported carbon-intensive goods. By requiring importers to purchase and surrender allowances, this measure imposes the same economic burden on imported products as it does on domestic industries.

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[39] See, *inter alia*, Javier de Cendra de Larragán, "Can Emissions Trading Schemes be Coupled with Border Tax Adjustments? An Analysis vis-à-vis WTO Law", 15 *Review of European Community and International Environmental Law* (2006), 131-145; Matthew Genasci, "Border Tax Adjustments and Emissions Trading: The Implications of International Trade Law for Policy Design", 2 *Carbon & Climate Law Review* (2008), 33-42; Gavin Goh, "The World Trade Organization, Kyoto and Energy Tax Adjustments at the Border", 38 *Journal of World Trade* (2004), 395-423; Roland Ismer and Karsten Neuhoff, "Border Tax Adjustment: A Feasible Way to Support Stringent Emission Trading", 24 *European Journal of Law and Economics* (2007), 137-164.

[40] See European Commission, Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to Improve and Extend the Greenhouse Gas Emission Allowance Trading System of the Community, 23 January 2008, COM(2008)16, 9.

[41] See, notably, Joost Pauwelyn, *US Federal Climate Policy and Competitiveness Concerns: The Limits and Options of International Trade Law* (Durham, N.C.: Nicholas Institute for Environmental Policy Solutions, 2007).

[42] GATT Working Party Report on Border Tax Adjustments, BISD 18S/97, GATT Doc. L/3464 of 2 December 1970, para. 4, available at http://www.worldtradelaw.net/reports/gattpanels/bordertax.pdf.

[43] See, e.g., Thomas L. Brewer, "WTO and the Kyoto Protocol: Interaction Issues", 4 *Climate Policy* (2004), 3-12.

[44] See, e.g., ZhongXiang Zhang and Lucas Assunção, "Domestic Climate Policies and the WTO", 27 *The World Economy* (2004), 359-, 361 *et sqq*.

And finally, market access for imported goods can be rendered conditional on compliance with energy efficiency or other product standards and labelling requirements, again levelling the competitive playing field for imported and domestic products.[45] While these measures may all differ in concept and implementation, their assessment under international trade rules tend to share a number of the same requirements. Not every available option can be analysed exhaustively here; instead, current proposals will be described in the following section, to be then subjected to a more detailed legal assessment.

3.3 Currently Proposed TREMs

3.3.1 TREMs proposed in the United States

In the United States, draft legislation currently under consideration in Congress already sets out detailed measures affecting imported carbon-intensive products. Drawing on a proposal by the International Brotherhood of Electrical Workers (IBEW) and American Electric Power (IBEW/AEP),[46] a leading bill submitted by Senators John Warner and Joseph Lieberman[47] in late 2007 would have required importers of carbon-intensive goods from certain countries to purchase greenhouse gas emission allowances as a condition for importing said goods. While this bill has since been defeated on the Senate floor, it still remains the most accurate proxy for future efforts to legislate a comprehensive climate measure at the federal level. In a section on international action, titled "Promoting Fairness While Reducing Emissions", this bill contained a provision setting out an "International Reserve Allowance Program".[48] Specifically, importers of covered goods – defined in the bill as "primary products or manufactured items for consumption which generate, in the course of the manufacture of the good, a substantial quantity of direct and indirect greenhouse gas emissions"[49] – would have needed to submit a written declaration and purchase allowances in an amount and at a price determined by an administrator,[50] provided these goods originated from a foreign country which had been determined by an "International Climate Change Commission" as having failed to adopt "comparable action to limit the greenhouse gas emissions of the foreign country."[51] Least-developed countries and countries whose emissions are lower than 0.5% of global greenhouse gas emissions would have been generally exempted from this requirement.[52]

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[45] See, e.g., Charles O. Verrill, "Maximum Carbon Intensity Limitations and the Agreement on Technical Barriers to Trade", 2 *Carbon & Climate Law Review* (2008), 43-53.

[46] See Michael G. Morris und Edwin D. Hill, "Trade is the Key to Climate Change", *Energy Daily* of 20 February 2007, available at: http://www.ujae.org/globalwarming/hill%20morris%20article%20in%20energy%20daily%20feb%2020%2007.pdf.

[47] Senate Bill S.2191, introduced by the independent Senator Joseph I. Lieberman (I-CT) and the republican Senator John W. Warner (R-VA) on 18 October 2007, in the version of the Boxer-Lieberman-Warner Substitute of 21 May 2008 ("Lieberman Warner Climate Security Act of 2008", hereinafter ACSA 2008), available at http://lieberman.senate.gov/documents/amendment.pdf.

[48] Sec. 1316 ACSA 2008.

[49] Sec. 1311(7) ACSA 2008; this definition further requires that such goods be "closely related to a good the cost of production of which in the United States is affected by a requirement of this Act", i.e. is covered by the mitigation and other duties set out by this climate legislation.

[50] Pursuant to Section 4(2), the term "Administrator" means the "Administrator of the United States Environmental Protection Agency."

[51] Sec. 1315(a) ACSA 2008.

[52] Sec. 1316(b)(2) ACSA 2008.

All proceeds from the sale of international reserve allowances were to be allocated to "mitigate the negative impacts of global climate change on disadvantaged communities in other countries." Conscious of the potential for challenges under international trade law, the bill expressly stated that it was geared towards "measures carried out by the United States that comply with applicable international agreements."[53]

3.3.2 TREMs proposed in the European Union

In the European Union, plans to adopt trade measures as a way of addressing leakage and competitive distortion have not yet reached this level of detail. On 23 January 2008, the Commission presented a set of documents to guide the future direction of European climate policy, including proposals for an amendment of the emissions trading directive. Included in these proposals is a new provision designed to "support certain energy intensive industries in the event of carbon leakage", mandating the Commission to submit, by June 2011, an analytical report assessing the situation of energy-intensive sectors "exposed to significant risks of carbon leakage."[54] Such an assessment shall be guided by the outcome of international negotiations and also be accompanied by "appropriate proposals", which "may include" an adjustment to the proportion of allowances allocated free of charge to affected sectors or an extension of the emissions trading scheme to importers of products produced by said sectors.[55] As the Commission explains in the introduction to this proposal, these measures – primarily aimed at safeguarding "the environmental integrity and benefit of actions by the Community" – could result in the introduction of an effective carbon equalisation system "with a view to putting installations from the Community which are at a significant risk of carbon leakage and those from third countries on a comparable footing."[56] Cognisant of the potential legal implications, however, the Commission also affirms that "[s]uch a system could apply requirements to importers that would be no less favourable than those applicable to installations within the EU", thereby ensuring its "conformity with the international obligations of the Community including the WTO agreement."[57] In its Conclusions of 13 and 14 March 2008, the European Council implied its support for such an approach by affirming that "in a global context of competitive markets the risk of carbon leakage is a concern in certain sectors" and needs to be analysed so that, "if international negotiations fail appropriate measures can be taken."[58]

3.4 Legal Assessment

By subjecting imports of certain goods to additional requirements, border adjustments geared towards a tariff or duty to purchase and surrender allowances have a direct bearing on the free flow of trade across borders. Accordingly, they have the potential to infringe upon central tenets of international trade law, and thus merit further discussion below.

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[53] Sec. 1312(3)(B) ACSA 2008.

[54] COM(2008)16, *supra* note 40, Art. 10b.

[55] Ibid.

[56] COM(2008)16, *supra* note 40, 8.

[57] Ibid.

[58] European Council, Presidency Conclusions, Brussels, 13-14 March 2008, para. 19.

3.4.1 Relevant General Provisions in WTO Law

3.4.1.1 National Treatment Principle (Art. III GATT)

Measures affecting international trade in goods are commonly governed by the General Agreement on Tariffs and Trade (GATT).[59] Art. III:4 GATT sets out the principle of national treatment, requiring equal treatment of *like* foreign and domestic products "in respect of all laws, regulations and requirements affecting their internal sale, offering for sale, purchase, transportation, distribution or use." Art. III:2 GATT further specifies this principle by stating that foreign products "shall not be subject, directly or indirectly, to internal taxes or other internal charges of any kind in excess of those applied, directly or indirectly, to like domestic products." Read in conjunction with Art. II:2(a) GATT, this affords states the right to impose charges on imported products, provided these are "equivalent to an internal tax in respect of the like domestic product." A measure does not have to be a tax or charge in the traditional sense to be covered; because it is compulsory and unrequited, even the duty to purchase and surrender allowances is commonly thought to be included.[60]

As Art. III:2 GATT states, border adjustments may only offset measures imposed on domestic *products*, not producers. Widely held to rule out direct taxes and related measures, this restriction has prompted debate on whether energy taxes and other constraints based on energy input (or carbon output) are sufficiently "product-related" to fall within the scope of this provision. Traditionally, these would have been considered a matter related to the production process, not the process itself.[61] Judging by more recent case law on the application of Art. III GATT, however, it is likely that even inputs which are not incorporated into the final product can serve as the basis for a border adjustment.[62] Instead, a sufficient nexus between the product and the adjustment measure needs to be established.[63] Still, even then, the requirement that it be applied to *like* products as stipulated by Art. III:2 and III:4 GATT needs to be satisfied, an aspect that is highly contested in a climate policy context. In its judicial practice, the WTO Appellate Body has consistently applied four criteria to identify the likeness of products: (i) the properties, nature and quality of the products; (ii) the end-uses of the products; (iii) consumers' perceptions and behaviour in respect of the products; and (iv) the tariff classification of the products.[64]

While it may be difficult to distinguish energy-intensive from less energy-intensive products based on these criteria, the Appellate Body has also stated that "a Member may draw distinctions between products which have been found to be 'like', without, for this reason alone, according to the group of 'like' imported products 'less favourable treatment' than that accorded to the group of 'like' domestic products."[65]

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[59] General Agreement on Tariffs and Trade (GATT), 15 April 1994, contained in the Marrakesh Agreement Establishing the World Trade Organization, Annex 1A, 1867 *UNTS* 187, 33 *ILM* 1153 (1994).

[60] See, e.g., *de* Cendra, supra note 39, 135; Ismer *et al.*, supra note 39, 8; Pauwelyn, supra note 41, 21.

[61] Such was the approach chosen, for instance, in *United States – Restrictions on Imports of Tuna*, Report of the Panel, DS21/R, 3 September 1991, BISD 39S/155, para. 5.13.

[62] See R. Andreas Kraemer et al., *What Contribution Can Trade Policy Make Towards Combating Climate Change?* (Brussels: European Parliament, 2007), 42-3, pointing to the decisions in *United States – Taxes on Petroleum and Certain Imported Substances (Superfund Case)*, Report of the Panel, 17 June 1987, BISD 34S/136, and *United States – Taxes on Automobiles*, Report of the Panel, 29 September 1994 (not adopted) DS31/R.

[63] On this view, see *Pauwelyn*, supra note 41, 20.

[64] See, e.g., *EC – Measures Affecting Asbestos and Asbestos-Containing Products*, Report of the Appellate Body, WT/DS135/AB/R, 12 March 2001, para. 101.

[65] *Ibid*., para. 100.

Such a distinction would need to be justified on substantive grounds, however, and not merely be based on the origin of the product.[66] As long as a measure is applied uniformly to domestic and imported products and is clearly based on measurable and transparent environmental criteria, not the country of origin, it may thus meet the conditions set out by the Appellate Body. A further important factor in the assessment of border adjustments and their admissibility will likely be the method used for their calculation, which again needs to avoid any discrimination based on country of origin. Past case law of the WTO dispute settlement mechanism suggests that such calculation should ideally be based on the actual greenhouse gas intensity or energy input of the imported product; in the absence of reliable data, however, a benchmark or average value may suffice, although distinctions based on the origin of the product are, again, to be avoided.[67]

3.4.1.2 Most Favoured Nation Principle (Art. I GATT)

A further provision with potential relevance for border adjustments is Art. I:1 GATT, which sets out the principle of most-favoured nation by demanding that "any advantage, favour, privilege or immunity granted by any contracting party to any product originating in or destined for any other country shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other contracting parties." If border adjustments are applied on products based on their country of origin, favouring products from countries with stringent climate policies and penalising products from countries with weak or no climate policies, a violation of this principle would clearly appear possible. This may be avoided by uniformly imposing border adjustments on all imported products.[68] However, one environmental rationale of the measure – to induce states to adopt appropriate climate measures of their own or join international efforts – would be undermined, with further reverberations when, for instance, the justification of a trade measure under Art. XX GATT is ascertained.

3.4.1.3 Exception Clause (Art. XX (b) and (g) GATT)

Even if a border adjustment is found to violate the most-favoured nation principle or the principle of national treatment, it may be justified under the general exceptions set out in Art. XX GATT, and thus still be considered admissible. Art. XX GATT contains two exception clauses which may help justify border adjustments motivated by climate and energy policies: one applies to measures "necessary to protect human, animal or plant life or health" (Art. XX(b) GATT), the other to measures "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption" (Art. XX(g) GATT). Given their objective to promote effective protection of the global climate, border adjustments based on carbon or energy intensity can meet the criteria set out in both provisions. Where sufficient international efforts cannot be agreed upon, border adjustments may become a necessary step to prevent an increase in vector-borne diseases and other health hazards induced by climate change, as well as loss of plant and animal habitats; likewise, earlier case law has affirmed that the atmosphere can be considered an exhaustible natural resource whose deterioration affects all states.

[66] *Pauwelyn*, supra note 41, 30.

[67] See e.g. *United States – Standards for Reformulated and Conventional Gasoline*, Report of the Appellate Body, WT/DS2/AB/R, 20 May 1996, 27.

[68] *Pauwelyn*, supra note 41, 32.

An introductory paragraph, or *chapeau*, additionally requires that such measures "are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade". Ultimately, thus, these exceptions amount to a balancing test, and judicial practice has placed particular emphasis on whether states have exhausted all prospects for a multilateral solution before resorting to unilateral trade measures.[69] But such efforts at multilateralism need not necessarily culminate in a multilateral agreement, provided the negotiations have been conducted seriously and in good faith.[70] In the context of current climate diplomacy, this latter aspect may still acquire distinct relevance.

3.4.2 Special rules for Countervailing Duties, Anti-dumping Duties and Quantitative Restrictions

3.4.2.1 Countervailing duties

Countervailing duties are imposed by a importing country to offset subsidies given directly or indirectly to producers or exporters in the exporting country. In the context of climate change policies and its competiveness implications, it has been argued that duties on imports from free riding countries could offset costs that EU industries face because of European climate change measures. In general, the GATT permits member states to impose extra tariffs to offset subsidies from exporting countries, regardless if these tariffs exceed the maximum ceiling under Art. X for tariffs of the imposing country. The GATT, however, rigidly restricts the use of countervailing duties.

According to Art. VI GATT, countervailing duty is a special duty levied for the purpose of offsetting any bounty or subsidy bestowed, directly, or indirectly, upon the manufacture, production or export of any merchandise. In other words, the application of countervailing duties depends on whether the imported product benefits, directly or indirectly, from a subsidy. The WTO-Framework includes a special Agreement on Subsidies and Countervailing Measures (ASCM), which in Art. 1 ASCM defines a subsidy as a "financial contribution by a government or any public body" which can take various forms. Pursuant to Art. 1.1 (a)(1) ASCM, such a financial contribution is – as one possible option – the failure to collect a government revenue that is otherwise due.

Against this backdrop, the key question is whether the failure of a country to price carbon emissions or to internalize the full costs of carbon emission constitutes a subsidy as defined in 1.1 (a)(1) ASCM. The WTO Appellate Body has ruled that Art. 1.1. ASCM requires a comparison between products in one single WTO member;[71] the provision does not foresee a comparison between different WTO members, for instance between WTO members with and without climate change commitments.

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[69] *United States – Import Prohibition of Certain Shrimp and Shrimp Products*, Report of the Appellate Body, WT/DS58/AB/R, 12 October 1998, para. 156: "a balance must be struck between the right of a Member to invoke an exception under Art. XX and the duty of that same Member to respect the treaty rights of the other Members." See also Panel Report, *Brazil – Measures Affecting Imports of Retreaded Tyres*, WT/DS332/R (12 June 2007), para. 7.104 and Appellate Body Report *Brazil – Measures Affecting Imports of Retreaded Tyres*, WT/DS332/ABR (3 December 2007), para. 182: "The weighing and balancing is a holistic operation that involves putting all the variables of the equation together and evaluating them in relation to each other after having examined them individually, in order to reach an overall judgement."

[70] United States – Import Prohibition of Certain Shrimp and Shrimp Products, Recourse to Art. 21.5 DSU, Report of the Appellate Body, WT/DS58/AB/RW, 22 October 2001, para. 176 et sqq.

[71] Appellate Body Report on United States - Tax Treatment For "Foreign Sales Corporations", WT/DS108/AB/R, adopted on 20 March 2000, at para. 90.

In consequence, the failure of a WTO member to price carbon emissions in its domestic market would not be regarded as a subsidy as defined in Art. 1.1 (a)(1) ASCM. In addition, the lack of a carbon price does not constitute a subsidy because no specific enterprise or industry or group of industry benefits from the omission, as required by Art. 1.2 and 2 ASCM. As a result, the failure of a government to impose a carbon tax or to otherwise force producers to internalize the full price of carbon may be "dumping" or a "subsidy" from an economic point of view, but from a WTO-legal point of view it does not normally give other WTO members the right to impose countervailing duties on imports.[72]

3.4.2.2 Anti-dumping Duties

In the context of climate change, anti-dumping duties are additional tariffs on imports from countries that do not have carbon restrictions in place and practise – as a consequence – de facto "environmental" dumping. Arguably, environmental dumping occurs if the prices of imports do not include the social costs of the carbon emitted during the production process of the imports, and if, moreover, the exporting country does not impose carbon cuts. In this case, the goods are effectively dumped on the market of an importing country. According to this argument, the importing country should be entitled to impose anti-dumping duties, i.e. additional duties to offset the "environmental" dumping equal to the amount of the social costs of carbon not reflected in the prices of imported products.

Anti-dumping duties or measures are permissible under the GATT but have to abide to strict requirements, in particular the requirements of Art. VI GATT and the Agreement on the Implementation of Art. VI of the GATT 1994 (ADA). Pursuant to these provisions, anti-dumping duties may be imposed on imported products only if these products are sold at a price that is lower than the price for like products sold in the country exporting such products. According to Art. 1 ADA, a product is to be considered as being dumped if the export price of the product exported from one country to another is less than the comparable price, in the ordinary course of trade, for the like product when destined for consumption in the exporting country. According to Art. 2.6 ADA, the term "like product" ("produit similaire") means a product which is identical, i.e. alike in all respects to the product under consideration.

Accordingly, the benchmark is the level of prices in the exporting country; prices of like-products in the importing country are not the relevant. In consequence, anti-dumping duties can only be levied when import prices of the like product are below the price in the exporting country. As climate change policies generally do not entail such a difference between import prices and regular domestic prices, anti dumping duties cannot be applied to imports from countries without climate change commitments in place, provided the export price is equal to the price at which the like products is sold in the market of the exporting WTO member.[73] In sum, it is unlikely that a lack of price-relevant carbon restrictions in one WTO member can be construed as a basis for imposing anti-dumping duties on products imported from this country. In addition, the ADA stipulates the additional requirement that dumping "causes or threatens material injury to an established industry in the territory for of a contracting party". Evidence of such damage has to be produced on the basis of an "objective examination" and has often been an important hurdle in any anti-dumping procedures.

[72] *Pauwelyn*, supra note 41, p. 14 et seq.

[73] *Pauwelyn*, supra note 41, p. 12.

3.4.2.3 Quantitative Restrictions

Quantitative Restrictions (QRs) could be considered to introduce quotas or even bans for carbon ¬intensive goods and services from countries that have no carbon restrictions in place. The quota may be applied on a selective basis, with varying limits set according to the country of origin or destination, or on a quantitative global basis that only specifies the total limit. However, QRs are, in principle, prohibited under Art. XI GATT. According to this provision, "no prohibitions or restrictions other than duties, taxes or other charges, whether made effective through quotas, import or export licences or other measures, shall be instituted or maintained by any contracting party". Following the interpretation of the Appellate Body, the provision has a wide scope and prohibits in principle de-facto trade restrictions through non-tariff government action. In addition, QR must abide to the most favoured nation obligation, i.e. may not discriminate among countries.

In consequence, QRs are not – in principle - among the lawful tools to ensure competiveness of Europe's economy while combating climate change. However, QRs are often in place in practice, either through a waiver or through the exception under Art. XI:2 GATT. According to Art. XI.2 (b) GATT, QRs are permissible for "import and export prohibitions or restrictions necessary to the application of standards or regulations for the classification, grading or marketing of commodities in international trade". Although this provision allows member states to restrict trade in an effort to ensure a certain quality of products, it is limited in scope as only necessary measures are eligible, i.e. the measures cannot be replaced by other, less trade distorting actions. In addition, QR may be justified under the conditions of Art. XII GATT, which has a limited scope, or Art. XX GATT. If QRs equally apply to domestic products, Art. III:4 GATT applies, which prohibits measures only if they are discriminatory.

3.4 Inter-dependencies with Other Environmental Regimes

Trade measures introduced by the EU aimed at maintaining competitiveness may also have to be assessed against other environmental regimes. There has been a long debate on the relationship between international trade law and multilateral environmental agreements (MEAs) that provide for trade measures.[74] In addition, conflicts between environmental regimes are possible.[75] In the Doha Declaration of 14 November 2001 Members agreed to negotiations on this relationship as well as on information exchange, and the *reduction* of tariff and non-tariff barriers to environmental goods and services.[76] However, apart from compiling and updating information on MEAs containing trade measures, there has been little progress within the WTO on these questions.

[74] See, for instance, Agata Fijalkowski and James Cameron, (eds.), *Trade and the environment: Bridging the gap* (London: Cameron May 1998); Gabrielle Marceau, "Conflicts of norms and conflict of jurisdictions. The relationship between the WTO Agreement and MEAs and other treaties", 35 *Journal of World Trade* (2001) 1081; Doaa Abidel Motaal, Multilateral environmental agreements (MEAs) and WTO rules. Why the "burden of accommodation" should shift to MEAs", 35 *Journal of World Trade* (2001) 1215.

[75] Cf. Rüdiger Wolfrum and Nele Matz, *Conflicts in International Environmental Law*, Series: Beiträge zum ausländischen öffentlichen Recht und Völkerrecht, Vol. 164 (Berlin: Springer 2003).

[76] WT/MIN(01)/DEC/1, para 31.

Besides the trade implications of the mechanisms under the Kyoto Protocol[77] there are not many MEA containing trade rules.[78] The most important of these are the International Plant Protection Convention (IPPC),[79] the Washington Convention on Trade in Endangered Species (CITES),[80] the Montreal Protocol on the Ozone Layer,[81] the Basel Convention on Hazardous Waste,[82] the Convention on Biodiversity (CBD),[83] the UN Fish Stocks Agreement,[84] the Cartagena Protocol on Biosafety,[85] the Rotterdam PIC-Convention[86] and the Stockholm POP-Convention.[87]

In principle, a state is bound by all treaty obligations it has entered into, even if they contradict each other, and remains responsible for fulfilling them.[88] Under the general rules on the international law of treaties, the Vienna Convention on the Law of Treaties ("Vienna Convention") [89] provides relevant rules on conflicting treaty obligations. Pursuant to Art. 30 of the Vienna Convention, an environmental regime may take precedence or be subordinate to the WTO regime, if the treaties relate to the same subject-matter. This general is not helpful in the WTO – MEA debate, because MEAs do not typically relate to the same subject-matter as the WTO regime, even if they contain trade rules.[90] In addition, and in contrast to the North-American Free Trade Agreement (NAFTA),[91] the WTO regime does not provide rules dealing with potential inconsistencies between its trade regime and MEAs.

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[77] Art. 6, 12 and 17 of the Kyoto Protocol on emissions trading and JI/CDM, further elaborated in more detail through subsequent decisions of the COP-MOP.Cf. Art. 2.1(a)(v) of the UNFCCC.

[78] Cf. the WTO's own matrix in WT/CTE/W/160/Rev.4 of 14 March 2007.

[79] International Plant Protection Convention of 6 December 1951, text at http://www.ippc.int.

[80] Convention on International Trade in Endangered Species of Wild Flora and Fauna, original text: 12 *ILM* (1973) 1055; amended texts at http://www.cites.org/.

[81] Montreal Protocol on Substances that Deplete the Ozone Layer,16 September 1987, 26 *ILM* (1987) 1550, amendments via the Ozone Secretariat at http://www.unep.ch/ozone/index.shtml.

[82] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 22 March 1989, 28 *ILM* (1989) 657, amendments at www.basel.int

[83] Convention on Biological Diversity, 5 June 1992, 31 *ILM* (1992) 851.

[84] Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea (UNCLOS) of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 4 August 1995, 34 *ILM* (1995) 1542.

[85] Cartagena Protocol on Biosafety to the Convention on Biodiversity, 29 January 2000, 39 ILM (2000) 1027.

[86] Rotterdam Convention on the Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in international trade, 10 September 1998, UNTS vol. 2244, p. 337, amendments at www.pic.int.

[87] Stockholm Convention on Persistent Organic Pollutants, 22 May 2001, 40 ILM (2001) 532.

[88] Under international law, in principle there is no hierarchy between norms. *Ius cogens* is an exception, albeit with controversial preconditions and consequences, see International Law Commission, Conclusions of the work of the Study Group on the Fragmentation of International Law: Difficulties arising from the Diversification and Expansion of International Law, UN Doc. A/61/10 para. 251; Dinah Shelton, Normative hierarchy in international law, 100 *AJIL* (2006) 291. No environmental rule has yet come close to the status of *ius cogens*.

[89] UNTS Vol. 1155, p. 331.

[90] Heintschel von Heinegg, in: Ipsen (Hrsg.), Völkerrecht, 5. ed. 2004, p. 16. If treaties relate to the same subject-matter, one treaty prevails if the other specifies that it is subject to, or that it is not to be considered as incompatible with, that treaty. In absence of specific provisions, between states parties to both treaties the earlier treaty applies only to the extent that its provisions are compatible with those of the latter treaty. Between a State party to both the WTO and the MEA, and a State party to only one of these regimes, the treaty to which both States are parties applies, Art. 30(3) and (4) of the Vienna Convention.

[91] Art. 104 NAFTA provides that in case of inconsistencies between NAFTA and specific trade obligations provided by certain MEA and bilateral environmental agreements, the latter shall prevail.

Although the WTO regime does in places refer to other legal rules outside the WTO regime, these references do not include trade measures under MEAs.[92] Likewise, MEAs trade rules are generally without prejudice to other trade regimes and do not resolve potential inconsistencies or conflicts with international trade rules or other environmental regimes.[93] For the same reasons, the WTO regime does not terminate or suspend previous MEAs, or vice versa, pursuant to Art. 59 of the Vienna Convention.

In absence of a clear precedence of one regime over the other, the trade related rules in MEAs may have to be taken into account *within* the WTO regime, i.e. when applying WTO rules and in assessing their potential violation pursuant to Article 3.2 of the DSU and Article 31(3)(c) of the Vienna Convention.[94] As shown above, general principles of international law are to be taken into account in the interpretation of WTO provisions[95]. In respect of MEA, however, the panel in a recent WTO dispute held that it was required to take into account MEA only if they are applicable to *all* of the Parties to the dispute.[96] It referred to the wording of Art. 31(3)(c) of the Vienna Convention, which requires taking into account any relevant rules of international law *applicable* in the relations *between the parties*. As the Cartagena Protocol on Biosafety was not binding on all parties to the dispute, the panel held that it was not *required* to take into account in interpreting the relevant WTO rules.[97] The panel argued that its approach was in line with the decision of the Appellate Body in the second *shrimp* case,[98] although in this case the Appellate Body referred to MEA which were not applicable to all disputing parties. According to the panel, the Appellate Body referred to these MEA because it considered that they were informative and aided it in establishing the meaning and scope of WTO provisions, but not because it was *bound* to take them into account. In other words, the panel The approach of the panel in this decision was widely criticised, *inter alia* by the International Law Commission, for being to narrow and making "it practically impossible" to ever use multilateral treaties as interpretative aids.[99]

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[92] For instance, the references in Art. XXI GATT; Art. 2:2 TRIPS.

[93] The Kyoto Protocol, for instance, does not contain specific rules on its relationship with international trade law, in particular the WTO/GATT regime: Pursuant to Art. 2.3 of the Kyoto Protocol, Annex I parties shall strive to minimise adverse effects of their climate policies under Article 2 on international trade. See also Article 3.5 of the UNFCCC; Art. 36 of the Tropical Timber Agreement; the Preamble to the International Plant Protection Convention, to the Rotterdam PIC-Convention and to the Stockholm POP-Convention.

[94] Cf. David Palmeter and Petros Mavroidis, "The WTO Legal System: Sources of Law", 93 *American Journal of International Law* (1998) 399; Lorand Bartels, "Applicable Law in WTO Dispute Settlement Proceedings", 35 *Journal of World Trade* (2001) 501.

[95] See the analysis of the exception clause above.

[96] Panel, *European Communities - Measures Affecting the Approval and Marketing of Biotech Products*, WT/DS291/R (joined with WT/DS292/R and WT/DS293/R), report of 29 September 2006, para 7.71. The matrix of the WTO lists parties to the WTO and MEA in WT/CTE/W/160/Rev.4 of 14 March 2007.

[97] The USA had not signed it, while Argentina and Canada had signed but not ratified it.

[98] Panel, *European Communities - Measures Affecting the Approval and Marketing of Biotech Products*, WT/DS291/R (joined with WT/DS292/R and WT/DS293/R), report of 29 September 2006, para 7.94, referring to Appellate Body, *United States – Import Prohibition of Certain Shrimp and Shrimp Products*, Recourse to Art. 21.5 DSU, WT/DS58/AB/RW, 22 October 2001.

[99] Martti Koskenniemi, *Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law,* Report of the Study Group of International Law Commission, UN Doc. A/CN.4/l.682, 13 April 2006, p. 227.

Despite these potential legal inconsistencies between MEAs and the WTO regime, states have so far refrained from bringing formal disputes about trade measures agreed under MEAs to the WTO.[100] Yet this might change given the increasing interest in trade measures related to climate change. WTO Director Pascal Lamy is currently arguing in favour of a new multilateral agreement that would act as an arbiter of environmental trade measures and "guide" the WTO in this respect.[101] However, the most recent case law of the WTO suggests that unless all WTO members became parties to this multilateral agreement, the Dispute Settlement Body could take this new agreement into account, but would not be bound to do so. Therefore, the legal uncertainty arising from potential inconsistencies between the WTO regime and other environmental regimes remains unresolved.

3.5 Conclusions

As the foregoing assessment has shown, border adjustments to offset the regulatory burden of climate policies are not, as a matter of principle, ruled out by the pertinent rules of international trade law. Indeed, past case law even suggests that such measures would stand a good chance of being found admissible in a trade dispute; and in the event that a violation of free trade disciplines is found, the measure would nonetheless be likely justified under the general exceptions of Art. XX(b) and (g) GATT. Any border adjustments should only follow upon serious efforts to negotiate a multilateral solution, and arising burdens should preferably affect domestic and foreign producers uniformly, and be justified on environmental, not competitive, grounds. But ultimately, legal uncertainties will remain: the relevant provisions are too indeterminate, their interpretation leaving ample discretion and susceptible to political concerns. From a legal point of view, a multilateral solution raises far fewer questions than unilateral trade measures. However, unless all WTO members would have to become parties to a multilateral solution, legal uncertainties remain. Although some studies have dared advocate a certain outcome, the final word, in fact, rests with the judicial bodies of the WTO.

[100] This is pointed out by the WTO, http://www.wto.org/english/tratop_e/envir_e/envir_neg_mea_e.htm. For instance, the restrictive trade measures to phase out ozone depleting substances under the Montreal Protocol were never challenged under the GATT - even though they applied to states not party to the Montreal Protocol. Whether the EC's reference to the Cartagena Protocol on Biosafety in the dispute *European Communities - Measures Affecting the Approval and Marketing of Biotech Products,* WT/DS291/R (joined with WT/DS292/R and WT/DS293/R) could make this dispute a "MEA"-related challenge cannot be assessed within the scope of this paper.

[101] WTO Director-General Pascal Lamy in a speech at the Informal Trade Ministers' Dialogue on Climate Change in Bali on 8-9 December 2007, http://www.wto.org/english/tratop_e/envir_e/envir_e.htm.

4. Border Adjustments - Implications of design options

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CIRED-SMASH

4.1 Introduction

Whether or not an agreement is reached at the Copenhagen COP in 2009, it is very unlikely that a single global price for greenhouse gases will prevail. First, some countries may refuse to ratify the future treaty; second, the treaty may well put different types of targets on countries with different development levels, following the principle of common but differentiated responsibilities; third, parties to the treaty will most likely remain free of choosing or not to cover their GHG-intensive industries by an emissions trading scheme or by other policies and measures.

In this context, industry groups will most likely continue to criticize the European Union Emissions Trading Scheme (EU ETS) for threatening their "competitiveness" (cf. box 4.1 for a clarification on this term). In other words, a persistent CO_2 price differential may induce carbon leakage and lower the environmental efficiency of the EU ETS. Some researchers (Ismer and Neuhoff, 2007; Demailly and Quirion, 2008b) and stakeholders (ETUC-CES, 2008) consider that Border Adjustments (BA) may effectively prevent climate policies from negatively impacting European industry's competitiveness. Besides, BA are sometimes presented as a way for the EU to induce other countries to participate in an international climate protection agreement (Stiglitz, 2006), although some experts come to an opposite conclusion (Landau, 2007). Above all, the challenge is to demonstrate that it is possible for the EU to implement an ambitious mitigation policy without condemning its industry.

A border adjustment would impose a cost on some GHG-intensive products imported in the EU market and a kind of rebate on products exported. An adjustment on the importations has the objective to avoid or limit competition distortions between European and non-European countries that may arise due to the unilateral climate action of Europe **in the European markets.** An adjustment on the exportations targets **the non-European markets**. Consequently, the adjustments have not the same importance in all sectors.[102]

In the present note, we do not discuss the *rationale* to implement such an adjustment. We rather assume that the implementation is decided on both exportations and importations and discuss the main design options and their capacity to fulfil the above-mentioned motivations for border adjustments.[103] More precisely, the implementation of a BA in complement to the EU ETS requires to precise the following elements:

1. The form of the border adjustment
2. The targeted products
3. The adjustment base
4. The countries covered
5. The enforcement issues specific to the border adjustment
6. The administration cost of the mechanism

[102] For instance, the limitation of carbon leakage in the cement sector would mainly come from an adjustment on importations due to the weakness of exports from the EU to the rest of the world, whereas the limitation of the carbon leakage from the steel & iron sector depends on a BA on both importations and exportations. According to IISI (2007), the exportations of the EU 25 to the rest of the world amounts to 35,4 Mt of steel and the importations from the rest of the world to 24,7 Mt of steel.

[103] It is to note that the mechanism design is constrained by the rules of the World Trade Organisation (WTO).

In this briefing note, we assume that allowances are auctioned since, first, a BA is much more difficult to justify under free allocation than under auctioning and, second, since with a BA the European industry does not suffer from a competitive disadvantage (or less so), there is little rationale for free allocation. Godard (2007) proposes a formula for a BA in case of a hybrid allocation with both freely allocated and auctioned allowances.

Box 4.1 Competitiveness – what are we talking about?

Competitiveness is a loosely defined word, which is often considered as meaningless at the macroeconomic level (Krugman, 1994). At the sectoral level, the Krugman critique does not apply but "competitiveness" is employed with very different meanings. Indeed the ETS is accused of increasing the production costs of European producers vis-à-vis their competitors and thus of (i) inducing carbon leakage, i.e., increasing emissions in countries not covered by the ETS; (ii) destroying jobs in industries exposed to international competition and either covered by the ETS (cement, iron and steel…) or indirectly impacted through its impact on electricity price (aluminium…); (iii) reducing profits in the above-mentioned industries. These three claims have to be qualified.

(i) In most general equilibrium models the larger part of leakage occurs through the "energy prices channel". That is, climate policies decrease the international prices of oil, gas and coal hence increase their use in countries without a climate policy. This mechanism has nothing to do with "competitiveness" and prevails also in sectors sheltered from international competition. Obviously BA cannot address it; the only policy that could is carbon capture and storage (CSC), which would actually increase the imports of fossil fuels by countries with climate policies (because CSC raises fossil fuel consumption), hence would raise the world energy prices. Yet BA can potentially address the other main leakage channel, i.e., the "GHG-intensive industry channel", by which European industry loose market shares, both in the domestic market and abroad, because its production cost increases.

(ii) The industrial activities the most sensitive to climate-induced relocations (clinker production, primary aluminium production, upstream steel production) feature a very low labour intensity, measured by the employment/value added ratio, compared to the average labour intensity of the economy, or to the labour intensity of activities likely to develop thanks to climate policies (renewable energy, building insulation…). Hence, on balance, employment is likely to improve. Yet some plant closures in industries affected by the ETS may occur and be highly visible and politically sensitive, especially since in such an event industry is likely to put the blame on the ETS, whether or not it had an influence on the closure decision.

(iii) BA are less efficient than free allocation (through pure grandfathering) to compensate profits losses. Indeed in many cases 100% free allocation largely over-compensate profit losses (Bovenberg et al., 2006 Demailly and Quirion, 2008a). This being said, any public policy creates winners and losers, raising profits for some industries and decreasing them in others so it is not obvious that profit loss compensation should be aimed at in the particular case of the ETS.

4.2 The form of the border adjustment

Until the mid-1990's, discussions on border adjustments were led in the context of proposed GHG taxes. Under a GHG tax, the adjustments would take the form of a tax on some imported products, and of a tax exemption on emissions entailed by the production of products exported by the EU.

Under the EU ETS, the adjustment **on the exportations** of GHG-intensive products would consist in exempting EU exporters from the requirement to surrender allowances for emissions induced by production of exported products.

For the importations, two options are possible: the BA can correspond to a price-based measure such as a duty, charge or tax on carbon-intensive imports or to imposing to the importers to surrender allowances for emissions induced by production of the imported products.

The implementation of a border *tax* adjustment in the complement to the ETS has been the option examined first in the literature. This is certainly because such adjustments already existed and were authorised by World Trade Organisation's rules (De Cendra, 2006; Ismer and Neuhoff, 2007). But recent analyses conclude that an adjustment imposing to surrender allowances to the importers could be authorised by the World Trade Organisation (WTO) depending on the precise design adopted (Pauwelyn, 2007; Godard, 2007).

Assuming that the two options are implementable, a BA imposing on importers of GHG-intensive products to surrender allowances is preferable for several reasons: (i) this option avoids evaluating a tax level, which would in any case be complex to determine and very probably contestable at the end; (ii) this option is more transparent and ensures a more "similar" treatment between European and non-European firms.

4.3 The targeted products

There is a relatively large consensus about the products that should be covered by the BA: it must concern the products for which a persistent CO_2 price-differential can induce big changes in trade patterns, i.e. the sectors of the economy which (i) face high cost impacts due to direct CO_2 emissions (combustion and process) and/or indirect emissions from electricity and (ii) are very exposed to international competition. Indeed the risks of significant carbon leakage exist only in these sectors. According to Hourcade et al. (2007) the most sensitive sectors are steel, cement and aluminium.[104] We thus assume for illustration that the BA would cover these three sectors, but it could be applied as well to refining, pulp & paper, glass, or to some chemicals (Houser et al., 2008).

A more delicate issue concerns the downstream products. This is because imposing a BA on CO_2-intensive products like steel, but not on downstream products, could induce a change in the trade patterns of these last products as well and thus lead to carbon leakage. For instance, imposing a BA on steel but not on cars could incite firms to produce cars outside of the EU and import them to EU after. Houser et al. (2008) gives some interesting figures highlighting what is at stake: "[…] the United States imported 36,9 million tons of steel in the form of final goods like automobiles and toaster ovens, more than the 30 million tons in actual steel products imported that year." The point is then to examine whether the downstream products are traded a lot between EU and the rest of the world and to evaluate the extra-cost they bear due to the EU ETS with a BA.

[104] The last sector is not currently included in EU ETS but suffers of an increase of electricity price and is very exposed to international competition.

For cement, only clinker and cement have to be included since the downstream products (concrete or concrete elements) are little traded, having an even lower value per tonne than cement or clinker.

For steel, more products have to be included[105] and in how far a BA should include the downstream products is a question that must be analysed further with caution. Of course, the BA cannot apply to any manufactured product containing steel – and does not have to. For example, according to ADEME (2007), the emissions related to the use of steel and aluminium in a car of 1 ton is around 1.6 tons of CO_2. If we suppose a price of a European allowance between 20€ and 30€ and we assume that the cost pass-through is complete in the electricity, steel and aluminium sectors, the increase of the cost to produce a car is between 32€ and 48€. This is negligible (less than 1%) compared to the price of a car. Hence cars do not need to be included, and the same argument probably applies for other transport materials and for appliances.

However, for some steel and aluminium products (like a car bodies or a soft drink can) their inclusion is not obvious. Two indicators could be helpful to set the perimeter regarding the BA: the openness ratio (non-EU imports + non-EU exports / EU production) and the CO_2 intensity, i.e., embedded CO_2 / product value. We suggest setting a BA on products reaching a threshold on both indicators. Further studies would be certainly useful in order to evaluate better what is at stake.

Electricity is a production factor for many products. The increase of the electricity price due to the EU ETS can be problematic to the electricity-intensive sectors very exposed to international competition. The aluminium sector is clearly identified as a sector where the carbon leakage can be important. A BA on aluminium can limit carbon leakage from this sector only if the BA is also applied to the indirect emissions related to electricity production. This point is discussed in the following section.

4.4 The adjustment base

4.4.1 The targeted emissions

For the firms of the sectors included in the EU ETS, the European climate policy takes the form of an obligation to surrender allowances corresponding to their direct emissions, but the policy also means a higher electricity price. For the firms of the sectors not included in the EU ETS but consuming a lot of electricity, these firms do not have to surrender allowances but they also face a higher electricity price which considerably impacts their business. To be more efficient in limiting carbon leakage, the BA must be applied not only to direct emissions (combustion and process) but also to indirect emissions from electricity.

According to Godard (2007) or Ismer and Neuhoff (2007), applying the BA also to the indirect emissions related to electricity should be compatible with the WTO. Indeed it does not induce discrimination between EU and non-EU products.

Taking into account the indirect emissions in a BA on the importations boils down to increasing the quantity of allowances that the importers must surrender. Concerning the exportations, the point is a little more delicate. Up to now we have supposed a BA on exportations as an exemption from the requirement to surrender allowances.

[105] At least pig iron, semi-finished products (slabs), sponge iron, coils, and concrete reinforcing bars should be included.

But, for the indirect emissions, the climate policy entails an increase of the electricity price. The BA must then compensate EU producers for this extra cost. Ismer and Neuhoff (2007) suggest directly compensating for the price change of electricity, using an electricity dispatch model to compute this price change.

4.4.2 Evaluating the amount of emissions imputed to importations and exportations

Whichever its form, a BA requires assessing the amount of emissions (direct and indirect) imputed to imported and exported products. This is particularly problematic for imports because most of the non-EU production installations have no obligation to declare – and thus do not know precisely – their CO_2 emissions. Another difficulty comes from indirect emissions from electricity generation. As stressed by Ismer and Neuhoff (2007), "in integrated electricity systems it is technically impossible to identify the origin of an electric energy delivery", and these then require a distinct treatment. A last difficulty comes from the fact that some production processes are such that several products are made at the same time. This is the case for the oil refineries for instance.

Products imported to the EU

A first option would be to ask importers to provide certified information on the carbon content of materials they want to import into the EU. However, it is difficult to oblige importers to do that since for a small importer, the administrative burden could be high in proportion of its sales. Other rules must thus be found.

One could use the average emissions of the exporting country, but this value could be difficult to compute, especially if the country is reluctant to participate.

Godard (2007) and Ismer and Neuhoff (2007) propose to use the Best Available Technology (BAT) "being actually used in industrial plants worldwide." However in many cases the BAT entails almost zero emissions: think of steel made with sustainable charcoal in Brazil or of aluminium made with hydro power in Canada. Thus some technologies have to be excluded from the BAT, otherwise the BA will have no effect at all – a point that the authors mentioned above recognize, of course. Hence Ismer and Neuhoff (2007) propose to label BAT "a technology that is commercialised, perhaps by requiring a certain market share on the world markets of the products build with the BAT production process". Godard (2007) rather proposes to "refer to the BAT within the predominant category of technology in use in Europe for each type of product (steel, cement, etc.)". For cement, the BAT, either defined with respect to the EU or to the world standard, would presumable be the dry process with pre-heating and pre-calcining and, say, 80% clinker in cement. Whatever the fossil fuel used the BAT emissions would be only slightly less than the EU average. However for steel both proposals would allow to define as the BAT the electric arc furnace, which features direct CO_2 emissions around four times lower than the average EU steel production. Hence the BA would not be effective in this case.

Pauwelyn (2007) proposes another option, easier to manage. The quantity of emissions could be the amount of CO_2 that would have been emitted, had the imported product been produced in the EU using the predominant method of production in case that the importer does not report voluntary information certified the carbon content of these products. This principle has been applied in the *US Superfund* legislation for the tax on imports produced with certain chemicals and has not been rejected by the GATT panel in charge of the dispute. We suggest following this approach.

We thus propose to use the EU average, which is easy to compute and grants a similar treatment to domestic and foreign producers. In most sectors, the EU average is lower than the world average, so the average importer would pay less per tonne of CO_2 actually emitted than the average EU firm.

A final issue is whether a particular exporter able to prove that his emissions are lower than the reference value (BAT or EU average) could be allowed to use this value instead. Godard (2007) proposes such an option, which has potentially the advantage of inducing foreign exporters to reduce their unitary emissions, and increases the compatibility with the WTO.

On the opposite, Ismer and Neuhoff (2007) suggest not to allow this option. Indeed, very few plants (if any) are designed to export specifically to the EU. Materials exported to the EU are produced in plants designed primarily for the domestic market and/or for other export markets. Hence it is unlikely that significant abatement will be induced by this option. Moreover materials produced by the least GHG-intensive processes (e.g. Brazilian charcoal-made steel, Canadian hydro-made aluminium, or biomass-fuelled cement) will be exported to the EU while other, more GHG-intensive materials, will be sold in other markets. World emissions would not decrease and could even increase since transport emissions would most likely rise.

Products exported from the EU

Similar choices have to be made for products exported from the EU. For the reasons mentioned above we suggest to fix the level of adjustment at the EU average and not to vary the level of adjustment according to the process. Indeed, imagine an EU exporter operating several facilities featuring different unitary GHG emissions (e.g. an oxygen steel plant, with high emissions and an electric one, with low emissions). This exporter will have an incentive to use the former to export and the latter for the domestic market. Moreover he will have no incentive to reduce unitary emissions of the oxygen plant.

4.5 Countries covered by the BA

Whereas the European debate on a BA in complement to the EU ETS is rather motivated by the non-ratification of the Kyoto Protocol by the United States and the fear not to reach a post-Kyoto agreement, emerging economies are the source of much of the concern in the US climate policy debate (Committee on Energy and Commerce, 2008). In both cases, the BA would not be applied to all trade partners in the same way. This discrimination among the countries depending on whether they have implemented a climate policy, or are committed in a multilateral climate agreement, would certainly be incompatible with the most-favoured-nation principle of the WTO (Godard, 2007; Pauwelyn, 2007).

Pauwelyn (2007) advocates rather to apply the same BA to all trade partners. If a partner is also a party to a multilateral climate agreement or implements an ambitious climate policy, it could in turn put in place a BA. This solution is coherent with the target to limit carbon leakage and to ensure the efficiency of the EU ETS but could become difficult to manage as the BA become more and more numerous. Ideally if other countries implement an ETS and if these ETS are linked to the EU ETS, they could share the same BA, no adjustment taking place between the EU and these third countries.

4.6 Enforcement issues

The form we advocate to implement a BA in complement to the EU ETS is to require importers of CO_2-intensive goods to surrender allowances. In a first option, importers would purchase the allowances on the market or on the same auctions as EU emitters, and surrender them in the same way. This option offers the most similar treatment with domestic producers but could induce a significant risk of free-riding. Indeed an exporter from a third country could choose to sell GHG-intensive goods in the EU without buying the allowances. It could do so for more than one year, since it would be required to surrender allowances four months after the end of the year during which it exported these goods. Admittedly, once found in non-conformity, this firm could be banned from exporting to the EU, but such a sanction is unlikely to deter non-compliance. Indeed, a firm willing to export to the EU, once found in non-compliance, may go on exporting through a dummy company and it seems difficult for the EU to sanction this behaviour.

Further analysis should be made in order to evaluate whether the risk of free-riding is high or not. In the first case, it would impact the design of the BA a lot and previous conclusions of this chapter could be changed. If the risk of free-riding is high, two alternative systems may be implemented to overcome this issue. First, the EU may set a tax, possibly equal to the current European Allowance Unit (EAU) price, or to a moving average of the EAU price, and force exporters to pay the tax before the exported product is registered at the EU border. Second, the EU could force the exporter to surrender allowances before the exported product is registered at the EU border.[106] Admittedly under both options an exporter could complain that it cannot benefit from a possible drop in the EAU price between the export (say, in year *n*) and the time when domestic producers have to surrender the allowances (30 April *n*+1). To address this issue, the EU may offer a rebate in such a case. For example, if the EAU price drops by 10% between the registrations at the EU border and, say, the average EAU price in April *n*+1, the exporter could get a rebate equal to 10% of the value of the surrendered allowances.

If such measures were required to limit free-riding, it would be necessary to examine once again the design the most appropriate to be compatible with the WTO.

4.7 The administration cost of the mechanism

Here we do not discuss the costs related to the international negotiations between the EU and its trade partners which ensure that no better option is feasible. We also do not discuss the costs of possible disputes before the WTO.

The management of the BA requires gathering and regularly updating the data necessary to evaluate the CO_2-emissions content of imports and exports. This work of data management can be more or less important depending on the options finally adopted. In particular, a BA based on BAT would require certainly more work than a BA based on the European averages. Data to evaluate the European averages generally exist already and are used regularly. Moreover the types of equipment used in the heavy industries change slowly, which lowers the updating work. An updating of the figures on a 5-year basis could be enough and would limit the management cost of the mechanism. On the other hand, establishing BAT is a complex process.

[106] The fact that the surrendering takes place upon importation rather than at the end of the period is something we have for import VAT too: importers have to pay it straight away at the border, which is different from other taxable persons that have to pay it monthly.

The Dutch example of the Benchmarking Covenant illustrates this issue.[107] The aim of this policy is that companies should come to rank among the top ten percent worldwide in terms of energy efficiency. To define the target, an international benchmarking must be decided. 97 industrial and 6 power generating companies (managing 232 plants) from 10 different industrial sectors[108] are participating in this policy. They have identified the Top Global Performers for their processes (528 different processes) with the help of independent consultancies. Effective supervision is crucial for the implementation of the covenant. The Benchmarking Committee is responsible for the whole implementation. The Benchmarking Verification Bureau has been specially established to monitor the practical aspects of the covenant since 2001. This independent bureau verifies for each company all the different stages in the benchmark process. In 2008, 14 people (including secretary staff and 2 managers) are working in this bureau. The benchmarks are updated every four years.

On the other hand, if a BA based on BAT is finally chosen, the administration cost could be heavy and there is a risk that the BAT finally adopted is contested.

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[107] For information on the Dutch policy of benchmarking covenants, see the web site of the Benchmarking Committee (http://www.benchmarking-energie.nl/index.php3).

[108] The sectors are: oil refineries; iron, steel and non-ferrous; breweries; cement; chemical industry; miscellaneous; glass; paper mills; sugar and electricity generating sector. Philips has also established a covenant.

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5. Employment effects within the Climate Change Policy Framework

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5.1 Introduction

Climate protection policies and their impacts on economic growth have become an issue of increasing debate in the last years. While the debate on the cause and effects of climate change settles as more and more effects become visible and therefore measureable and the measuring techniques improve, the discussion about the political instruments for mitigation and the consequences of the mitigation policies has just begun. It becomes increasingly important to design a post Kyoto agreement until 2009.

The EU has taken up the initiative and suggested a climate change (CC) package that will lead to a reduction of greenhouse gases (GHG) of 20% by 2020. Additionally, the legally enforceable target for the share of renewable energy sources (RES) in gross final energy consumption has been set to 20%. The possibility to use flexible instruments as JI/CDM is very limited. An even higher reduction target of 30% will be set if the EU efforts are not unilateral but international targets can be agreed upon.

The CC package consists of several measures:

- an **improved emissions trading system (ETS)** covering more emissions and allowing firms in one EU country to buy allowances in any other,
- an **emission reduction target for industries not covered by the ETS** (e.g. buildings, transport, waste) so that everyone is contributing,
- **legally enforceable targets for increasing the share of renewables** in the energy mix – the targets will reflect each country's individual needs and its potential, and
- new rules on carbon capture and storage and on environmental subsidies (from EC 23/01/2008).

Each measure has different effects on the price structure, international trade, the economies of the member states, and therefore on employment. These effects have been studied within different frameworks for the EU and for single member states. A survey of the results of these studies has to carefully categorize the different indicators used and the underlying assumptions of the different approaches. Therefore, this briefing paper will start with an overview over the economic reactions to CC and RES policies (section 5.2). Section 5.3 will give an overview over the different estimates of employment effects of CC and RES policies in the literature and sorts the different modeling approaches and assumptions. Section 5.4 concludes.

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5.2 General impacts of policy on employment

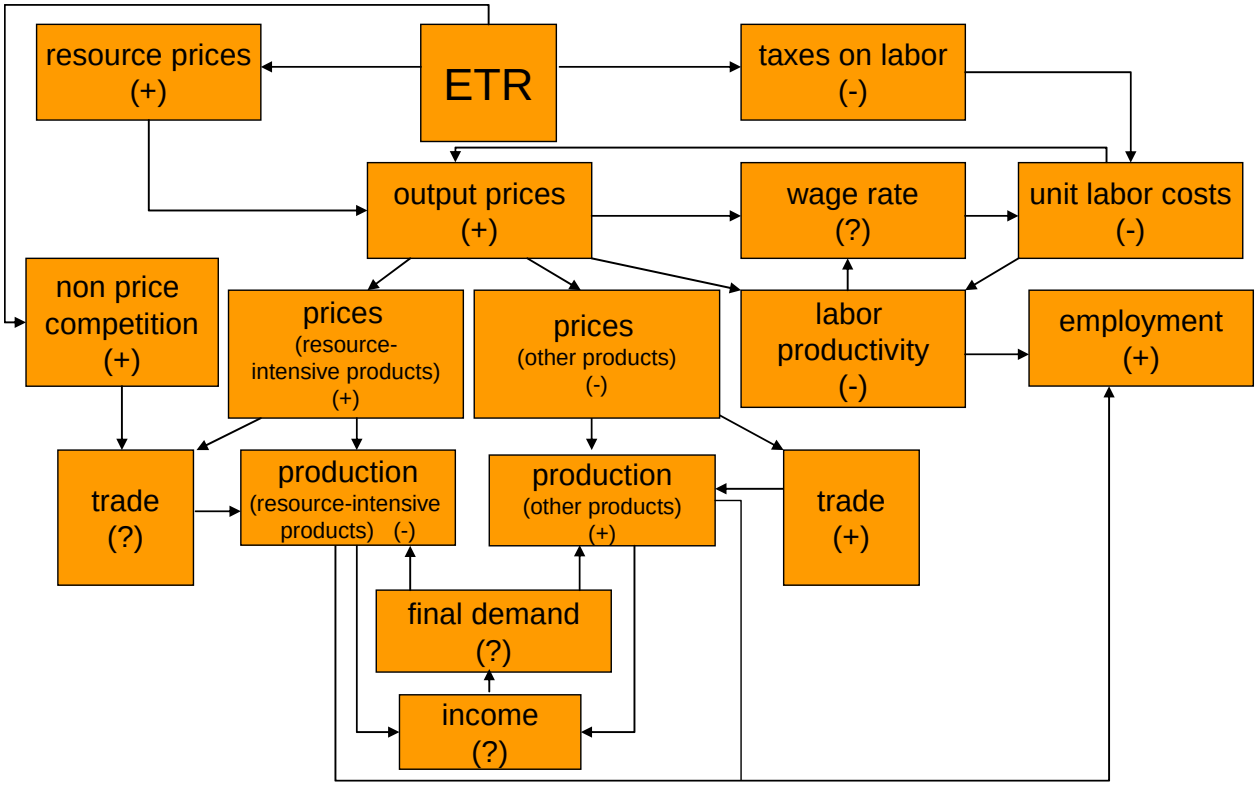
Policy measures have impacts on employment through different channels of influence. Support programs increase investment in certain sectors. Investment leads to higher turnover in the respective industries and thereby to employment increase. For instance, if support instruments for renewable energy are successful, they increase investment in RES technologies and create *direct* employment in the wind energy, biofuel, photovoltaic etc. industry. Also, the so-called *indirect* employment in the intermediate input sectors for these industries will go up due to increased demands for inputs. Therefore, employment in the metal industries and mechanical engineering etc., linked to RES investment will go up. The sum of direct and indirect employment is called *gross employment* in the literature. If employment increases, households get more income and can spend more on consumption. When the investment has to be paid for from private or public budgets, it causes negative effects from foregone demand and consumption in other sectors. However, investment security and attractive conditions can also attract international capital and yield positive or non-negative impacts, an effect hardly quantified yet. The balance of the positive and negative effects on the job market is often referred to as *net employment*, which is always the result of complex modeling work.

The role of investment is important for the employment impacts and difficult to model. In the short run, investment increases demand and production, if it does not crowd out other investment. In the long run, depreciation of capital causes additional costs. Technological progress, especially for new RES technologies strongly depends on cumulated global investment and assumptions on learning curves. These interactions over time are complex. Very positive or negative employment impacts can often be traced back to (simplified) assumptions on these interrelations.

Price increases from taxes or as a result of other policies lead to decreases in demand for the more expensive goods and vice versa subsidies increase demand with employment behaving accordingly. Relative price changes within the economy cause shifts between different production inputs and therefore shifts between the respective sectors. Price changes compared to international prices influence international trade and affect employment in the respective industries. If energy becomes more expensive in a country or region as a consequence of CC policies, energy intensive products are exported less and more energy intensive products will be imported or whole production lines will move abroad. This not only has a negative impact on employment but also thwarts global GHG reduction, if the production abroad is more polluting than at home; an effect that is referred to as “carbon leakage”.

Figure 5.1 shows important relations for the example of Environmental Tax Reform (ETR). Not only the design of the policy measure, but also the recycling of possible additional revenues (in the figure via lower labor costs) may affect the employment impacts. The effects on production are open ex-ante, whereas the employment effects are expected to be positive due to the specific use of the revenues to reduce labor costs (double dividend of environmental improvement and more employment).

Figure 5.1: Possible Impacts of Environmental Tax Reform (based on Barker et al. 2007)



Price decreases on international energy markets due to lessening demand pressures as a consequence of CC policies add to the leakage effect. New requirements defined by CC policies induce technological change and bring about innovation of products and processes. They thereby lead to competitive advantage and increasing market shares, turnover and employment in the innovative sector. The development of the innovative sectors strongly depends on international developments on the energy markets and the international CC policy design. Positive impacts will rise with higher international energy prices and the stringency of international climate policy, which itself depends on EU action. Table 2.1 gives an overview of the policy measures of the CC Package and its effects on the economy and on employment.

Apart from the basic reaction schemes in the economy much of the actual outcome of a policy depends on the details of its design. Though theoretically identical in an optimal world, price based feed-in solutions and quantity based quotas for instance do not lead to equally efficient and effective solutions in the expansion of the share of electricity from renewable sources (EU 2005). The design details of a quota system, the setting of the opting out price, the penalty, the technology specificity contribute crucially to the success of a system. The duration of feed-in tariffs and the guarantee of a continuation of the support system seem to be the decisive design elements of the feed-in system. Therefore, any finding on the economic impacts of the different support mechanisms has to be paralleled by an analysis of its framework conditions. Barker et al. (2008) show how the treatment of revenues from an environmental policy affects the results of the economic models. The revenue recycling debate originates in the discussion of the double-dividend-hypothesis of environmental taxation, but becomes of interest in the discussion of the design of an efficient ETS as well. Barker et al. report small decreases in GDP if no revenue recycling or a lump sum recycling is modeled and increases of up to 0.5% if labor costs or social security contributions are lowered by redistributive revenue recycling.

Table 5.1: Policies and economic effects

	Target	Policy	Economic result	Change of Employment
EU ETS	CO_2	Certificates w. cap Auction or grandfather	Prices of energy and carbon	Depends on auctioning/grandfathering/ revenue distribution
Biofuel	Share of biofuels	Command and Control	Investment	Increase in the agriculture sector
Renewable Energy	Share of RES in fuel mix	Feed-in tariff or Quota Tax breaks Financial support Command and Control	Investment	Increase in the RES Industry
Non-ETS EU	GHG	Taxes Command and control Credits below market rates	Investment, Prices (through taxes)	Increase in the construction sector, decrease in fossil fuel processing

The complex economic interactions require rather complex models for a careful analysis of the effects. A variety of models has been used in the literature which does not facilitate the comparison of the results. Each model has its own philosophy. A reference development has to be constructed and compared to a policy scenario to capture net effects. Oberndorfer et al. (2006) conclude from a review of the literature on the impacts of the EU-ETS on employment that the definition of the reference scenario is most crucial in the analysis, as the implicit distance to target determines the magnitude of effects. They point out that the reference case cannot be a BAU scenario since the international community has decided the Kyoto protocol and its targets and will hopefully decide post-Kyoto targets as well.

Analysis of economic effects, especially of employment, is one attempt to state sustainability of the CC policy and as such very valuable. But it should be kept very clearly in mind that the benefit of CC policies lies in climate protection, the benefits of an increased share of renewable energy lie in the smaller use of fossil resources, the decreasing dependence on imported resources and the restructuring of the energy mix towards more decentralized structures. The goal is to design the policies necessary to support this re-structuring process in an efficient and effective way.

5.3 Estimates of employment effects

This section comprises a literature review on the employment effects of different policy instruments that are also part of the CC package. Since the package is fairly recent, also studies that have been carried out before 2007 are included to complete the picture. Table 5.2 gives an overview of the results.

5.3.1 Carbon trade

The annex to the impact assessment (SEC(2008) 85) provides estimates on the macro-economic effects of different designs of the burden sharing mechanism of the 20% reduction target, of the EU ETS and the different possibilities of revenue generation as well as of the 20% RES target. The results of the analysis reflect the models used.

The annex proceeds in the following steps. Firstly, it sets the reference year to 2005 due to data availability. The GHG reduction objective then translates into a reduction by 14.5% of 2005 emissions by 2020. Next, the effects of a cost efficient GHG reduction across the EU are considered. The PRIMES/GAINS model focuses on the reduction of CO_2. The additional costs of reduction of the non-CO_2 GHGs and the investment to meet the 20% RES target are not included.

To calculate macroeconomic impacts of the EU package, the GEM E3 model is applied. The overall carbon value is estimated at €50/t CO_2, GDP is 0.54% lower compared to the baseline scenario and the decrease in employment is estimated at -0.41%. The next step turns to the comparison of the different distribution mechanisms for tradable permits in combination with different regulatory approaches for the non ETS sector; i.e. auctioning with command and control instruments, auctioning with taxation and grandfathering with command and control instruments. The latter leads to the largest negative effects with -0.54% on GDP, -0.11% on Private Consumption and -0.41% on employment.

Auctioning in combination with either a tax or cost effective command and control instruments leads to a smaller decrease in GDP and positive effects on consumption due to revenue recycling from auctioning (and taxation). In combination with taxation employment decreases by 0.06%, the larger decrease compared to the Command and Control situation is due to lack of labor supply because of the high transfers from revenue recycling. This reaction to rather small income changes is more an artifact of the models used. The analysis continues with the inclusion of the flexible mechanisms (JI/CDM). It yields an increase in employment and a smaller decrease in GDP since the carbon price sinks to 30 € (€43 without CDM). If the target is set at 30% and there is an international agreement, the pressure on GDP increases slightly, since carbon values increase and projects in the framework of the flexible mechanisms become more expensive.

The global PACE model is used to calculate output effects for some energy intensive industries. Output losses against the baseline reach up to 8.5% in the non-ferrous metal sector. Also other energy-intensive sectors such as iron and steel, paper or chemicals suffer output reductions of up to 5%, depending on the inclusion in trade and the allocation of certificates.

Table 5.2: Summary employment effects reported in the literature

1	2	3	4	5	6	7
Study	Method/Model	Policy	Target	Indicator	Effects of the indicator (column 5)	Remarks
EU CC and Renewable Energy Package						
Annex to the Impact Assessment [43]	GEM E3	Different distribution mechanisms for carbon credits	GHG	Net employment	-0.54 to -0.06%	Results improve with added flexibility (CDM/JI) and revenue recycling from auctioning of carbon credits:
Annex to the Impact Assessment [43]	PACE	Different distribution mechanisms for carbon credits	GHG	Output in energy intensive industries	Up to -8,5% for non-ferrous metals and 4,5% for chemicals	Results improve with added flexibility (CDM/JI)
Climate Change and Employment from Trade Union perspective [19]	Literature review, stakeholder interview	Emission trade	GHG Climate change	Sectoral gross employment	Structural change, e.g. transport +20% innovative technology, construction 200,000	Includes estimates on the effects of climate change in the agriculture, tourist, insurance sector
Effects of Post-Kyoto Carbon Regimes [35, 36]	GINFORS	Auctioning in electricity sector, benchmarking in rest of industry	CO_2	Net employment	Around -100,000 in Germany, negative also in most other EU countries	Results depend on concrete policy design, worsen with auctioning in industry
ICCF: The cost of the Kyoto protocol[22]	Global Insights macro models	International trading system	CO_2	Net employment	-1,500,000 in Germany, Italy, UK and Spain	Carbon regime for the whole economy, cost passed on to energy consumers

1	2	3	4	5	6	7
Study	Method/Model	Policy	Target	Indicator	Effects of the indicator (column 5)	Remarks
Carbon Leakage						
Carbon Leakage revisited [17]	Analytical model	Cap&Trade	CO_2	CO_2 emissions, leakage	Unconstrained country will voluntarily decrease emissions	Results depend on directed technical change
Carbon leakage with international technology spillovers[21]	Meta analysis Analytical model GTAP-E	Cap&Trade	CO_2	CO_2 emissions, leakage	15% to -15%, depending on spill-over	Rates depend on development of technology and spill-over
Carbon leakage: general equilibrium view[12,13]	GREEN	Cap&Trade	CO_2	CO_2 emissions, leakage	2-5%	Inelastic supply of energy=> answer to lower demands = lower prices
Sub-global actions &international capital flows [1,2,3]	MIT-EPPA	Cap&Trade	CO_2	CO_2 emissions, leakage	>100%	Perfect substitution of energy intensive production in different countries
Energy base for GTAP-E [10]	GTAP-E	Cap&Trade	CO_2	CO_2 emissions, leakage	14%	Inelastic supply of energy=> answer to lower demands = lower prices
Effects of Post-Kyoto Carbon Regimes [35]	GINFORS	Auctioning in electricity sector, benchmarking in rest of industry	CO_2	CO_2 emissions, leakage	14%	Inelastic supply of energy=> answer to lower demands = lower prices
Stern Report [48]	Input-Output data	UK	CO_2	CO_2 emissions, leakage		Only a few processes and facilities affected

1	2	3	4	5	6	7
Study	Method/Model	Policy	Target	Indicator	Effects of the indicator (column 5)	Remarks
Renewable energy and/or energy efficiency measures						
Biomass action plan [45]	Literature review, indicators		RES-E; RES-H; Transport	Direct employment EU-25	250,000 – 300,000	
Renewable energy: employment [8,33]	I/O Analysis, PANTA RHEI model	Feed-in tariff, quota of fuels, Burden sharing for RES-H	All RES	Net effects, Germany	70,000 – 80,000 by 2020	Germany is the largest market in the EU, Results depend on export, world markets and domestic support
Economic effects of the EU targets for Austria [32]	E3.at	Feed-in tariff, obligation for RES-H, C&C efficiency	RES and efficiency	Net effects, Austria	25,000 – 75,000	Includes efficiency in the housing sector.
Approaching the effects of Renewable Energy on Employment in the Spanish regions. The case of Asturias (2005) [38]	Indicators: jobs per capacity installed, literature	Renewable energy plan, feed-in tariffs	RES	Net effects, balance of loss in fossil fuel industry and RES, Spain	Slight overcompensation of losses	Regional study
Employment in RES in Germany 2006; 2007[7]	I/O analysis	Feed-in tariff, quota of fuels, subsidies for RES-H	All RES	Current Gross employment	214.000 245.000	Annually updated data on gross employment based upon the RES statistics in Germany
Employment Effects of Photovoltaics (2006) [43]	I/O analysis, survey	Feed-in tariff, financial support, R&D support	PV	Gross employment, Germany	36.000	Large database on producers and firms in O&M in photovoltaic sector

1	2	3	4	5	6	7
Study	Method/Model	Policy	Target	Indicator	Effects of the indicator (column 5)	Remarks
Employment in the UK Renewable Industry(2004) [9]	Survey, figures along the value chain	Quota, subsidy	All RES	Gross employment along the complete value chain, UK	5.500	Study aimed at new technology fields for innovation in GB
Impact assessment of the Renewable Energy Roadmap, SEC(2006) 1720 [44]	Survey	Tariff and price change RES-E Public support RES-H Financial support RES-T	RES-E	Net employment Europe	650.000	
Putting renewables to work. [28]	Meta analysis indicators	Tax breaks	All RES	Gross employment, USA	190,000 – 270,000	
REN21 Global Status Report 2004 [42]	Survey	Global worldwide	All RES, technology specific	Gross effects, partly only direct effects	Small hydro: 56,500 Wind power: 31,160 – 60,680 Biomass power: 1,600 – 6,800 Geothermal power: 800 – 3,500 Solar PV 22,590 – 29,097 Solar Thermal: 13,605 Total: 249,00-293,000	Employment in O&M: approx. 500,000
Stern Report [48]	Survey	Global	All RES	Gross employment	current size of the market for renewable energy $38 billion, employment around 1.7 million people	

Especially some studies published before 2006/07 have been very pessimistic about employment impacts of reaching the Kyoto protocol and additional post-2012 reductions, partly due to the assumption of very low international energy prices from today's point of view. ICCF (2005) analyzes a carbon regime for the whole economy in single-country macro models. Costs are fully passed on to consumers. Permit prices reach 39 Euro/t in the period 2008-12. It remains unclear whether permits are grandfathered. The explanation of economic losses via strong cuts in household's disposable income remains vaguely, as the companies, in the case of grandfathering, or the government, in the case of auctioning, can increase their income.

A study on Post-Kyoto carbon regimes by Lutz et al. (2007) shows also some negative employment effects of a unilateral EU carbon regime in the global model GINFORS. A stronger support for RES is not included in the study. Negative impacts strongly depend on the design of the carbon regime. Benchmarking instead of auctioning in energy intensive industries, the use of CDM/JI and the assumption of higher international energy prices can substantially reduce or even level the employment losses. The assumption of additional international demand for RES equipment from the EU could even yield small positive impacts on employment.

5.3.2 Carbon leakage

As has been pointed out in section 2, CC policies lead to higher carbon and energy prices within the EU and result in increasing prices for energy intensive products and therefore to more imports of these products from countries where the production might be even less efficient than in the original country. Thus, the GHG reduction policy leads to less reduction than originally planned. On top of that, reduced demand for energy of the mitigating states results in less pressure and scarcity on the energy markets and exerts a downward pressure on energy prices (Felder and Rutherford 1993). This leads in the unrestricted economies to increasing energy consumption. Both effects are subsumed under the header of "Carbon leakage". The 2nd assessment report (IPCC 1995) notes "*Conversely, a failure to achieve international cooperation could compromise unilateral attempts by a country or a group of countries to limit greenhouse gas emissions. However, estimates of so called leakage effects vary so widely that they provide little guidance to policymakers."* The situation has been improved, and the TAR (IPCC 2001) states:" *The possible relocation of some carbon-intensive industries to non-Annex I countries and wider impacts on trade flows in response to changing prices may lead to leakage in the order of 5%-20%. Exemptions, for example for energy intensive industries, make the higher model estimates for carbon leakage unlikely, but would raise aggregate costs. The transfer of environmentally sound technologies and know-how, not included in models, may lead to lower leakage and especially on the longer term may more than offset the leakage, also.* The most recent 4th assessment report (IPCC 2007) then assesses the growing literature and arrives at rather detailed conclusions. Different results on carbon leakage in the literature can be traced to different modeling assumptions. Of crucial importance is the assumed degree of substitutability between imports and domestic production, if imperfect substitution is asserted, the estimates of carbon leakage will be much lower. Further, the assumed degree of competitiveness in world markets influences the estimates on the market price driven leakage effects. More recently, studies have analyzed the effects of spillovers from the development of energy efficient technologies on carbon leakage and have found that the inclusion actually reverses the effects. If the industry in the mitigating countries responds to mitigation policies with the development of innovative processes and technologies, the market diffusion of these technologies will increase global emission reduction. The industry abroad will adopt the technologies because of savings in raw material inputs.

The 4th assessment report concludes: *"New energy infrastructure investments in developing countries, upgrades of energy infrastructure in industrialized countries, and policies that promote energy security, can, in many cases, create opportunities to achieve GHG emission reductions compared to baseline scenarios. Additional co-benefits are country specific but often include air pollution abatement, balance of trade."*

Typically, carbon leakage effects have been analyzed with Computable General Equilibrium (CGE) models (see e.g. Burniaux and Oliveira Martins 2000, Babiker 2005, Bollen et al. 2000) assuming different substitution relations between domestic and external production. Using the general equilibrium model GTA-E without any further assumptions on technology spillovers or directed technological change yields leakage rates of 14% (Burniaux and Truong 2000), Babiker (2005) assumes perfect substitution of energy intensive production between different countries and uses the MIT-EPPA model to calculate leakage rates of over 100%. This would mean that unilateral policies lead to a global emission increase. Lutz et al. (2007) support that emissions outside the EU-27 rise by 14% (85 Mt CO_2) of the within the EU avoided emissions (589 Mt CO_2), due to relocation effects (carbon leakage) mainly to the U.S. and G5 countries China, India, Brazil, South Africa and Mexico.

Lately, the analysis has been supplemented with the modeling of directed technological change (Di Maria and van der Werf 2005) or the accounting for technology spill-over (Gerlagh and Kuik 2007, G). Under certain assumptions for technological change or the amount of spillovers, carbon leakage can be shown to "turn around" and the unrestricted economies additionally save energy and decrease emissions. Most of the studies on carbon leakage are ex ante analyses of policies still to come. Barker et al. (2007) develop the literature by an ex-post analysis of the carbon leakage effects of Environmental Tax Reforms in Europe. They find that leakage is very small and in some cases negative.

A main obstacle of modeling efforts to measure carbon leakage is the aggregation problem. Most models do not differentiate more than 10 to 15, some national models up to around 60 homogeneous industries. But carbon leakage is a problem at the level of single production plants or at least the 3 or 4digit sector level of industry classification (Lutz et al. 2007, p. 78). It is neither "the" energy intensive industry nor "the" iron and steel industry that are threatened by unilateral action, but the very energy intensive part of it, especially if it faces strong international price competition. For most countries carbon leakage is not a macro-economic problem (Stern, p. 294). Models measure average impacts of sometimes very heterogeneous sectors, which put additional uncertainty on the results. The direct share of energy intensive sectors (not the energy sectors) in the EU economies is rather small. Lutz et al. (2007) report a share of about 0.6 % in Germany for the year 2004. It is worth noting, that the German share is above EU average and the share of these sectors is expected to decrease already in the baseline over time.

Carbon leakage as presented in the table is a result of complex modeling exercises, which report employment deviations between different scenarios. Employment effects are not directly caused by carbon leakage, but both are model results. It is therefore not possible to measure the net employment impact of carbon leakage.

5.3.3 Renewable Energy

In the discussion about the support of renewable energy the possible loss or gain of employment has very early been a major issue. Critics of renewable energy have often claimed that the burden on the economy will outweigh any positive effect. Supporters on the other hand consider the competitive advantages in future growth markets as larger than the additional costs. Given the recent development of the field, the latter view seems to describe the current situation at least for some European countries more correctly. The analysis of the new allocation of shares among the member states needs in most countries still to be analyzed. There are few studies which already analyzed the effects on a national level (eg. Lehr et al. 2008 for Austria).

Different quantities are published in the literature: Starting from statistical data on the number of employees in the companies that produce windmills, photovoltaic systems, turbines to indicators measuring jobs in production of the systems and operation and maintenance per mega watt installed capacity to estimates of gross employment including the whole value chain. Examples for each type of estimate as well as for total economic effects resulting in net employment are given in the following.

5.3.4 EU-wide studies

The White Paper of the EU on renewable energy (COM 97(599)) triggered a series of publications and studies on the economic effects of the RES increase. It also gave rise to the establishment of RES yearbooks and statistics in some countries (REN21 Status reports, Germany's AGEE-Stat, EWEA annual reports), which provide annually updated numbers on gross employment in the RES sector in the EU or in its member states. The European Renewable Energy Council (EREC) calculates gross employment in the renewable energy industry, in the related agricultural production and in operation and maintenance of 2 million jobs by 2020 if the 20% target is to be reached.

The Monitoring and Modeling Initiative on the Targets for Renewable Energy (MITRE 2004) uses an I/O approach where the RES sector has been integrated as an own vector in the input-output tables (Renewable Input-Output-Model, RIOT). The continuation of current policies leads to an overall net employment of 1.4 million in the EU-15 by 2020, an advanced policy scenario results in 2.5 million jobs, including all indirect effects[110]. The Stern report states that "The current size of the market for renewable energy generation products alone is estimated at $38 billion, providing employment opportunities for around 1.7 million people. It is a rapidly growing market, driven by a combination of high fossil fuel prices, and strong government policies on CC and renewable energy. Growth of the sector in 2005 was 25% (Stern 2006). GHK, IEEP and Cambridge Econometrics (2007) analyzed the direct and indirect impacts of Environment related activities in Europe. They found positive impacts on employment for policies among others leading to increased efficiency in manufacturing, an increase in bio-fuels and a higher share of renewables in electricity generation. A briefing note on employment potentials of RES and increased efficiency (DGIP 2008) gives an overview over existing studies. However, gross employment figures for the renewable energy industry are compared to direct employment figures from the fossil based electricity generation and distribution industry, therefore the analysis is biased.

[110] Though the authors state, that they include the budget effect and the „calculation tends to overstate employment losses from renewables", the so-called net figures for Germany in 2010 are quite close to expected gross numbers.

A survey of studies from a trade union perspective has been carried out by ETUC (2005). This study not only includes the impacts of CC mitigation measures but presents one of the few attempts to analyze the impacts of CC itself on employment in the EU-25. Without quantification it finds negative impacts on the agricultural sectors in the southern European countries and balanced or slightly positive effects on agriculture due to potential gains in arable land and new types of crops in the Nordic countries. Forestry might suffer from forest fires and storms with decreasing revenues and employment. Tourism is one of the main sectors affected, either due to worsening conditions of winter tourism in the lower-mountainous regions or from less demand for vacations in warmer regions due to warming in the higher latitudes. If CC induced damages increase, insurances will lose in general and employment for certain areas of expertise will increase. The study further analyzes the sectoral impacts of mitigation policies. Energy intensive sectors can lose from higher energy prices and gain competitive advantages if they switch to less fuel intensive production modes.

5.3.5 Single country studies

Single country studies have the advantage that the issue at hand can be analyzed in greater detail and the disadvantage that the results cannot be aggregated to a European result, since they often depend strongly on national characteristics and national policy approaches. Since the carbon trade sector will be harmonized, more national policy differences will be found in the RES sector and the non-trade GHG reduction.

The German Environmental Ministry has launched a series of studies on the employment effects of renewable energy (Staiß et al. 2006, Kratzat et al. 2007, and Lehr et al. 2008). The approach uses an extended I/O table in combination with the macro-econometric model PANTA RHEI. The results are expressed in net employment effects of the policies that increase the share of renewable energy in Germany. Given the size of the German economy and the German renewable energy market some of the results in the very detailed analysis might provide interesting information for the EU. Based on a survey among 1,200 companies in the RES sector, the input structure in the I/O systematic could be derived for the RES industry (vector: production of systems for the use of RES). From this structure the calculation of gross employment (direct and indirect employment) yielded 245,000 in 2007 (214,000 2006, 157,000 in 2004). Net employment of 70,000 – 80,000 can be gained by comparison with a reference case. An update provided an answer to the question of the overall employment effects, i.e. compared to a situation where no support of RES had taken place. Currently, the consortium updates the empirical data and puts a focus on biomass applications and regional impacts.

A very detailed analysis of employment along the value chain is provided in Boira-Segarra (2003). The study had been commissioned by UK's DTI to investigate the ability of the UK's renewable industry to grow with the key objective to identify target areas for central/regional funding. About 5,500 full-time jobs were sustained by the domestic UK industry, with further employment to support export activity in the order of 630 jobs. Emerging technology companies contributed another 240 jobs.

Kammen et al. 2004 calculated the gross employment effects of renewable energy for the United States deriving indicators for employment /MW capacity installed from an extensive literature review. The authors describe a conversion method of one-time employment into ongoing employment. The analysis results in gross employment by 2020 of between 190,000 and 270,000 depending on the scenario for future development.

Moreno and Lopez (2006) analyzed the regional effects of a fuel switch for a fossil fuel based industrial region in Asturias, Spain. They considered gross employment and counterbalanced it with employment losses in the fossil fuel industries of the region. The balance turned out to be slightly positive, i.e. the additional employment outweighed the losses.

Stocker et al. (2008) found for Austria net employment gains of between 10,000 and 20,000 by 2020 for three different scenarios, including an enforced increase of biomass applications and a photovoltaic and solar oriented scenario. Lehr et al. (2008) analyze the economic impacts of reaching the 34% RES target following the CC Package. They suggest a combination of measures to decrease final energy consumption especially in the heating sector by increasing the refurbishment from currently 1% of the existing building stock to 3% and of measures to support RES. The comparison of this scenario with a reference case shows persistently a higher GDP and an increase in employment with a peak of 75,000 additional jobs in 2017. Earlier studies for Austria (cf. Kratena et al. 2005, 2008) also show similar increases in employment.

5.4 Conclusions

Reported employment impacts of the EU CC and RES package tend to be negative, particularly those concentrating on emission trading, and strongly depend on policy design and international participation. Carbon leakage is expected to be rather small in most studies and can be offset by technology spill-over. Employment losses due to carbon leakage will be concentrated in a few processes and facilities. Renewable energy and other policies outside the ETS are reported to be rather positive for the labor market.

High positive and negative numbers should be treated with caution. They may be a result of a partial analysis (e.g. how many people are working directly and indirectly in the RES industry), that does not (intend to) take into account interdependencies such as the negative budget effect. High net employment impacts, either negative or positive, can in most cases be traced back to missing inter-linkages or simplified assumptions in the models, i.e. they are no net effects in the definition of this paper. The net effects are gained by comparing different scenarios in comprehensive and complex models. High gross employment in the field of RES may also be delusive. The more public money is put into any specific sector, the more direct jobs will be created. Net employment is something completely different.

The bulk of the analyzed studies show only small net employment impacts, which is encouraging in the light of the 2° target. The necessary GHG reduction will not cause economic disaster and could even increase employment. Even unilateral actions may slow down only a few energy intensive sub-sectors. Employment impacts will improve with high energy prices and strong international participation. The EU CC and RES package is in a sense a bet. The EU can improve the probability to win on the labor market by stepping boldly ahead, take care of some energy intensive facilities and, most important, convince others to join.

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Annex I - DG External Policies Study "What contribution can trade policy make towards combating climate change?"

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Executive Summary

Trade policy presents an area of opportunity for the EU to address the problem of global climate change. One approach is implementing measures to increase trade in environmental technologies and green services, as EU Trade Commissioner Peter Mandelson has identified in his call for a WTO-level initiative that would allow a 0% tariff deal for such goods and services. Of even greater potential significance are trade policies that help ensure countries' own climate-change initiatives do not put them at a competitive disadvantage in the international marketplace.

International trade is significant in size and continues to grow. Between 1990 and 2005, world trade volumes increased by 5.8% annually, while total economic output grew by 2.5% per year. Growth in trade was highest for manufactured products (6.4%), followed by agricultural products (3.8%) and fuels and mineral products (3.5%). Alongside this increase in trade volume, CO_2 emissions—especially from the transport sector—have also increased. Emissions from the European transport sector increased by 20% between 1990 and 2001. Also, international trade in climate-specific instruments is already underway, spurred on by the linking mechanisms that join the EU European Trading System (EU ETS) to the flexible JI/CDM project-based mechanisms of the Kyoto Protocol.

This report covers three different but related issues in international trade and climate change. First, by comparing the climate impacts of specific EU-produced goods with their imported counterparts, the report quantifies some of the ways in which international trade contributes to increased global greenhouse gas emissions. Secondly, the report examines ways in which market-based policy instruments could be employed within the context of trade policy. Lastly, the report examines the legal opportunities and obstacles to employing trade-related measures as a means of combating climate change, including the possibilities for altering the WTO rules. The climate impacts of trade are substantial and key mechanisms exist that could help deal with these impacts, although full realisation of these opportunities requires the establishment of clear institutional and legal frameworks.

Key Findings

- **Trade, transport and CO_2 emissions.** CO_2 emissions related to trade are steadily increasing. A shift in emissions from developed to developing and emerging countries is also occurring, due to the relocation of resource-extraction and production activities through international trade. This "CO_2 leakage" is in many cases accompanied by increasing levels of overall emissions due to less efficient overseas production processes.

- **Efficiency vs. total quantity in emissions.** Sea-based shipping emissions are 40 times lower than air freight emissions per ton-kilometre of freight. However, due to the fact that sea-based shipping currently accounts for 90% of world freight transport, it contributes twice the overall level of CO_2 emissions compared to freight transport by air.

- **Carbon emissions from traded versus EU-produced goods.** For most empirical case studies in this report, producing and delivering goods within Europe is less CO_2 intensive than importing from overseas, with this difference driven mainly by transport emissions. In some cases, however, higher production-related emissions in Europe outweighed the lower transport emissions.

- **Impact of overseas relocation on unit costs of production.** The impacts of the EU ETS on unit production costs are most significant in energy-intensive sectors due to the pass-through of ETS-permit costs from electricity producers to electricity users. However, the contribution of EU ETS prices is still small when compared to other cost factors, such as labour.

- **Consumer vs. producer countries.** The total cost of production for the four sectors examined in this study (i.e. steel, aluminium, newsprint, cement) would increase between 1.3% and 3.7% in Europe, assuming an EU ETS price of CO_2 of 10 € per tonne. These costs increases would not be faced by non-Annex B (developing) countries (which lack Kyoto-mandated carbon caps). Thus the cost advantages of these countries are also in the range of 1.3% to 3.7% due to the EU ETS system.

- **EU European Trading System (EU ETS) and Kyoto Protocol.** The EU ETS dominates the global carbon market, representing 74% of volume and 87% of value as of September 2006. The EU ETS is the key driver of international demand for project-based emission reduction projects through the CDM/JI flexible mechanisms of the Kyoto Protocol.

- **Market based instruments (MBIs).** Recent experience in using market-based instruments in environmental policy has demonstrated their ability to improve environmental performance in a cost-efficient way. Climate-related MBIs could also be effectively implemented in the context of trade policy, provided the appropriate institutional and legal frameworks are put in place.

The following table (on the next page) summarises key opportunities for trade-related measures that could be adopted to combat climate change. Further detail is provided in the main report.

Summary Table: Potential opportunities for trade-related measures to combat climate change

Measure	Potential use	Key issues
Lower tariffs for climate-friendly goods and services	Lower tariffs reduce costs, thereby increasing trade in these goods	• Could be pursued bilaterally or multilaterally (WTO rules present no obstacles) • Defining "climate friendly" difficult and contentious
Government subsidies related to energy efficiencies	Subsidies reduce costs, stimulating investment and demand	• Permissible under WTO, but cannot be contingent on export performance or require use of domestic products. Also cannot target a specific industry.
Climate labelling schemes (voluntary and mandatory)	Labelling informs consumers of climate impacts of goods and services	• WTO's Technical Barriers to Trade agreement bars standards that create an "unnecessary obstacle to trade", and favours international standards over national ones. • It is unclear whether standards can be set on production and process methods (PPMs) that do not affect the end characteristics of final products
Government procurement policies	In purchasing, governments could consider climate attributes of goods and services	• WTO Agreement on Public Procurement allows consideration of non-economic factors and establishment of standards (preferably international ones) • Still uncertain to what extent governments can prefer products (e.g. biofuels) certified as "sustainable"
International trade in greenhouse-gas credits via Kyoto's flexible mechanisms	Trade in GHG credits allows carbon reductions at least cost	• Has been quite successful but key challenges remain related to cost effectiveness, additionality of emissions reduction and effect on EU-based emissions reductions.
Responses to competitive distortions due to Kyoto Protocol		
Countervailing duties	Duties against imports from non-parties could offset costs of EU carbon measures	• WTO does not currently allow countervailing duties for "implicit subsidies" such as lack of carbon charging
Carbon taxes (or tradable permits) with border tax adjustments	Border tax adjustments could offset costs of EU carbon measures	• GATT allows BTAs to adjust for direct taxes, but it is unclear and untested whether adjustment can be made for indirect taxes on an input (e.g. energy) consumed during production