THE ROLE OF AUCTIONS FOR EMISSIONS TRADING

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About Climate Strategies

Climate Strategies aims to assist governments in solving the collective action problem of climate change. It connects leading applied research on international climate change issues to the policy process and to public debate, raising the quality and coherence of advice provided on policy formation. Its programmes convene international groups of experts to provide rigorous, fact-based and independent assessment on international climate change policy.

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The Role of Auctions in Emissions Trading: Executive Summary

Karsten Neuhoff and Felix Chr. Matthes

The European Union Emissions Trading Scheme (EU ETS) is a central pillar of European climate policy, which has many strengths but also opportunities for improvement. The EU ETS:

- puts a price on carbon for investment and operation decisions- the carbon price is also intended to feed through the value chain to incentivise CO_2-efficient production and use of products and services;
- creates clear accounting rules to ensure management focus;
- creates incentives for low-carbon innovation and investment;
- generates revenues through payment of the carbon price, which can be used for variety of valuable applications;
- allows government to credibly commit to a low-carbon trajectory, with a clearly defined emissions target and cap for the installations under the EU ETS.

As well as being an essential part of the EU's commitment to reduce its own emissions the EU ETS is a component of, and serves to reinforce global efforts. It is the major driver behind the global carbon market, which assists low-carbon investment in developing countries through the use of project credits and auction revenues. The scheme has the potential to be the 'strongest currency' in a network of interlinked emissions trading schemes that are already emerging in different parts of the world. An effective European system post-2012 could form a focal point for global negotiations up to the Copenhagen 2009 conference and beyond.

However, the EU ETS in its current design is far from perfect and to deliver the far-reaching objectives of effectiveness, efficiency and innovation, a significant revision of EU ETS after the first two trading phases is required. In particular, experience has revealed a number of serious problems arising from the free allocation of emissions allowances. A key element of the EC package proposes that most emissions allowances for the period beyond 2012 should be sold in auctions rather than handed out for free to emitters.

This report explains the economic rationale for auctioning, and examines the practical implications.

I. Problems of free allocation and the rationale for auctioning

Within a given cap allowances can be either given out for free or auctioned. Extensive analysis and accumulated evidence suggests the following:

1. Within the framework of the EU ETS as a multi-period scheme with a series of direct and indirect updating provisions, free allowance allocation distorts the carbon price signal for efficient investment, operation and consumption choices; uncertain future allocation rules complicate investment decisions.

- *Auctioning creates a robust policy framework, ensures efficient corporate and private decisions that contribute to the most economical response to climate policy, and removes uncertainties about further changes in the allocation scheme.*

2. The wide range of options for free allocation of allowances was used by many Member States, in the first two phases of the EU ETS, to offer support for the continued use of carbon intensive technologies and production processes. These approaches delay market opportunities and create uncertainties for low-carbon alternatives.

- *Auctioning creates a clear and transparent market framework for innovation and investment in low-carbon processes, products and services.*

3. Free allowance allocation distributes public assets to the operators of installations, which are often financially strong companies. These companies are not required to use the income either for investment and innovation in low-carbon options or for any other activity that benefits the country that issues the allowances.

- *Auctioning creates government revenue to support innovation, cooperation with developing countries, tax reductions to support economic growth and to address the economic hardship of high energy prices for poor households.*

Free allowance triggers public opposition to windfall profits, as illustrated by the 2006 debates in Germany, Netherlands, UK, Spain and Scandinavia. This can spread to other countries and sectors, and undermine support for EU ETS. National responses, such as windfall profit taxes, also create investment uncertainty and can create distortions between European countries.

- *Auctioning provides a fair and simple scheme to enhance public support for climate policy and thus contributes to long-term investment security.*

Given these factors, the EC package is right to place the 'burden-of-proof' on why allowances should be given out for free. Eight years after the introduction of the EU ETS with almost free allocation for two trading periods, the most serious argument in favour of free allocation could be the need to avoid leakage. However, the existing indications show that serious leakage problems only could occur for a narrow range of sectors and products. Only certain types of free allowance allocation can address this leakage concern and these must be tailored to the specific requirements of the sector. Other options to address leakage, such as provision of State Aid or border adjustment, might be more suitable.

Careful analysis and international cooperation is required to find the most suitable solution. Premature commitment to free allowance allocation for specific sectors obstructs the choice of the most effective policy instrument to tackle leakage concerns. It also pre-empts the outcome of international discussions on climate policy and thus undermines international cooperation on effective climate policy.

Any decision on specific instruments needed to address leakage requires careful and well-founded analysis. If leakage concerns are the primary motivation for the debate on free allocation and its alternatives, the complex issues of identifying leakage-sensitive sectors, the differentiation between operational and investment leakage problems, and the most practical and least-distorting implementation approaches of compensation measures, must all be analysed in a comprehensive way.

The remainder of the report sets out findings with respect to auctioning in the power sector and manufacturing industry.

II. The role of auctions for the power sector

The power sector represents the largest share of emissions covered by the EU ETS. No serious leakage concerns can be identified for the power generation sector in the EU-27. Against this background there is no reason to exempt any party in the electricity generation sector from allowance auctions.

Furthermore, from the first two phases of the EU ETS, robust evidence of the pass-through of the full costs of carbon in liberalised electricity markets exists. This trend was observed even in cases where a significant share of the allowances was allocated for free. As the new Member States are now also liberalising their power markets, the same effect is currently being observed in these countries.

Our analysis suggests that cost increases for fossil fuel based power generation, and the associated increases in wholesale prices, are unlikely to result in large scale relocation of power generation to countries not covered by EU ETS. This is because of the limited existing interconnection capacity, the time delay in network expansion and the uncertainty surrounding the long-term viability of projects. The concern about relocation of electricity intensive production processes in response to power price increases is constrained to a few sectors, and is most likely better addressed by direct measures like State Aid.

III. Equity considerations

The purpose of emissions trading is to create incentives to shift production and consumption choices to less carbon-intensive products and services. This shift is intrinsically gradual, and will be accompanied by continued emissions. The draft Directive of the European Commission proposes for the cap within the unilateral EU target a budget of 2 billion allowances for 2013 that falls to 1.7 billion by 2020. At a carbon price of 30 Euro/t CO_2, the rights to emit this carbon are valued at 50 to 60 billion Euro annually.

The allocation will thus have significant distributional impacts and will raise equity issues – that if miss-handled may reduce the political acceptability of the ETS in the long-run. Free allocation will generally make high-income households better off compared to low-income households, since they tend to benefit more from higher share price increases. Auctioning of allowances creates public funds - some of which can be used to compensate poor households for short-term increases of energy and commodity prices associated with climate policy.

This can be illustrated by the example of the power sector: Compensation for poor households for the power price increases can involve direct payments, increases of benefits and pension schemes, or support for investment in energy efficiency measures. Auctioning in the power sector provides the necessary financial resources.

IV. Empirical and analytic evidence on leakage

If auctioning is the generic approach to allocation for the EU ETS from 2013 onwards, the question is raised for which sectors and products leakage presents a serious concern. Detailed analysis is available on cost increases due to carbon prices in different sectors across many countries. Analysis suggests that leakage is not an economy-wide problem, but is specific to individual activities.

Detailed analysis for Germany and the UK shows that only 1% to 2% of GDP is associated with activities that face significant cost increases from carbon pricing. These activities are, however, significant in terms of emissions. Therefore it will be important to avoid leakage in these sectors to ensure environmental effectiveness.

Many factors have to be considered in assessing whether leakage really is a concern in the sectors that have been identified in the existing analysis. Three approaches are currently being pursued to see whether a sector with significant cost increases could be subject to leakage, and to evaluate the different mechanisms and where they are required to address leakage concerns.

- Empirical evidence of leakage – or no leakage – based on changes of trade flows or investment choices is desirable. However, with less than two years of significant carbon prices during the first trading period, the observation period is short. Also, with large increases in fossil fuel and commodity prices it is more difficult to identify changes that can be attributed to carbon pricing. Hence it is too early for empirical data to give robust evidence on the existence or non-existence of leakage.

- Economic models of the entire economy, like Computable General Equilibrium approaches, offer the opportunity to assess the interactions across production processes and terms of trade. They have provided robust results that leakage from relocation of production has only a very limited impact on the overall economy. The model resolution is currently not high enough to analyse the risk of leakage in individual activities. The analysis also points to the potential interactions for fossil fuels with global markets. While not directly relevant to the analysis of leakage effects associated with industrial production, it does warrant further analysis on an empirical basis and possible policy responses.

- Analysis of individual sectors shows that the leakage problem differs in nature between sectors. First, leakage concerns as a result of the direct costs of CO_2 from the purchase of allowances are assessed. With respect to leakage concerns, these CO_2 costs are significant for only a few sectors or products. Second, indirect costs from CO_2 cost pass-through in the power sector are far less relevant than direct costs in other key sectors with leakage concerns. Third, the different leakage mechanisms must be considered. Whilst short and medium-term operational leakage as a result of relocation of production from existing installations is a major problem, it is only relevant to a few products. For some other sectors investment leakage might be of concern, specifically where the relocation of production is linked to investment decisions for new facilities.

This illustrates that the analysis of leakage concerns requires a sector specific assessment. Only a narrow selection of sectors could prove to be relevant regarding leakage concerns. This study presents different approaches to identifying sectors where leakage could potentially occur and where provisions to avoid leakage might be necessary. We identify indicators of direct and indirect CO_2 costs, gross value added (at factor costs), trade-intensity and capital-intensity of the sectors or products as robust and suitable approximations for the reliability of leakage concerns. In addition to these indicators; transport costs, expected growth of production, and product differentiation should also be considered for the in-depth assessment of leakage concerns.

V. Policy instruments to address leakage concerns

The portfolio of provisions to deal with leakage concerns is significantly larger than that of free allocation of allowances. No individual measure is suitable to effectively address all forms of leakage given the variations of leakage concerns.

The experience from the first two phases of National Allocation Plans was that the repeated free allowance allocation created perverse incentives for market participants. The ability of the EU ETS to support effective investment, operational and closure decisions has been limited. One important motivation for the move to auctioning was to avoid these distortions.

The justification of free allowance allocation post-2012 lies in its use as a mechanism to address potential leakage concerns. However, any attempt to address these leakage concerns through allocation must be conditional on investment, operational and closure decisions of firms. This illustrates that free allowance allocation as an instrument to address leakage will create perverse incentives for and undermine the efficiency of investment, operational, closure and consumption decisions.

- Free allocation to existing installations coupled with plant closure provisions could prevent leakage as a result of relocation of facilities. However, the first two trading periods have demonstrated the difficulty in formulating effective plant closure provisions, particularly in sectors with many or complex site installations.
- Free allocation to leakage-sensitive new entrants could reduce the incentive to locate new facilities in regions without carbon pricing. In the first two trading periods support was usually technology specific, thus reducing incentives to shift to low-carbon fuels. Outside of the power sector the definition of uniform benchmarks has proven difficult, thus the incentives for investment in energy and carbon efficiency have been limited.
- The design of free allocation to address operational leakage from existing installations is challenging. In theory, linking the allocation to current or recent production volumes is effective. In practice, ex-post adjustments of allocation volumes create uncertainties for the entire scheme and have been excluded by Commission and Parliament. They also create administrative constraints that restrict innovation in production processes and substitutes.
- For all options, the specific design of the allocation provisions is crucial to prevent operational or investment leakage. The definition of benchmarks will play an important role. If the benchmarking scheme for free allocation reflects technology, fuel, and other specifics of the respective installations, it could further increase the cost of emissions reductions.

A second option for dealing with leakage concerns is direct compensation (State Aid) applied to support investment or re-investment in sectors that are at risk of leakage. This could help to avoid leakage from capital-intensive investment with leakage effects that could be far-reaching in the future. Thus State Aid could replace free allocation in leakage-sensitive sectors. According to our preliminary assessment this approach could provide more certainty to investors in sectors which are sensitive to investment leakage (i.e. capital-intensive sectors), than implicit capacity payments from free allocation in a multi-period emissions trading scheme in the context of an emerging multilateral climate regime. However, potential difficulties in gaining State Aid approval within the EU must be addressed early and consistently to avoid legal and regulatory aspects of State Aid create significant barriers to the introduction of direct compensation.

A third option for addressing leakage concerns is the use of border adjustments. This approach is very similar to value added tax. An example could be the implementation of an import duty, corresponding to the costs a domestic producer with best available technology faces when buying allowances. Exports are reimbursed for the cost at the same level. Thus the combination of full auctioning and border adjustment does not discriminate against foreign producers – an important aspect needed to ensure WTO compatibility.

The challenge for border adjustment is not the economic dimension, or WTO legality, but the political implications. After all, developing countries have experienced decades of border measures that hindered their economic development and might see border adjustment as a further impediment. This would undermine efforts for international cooperation on climate policy.

Border adjustments can therefore only be taken forward in an international approach. To gain the support of other countries, it will be important:

- To clearly demonstrate the need for border adjustment to ensure environmental effectiveness of emissions trading with auctioning – by allowing the carbon price to feed through the economy and preventing the use of free allowance allocation that undermines incentives for innovation.
- To discuss in an international and transparent manner all aspects related to the approach, in order to develop a common basis of understanding and trust for cooperation on potential implementation of border adjustment. This could be done either by using informal platforms or through formal institutional arrangements, to limit the use of border adjustment in scale and scope.
- To focus border adjustment on a narrowly defined group of products and implement it in a way that does not discriminate against foreign producers.

Border adjustment is not the solution for all leakage concerns, but can provide one economically effective option. As such it is worthwhile exploring the detailed provision and international structures required for its potential implementation.

A key result from the analysis of leakage concerns is that a combination of provisions will be required, not only to ensure that the wide range of leakage concerns are effectively addressed, but also to provide a tailored solution that is suited to the basic architecture of carbon pricing within the EU ETS. In this context, free allocation will not play a major role if leakage concerns constitute the primary motivation.

The emerging international climate regime, which will take shape in 2011, will have a significant impact on the role of free allocation and other measures to avoid leakage for the trading phases beyond 2012. However, the interactions between the international regime and the need for special provisions to address leakage concerns require the ability to adjust these measures in the context of the existing regulatory framework of the EU ETS.

VI. A simple and robust design of auctions within the EU ETS can be implemented

The introduction of large allowance auctions is not a highly complicated issue for the EU ETS. The fundamental structure of the scheme enables a robust and simple design of auctions. The large coverage of the scheme in terms of regions, sectors and participants limits the problems that could develop regarding collusion and/or market manipulation. A move from free allocation to auctions improves market performance by increasing liquidity in spot and hedging markets and reduces the incentives for market manipulation. The ongoing EU ETS allowance with publicly quoted prices avoids any need for complex auction designs and also ensures that auctions do not interrupt the continuity of the market.

The analysis on appropriate auction designs for the EU ETS suggested that single round, sealed bid auctions with a uniform market-clearing price would be most effective. To ensure the transparency and reliability of the market, the frequency of auctions should be high (at least monthly) and the distribution of allowances to be auctioned over time should be clearly defined and announced in advance by the relevant authorities. No serious argument was identified to limit the eligibility for the participation in auctions beyond the registry account holders within the EU ETS. European harmonization is a crucial issue for the phase-in of auctions at a large scale within the EU ETS. However, different options exist for formal and informal coordination of EU ETS auctions. These must be explored in more detail, especially to take into account political and legal constraints.

The concerns of strategic behaviour and exercising of market power are relevant in all markets, and therefore should also be considered in emissions trading schemes. A market monitoring mechanism for allowance trading, like in other commodity markets, will be necessary and useful to improve the market transparency and to limit concerns on the abuse of market power or collusion. Auctioning will contribute to better market performance by increasing liquidity of trading and hedging activities, and by reducing the ability of market participants to exercise market power in order to alter the value of grandfathered allowances in spot markets.

1. Introduction

Felix Chr. Matthes and Karsten Neuhoff

Dealing with climate change is one of the major challenges of the 21st century. Reaching the target to limit the increase of the mean global temperature to 2 degrees above pre-industrial levels will require a fundamental transformation of the economies of European countries and the OECD, as well as on the global level.

This fundamental transformation will require strong targets and a comprehensive policy mix, in addition to a strong international climate change regime. Irrespective of how the policy mix will evolve in different regions of the world and over time, and how the international climate regime will be designed, putting a price on carbon will be a central element.

The recent trends in the formulation of climate policies in the EU, Australia, the USA and other OECD countries highlight that emissions trading has emerged as the preferred option to internalize the external costs of greenhouse gas emissions over the last decade. The reasons for this trend can be found in both political and economic considerations. Emissions trading will be a central pillar of ambitious climate policies.

The introduction of the European Union Emissions Trading Scheme (EU ETS) in January 2005 is a milestone for European and international climate policy. Never before emissions trading as an innovative political approach was implemented at such large scale. Never before did a large economic zone introduce a scheme which puts a harmonized price on a pollutant. Never before was the internal European market complemented by powerful, far-reaching and harmonized environmental regulation which relies fundamentally on market mechanisms.

As well as being an essential part of the EU's commitment to reduce its own emissions, the EU ETS also sits within and reinforces the global effort.
It is the major driver behind the global carbon market that assists low carbon investment in developing countries; with project credits and auction revenues, and it has the potential to be the 'strongest currency' in a network of interlinked emissions trading schemes that are already emerging in different parts of the world; and an effective European system post 2012 could form a focal point for global negotiations up to the Copenhagen 2009 conference and beyond.

The novel characteristics of the scheme allow policy makers to choose an architecture which incorporates learning-by-doing and evidenced-based fine-tuning of the scheme. After the pilot phase ended and the system is well into the first year of its next trading phase, a major revision of the scheme is now underway to prepare and improve the scheme for the period 2013-2020 and to extend its scope.

Despite overall success, the EU ETS in its current design is far from perfect. In order to deliver the far-reaching objectives of effectiveness, efficiency and innovation, a significant revision of EU ETS after the first two trading phases is required.
In the context of the experiences made with a large-scale, real-world ETS for greenhouse gases and the progress of scientific analysis the empirical and the theoretical evidence constitute an important contribution for the recent revision process of the EU ETS directive.

Not surprisingly the debate on the revision of the EU ETS has created a strong focus on the distributional aspects of the EU ETS. However, some of the other design features of the scheme, the cap, the interaction of the scheme with other policies and measures, and the links to the international carbon markets would benefit from similar attention. Clarity about the broader objectives of the scheme can ensure that proposals for individual features and provisions of the EU ETS enhance its effectiveness:

- The EU ETS allows governments to credibly commit to a low-carbon trajectory, with a clearly defined emissions target and cap for installations under the EU ETS.
- The EU ETS puts a price on carbon for investment and operation decisions, the carbon price is also intended to feed through the value chain to incentivise the CO_2-efficient production and use of products and services.
- The EU ETS creates clear accounting rules to ensure management focus.
- The EU ETS creates incentives for low-carbon innovation and investment.
- The EU ETS generates revenues through payment of the carbon price that can be put to a variety of valuable applications.

In this context, this paper is intended to contribute to the emerging debate on how to re-design the allocation approach within the EU ETS. Previous experience has revealed a number of serious problems arising from the issuing of emissions allowances for free; a key element of the European Commission's proposal on the revision of the EU ETS directive, and the energy and climate package as a whole, is that most emissions allowances for the period beyond 2012 must be sold in auctions rather than handed out for free to emitters.

In this paper we address the significant aspects of auctioning allowances; the problems and respective alternatives to auctioning are considered. There are four main points to this analysis:

1. The EU ETS as a multi-period scheme with a series of direct and indirect updating provisions. Within this framework, free allowance allocation distorts the carbon price signal for efficient investment, operation and consumption choices and uncertain future allocation rules complicate investment decisions.

2. The wide range of options for free allocation of allowances was used by many Member States in the first two phases of the EU ETS to offer support for the continued use of carbon intensive technologies and production processes. These approaches delay market opportunities and create uncertainties for low-carbon alternatives.

3. Free allowance allocation distributes public assets to the operators of installations, which are often financially strong companies. However, these companies are not required to use the income for investment and innovation in low-carbon options, or use revenue for any other activity that benefits the country that issues the allowances. Specifically the issue of the windfall profits, which are estimated to reach the size of 20 to 30 billion Euro annually in the actual trading period, triggered major public debates in some Member States including Germany, Netherlands, UK, Spain and across Scandinavia (see Matthes and Neuhoff 2007; Matthes 2008; Point Carbon 2008). This can spread to other countries and sectors, and undermine support for EU

ETS. National responses, such as windfall profit taxes, create investment uncertainty and can lead to new distortions between European countries.

4. The main argument against full auctioning of allowances is the concern about carbon leakage. These concerns have to be taken extremely seriously, because a major occurrence of leakage would undermine European, and even international climate policy; the integrity, acceptance, and efficiency of the EU ETS would be questioned. However, leakage concerns require substantiation by evidence, and countermeasures have to be appropriate and fit into the regulatory framework of the EU ETS. There is a risk that policies implemented to address leakage concerns pre-empt the outcome of the emerging international climate negotiation process.

5. Last but not least, other distributional aspects of the EU ETS must be considered. Many of these aspects cannot be handled within the EU ETS and will require complementary public spending. Using revenues from allowance auctions for such interventions is an import issue in the EU ETS debate.

This paper aims to provide some analytical and empirical evidence to this complex debate. The massive phase-in of allowance auctions as a rational and reasonable goal of the emerging revision of the allocation scheme within the EU ETS is starting point. The second point is the analysis of potential exemptions from auctioning due to reasonable leakage concerns and the potential alternatives to such exemptions. The third point is analysis of practical implementation of auctions at a large scale and the concerns surrounding this new feature of the EU ETS.

The paper is organised as follows. In section 2 Felix Chr. Matthes and Karsten Neuhoff discuss the key criteria and the key design options for large-scale auctions in the EU ETS. These issues are focussed in a way that the specific features of the EU ETS, including harmonization issues are reflected.

In section 3 Misato Sato and Lennart Mohr describe analytical approaches to identify sectors which could face significant leakage concerns based on statistical data on CO_2 emissions and trade intensities. Felix Chr. Matthes extends this analysis to other indicators in section 4 by examining the structure of potential leakage mechanisms in some more detail. In section 5 Andreas Löschel provides an overview on the use, and limitations of, numerical models to assess the wider economic and leakage impacts of climate policy.

Based on the evidence that some sectors could face serious leakage problems, Stéphanie Monjon and Felix Chr. Matthes discuss the merits and the problems of free allowance allocation to tackle carbon leakage in section 6. In section 7 Angus Johnston discusses legal aspects of direct subsidies (State Aid) as one of the alternatives to leakage prevention by free allowance allocation. In section 8 Susanne Dröge describes the potential of border adjustments to tackle carbon leakage, as a potential alternative within climate policy as an element of a policy package to limit carbon leakage.

Wojciech Suwala, Mariusz Kudelko and Karsten Neuhoff analyse in section 9 the concerns about auctions in the power sectors, using a case study of Poland to illustrate the debate on auctioning in this sector. In section 10 Regina Betz and Karsten Neuhoff discuss equity implications related to carbon pricing and suggest auction revenue can be used as to address these negative impacts.

2. Auction design

Felix Chr. Matthes and Karsten Neuhoff

In this section we review the main criteria for the selection of an auction design for EU ETS allowances, and then discuss the specific features of EU ETS that are relevant to the auction design. A simple and effective auction design is the most favourable option. The section concludes with the discussion of the suitable institutional arrangement for an auction including the question of a European harmonization or coordination.

I. Criteria

For an auction of allowances to be considered successful it must meet two general criteria: First, it must support the efficient operation of the allowance market into which the allowances are sold, and second, it must be fair. If auctioning fails in either of these dimensions, it will not further the purpose of the allowance trading scheme. Both of these two key criteria have a number of important components.
Among other things, economic efficiency depends critically on selecting auction design features that:

- Enhance *price discovery*, that is, the market's ability to set the price of allowances close to the marginal cost of reducing emissions
- Improve *liquidity* of the allowance market because the availability of allowances to trade aids price discovery and lowers risks for participants
- Avoid increasing *price volatility* in the allowance market
- Avoid disruption of other markets such as electricity, capital, and commodity markets,
- Help avoid *collusion and market manipulation*
- Lower the actual *cost of participation* in the auction to maximise the number of participants
- Keep the *cost of administration* as low as possible
- Encourage participants to bid their *true valuations* at auction since this increases the likelihood that winning bidders will be those who value the allowances the most, a requirement for efficiency

Fairness is a function of:

- *Openness* of the auction to a wide range of participants
- *Transparency* of the rules for bidding and for awarding winning bids
- *Equal treatment* of small, medium, and large bidders

II. The characteristics of EU ETS relevant to the auction design

The EU ETS has several features that simplify the design for large-scale auctions which will be relevant especially for the trading periods beyond 2012:

- The EU ETS covers a broad range of industrial activities and countries. The diversity of the included sectors and the large regional coverage of the scheme (Figure 2.1) ensures a large number of participants and competitive price formation. Although the European power market is characterized by large generators, the largest emitter from the power sector represents only a share of 8% in the total emissions covered by the EU ETS and 13% of the total emissions from the power sector within the scope of the EU ETS. Nevertheless, because the market participants under the EU ETS are very different in size and sophistication, and the auction design needs to ensure fair access to allowances for all market participants.

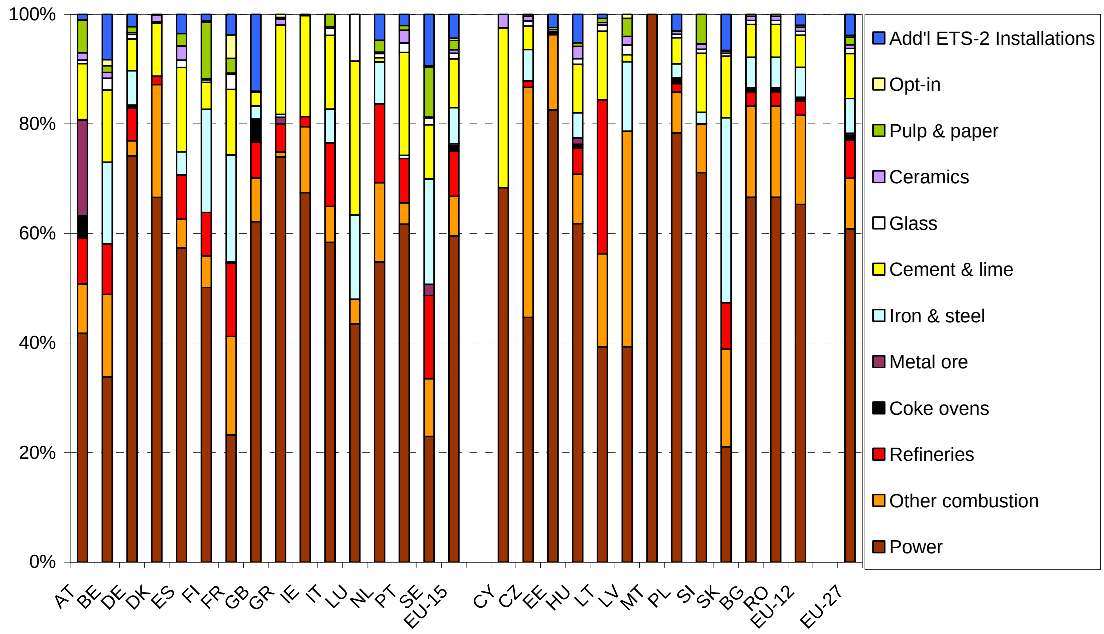

Figure 2.1: Sectoral coverage of the EU ETS for the participating Member States (Sources: European Commission 2008; Öko-Institut estimates).

- Already in the first two trading periods, which are characterized by a large proportion of free allocation, a large scale secondary market developed. The monthly market volume (OTC and exchanges) was about 150 to 280 million allowances which is significant compared to the total scope of about 2 billion tons of CO_2 and the large share of free allocation and considering the fact that the system is in the fourth year of operation. There is comprehensive information in the market and a robust price signal can be observed in the secondary market. This reduces the level of uncertainty about the auction outcomes and facilitates participation.
- As EU ETS will continue to be a scheme with unlimited banking and borrowing within the trading periods. The scheme does not require, and the recent legislative proposals have not envisaged, the introduction of vintages or comparable features. Therefore one homogenous commodity is traded; further increasing liquidity and market transparency.

These three features enable a simple and robust design of auctions at large-scale as envisaged after the first two trading periods. However, it should be pointed out, that in-depth analysis for other emissions trading scheme with a much smaller sectoral and geographic scope came to very similar proposals for auction design (Holt et al 2007, RGGI 2008).

III. Suitable auction design

There is a large body of practical experience and theoretical analysis available to inform the auction design. First and foremost, a growing body of experience with allowance auctions within the EU itself is being gathered. Added to this, is experience from other environmental and commodity markets, and analysis for the auction designs in North America and Australia (Cramton and Kerr 2002). Finally, experience from other cases of the sale of large quantities of government assets can provide valuable design insight. Governments have used auctions to sell standing timber, electromagnetic spectrum, real estate, oil exploration leases, and government bonds (Ausubel and Cramton 1998). In a closely related function, governments use auctions to purchase goods and services. Many of these functions have been subjected to careful empirical evaluation. This body of evidence should also be of use in choosing design elements for the EU ETS.

The current analysis and discussions suggest that a single round, uniform price auction is a suitable approach. It is simple and ensures all market participants pay the same price irrespective of their size, level of information or experience. A large number of market participants can ensure a competitive market clearing price, and limits the risk that strategic buyers shed their bid in order to depress the price they have to pay for allowances. The large-scale secondary market which emerged in the first two periods of the scheme flags that sufficient information is in the market and single round auctions with a uniform market clearing price do not distort price discovery.

This leaves the choice of the frequency of the auctions and the distribution of allowances over time. The respective provisions must reflect the order of magnitude of allowance which shall be brought to the market by auctions. In the recent trading period of the EU ETS the annual auctioning volume will be 60 to 70 million allowances. The range of annual auctioning volumes will be 1 to 1.5 billion allowances for the third trading phase and beyond. In this context, future auctions could be carried out with a high frequency, perhaps monthly or even weekly. This would allow market participants to buy allowances close to their demand, limit cash flow and the need for collateral, and address concerns about short-squeezing. This also allows participants to auction allowances over time so as to match cash flow requirements, limit exposure to carbon price volatility and facilitate hedging of forward positions.

For the detailed implementation further aspects need to be considered, including the timing of any auction event, setting of collateral and reserve price, specific platform and bid format, minimum and possibly maximum bid volume and possible use of non-competitive bids. Thus auctions can support the liquidity of the secondary market and overall transparency of the price formation process so as to enhance trust of market participants and support low-carbon investment choices.

The ongoing discussions have also raised the question as to whether government bodies (e.g. treasuries) execute the auction of allowances or whether a private sector organisation is commissioned to execute the auction according to clearly specified requirements. The experience from the implementation of auctions in the UK suggests that one important and demanding task for any such body is to verify that bidders are not using the carbon market to launder money. Several private sector organisations have extensive experience of such audits, while government bodies might avoid pursuing the onerous task themselves. However, if the task were delegated to third parties that do not operate in the auction, then this could imply that some market participants do not have direct access to the auctions – potentially limiting transparency and competitiveness of the auctions.

In the context of the size and the diversity of the EU allowance market as well as the existing secondary market for allowances no necessity emerges to restrict the participation beyond their technical ability to take part in the scheme. Thus the only restriction to take part in the allowance is auctions under the EU ETS is to hold an account in the EU ETS registries (operator holding account or personal holding account) which enables transfers of EU allowances.

Although concerns regarding market manipulation have in some auctions led to provisions which restrict the maximum bid to a certain share of the total auctioning volume, no immediate evidence exist that such provisions could be fundamental for auctions under the EU ETS. To ensure a simple and robust architecture of the phase-in of large-scale auctions, no restrictions on bids is an appropriate approach if the volume and the frequency of auctions is high. However, the possibility of future restrictions on bids and the related procedures could be introduced among the optional provisions of the regulatory framework which allows a future adjustment if empirical evidence proves that this would be necessary.

IV. Harmonisation

In the case of Member States pursuing independent auctions, additional questions emerge relating to the coordination of the timing of these auctions. Auctioning within the EU ETS must be harmonised to a certain extent to avoid distortions, increase transparency, limit transaction costs and ensure a robust liquidity and price formation. However, any harmonization has to fit into the legal and political framework of the EU in which subsidiary plays an important role and the revenues will largely go to the Member States.

Against this background, several options must be elaborated as to how auctions of individual Member States could relate to each other:

1. All Member States auction their allowances independently.
2. All Member States auction their allowances independently, but harmonise design features of the auction.
3. Several or all Member States commission one commercial organisation to auction allowances on their behalf. The institution returns revenues to participating Member States in proportion to the volume of allowances they submitted.
4. All Member States commit, or the Directive requires that one common institution (which could be private or public), commit auctions allowances on their behalf and returns revenues in proportion to the submitted allowances.
5. Appropriate combinations can be identified between these options to allow more flexibility for the large diversity of the EU Member States.

The main conclusions on the basic options for harmonization are summarised in Figure 2.2.

Indicative results (+ positive / - negative)		Independent auctions	Harmonised design	Commissioning same institution	Joint Auction
Number of auction places in EU		27	27	1 … few	1
Subsidiarity principle		+		+	
Risk of failed implementation		-		-	-
Transaction costs seller		-	-		
Participants Perspective	Only one registration			+	+
	Frequent auctions available			+	+
	Simplicity ETS scheme		+	+	+
Coordination	Attention/demand fatigue if auctions conincide	-	-		
	Governments pre-empting to maximise revenues	-	-		
	Lock in 'random' national designs	-			
Predictability	Reserve price can support price floor			+	+

Figure 2.2: Pros and cons of different approaches to relate auctions between Member States to each other (Source: Matthes and Neuhoff 2007).

The issue of subsidiary argues against centralisation wherever decisions can be made locally. This is a necessary aspect to create space for local democracy and institutions that reflect the local characteristics. Certainly at this stage there is little evidence that different countries have distinct preferences for a specific auction design. However, once countries have established their national auction design, the stakeholders in the country will have gained experience with this specific auction design and might be reluctant to alter their design to achieve harmonization.

The reputation of the EU ETS and thus low carbon investment decisions might suffer from any failed auction. The more countries that implement auctions, the higher the likelihood that some stakeholders in these countries manage to manipulate the process of designing the auction towards their private benefit and at the expense of the overall scheme.

If countries join up and commission one institution to implement the auction on their behalf rather than implementing separate auctions, the smaller number of joint auctions could save for the seller set-up and registration costs and the execution and bid clearing costs of parallel auctions.

Likewise, it could save transaction costs for market participants as they do not have to spend time deciding on whether to participate in an auction, and do not have to register auction participation within their organisation as well as at the place of auction. Smaller emitters might consider only registering in their national auction. Particularly in smaller countries with less frequent auctions, this might imply that an auction would not always be conveniently timed with regard to hedging demands, cash flow situation and the time availability of staff. If auctions are combined, the combined auction is likely to be executed *more frequently* and might thus be timed conveniently.

For market participants, it is risky to participate in an auction if they are not aware of all the fine details. A harmonised approach reduces the transaction costs for market participants to learn about the auction designs, and is likely to allow them to participate in more national auctions. High participation rates in auctions will increase the robustness of the price signal and reduce any risk of bid-shedding and market manipulation.

A joint auction also offers the opportunity to implement a reserve price that not only protects the integrity of an individual auction event from technical difficulties, but also serves as a longer-term commitment by government to avoid extremely low carbon prices. As some allowances will be bought with a reserve price in the auction, this translates into a price floor for allowance prices (Hepburn et al. 2006). This could support investment in low carbon projects in cases where funding is otherwise restricted because too much uncertainty exists about future carbon prices. A reserve price can however only be implemented in a joint auction, otherwise national governments have strong incentives to compete in selling their allowances.

Finally, a joint auction ensures a transparent timing of the auction. If Member States individually executed their auctions, these could either coincide or result in a rather unbalanced distribution of auction volumes over time. This could by itself result in more volatile auction results. Financial intermediaries would play a bigger role in matching the supply of allowances with the demand for allowances by emitters. As financial intermediaries bear a price risk for carrying open positions, they have to charge risk premiums for offering this service. This can increase the overall costs of the scheme without delivering additional emissions reductions.

V. Market monitoring

The confidence of market participants in the correct execution of an auction is important. An independent observer or an existing regulatory body should have access to all information about the auction and should monitor that the auction is executed in line with the initial criteria.

The concern about market manipulation is however not the most prominent issue in the auction design. In fact, auctioning might reduce some concerns about strategic behaviour. For example, if large power generators have to buy their allowances, then they have less incentive to increase the allowance price so as to push up power prices. Despite this the risk of market manipulation is not eliminated. Therefore continuous monitoring and reporting of market activities is desirable. In all commodity markets in the USA, exchanges report the daily positions and transactions of each clearing member to the Federal Commodities Futures Trading Commission (CFTC). In addition, most large traders provide information on their bilateral trades and open positions on a voluntary basis. Similarly, or given the current experience in financial markets, more stringent requirements are desirable for EU ETS so as to ensure transparency and trust in the carbon price signal.

The early set-up of sufficient market monitoring and market oversight mechanism is also important in the context of linking of different emissions trading schemes. The recent discussions on market oversight for the CO_2 allowances market in the USA indicate that the interest in linking will increase if the intensities of market monitoring and market oversight converge between the existing and emerging schemes.

VI. Conclusions

The introduction of large allowance auctions is not a highly complicated issue for the EU ETS. The fundamental structure of the scheme enables a robust and simple design of auctions. The large coverage of the scheme in terms of regions, sectors and participants limits the problems that could develop regarding collusion and/or market manipulation. A move from free allocation to auctions improves market performance by increasing liquidity in spot and hedging markets and reducing the incentives for market manipulation. The ongoing EU ETS allowance marked with publicly quoted prices avoids any need for complex auction designs and also ensures that auctions do not interrupt the continuity of the market.

The analysis on appropriate auction designs for the EU ETS suggested that single round, sealed bid auctions with a uniform market-clearing price would be most effective. To ensure the transparency and reliability of the market, the frequency of auctions should be high (at least monthly) and the distribution of allowances to be auctioned over time should be clearly defined and announced in advance by the relevant authorities. No serious argument was identified to limit the eligibility for the participation in auctions beyond the registry account holders within the EU ETS. European harmonization is a crucial issue for the phase-in of auctions at a large scale within the EU ETS. However, different options exist for formal and informal coordination of EU ETS auctions. These must be explored in more detail, especially to take into account political and legal constraints.

3. Leakage Concerns: A Small Number of Sectors are Potentially Affected

Misato Sato and Lennart Mohr

Introduction

Manufacturing industrial sectors collectively account for around 40% of global GHG emissions (IEA 2003). Undoubtedly, the manufacturing sector has a key role to play in reducing global CO_2 emissions.

One of the main issues surrounding CO_2 regulation for the manufacturing industry is the concern about relocation and emissions leakage. Because the manufacturing sectors potentially have some degree of mobility of production - unlike the power sector which requires local production (section 9) - there is concern that if other countries don't implement similar levels of CO_2 pricing, EU manufacturing industry would relocate to these countries. This would result in leakage of EU industrial emissions rather than a reduction.[1]

Recently, several studies (including those in the UK, Germany, USA, Australia and The Netherlands) have examined this issue in detail. These studies consistently show that cost impacts are highly differentiated across a wide range of manufacturing industries and only a few specific industrial activities could be significantly impacted. This section presents and summarises the results of these studies.

Cost impacts

The first step in assessing the evidence behind the feasibility of relocation and emissions leakage is to identify which sectors are potentially at risk. As emissions leakage is a secondary effect induced by the primary effect of carbon pricing on costs, assessing the impact of climate policy on sector costs acts as an initial screening process for potentially exposed sectors.

The Climate Strategies' report "Differentiation and dynamics of the EU ETS industrial competitiveness impacts" provides such an assessment, examining the potential cost impact of carbon pricing at €20/tCO_2 for 159 manufacturing sub-sectors[2] in the UK and Germany. Results are shown in Figure 3.1. The height of the lower part of the bars depicts the *indirect* cost increase from anticipated electricity price increases with the ETS[3], relative to gross value added (GVA).[4] The upper part of the bars reflects the *direct* cost increases relative to GVA, due to CO_2 emissions in combustion and process. The horizontal axis plots the relative contribution towards national GDP of these sub-sectors; in the UK, only 1% of all economic activities face total cost increases of over 4% or an indirect cost increase of over 2%, relative to value-added.

[1] See section 4 for the definition of leakage which was used in this study.
[2] Defined using Standard Industrial Classification (SIC, 92) at 4-digit resolution.
[3] This is assumed at €10/MWh for the UK and €19/MWh for Germany.
[4] GVA has some advantages as reference for cost increases over costs, prices, or profits. It excludes costs of input factors that might not be under control of the firms (e.g. oil input in refining), and thus focuses on controllable costs. It is also more robust than profits that depend on depreciation and tax strategies and can thus vary across firms, countries, time and changes in complex manner in response to carbon pricing.

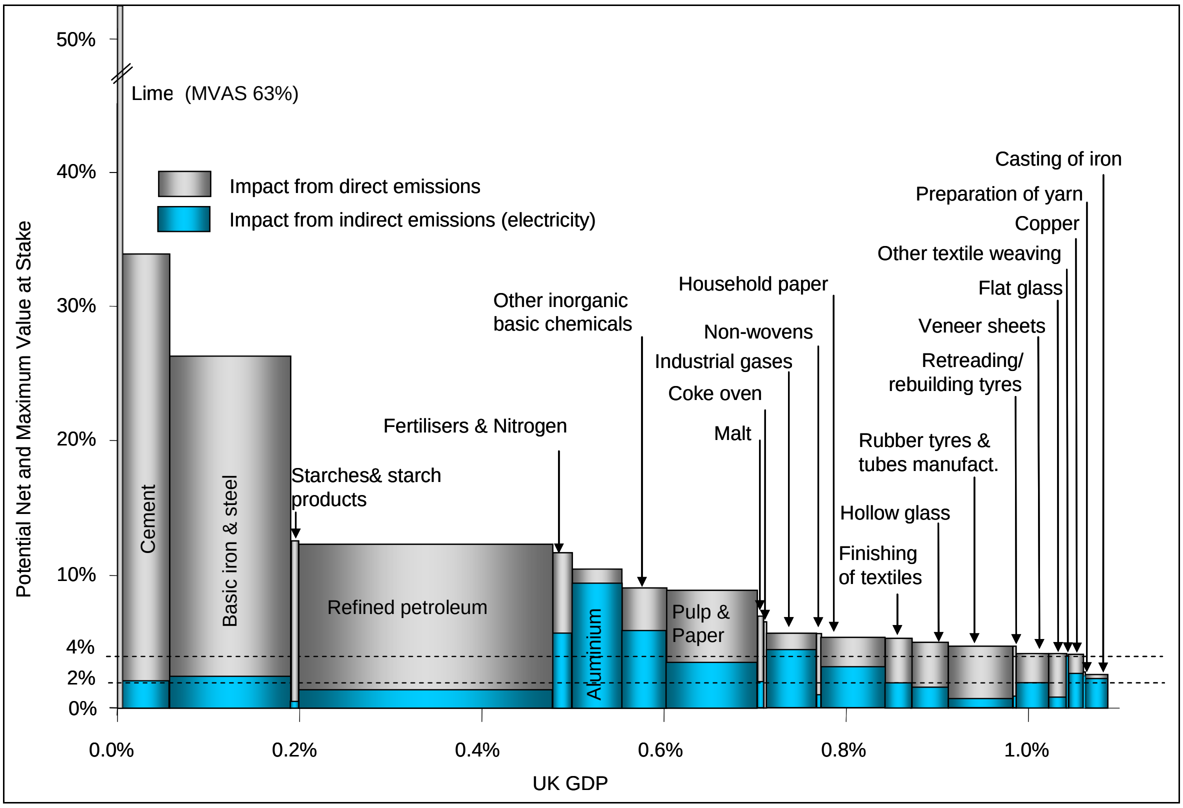

Figure 3.1: Direct and indirect cost impacts on manufacturing sub-sectors in the UK - assuming 20 €/tCO_2 carbon price and corresponding 10 €/MWh electricity price increase: 2004 data (Source: adapted from Hourcade et al 2008).

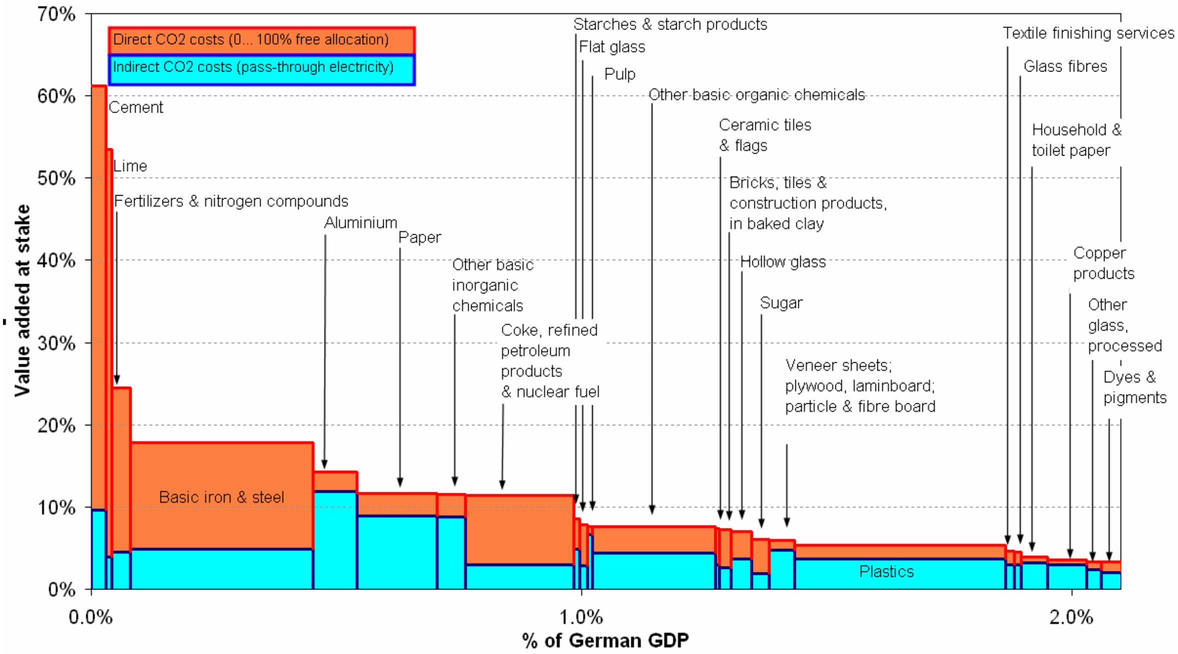

Figure 3.2: Direct and indirect cost impacts on manufacturing sub-sectors in Germany - assuming 20 €/tCO_2 carbon price and corresponding 19 €/MWh electricity price increase: 2004 data (Source: adapted from Öko-Institut 2008).

For the majority of manufacturing sub-sectors, the carbon price has less than 1% impact.[5] Those with high potential impact tend to be the upstream internal sub-sectors, which use CO_2 intensive processes for the production of low value-added products.

Figure 3.2 shows strikingly similar results for the German manufacturing sectors, with the focus of cost impacts being on the lime, cement, basic iron & steel, and fertiliser sectors. Electricity impact is most notable on aluminium, paper and other basic inorganic chemicals.

A recent study on Dutch manufacturing (CE Delft 2008), also finds comparable results whereby lime, cement, basic chemicals and basic steel stand out in terms of total cost impacts, and aluminium stands out in terms of indirect impact. This study, however, uses a broader classification of sectors ranging from 2 to 4 digit resolutions. The broader sector classification may therefore mask the higher impacts experienced at sub-sector level.

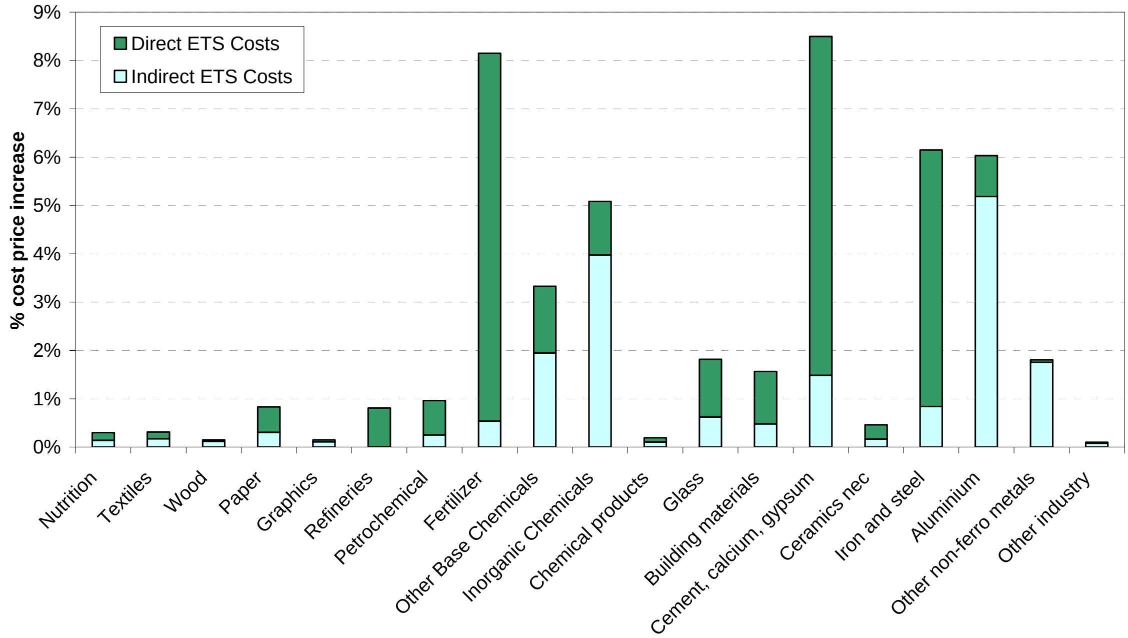

Figure 3.3: Potential cost price increase as a percentage of sectors' total costs for Dutch manufacturing sectors - Scenario with full auctioning (Source: CE Delft 2008).

The study by Morgenstern et al (2004)[6] examines cost impacts on the manufacturing industry in the US, taking into account the inter-industry flows of products and embodied energy using the Input-Output approach. As shown in Figure 3.4, of the 361 manufacturing industries studied, only a few experience a large cost impact.

[5] These results are in line with previous studies in the literature on cost impacts of CO_2 pricing, which in general have been found to be modest for energy-intensive industry. Baron and ECON-Energy (1997) carry out a statistical analysis on four energy-intensive sectors in nine OECD countries and estimate an average 3% increase in production costs from a CO_2 tax of ~$US30/tC$0_2$. Andersen (2007) finds that the cost burden of environmental tax reform in eight energy intensive sectors in Germany, Denmark and Sweden does not exceed 5% of gross operating service. When revenue recycling (e.g. recycling of employer's social security contributions) is taken into account, this figure falls to 2%.

[6] Estimated cost exposure of refined petroleum is higher than cement and steel in this study because it does not take into account process emissions.

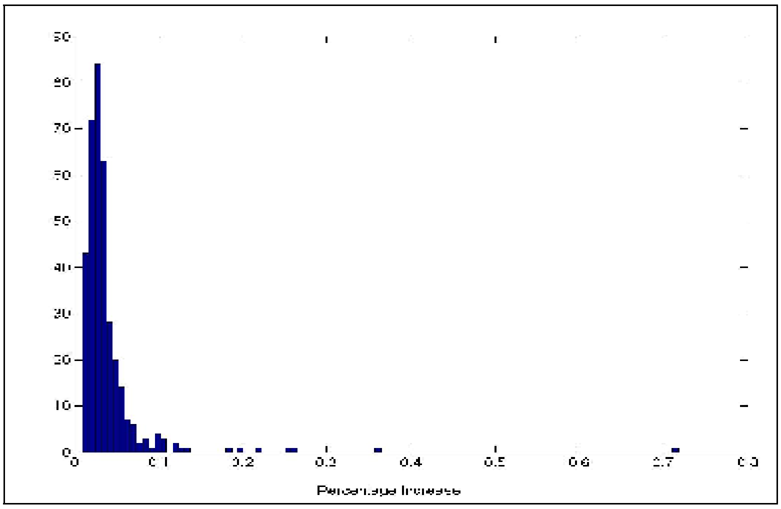

Figure 3.4: Distribution of percentage cost increase per dollar of carbon charge for US manufacturing: 1992 data (Source: Morgenstern 2004).

A study on Australian industry (Citi Investment Research 2008) also quantifies CO_2 cost effects and highlights that impacts are concentrated on a few sub-sectors (see Figure 3.5 below). This research examines the impacts of the announced Carbon Pollution Reduction Scheme in Australia on the ASX100 companies by quantifying potential impacts of an A$20/t carbon price at a company level. The study finds that for three quarters of the companies, the impact is below 2% of value, and often well below 1% of value.

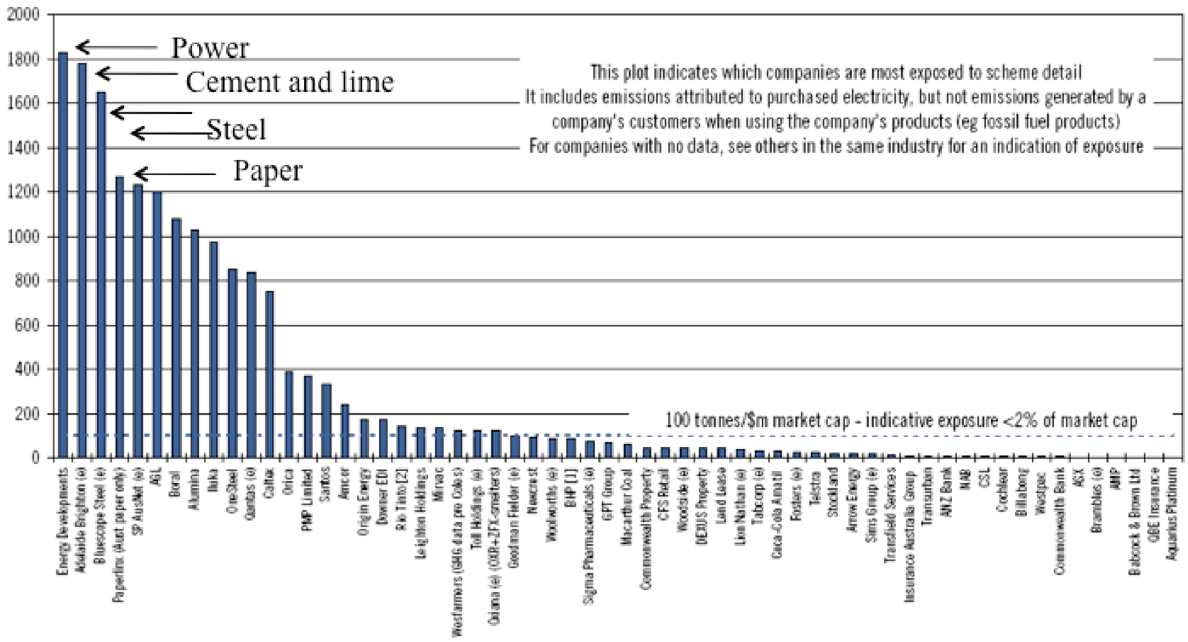

Figure 3.5: Australian Emissions: Tonnes CO_2e. Generally for FY07: per A$Million of Market Capitalisation (Source: Citi Investment Research 2008).

In summary, a number of studies have examined the CO_2 cost impacts on manufacturing across several countries. This screening process for first order impacts of carbon pricing has also assessed manufacturing sub-sectors for potential emissions leakage, a secondary effect. The studies have consistently shown that CO_2 costs are significant relative to value-added of only a few sub-sectors. There are variations in the methodology and assumptions used across these studies to quantify costs effects (see Table 3.1).

Study	Country	Disaggregation level	CO_2 price	Denominator	Process emissions	Electricity
Carbon Trust (2004)	UK	2-3 digit SIC	€20/tCO_2	GVA	yes	yes
Morgenstern et al (2004)	USA	4 digit SIC (US)	US$ 1/ ton	Total cost	no	yes
WRI (2004)	USA	2 digit SIC (USA)	-	Final sales value	yes	no
Hourcade et al (2008)	UK	4 digit SIC	€20/tCO_2	GVA	yes	yes
Öko-Institut et al (2008b)	Germany	4 digit SIC	€20/tCO_2	GVA	yes	yes
CE Delft et al (2008)	Netherlands	2-4 digit SIC	€20/tCO_2	Total cost	yes	yes
CITI Investment research (2008)	Australia	Company (ASX100)	A$20/t CO_2	Market Capitalisation	yes	no

Table 3.1: Summary of cost impact studies and assumptions.

Ability to pass through CO_2 costs

International Trade

If a sector experiences a sharp rise in production costs in one region, will this necessarily result in relocation to other regions? In short, the answer is no. As was demonstrated by the experience of profit making from the EU ETS by the power sector, high cost impact does not directly translate to loss in competitiveness. Competitiveness also depends on the degree to which the sector can pass on the CO_2 cost to consumers. Whilst it is desirable and necessary for industry to pass through CO_2 costs to product prices in order to create the incentive for consumers to switch away from CO_2 intensive products, some firms may be unable to pass on the full cost of CO_2 if they are in competition with foreign producers that face lower CO_2 costs.

The existing degree of trade in the sectors gives an initial indication for assessing different levels of cost pass-through abilities of sectors. This is because the biggest single constraint on the ability to pass CO_2-related costs on to customers is foreign competition from outside regions that are not affected by carbon policies. Figure 3.6 compares the EU and non-EU trade intensities of the UK's "top 20+3" subsectors, with their German counterparts. This comparison illustrates that for most sectors, the overall trade intensity is comparable in Germany and the UK. In all sectors, for which data was available, other than copper and lime, the overall trade intensity is bigger in Germany. As one would expect from the geographical location and Commonwealth affiliation of the UK, in all sectors but the Malt sector, the UK exhibits higher trade intensity with non-EU countries while share of intra-EU trade intensity is far higher for Germany.

Trade volume is only a static indicator of the ability to pass CO_2 costs through to consumers. Over time it can change in response to cost differences, therefore for the sectors with high cost impact, a more detailed examination is required to understand the additional factors that influence the level of exposure to international competition and the degree of production mobility.

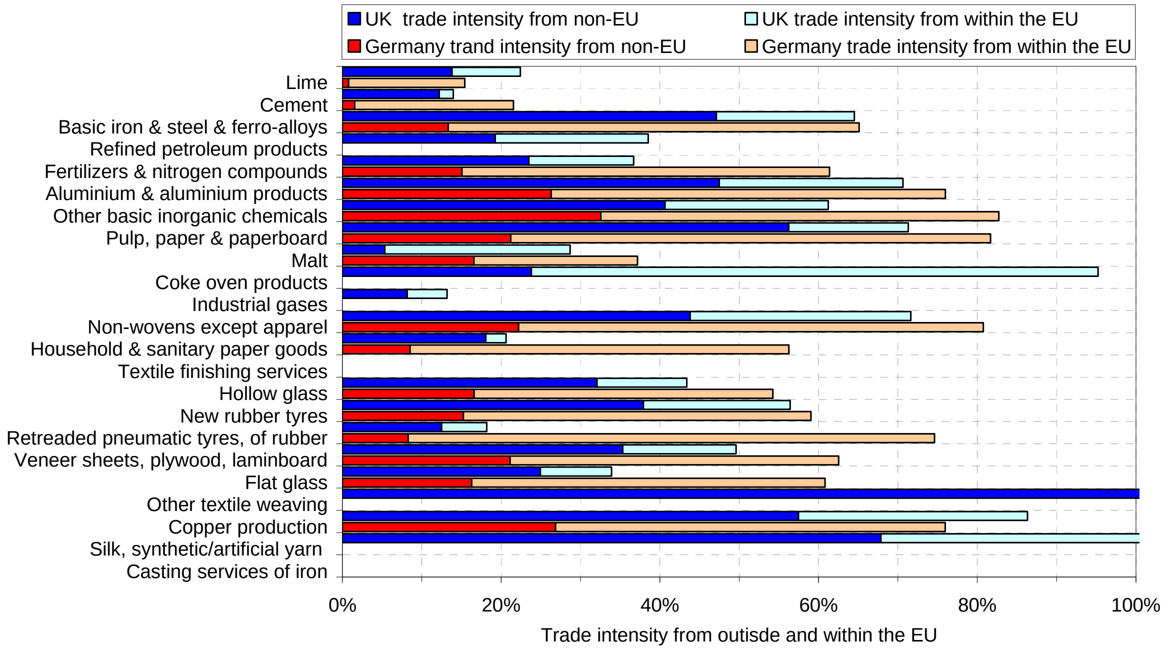

Figure 3.6: Trade intensity of carbon intensive products with Non-EU and EU countries in UK and Germany: 2004 data (Source: Hourcade et al 2008).

Barriers to trade

What are the factors that influence the barriers to trade? The trade barriers take various forms as detailed in the report by Hourcade et al (2008). For example, transport costs are increasingly important for bulky, fragile or toxic products. Limitations in port facilities may also act as a barrier for imports. For products like steel, product differentiation is also important e.g. German steel companies can afford to charge for specialist high-grade steel that meets the specifications required by the automobile industry. Customers also have pre-existing relationships with local producers; proximity of production helps to build and maintain trust in business relationships and to meet delivery times. Trade barriers and their relative importance are usually specific to sectors and are difficult to disentangle and to quantify.

A company's decision on where to locate new investment is a function of many factors, for example the differences in labour costs, access to markets and environmental policy. Steel plants do not simply "pack up and leave" given high 'sunk costs' i.e. capital investment with long pay-back periods. Additional barriers include the need for a high quality of labour force, product norms and specifications (Reinaud 2005, Walker 2006), access to raw materials (e.g. scrap steel), and the advantage they have in supplying local consumers. Relocation also involves risk around various aspects including exchange rate fluctuations, freight cost fluctuations, impact on production costs and government policies. In terms of the latter, climate policy may converge internationally over the course of the investment pay-back period, hence reducing the competitive advantage of investments in production capacities in countries taking slow climate action.

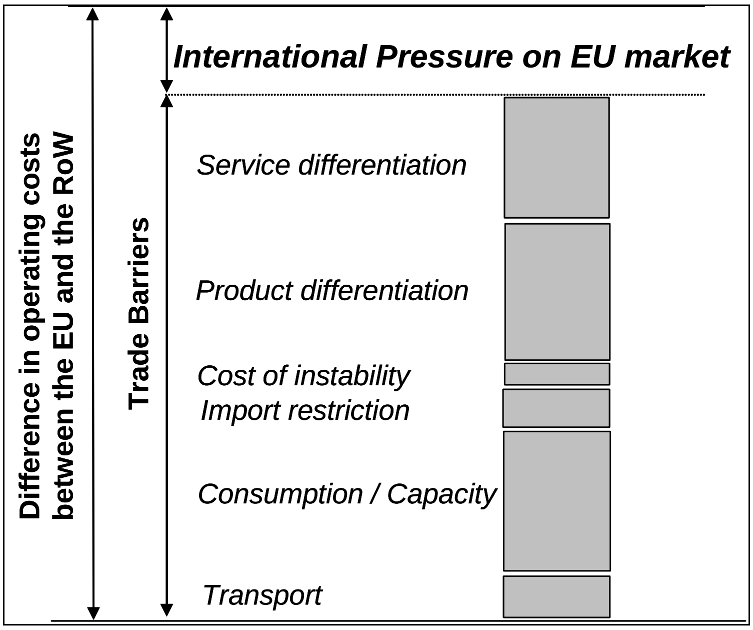

Figure 3.7: Trade barriers in the steel sector (Source Hourcade et al 2008).

Another risk that manufacturers face is that the host countries may impose export tariffs. For example in early 2007, Egyptian authorities imposed an export duty on selected cement products which amounted to more than €20/t CO_2.[7] Similarly, in the same year, the Chinese government increased the export tariffs by 5% on many finished and semi-finished steel products while scrapping or lowering a range of export rebates[8]. This was equivalent to a US$65/t CO_2 tax and the Chinese export tax on cement was equivalent to a US$12/t CO_2 tax.

Therefore whilst differences in environmental regulation may effect the decisions for location of new investment, other factors are likely to be more important. There are many trade barriers that restrict the degree of international mobility for manufacturing industries. The historic trend of low trade volumes in energy-intensive products such as basic steel and cement implies that these barriers are high. However, it is very difficult to disentangle the impact of climate policy from the effect of other factors on these decisions. Moreover, historic patterns of trade and fluctuations in industrial goods such as cement show little sensitivity to factors such as exchange rate fluctuations and its impact on production costs. These impacts are significantly higher than the potential cost effects from climate policy for most industrial sectors.

As such, a sector-by-sector analysis is required, to assess the ability to pass cost through the value chain and the degree of mobility of production; i.e. whether there really is a concern for relocation and emissions leakage. Some studies have already examined the steel, cement and refining industries (e.g. Hourcade et al 2008, Reinaud 2008). However more time and discussion, with all stakeholders including industry, is required as well as a clear and transparent process, in order to find technical solutions to address the emissions leakage for sectors where there is a legitimate cause for concern.

[7] Business Today (2007) *Steely Resolve* http://www.businesstodayegypt.com.
[8] Baron et al (2007) *Sectoral Approaches to GHG mitigation. Exploring issues for heavy industry*.

Conclusion

Results from recent studies consistently show that CO_2 cost effects are concentrated in a few industrial activities, of which a few are exposed to international competition (i.e. cost pass through abilities are limited).

A sector-by-sector and company level analysis at a disaggregated level that considers transport costs, trade barriers, demand trends and the cost structure of the specific carbon intensive production processes is required to assess whether high costs create risks of leakage.

4. What Makes a Sector with Significant Cost Increase Subject to Leakage?

Felix Chr. Matthes

Leakage concerns within the EU ETS

If carbon pricing is an indispensable part of effective policies for the transformation of today's economies towards low-carbon economies the price of carbon should be reflected in all economic decisions:

- regarding the level of demand of a certain product or commodity;
- regarding the operation of existing plants;
- regarding the investment in new installations.

Thus the carbon price signal must be reflected in decisions that have a direct impact on the level of greenhouse gas emissions as well as through the whole value chain of products and services.

In a global and perfect emissions trading scheme a comprehensive and non-distorted carbon price signal would be created and would ensure the most efficient allocation of scarce resources. However, the EU ETS is neither a global nor an economy-wide carbon-trading scheme and some precautions could be required to ensure the integrity of the scheme.

For the EU ETS as a partial (in terms of sectors) and unilateral (in terms of regional coverage) scheme, the main integrity problem arises from leakage mechanisms. In the framework of the EU ETS, leakage is understood as relocation of carbon intensive production activity to production sites outside the European Union as a consequence of the EU ETS, which does not ensure carbon free production and thus increases global emissions.[9] Regarding the relocation of production within the European Union it should be pointed out that this kind of relocation would not be seen as carbon leakage because installations in all EU Member States face the same CO_2 price.

One of the major challenges regarding leakage effects from the EU ETS is that the ex-ante identification of significant leakage effects faces multidimensional assessments:

[9] The explanatory memorandum of the Commission for the proposal for the revised EU ETS Directive (CEC 2008) defines carbon leakage in this notion: '… risk of 'carbon leakage', i.e. relocation of greenhouse gas emitting activities from the EU to third countries and thereby increasing global emissions'. The draft report from the European Parliament uses other definitions of 'carbon leakage' which do not conceive the specific leakage issue within the EU ETS ('In the event that other developed countries and other major emitters of greenhouse gases do not participate in this international agreement, this could lead to an increase in greenhouse gas emissions from less carbon efficient installations in third countries where industry would not be subject to comparable carbon constraints ('carbon leakage')' (EP 2008, draft amendment 6) and 'loss of significant market share to less carbon efficient installations outside the Community in countries which do not participate in the future international agreement ('carbon leakage')' (EP 2008, draft amendment 24)). The specific leakage issue within the framework of the EU ETS results from a potential increase of emissions outside the EU ETS because of relocation of production which does not lead to an emissions reduction within the EU because the cap for the total emissions is fixed.

- the effect from the EU ETS on the production costs must be significant, i.e. the direct and indirect costs of carbon must be significant compared to value-added or the product prices;
- the ability of passing-through the carbon costs to the product or commodity prices must be sufficiently low, i.e. market structures, market phases and investment cycles will not allow a significant pass-through of the costs of carbon;
- the costs, other economic and regulatory risks related to a relocation of production activity must be sufficiently low;
- the set of these factors incentivising the relocation of production must be stable over a period which is sufficiently long to attract investments in capital-intensive production facilities.

A more differentiated view on leakage concerns

Ideally the assessment of leakage problems would rely on an assessment of cost impacts and related price effects followed by an assessment of the price elasticities for the relevant products and commodities. In reality this approach faces a series of conceptual and practical problems:

- The cost effects from the EU ETS differ across the European Union and the different sectors. This is especially an issue regarding the indirect costs of carbon in the electricity prices. In some regional markets (continental Europe) the marginal price of electricity is mainly set by coal fired power generation and thus the price impact from pass-through of carbon costs is relatively high. In other regional markets (UK, Iberian Peninsula, Italy) gas-fired power generation plays a more significant role in the price formation and the impact from carbon costs on the electricity prices is rather low. However, these regional differences also exist regarding other factors, e.g. the quality and availability of raw materials and fuels. As a consequence, all provisions to address leakage concerns should reflect the most carbon efficient production of the relevant products or commodities within the European Union.
- The specification of trade elasticities for certain products or commodities faces serious practical problems. The data required for the estimation of price elasticities is only available at high levels of aggregation and could lead to an overestimation as well as an underestimation of price elasticities for single products or commodities especially in those statistical sectors that cover a broad range of products.
- The specification of trade elasticities, even if possible in principle, is only relevant for longer time periods averaging the effects of product, investment and market cycles. If leakage resulting from unilateral policies like the EU ETS is assumed as a temporary problem, analysis of long-term elasticities might not be a sufficient methodological approach.

Against this background some more differentiation of leakage mechanisms could be suitable to enable tailored provisions to deal effectively with leakage concerns on the one hand and on the other hand, to limit the distortions within the EU ETS as much as possible.

1. *Operational leakage* is a relevant mechanism for existing installations.
   If, due to the costs of carbon, the short-term operational costs of production exceed the price of the respective product or commodity on the market, production activity will be decreased or shut down completely and the production activity could be relocated to other plants which are not subject to similar carbon pricing.

Operational leakage will mainly appear in the short and medium-term. It is typically an issue for less capital-intensive production facilities because capital-intensive production equipment will regularly enable higher contribution margins and make these production facilities less vulnerable to carbon leakage. The profit margins of these production facilities will decline but this should not necessarily lead to carbon leakage. Operational leakage will particularly occur in market phases that are characterised by high surplus capacities for the respective products and commodities outside the European Union. The barriers for operational leakage will be higher if additional investments would be necessary to relocate the respective production. This is an additional indication that operational leakage will be an issue for less capital-intensive productions.

2. *Investment leakage* is a relevant mechanism for more large-scale investments in new production facilities, either for the extension of production capacities or for the re-investment in production facilities that have reached the end of their technical or economic lifetime. If the carbon costs from an unilateral climate regime will offset the other cost factors from relocation of production (such as transport costs, currency and regulatory risks) the rational profit-maximising investment decision for the new investment will be made for the production site where no carbon costs will occur for a sufficient period of time. Investment leakage is a relevant mechanism for both high capital-intensive and low capital-intensive investments. Against the background of the structure of the investment leakage problem, this type of potential leakage can only be avoided if the compensation applies to the investment itself or the compensation measures for production (e.g. free allocation of allowances) can be guaranteed for a sufficiently long period of time into the future.

An illustrative comparison

If such a differentiated perspective is taken into account, different needs and different options for dealing with the leakage problem can be seen as preferential ones. For capital-intensive productions the problem of investment leakage can be assessed as the more relevant one and for low capital-intensive facilities the problem of operational leakage could emerge as the most significant one.

The role of carbon costs, against the background of the capital-intensity of different productions, can be illustrated by a more detailed analysis for a selection of products. Unlike the top-down results presented in section 3 the bottom up analysis presented here addresses products instead of sectors. For the following products the specific costs of carbon as well as the specific investment costs were analysed:

- Cement clinker production
- Crude steel production from basic oxygen furnace (BOF)
- Crude steel production from electric arc furnaces (EAF)
- Primary aluminium production

The purpose of the analysis is to identify the ratio between specific investments for different products that could be subject to leakage and the direct and indirect CO_2 costs for the production. The ratio between investment and CO_2 costs therefore is a rough indication for the general time-frame for leakage concerns.
If the ratio between the investment costs and the CO_2 costs is low than this should be seen as an indication of a higher probability of operational leakage because the contribution margin

of the production typically would be low compared to the operational costs. If then the increase of operational costs from additional CO_2 costs is high, this could strongly encourage the relocation of production.
If the ratio between investment costs and CO_2 costs is higher, this would indicate that the CO_2 costs will probably lower the profit margins but not necessarily increase the problem of leakage. This is because the higher contribution margins of the production result in less leakage vulnerability from an increase of operational costs. However, in the case of a new investment the level of CO_2 costs would encourage the selection of production sites outside the EU.

	CO_2 emissions			Total CO_2 costs at 30.00 €/EUA	Specific investment	
	direct	indirect (electricity)	total		low	ligh
	t CO2/t			€/t	€/t	
Cement clinker	0.758	0.065	0.822	24.7	50	165
Crude steel BOF	1.531	0.222	1.753	52.6	455	600
Crude steel EAF	0.005	0.524	0.529	15.9	140	205
Primary aluminium	1.367	15.622	16.989	509.7	2,888	4,547
Refinery	0.230	0.058	0.288	8.6	141	253

Notes: Investment costs for greenfield investments, cost ranges for investments in Europe and abroad from recent literature and company data, all emissions data for EU facilities, indirect costs according to pass-through in Germany.

Table 4.1: Specific direct and indirect CO_2 emissions - CO_2 and investment costs for selected carbon-intensive products (Sources: Öko-Institut et al. 2008a and 2008b; McKinsey and Company 2008; Schumacher and Sands 2007; Öko-Institut estimates - company data).

The illustrative numerical analysis based on the data shown in Table 4.1 indicates a differentiated view on the leakage issue (Figure 4.1):

- Among the products that were considered in the comparison only the cement clinker production indicates a very low ratio between the cost of a new investment and CO_2 cost (ranging from 2 to 7). In other words: the incentives for both operational and investment leakage could be significant. However, investment leakage could be more significant when the fact is assumed that typical investment costs for clinker production facilities are significantly lower abroad than in the European Union (McKinsey 2008).
- The ratio between investment costs and CO_2 costs is comparable for the BOF and the EAF (ranging from 9 to 11 and 13) at least for the case of a high cost pass-through which was assumed for the calculation. If a significantly lower share of CO_2 costs in the electricity price is taken into account (which could be assumed e.g. for the UK market) the ratio for crude steel from BOF (ranging now from 9 to 12) is only about the half of the result for EAF (ranging from 17 to 25). However, the structure of CO_2 costs indicates a fundamental difference between steel from BOF and EAF. For crude steel production from BOF the indirect emissions dominate the result and for steel produced in EAF the indirect CO_2 cost from electricity consumption is the crucial contributor. These results indicate that the risk of investment leakage in the steel sector could be higher than the risk of relocation of production activity from existing plants that have not yet reached the end of their technical or economic lifetimes.
- The indicator results for primary aluminium (ranging from 6 to 9) are lower than for steel in the case of the high CO_2 costs in the power price. If a lower share of CO_2

costs in the electricity prices is assumed the results for primary aluminium production (ranging now from 10 to 16) are higher than for steel from BOF in this case. This indicates that for aluminium smelters the problem of investment leakage could also be more significant than operational leakage effects.

- The ratio between investment costs and CO_2 costs is significantly higher for refineries than for all other products analysed in this numerical exercise. The specific costs of refinery investments exceed the direct and indirect CO_2 costs by the factor 16 to 29. This result indicates that the occurrence of operational leakage from the refining sector could be seen as highly questionable for the type of refineries that were considered in this numerical exercise. The results also only give a much weaker indication for investment leakage in the refinery sector.

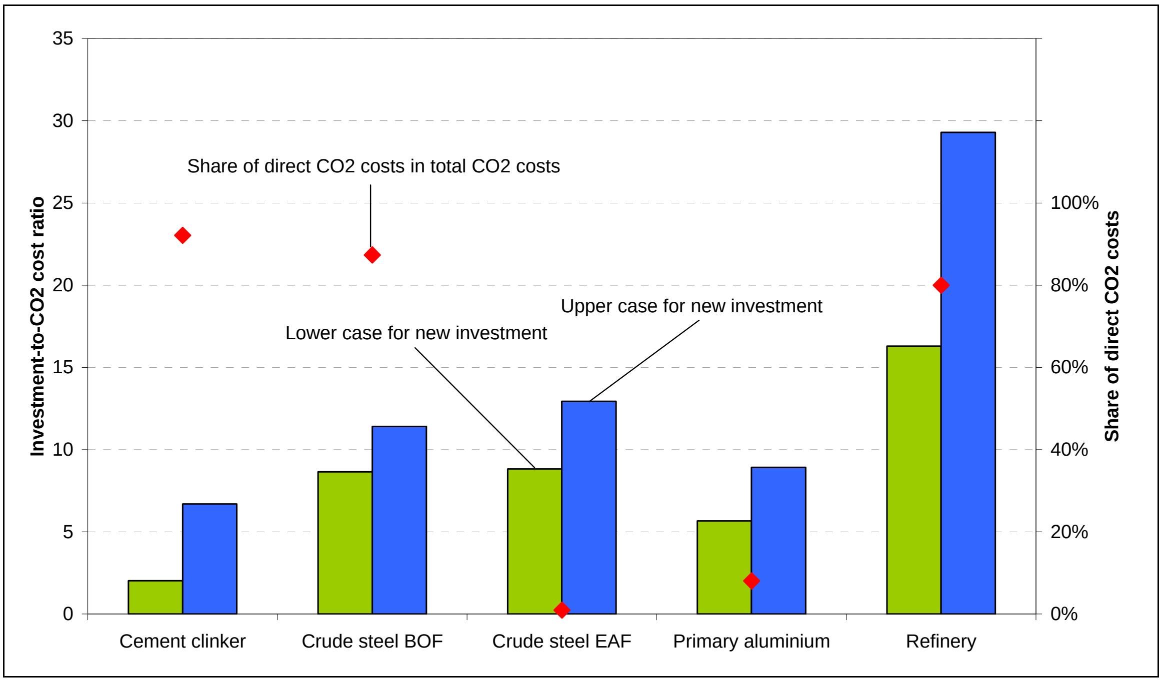

Figure 4.1: Ratio between investment costs and CO_2 costs for selected carbon-intensive products (Source: Öko-Institut calculations).

Conclusions

The ex-ante assessment of leakage concerns is a complex issue. The analysis has shown that the leakage problems for different sectors, at least for those that were analysed here, have significantly different structures, regarding the direct and indirect costs from CO_2 on the one hand and regarding the occurrence of operational and investment leakage on the other hand.

In order to minimise the distortion of the CO_2 price signal from the EU ETS and to enable short-term adjustments resulting from an emerging multilateral climate regime, the introduction of provisions to limit leakage from the EU ETS should be differentiated and tailored towards addressing direct and indirect costs as well as operational and investment leakage problems. The analysis of investment intensities could be a useful approach to identify the products and commodities that primarily face investment leakage concerns and to address leakage issues through the analysis of the investment costs rather than through the free allocation of allowances. This could be used in addition to the pragmatic approach of analysing direct and indirect CO_2 price effects and trade intensities as approximate indicators for the specification of sectors that could receive free allocation of allowances. Nevertheless, the detailed and evidence-based analysis of market structures and their impact on the ability to pass-through the costs of carbon, constitute an additional precondition for any consideration of leakage provisions for the respective sectors, products or commodities.

If the problem of carbon leakage is to be mitigated by tailored compensation measures, specific investment costs could be used as criteria to identify the suitable compensation measures that would limit the impact on respective efficiency and decrease CO_2 price distortions within the EU ETS. Compensation for productions that face operational leakage could be provided by suitable free allocation approaches and the issue of investment leakage could be alleviated by direct compensations for investments which would also allow compensations for the indirect CO_2 costs.

5. Role of Auctions: The Role of Numerical Models

Andreas Löschel

Since world economies are increasingly linked through international trade, capital flows and technology transfers, emissions abatement by one country has spill-over effects on other countries. Environmental implications of international spill-over effects concern the phenomenon of carbon leakage due to unilateral abatement policies, which effect trade, competitiveness and the location of industrial production. There are three basic channels through which carbon leakage can occur. First, leakage can arise when, in countries undertaking emissions limitations, energy-intensive industries suffer from reduced competitiveness and therefore relocate the production of emissions-intensive goods, raising emissions levels in the non-participating regions (*trade channel*). Second, cut-backs of energy demand in a large region due to emissions constraints may depress the demand for fossil fuels and thus induce a significant drop in world energy prices. This, in turn, could lead to an increase in the level of demand (and changes in its composition) in other regions (*energy channel*). Third, carbon leakage may be induced by changes in regional income (and thus energy demand) due to terms of trade changes. The different leakage channels are difficult to assess and interfere with each other. Hence, the ex-ante analysis of leakage rates and policy instruments to address leakage, call for the use of numerical model techniques in order to facilitate informed decision-making. Complementary econometric studies using historical data are capable of evaluating carbon leakage ex-post and provide the empirical foundation for numerical models.

Modelling approaches

The main challenge of modelling is to select only those system elements and their relationships that are most relevant to the question at hand, in this case carbon leakage. To put it differently: the exclusion of components that are outside the chosen system boundaries should not significantly affect the order of magnitude of quantitative results nor the ranking of alternative policy options. Obviously, there is a trade-off between the scope of the system to be captured and the level of detail. Basically, there are two types of modelling approaches to the ex-ante assessment of the impacts on competitiveness of carbon policy: sectoral analysis (bottom-up) and macroeconomic impact analysis (top-down). These approaches differ with respect to the emphasis placed on a detailed, technology-based treatment of the respective economic sectors and a theoretically consistent description of the general economy. Bottom-up models are purely partial models of a specific economics sector, e.g. the energy sector. Essentially, they represent engineering-based linear activity models that include a large number of technologies to capture process substitution and process improvements (e.g. gross efficiency improvement or emissions reduction). A general disadvantage of bottom-up models is the lack of interaction with the rest of the economy. Top-down models are macro-econometric or computable general equilibrium (CGE) models with a highly aggregated treatment of sectors by means of neoclassical production functions, which capture substitution possibilities by means of substitution elasticities. CGE models capture feedback effects of environmental policies on other markets such as price changes for factors or intermediate goods. Only CGE models are capable of analysing the energy channel of carbon leakage and terms of trade effects. Current CGE models have difficulties in addressing the industry location channel, which requires a high level of disaggregation and is in the centre of the analysis. It is generally overlooked that the differences between top-down models and bottom-up models are not so much of a theoretical nature; rather, they simply relate to the level of aggregation and the scope of *ceteris paribus* assumptions as one will see.

Leakage rates reflect the impact of sub-global emissions abatement strategies on comparative advantage. The use of grandfathering instead of auctioning might be justified, only if cost pass through is not possible. Therefore, numerical models have to assess the addition of the direct and indirect costs of carbon policies and whether and to what extent sectors are likely to pass on the cost of carbon under current design. The former calls for a detailed specification of sectoral production technologies and emissions originating from the production process itself, substitution elasticities in production, and inter-sectoral linkages between production sectors. The latter requires the specification of market structure, trade linkages, and aggregate demand elasticities. The price elasticity of market demand involves the various demand categories at the different market stages: intermediate demand from the various production sectors, private and public consumption demand, investment demand and export demand. The aggregate demand function is a weighted average of the demand elasticities in the various demand categories which in turn are functions of substitution elasticities and value shares within the various aggregates. To put it more succinctly: The elasticity of demand for a commodity is the weighted average of the price elasticities of export demand and domestic demand (intermediate, consumption and investment demand). This is, in a complex way, composed of substitution elasticities that characterise production and utility functions (for more details see Böhringer et al. 2008). Most models assume nested CES production or utility function with constant returns to scale. However, in the short run capital stocks are often assumed to be fixed by sector resulting in decreasing returns to scale and increasing marginal cost functions. Long-term capital stock adjustments result in constant long-run marginal costs. Carbon cost pass-through is greater the less elastic is demand relative to supply. With increasing marginal costs of production in the short run, high price elasticities of demand imply that additional costs lead to large reductions in demand and lower pass-through of direct and indirect costs. With constant returns to scale production (perfectly elastic supply) - a common characteristic of manufacturing industries - carbon prices are fully passed through in the long run. It has also been shown that market structure is important for pass-through rates (Sijm et al. 2006). Böhringer et al. (2008) analyze the potential importance of imperfect competition for induced structural change of environmental regulation. Carbon pricing in an open economy – by changing comparative advantage – leads to a shift in the demand structure facing the various industries and hence, to a shift in their overall demand elasticities: because the elasticity of demand is typically higher for sales abroad than for sales in domestic markets, industries that gain in comparative advantage – and therefore sell a larger portion of their output abroad – are facing a higher overall demand elasticity. This is in principle desirable, because it reduces market power, drives inefficient firms out of the market and raises economies of scale. The reverse happens to industries that lose in comparative advantage: their demand elasticity drops and economies of scale decrease. As a result, the change in relative costs across industries is enhanced under imperfect competition and so, induces structural change. A wide range of different models of firm conduct with the use of market power find cost pass-through of 100 per cent or more (Freebairn, 2008). After emphasizing the role of market structure for competitiveness and leakage, one might now turn to other important assumptions in numerical models: the representation of sectoral production and the specification of substitution elasticities.

Representation of sectoral production

The representation of production and trade in energy-intensive products in numerical models e.g. in CGE models, is often on quite an aggregated level. This suffices to assess the aggregate economic impacts of emissions constraints, but is too broad for the definition of concrete policy measures against leakage. Several studies showed that leakage is not very relevant at a macroeconomic scale given the small share of energy intensive industries in most economies. Leakage becomes more relevant at least at the 3-digit industry classification level (see, for example Lehr and Lutz 2008). The importance of sectoral detail for the implementation of policies is illustrated by Hourcade et al (2008) which compares the values at stake using a 3-digit sector classification with a 4-digit resolution that includes 12 sub sectors. As an example, the sector "cement, plaster and lime" experiences as a whole, a cost increase of 6% relative to gross value added. However, if broken down to a 4-digit resolution, it becomes clear that the impacts of carbon prices are different within the sector, leading to significant cost increases of more than 30 % relative to gross value added in the manufacturing of cement and lime. Higher impacts at sub-sectoral level are hidden behind the broad sector classification.

Since CGE models build on input-output (IO) tables, they are restricted to the classification used in the input-output tables. The European System of Accounts (ESA) uses, for industries, the 'General Industrial Classification of Economic Activities within the European Communities' (NACE) and for products the 'Classification of Products by Activity' (CPA). The current data transmission programme of the ESA Regulation requires the application of the main classifications with 60 industries and 60 products which is then the maximum level of detail for economic models based on Eurostat data (Eurostat 2008). A large number of CGE models (and not only CGE models) use the GTAP-6 database as their main database. The GTAP-6 database has 57 sectors defined, with a focus on international trade. The sectoral disaggregation is mainly on a 2-digit disaggregation level. Energy-intensive sectors in GTAP-6 include Paper & Paper Products (including publishing, printing and reproduction of recorded media), Chemical Rubber Products (basic chemicals, other chemical products, rubber and plastics products), Non-Metallic Minerals (cement, plaster, lime, gravel, concrete), Iron & Steel (basic production and casting) and Non-Ferrous Metals (production and casting of copper, aluminium, zinc, lead, gold, and silver).

Partial equilibrium sectoral models usually have a higher level of disaggregation e.g. on a 3-digit level for Iron and Steel (Demailly and Quirion 2008). However, even 4-digit levels might be insufficient to identify the impact of carbon pricing on particular industries and products (e.g. energy-intensity of aluminium manufacture depends on whether raw material or recycled inputs are used). It should be noted that a more aggregated sectoral resolution is not an inherent feature of CGE models, but is rather owing to the fact that input-output tables with higher sectoral disaggregation are not available - certainly not on a global scale. However, there are, for example, input-output models and CGE models which use 6-digit detailed level input-output tables to disaggregate the US economy into as many as several hundred producing sectors (U.S. Department of Commerce 1993). A further disaggregation of exposed sectors into sub-sectors as used in bottom-up models is in principle also possible for top-down models based on Eurostat or GTAP data.

There are two basic approaches to model linking, which are loosely termed as soft-link and hard-link. The hard-link approach puts strong emphasis on internal consistency and therefore makes use of a single integrated modelling framework e.g. a CGE model. This requires additional data on production and trade at a more disaggregated level compatible to the input-output framework. A general approach for a detailed bottom-up representation of certain segments of the economy, within an otherwise aggregated model, by disaggregating IO tables based on technologies, is described in Schumacher and Sands (2007) for the steel sector and in Böhringer and Löschel (2006) for electricity production. Roughly speaking, the soft-link approach involves a combination of two models that have been developed independently from one another and can be run as stand-alone simulations. The disadvantage of the soft-link approach is that due to the heterogeneity in complexity and accounting methods across different models, it is difficult to achieve overall consistency and convergence of iterative solution approaches. On the other hand, the soft-link approach allows for detailed information embodied within the various, often interdisciplinary, models to be maintained without requiring comprehensive expertise. Furthermore, linkages can be based on established models rather than requiring modelling work to be developed from scratch. Böhringer and Rutherford (2008) advocate the use of 'complementarity' methods to solve the top-down economic equilibrium model and quadratic programming to solve the underlying bottom-up energy supply model. This approach might be extended to partial equilibrium models for energy-intensive industries like cement (Demailly and Quirion 2006), iron and steel (Demailly and Quirion 2008) or aluminium (Demailly and Quirion, forthcoming) to analyze leakage issues.

Specification of substitution elasticises

The demand elasticity for energy-intensive goods in CGE models depends, for example, on substitution elasticities between production factors in the sectoral production functions, and trade elasticities. Nesting structures (mostly multi-level nested CES-functions) and substitution elasticities govern the substitution possibilities, both in production and final consumption. The substitution elasticities determine to what extent cost shocks lead to direct and indirect price increases. There are several possibilities for input substitution and leakage down the value chain. Neuhoff (2008) describes the value chain from clinker to cement, concrete and buildings. Leakage concerns are most pronounced for primary products (like clinker) which are most carbon intensive and often easily transportable (also cement or steel). If primary products are not transported, only exposure of products down the value chain matters. However, carbon intensity decreases for more complex products and leakage is typically small. CGE models based on input-output tables fully account for these upstream and downstream linkages (if the sectoral disaggregation is high).

However, econometrically estimated substitution elasticities between intermediate inputs and other inputs are in general low on a 2-digit level and are not differentiated in the value chain. In fact, the substitution elasticity used in CGE is often close to zero due to the difficulties in multi-stage estimations and the disaggregation level employed. With a higher level of sectoral disaggregation in the models the elasticities might be higher in upstream industries. Substitution possibilities might therefore be underestimated in a more aggregated specification and potentially low cost mitigation strategies might not be exploited. In addition, the moderating impact of free allowance allocation on intermediate product prices might not be fully captured and the ability for innovative products to penetrate the market underestimated.

Most CGE models use a trade specification based on the 'Armington assumption' which differentiates commodities by their country of origin. It assumes that products of an industry, which come from different countries, are imperfect substitutes for each other. The choice of

Armington elasticities and the size of the substitution elasticities determine the effect on the terms of trade (the ratio of export to import prices). Armington elasticities are also an indicator of the ability of firms exposed to international competition to pass-through cost increases: The higher the Armington elasticity, the easier imports substitute domestic commodities and the lower the pass-through capabilities of firms. The econometric critique advocates the use of consistent econometric estimation in CGE models. However, econometric estimates are usually derived at levels of aggregation and exploit sources of price variation which are different from the numerical model. The estimates are rarely generated in a way that is consistent with the model structure, and might be derived at a higher or lower level of aggregation than the level of analysis in the numerical model (Hertel et al. 2007). There are only a few estimates for Armington elasticities for the energy-intensive sectors available. Most of these estimates are at the 2-digit level. An exception is Gallaway et al. (2003) which estimate Armington elasticities at a 4-digit level. There are also considerable differences in the literature between elasticities across countries. From a sectoral perspective, more aggregated data increases the intra-industry diversity and might yield lower elasticities than less aggregated studies (McDaniel and Balistreri, 2003). More disaggregated numerical models like partial equilibrium models should hence use higher Armington elasticities. Again, the problem of a correct specification of Armington elasticities is not specific to CGE models. Partial equilibrium models working with a higher level of sectoral detail might even have more problems with the empirical validation of their Armington assumptions given the empirical literature.

There are large uncertainties as to the true elasticity values. Nevertheless, numerical models very often use point estimates from the econometric literature without taking into account the precision of these estimates i.e. the accompanying standard errors. The robustness of model-based conclusions depends critically on the size of the confidence interval around parameter estimates. This is usually ignored in the numerical analyses of leakage and competitiveness issues. Harrison and Vinod (1992) and Hertel et al. (2007), for example, develop methods for Systematic Sensitivity Analysis (SSA), which allow the confidence intervals instead of point estimates of model outcomes to be reported. With SSA it is possible to track the influence of parameter choice on modelled outcomes. This highlights the critical model parameters.

CGE and partial models should be used to elicit the implicit pass-through rates and price elasticities in the model. To make a final judgement on this matter empirical analysis is required. Different studies directly estimate pass-through rates for industry. Robust results are available for the power sector, because the daily and hourly markets provide sufficient data points to support an analysis. These results are in line with the assumption that producers pass the full cost of carbon of the marginal unit to power prices (Sijm et al., 2006, and Zachmann and von Hirschhausen, forthcoming, for evidence on asymmetric cost pass through). For other sectors less frequent, and often less robust, price information is available. Löschel and Oberdorf (2008) estimate pass-through rates for additional energy-intensive sectors using UK data. Their first results suggest that there are important differences in pass-through behaviour at the sectoral and even the sub-sectoral level. The calculations, however, indicate a significant potential to pass through carbon costs in energy intensive industries. The pass-through rates and the price elasticities of demand in simulation models depend on the different assumptions concerning model structure and parameterization. Model simulations allow these figures to be computed and compared to available econometric studies in order to assess the significance of the model assumptions in the analysis of carbon leakage.

Conclusions

This discussion illustrated the value of CGE models in assessing the wider economic implications of climate policy and leakage effects through the energy channel and changes in terms of trade. It also revealed that current CGE models have difficulties addressing the industry location channel, which requires a high level of disaggregation. The low sectoral resolution gives rise to lower substitution elasticities between intermediate products and other inputs and lower Armington elasticities. Possibilities for input substitution and leakage down the value chain and their implications on mitigation costs are hence not fully captured.

However, it was argued that a more aggregated sectoral resolution is not an inherent feature of CGE models. Several approaches for a detailed bottom-up representation of certain segments of the economy in CGE models were outlined. Hybrid modelling that synthesizes bottom-up and top-down approaches would improve the model-based analysis of plant relocation effects. However, the empirical foundation of substitution and trade elasticities on the higher level of sectoral detail (as in partial equilibrium models) is largely missing. It points to the need for extended econometric studies to provide an empirical background for more disaggregated modelling and the use of Systematic Sensitivity Analysis to track the influence of parameter choice on modelled outcomes.

6. Free Allowance Allocation to Tackle Leakage

Stéphanie Monjon and Felix Chr. Matthes

The specification of free allocation approaches and its impacts on the efficiency of the EU ETS

In its draft for the revision of the EU ETS Directive, the European Commission proposes continued free allowance allocation to the "energy-intensive industries which are determined to be exposed to a significant risk of carbon leakage" (CEC 2008, recital 20) as one of the possible measures to address leakage concerns. It is argued that free allocation shields carbon intensive companies exposed to international competition from full or part of the cost of carbon (Böhringer and Lange 2005).

However the extent of carbon leakage will depend on the strategy that firms adopt concerning the management of additional costs and whether they will pass these through to their consumers. Free allowance allocation based only on historic information constitutes a financial transfer to firms that can compensate the owners for potential carbon cost impacts. But to have a significant influence on strategic investment, operational, or closure decision, the free allocation has to be linked to production or activity levels of the installation.

This does however raise a serious concern. During the discussions of National Allocation Plans for the first two phases of EU ETS an increasing body of analytic and empirical evidence pointed to perverse incentives that result from repeated free allowance allocation. It can undermine efficient technology and/or fuel choices, reduce incentives to invest in carbon and energy efficiency (early action problems) and distort the carbon price signal for efficient choices of inputs and consumption decisions. Therefore the ambition during the first two periods of national allocation plans was to move towards less distorting allocation methodologies.

The key issues to be addressed, when assessing the impacts of free allocation, are:

- whether and to what extent free allocation can address the carbon leakage and which is then the most appropriate design;
- whether and to what extent the design of free allocation to mitigate the leakage problem would undermine the architecture and the efficiency of the EU ETS.

Thus the effectiveness of free allocation to avoid leakage problems within the EU ETS must be compared with the problems that could be created by such provisions in terms of efficiency and the general architecture of the scheme.

In this context, a closer look at the different options for free allocation and the fundamental design features of the EU ETS is necessary, while assessing their impacts on the efficiency of the EU ETS, in terms of distortion of the CO_2 price signal. The subsequent section will then assess how these design features can be used to address leakage concerns.

Design options for free allowance allocation and interactions with carbon price signals

The main options for implementing free allocation are the following:

Free allocation for existing and/or new installations:

In many Member States **allocations for existing installations** in the first two phases of the EU ETS were **free** and mostly based on historical emissions or activities. Nevertheless, between the two phases, some Member States updated a part of the data used to calculate the allocation of the existing firms, inducing a change in the incentive structure of the EU ETS.[10]

In some Member States the **free allocation for new entrants** was more restricted than for existing installations. For the period when the installation was commissioned, the allocation for the new entrant was mostly based on benchmarks and standardized load factors. Then, in the subsequent phases, the new entrant is treated as an existing installation. Free allocation to new entrants represents an investment subsidy and can distort the price signal from the EU ETS significantly. Given the current rules, strong ties exist with the provisions for existing installations in multi-period schemes like the EU ETS. As long as the existing installations receive more generous allocation than new entrants (and as a new entrant in one phase becomes an existing installation in the following period) the extent of the distortion in fact depends on the treatment of the existing installations above all. Last but not least, free new-entrant allocation requires a 'new entrant reserve' that must be set aside from the cap and creates additional distributional effects.

Free allocation based on emissions and/or activities

Many EU Member States used **historic emissions** as the basis for free allocation in the past. If this type of free allocation is combined with any updating provisions, the CO_2 price signal faces major distortions because a decrease of emissions could lead to less free allocation in the future.

The European experience has demonstrated that free allowance allocation was never really a fixed allocation, but always included some forms of updating.

The allocation **based on activities and benchmarks** has emerged as the key debate on free allocation. In this case the free allocation is based on historic or standardised production levels and emissions benchmarks. However, the design of the emissions benchmarks is crucial for the assessment of benchmarking as an allocation approach.

- Strictly product based benchmarks (uniform benchmarks) relate the emissions level to the output product only and do not reflect any technology or fuel specifics of the respective installation. This type of benchmark creates only small distortions to the CO_2 price signal because technology and fuel-shifts are fully incentivised.

- Technology and/or fuel specific benchmarks do reflect the technology and the fuel or raw material used in the respective installation for the definition of the emissions level. Fuel or technology specific benchmarks lead to major distortion of the CO_2 price signal because EU ETS would provide no or only limited incentives for technology or fuel-shifts.

[10] Without any updating provisions (see below) the allocation to incumbents will not change the incentive structure of the EU ETS.

Direct updating of free allocation was implemented in the EU ETS as allocation updating between the trading phases and direct updating of allocation within a trading phase.

- The updating of allocations for the different trading phases is an inherent feature of the EU ETS as a multi-period scheme. The political economy of allocation in this type of scheme shows that it is difficult not to update the base data (emissions and/or production data) for allocation between the trading phases even if this creates distortions of the CO_2 price signal. The transition to less distorting allocation approaches (uniform benchmarks) could limit these distortions but will not fully incentivise the optimal level of production (Figure 6.1).

- In the pilot phase of the EU ETS, Germany introduced direct updating provisions for certain allocations. Although Germany won the legal case against the Commission, the Commission's approach towards direct updating constitutes the basis for free allocation for the trading phases beyond 2007. Direct updating of allocation according to recent output levels creates major distortions of the CO_2 price signal and creates significant procedural burdens and additional distributional effects (inflow and outflow to and from the new entrants reserve, ongoing legal allocation decisions, practical registry problems, etc.).

Plant closure provisions and free allocation to new entrants can be seen as special specification of updating provisions.

- Instead of a strict grandfathering scheme that allows the operators to retain their allocation, even in the case of plant closure, the EU ETS foresees that only operators who held a permit for a certain installation can receive free allowances. In the case where an operator hands back its EU ETS permit, no free allowances will be issued to the installation. Some Member States have introduced more restrictive plant closure provisions that assume plant closure if a certain production level is not exceeded. However, plant closure provisions can provide incentives to keep inefficient units operational.

- Free allocation to new entrants represents a capacity payment for new investments, which could also be seen as an aspect of updating. Depending on the approach for the allocation to new installations (see above) the CO_2 price signal will be more or less distorted. If uniform benchmarks are used to calculate the new entrant allocation amount, the price distortion will be significantly less compared to the case where fuel or technology-specific benchmarks apply and the allocation to a new entrant depends on its emissions level.

Error! Reference source not found. summarizes the wide range of allocation options and the pyramid of distortion to the CO_2 price signal from the EU ETS. This table emphasises firstly that updating (in its different specifications) is the key contributor to CO_2 price distortions. Secondly, the different specifications of free allocation (from pure grandfathering based on historic emissions to uniform product-specific or capacity benchmarks) lead to significant differences in the fundamental pricing mechanism of the EU ETS. The more product-, process- or fuel- specificities are reflected in the approach for free allocation, the more significant price distortions and efficiency losses for EU ETS will be.

The level of distortions to the carbon price signal and economic efficiency of EU ETS depend on the rules chosen for free allocation. We now discuss how the objective to limit distortions is to be balanced with the objective to avoid leakage – if free allowance allocation is to be used as an instrument to address such concerns.

	Optimal level of		Optimal intensity for	
CO_2 price signal creates incentives for	demand/ product innovation	production	CO_2 (energy, fuel, other inputs)	Energy
Incentivized optimization is	System-wide		Plant-specific	
Distortion of CO_2 price signal = loss of economic efficiency = higher allowance prices in future	Comprehen-sive price signal. Least distortion	Price signal for optimal production at given demand	Price signal for optimal specific CO2 emissions at plant level	Price signal for optimal energy efficiency at plant level
Auctioning	X*	X	X	X
Free Allocation – No updating – Historic emissions	(X)	X	X	X
Free Allocation – No updating – Benchmarks based on – All parameters (products, technology, inputs and/or fuels)	(X)	X	X	X
Free Allocation – Updating (incl. new entrant allocation) – Benchmarks based on – Capacity only	(X)	(X)	X	X
Free Allocation – Updating (incl. new entrant allocation) – Benchmarks based on – Product-specific only	O	(X)	X	X
Free Allocation – Updating (incl. new entrant allocation) – Benchmarks based on – Product- and technology-specific	O	O	(X)	X
Free Allocation – Updating (incl. new entrant allocation) – Benchmarks based on – Product-, technology- and input-/fuel- specific	O	O	O	X
Free Allocation – Updating (incl. new entrant allocation) – Historic emissions	O	O	O	O

O - not ensured. X - ensured. (X) - ensured in general, but depends also from other factors. X* - ensured in general, if no carbon leakage can be assumed

Figure 6.1: Allocation approaches and distortions of the carbon price signal

Free allocation design – to tackle leakage

Bearing in mind the different allocation methods that can be used to give allowances for free (Matthes et al 2005; Carbon Trust 2006; Öko-Institut et al 2008a, Reinaud 2008), the key question arises as to which basic mechanism of free allocation could best address leakage concerns? Obviously free allocation could only address this issue if the allocation is related in some way to continued operation.

The most basic provision to deal with the leakage problem is the plant closure provision. If installations do not retain their free allocation in the case of plant closure, the incentive to relocate the production will be reduced significantly. Thus free allocation to existing installations combined with ideal type plant closure provisions could avoid leakage from plant closure and subsequent relocation of production to sites outside the scheme (operational leakage). In contrast, investment leakage cannot be tackled by plant closure provisions.

Basic precondition for this mechanism are that an effective and robust definition for plant closures is implemented and the plant closure provisions can be strictly applied. However, the practical implementation of the EU ETS indicates that in many cases plant closure provisions will not be effective. Firstly, for many of the larger and more complex installations (which could often be subject to leakage concerns) the closure of installations will only apply to the parts of the installations that received the EU ETS permit and thus no need exists to hand back the permit if an individual component of an installation is closed[11]. Secondly, many operations could postpone the application for plant closure provisions by operating the respective installation slightly above the plant closure threshold as long as this remains feasible. A smart design for the phasing-out of installations will, in many cases, allow the retention of free allocation for a significant period of time. If we cannot assume perfect plant closure provisions (partial plant closure opportunities for complex installations, profit-maximising phase-out strategies, etc), the effect of free allocation regarding leakage could converge to the effects of an allocation regime without free allocation because even closing plants can, at least for a certain time, retain their free allocation. The probability of leakage prevention is higher if stringent and effective plant closure provisions can be implemented. However, as for all updating provisions, broad plant closure provisions will decrease the economic efficiency of the EU ETS.

The second main specification of (indirect) updating provisions is a free new entrant allocation. Free allocation for new entrants represents an investment subsidy that equals the expected net present value of future free allocations. The empirical evidence from a wide range of comparable measures within the EU shows that investment subsidies can successfully support investments within the EU. In the context of leakage concerns, the question arises as to how investment certainty can be provided for investors in a multi-period scheme such as the EU ETS. If the investors assume that free allocation will be continued for a long period of time they will attribute a higher value to the free allocation in their investment appraisal. If they assume that free allocation will only be for the period where the allocation regime is legally fixed, the net present value of the free allocation will decrease.

This illustrates that investors will discount the value of free allowance allocation as investment subsidy, because of carbon price volatility and uncertainty about future allocation provisions. Explicit subsidies in form of State Aid (section 7) can provide a more robust support.

The third track of leakage prevention is the free allocation to existing installations. As pointed out above, the free allocation itself will definitely maintain profit margins but could only prevent leakage effects under certain circumstances. If the allocation is not adjusted for the actual output (in the most extreme case specified as plant closure provision) the operators of the plants will take the opportunity costs of the free allocation into account when they design profit-maximising production strategies. If the value of allowances is less than the contribution margin of an existing facility no operational leakage problem should occur even in the absence of any free allocation (see section 4).

A suggested approach to tackle this problem is output based benchmark allocation, which is in fact a rolling updating scheme (Cembreau 2006; Eurofer 2005; Ecofys 2008). However, this specification is not an option for the EU ETS, which is based on a strict ex-ante allocation architecture that does not allow output based allocation because of the major distortion of the price signal on the one hand and the many practical, procedural and legal problems on the other hand. The only option to implement a more permanent updating

[11] For example the most integrated steel mills in the EU did not receive a permit for every blast furnace but for the integrated facility ('bubble installations'). If the permit was issued for the integrated steel mill the closure of a single blast furnace will not necessarily result in an adjustment of the ex-ante free allocation.

process within the basic architecture of the EU ETS is the definition of rolling base periods for the different trading phases. On the one hand, this could establish an updating procedure in principle. But on the other hand, the effect of this type of updating would be small if longer trading periods (e.g. 2013-2020) are introduced, as the discounting of future allocations will decrease the effect of updating on leakage prevention. As a result, it is uncertain to what extent free allocation to existing installations without near-term updating of allocations will tackle operational leakage.

The analysis of the use of free allocation to existing or new installations to prevent potential leakage effects (for products which are sensitive to operational and/or investment leakage) only provides preliminary results:

- Free allocation to existing installations and effective plant closure provisions could prevent operational leakage if a perfect application of plant closure provisions can be assumed. If imperfect or no plant closure provisions must be assumed, this combination of provisions would maintain at least a significant part of the incentives to relocate production. The main disadvantage of this provision is that the operation of non-efficient plants will be encouraged.

- The effectiveness of unconditional free allocation, regarding operational leakage for existing installations, is highly questionable. Strong updating provisions could prevent operational leakage effects to a certain extent, but would, beside the general problem of CO_2 price distortions, fundamentally change the ex-ante architecture of the EU ETS. Therefore this option is neither realistic nor worth pursuing.

- Free allocation to leakage-sensitive new entrants represents a capacity payment to the investor, which could prevent investment leakage. The ability of this option to prevent investment leakage depends on the certainty that free allocation will continue for a suitable time period. If there is high uncertainty for investors, free allocation for new entrants will not tackle potential investment leakages. Regarding free allocation for new entrants the question arises as to whether other options for capacity payments could decrease uncertainties for investors and avoid the perverse incentives resulting from certain specifications of free new entrant allocations (technology or fuel-specific benchmarks, etc).

- For all options to use free allocation to prevent operational or investment leakage the specific design of the allocation provisions (besides the different updating mechanisms) is crucial. A careful design, which fully acknowledges the wide range of CO_2 price distortions resulting from free allocation schemes, could limit the perverse incentives from free allocation to a minimum. Practically, this means that benchmarking should be used as the approach for free allocation and the benchmark specification should strictly rely on uniform benchmarks which should not be specific to technologies, raw materials, fuel-use or other specifics of the respective installations.[12] In addition, the definition of the basis for benchmarks is a crucial issue for benchmarking schemes and could also have a major impact on leakage effects.

[12] This should be seen as the fundamental principle of benchmark design. However, for a very narrow range of processes the use of more technology-specific benchmarks can be justified (e.g. steel production from electric arc furnaces or from basic oxygen furnaces) with regard to a non-distorted CO_2 price signal as well as leakage concerns.

The latter issue can be illustrated by an example from the cement sector (Demailly and Quirion 2006; Öko-Institut et al 2008a). Most of the emissions are emitted during the production of the clinker, the intermediate product of the cement. If the allocation is based on the production volumes of the clinker, the firms are encouraged to decrease the clinker consumption in cement production, which results in a promising lever to reduce the emissions of the cement industry. But, if allocation is conditional on the cement production, the CO_2 intensive intermediate product (clinker) can be imported from a region that does not have a carbon cost policy. The company can then receive free allowances for emissions not covered by the EU ETS, leading to windfall profits and carbon leakage. In this last case, additional constraints are necessary to limit carbon leakage at the clinker stage.

Free allocation – tackling carbon leakage but at what cost?

Free allocation is supposed to compensate firms for the cost of carbon and allow them to limit the pass-through of carbon costs in their prices. This is in order to limit the loss of market shares and relocation of production or investments in response to carbon price (leakage) in certain cases and preserve the integrity of the EU ETS. But the consequence of implementing free allocation provisions could be a significant loss in efficiency of the ETS, if their implementation is not limited to a very narrow segment of installations.

If the pass-through of CO_2 costs is limited in this way, the product price impact of the EU ETS is also eliminated. This removes the incentive to use products efficiently and to substitute products with alternative lower carbon commodities that could provide the same service. The incentive for any low carbon innovations, which compete with high carbon products benefiting from free allocation, is also reduced, because the price of the competing product does not incorporate the carbon externality costs.

Free allocation combined with updating mechanisms offers incentives to improve the production process only up to the product used to define the benchmark. The cement example shows that if the allocation is based on the clinker production volume, the firms have incentives to make the production of the clinker more efficient but there are few incentives to improve the subsequent production steps.

Lastly, it is important to recall that the firms still face the full carbon cost in their marginal production decisions (Smale et al. 2006). Granting free allowances does not guarantee that the firms will limit the cost-pass through in their price. Indeed it can be rational for them from a profit-maximising perspective, to take into account the opportunity cost of allowances in their price, even if they lose market shares. The effectiveness of free allocation in limiting carbon leakage in the short term becomes uncertain.

Free allocation – a lukewarm conclusion concerning its capacity to avoid carbon leakage

All in all, the effectiveness of free allocation to limit carbon leakage is rather uncertain. In a narrow range of segments with high exposure to short-term operational leakage, the carbon leakage could be reduced to some extent if the firms limit the carbon cost pass-through in their prices. However the incentives to make efficient consumption choices resulting from higher product prices would be removed. In the long term, there are serious concerns about the ability of free allowances to significantly reduce the trend of operational and investment carbon leakage. If appropriate, alternative practical, effective and long-term options for dealing with carbon leakage should be explored.

The major effect of using free allocation, for the sectors exposed to a significant risk of carbon leakage, will be to gain some time, even if the effect of free allocation on operational and investment leakage is rather uncertain. If a global multilateral climate agreement fails, then the EU will have to develop other options to limit carbon leakage. Any scheme to use free allocation in the trading phases beyond 2012 should reflect this, with provisions to remove the free allocation if alternative mechanisms for tackling carbon leakage are to be introduced.

7. State Aid to Tackle Leakage: EC Law Considerations

Angus Johnston

The general prohibition on the grant of State Aid under EC law

Introduction

Asymmetric carbon prices will have different effects across industrial activities. As discussed in section 3, it might create leakage concerns for specific activities, and section 4 outlined a methodology to categorise leakage into investment and operational leakage. If capital costs of an activity are high relative to carbon costs then production at an existing facility will continue, even if carbon costs increase relative to other parts of the world. Leakage is only of concern in the case of new investment or in the case of significant reinvestment.

This section provides a legal analysis as to whether public subsidies (State Aid) could be provided to support investment and reinvestment decisions under such circumstances to address the leakage concerns.

One of the merits of direct compensation for investments could be seen in the fact that a direct capacity payment could deliver greater certainty than free allocation for new entrants in the EU ETS as a multi-period scheme, given its recent and more stable regulatory framing. If new installations were to be commissioned in the third trading phase, the net present value of free allowance allocation will decrease significantly as the commissioning date gets closer. Thus, the effectiveness of the leakage-prevention mechanism of free allocation would erode significantly, whereas a direct payment could provide a more transparent and robust investment framework.

The European State Aid procedure offers a robust framework for the assessment of such subsidies. As the provision of State Aid could be linked to some environmental or efficiency requirements, it could also contribute to additional innovation in the relevant sectors. Finally, as State Aid assessment can be pursued on a case-by-case basis, it offers the opportunity to reflect the specific situation of any given facility in a robust analytic framework.

Any move to address carbon leakage by using subsidies provided by a Member State of the European Union must comply with the State Aid rules laid down by the EC Treaty. The scheme of the EC Treaty assumes that aid granted by a Member State is prohibited unless some exception or exemption is provided for in or under the Treaty.[13] The general prohibition against such aid is laid down in Article 87(1) EC:

> "Save as otherwise provided in this Treaty, any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the common market".

[13] In the EC Treaty itself, there are both automatic and discretionary exceptions from the prohibition, although both require Commission approval after notification of the aid by the Member State. Under the Treaty, legislation has been adopted to exempt various aids from the prohibition, in the style of the Block Exemptions used to give effect to the exemption in Article 81(3) EC. See Joined Cases T-447/93 and T-448/93 *AITEC* v. *Commission* [1995] ECR II-1971.

From this provision, the Court's case law and the decisional practice of the Commission, certain criteria must be met to show that something amounts to "State Aid" for these purposes. It must be established that:

> (a) an 'advantage' has been conferred[14] …
> (b) which was granted by the State or through State resources[15] …
> (c) which distorts or threatens to distort competition[16] …
> (d) by favouring certain undertakings or the production of certain goods or services (i.e. a 'selectivity' criterion)[17] …
> (e) and which affects or may affect trade between EC Member States.[18]

It seems highly likely that most aid measures which might be used to combat carbon leakage would satisfy these criteria. In the absence of detailed aid proposals for analysis, it will be assumed here that any such aid measures would, *prima facie*, fall within the scope of Article 87(1) EC.

Exemptions from the prohibition

Any measure, which amounts to State Aid according to these criteria, must then meet the criteria for excepting or exempting it from this prohibition. By virtue of Article 88 EC, such aid must ordinarily be notified to the Commission and may only be implemented once the Commission has approved the aid in question.

However, there are also Block Exemption regulations which have been adopted under the EC Treaty: these legislative measures provide a framework within which certain aid measures may escape the need for notification to, and clearance by, the Commission, because the effect of the regulation is to declare such aid compatible with the common market and thus not in breach of Article 87 EC.

Block exemption regulations, which could be relevant in the field of aid to tackle carbon leakage, are Regulation 1998/2006/EC on *de minimis* aid and Regulation 800/2008/EC on various categories of aid (including regional aid, aid for environmental protection, aid for Small & Medium-sized Enterprises, aid as risk capital, aid for R&D, innovation and training).

Such an exemption, however, only applies within the formal criteria laid down by the relevant block exemption regulation(s): any aid measure which falls outside those criteria, or is in a field not covered by any such regulation, can only be exempted via the notification route. For our purposes here, the key general exemption provision after notification is Article 87(3)(c) EC, concerning "aid to facilitate the development of certain economic activities or of certain economic areas where such an aid does nor adversely affect trading conditions to an extent contrary to the common interest". Under this provision, various communications

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[14] Case C-256/97 *Déménagements-Manutention Transport SA (DMT)* [1999] ECR I-3913: has "the recipient undertaking receive[d] an economic advantage which would not have obtained under normal market conditions"?
[15] See, e.g., Joined Cases 67, 69 and 70/85 *Kwekerij Gebroeders Van der Kooy* v. *Commission* [1988] ECR 219.
[16] See, e.g., Case 730/79 *Philip Morris Holland B.V.* v. *Commission* [1980] ECR 2671 and Cases 296 and 381/82 *Netherlands and Leeuwarder Papierwarenfabriek* v. *Commission* [1980] ECR 809.
[17] Favourable treatment granted to a given sector within the scope of general taxation will normally be regarded as an aid (Case 70/72 *Commission* v. *Germany* [1973] ECR 813) but may also be sometimes objectively justified as a response to market forces (Case 67/85 *Van der Kooy* [1988] ECR 219, although that justification was not established in the case itself).
[18] See, e.g., Case 102/87 *France* v. *Commission* (*Brewery loan*) [1988] ECR 4067. This criterion is generally very easily found to be satisfied – indeed, such an effect is often assumed if the other criteria are met.

and guidelines have been adopted by the Commission, the most relevant for our purposes being the Communication on the Multi-sectoral framework on regional aid for large investment projects (Commission Communication 2002a) and the Communication on rescue and restructuring aid for the steel sector (Commission 2002b).

Under the combined regime of these two Communications, investment aid, rescue and restructuring aid are all prohibited in the steel sector. Certain types of closure aid to facilitate structural adjustment in the steel sector may be permitted however, including aid for redundancy (or similar) payments and aid to steel firms that permanently cease production (under strict conditions).

Possible types of State Aid to address leakage concerns

Drawing upon recent suggestions (Neuhoff 2008) concerning the basic carbon leakage channels, it seems that State Aid might be granted to support re-investment in existing facilities and support new investment where this is necessary (partially) to compensate for higher carbon costs and thus mitigate carbon leakage.

The extent to which any such aid is acceptable will be dependent upon both its *purpose* and its *extent*. The focus here[19] will be upon Regulation 800/2008/EC and, in particular, aid for environmental protection. Table 7.1 below illustrates the types of environmental aid which would be exempted by the Regulation, and the levels to which such aid would be acceptable.

It is clear from Table 7.1 that the range of aid which might be ‘block exempted’ under the current Regulation (without the need for notification and individual consideration by the Commission) is relatively narrow. In particular, it does not cover the costs of adaptation to environmental standards required by EC legislation, unless concerning SMEs and relating to future EC standards (Article 20), although it would cover investment aid enabling environmental standards to be met which were higher than those required by EC legislation or increasing environmental protection where no EC standards were in place (Article 18).

Of course, this is not to preclude the possibility that individual notification of particular proposed aid measures (otherwise falling outside the scope of the block exemption) might be approved by the Commission on a case-by-case basis. Once a proposed aid measure has been notified to the Commission, the procedural rules laid down in Article 88 EC and Regulation 659/1999/EC, as augmented by Regulation 794/2004/EC, must be followed. In brief, the Commission may: (a) after summary scrutiny, conclude that the aid is compatible with the common market (unlikely in the scenarios contemplated here); (b) follow the preliminary examination procedure (under Article 88(2) EC) and decide within two months whether the proposed aid is compatible with the common market; or (c) conclude that it requires more time to investigate the matter, and open the formal investigation procedure under Article 88(3) EC. This procedure must be completed within 18 months and may lead to a decision clearing the aid unconditionally or subject to conditions, or to a decision that the aid is incompatible with the common market and thus may not be paid by the Member State to its intended recipient. This last procedure provides for comments from the parties concerned

[19] Largely for reasons of space, although note that many of the types of aid which might be exempted under this Regulation will be of little or no relevance to the carbon leakage scenario (e.g. aid to SMEs, training aid); regional aid may be significant, and involves a complex calculation which refers to the EC’s regional aid map for 2007-2013, and a number of provisions concerning aid intensity (see Article 13ff. of Regulation 800/2008/EC for details).

(including the Member State, the intended recipient, competitors, etc). (For further details, see Slot and Johnston 2006.)

Type of aid	Basic rate	Bonus	Special remarks
1. Investment aid enabling undertakings to go beyond EC standards for environmental protection or increase the level of protection in the absence of EC standards [Article 18]	35% of eligible costs	+20% for SEs +10% for MEs	Eligible costs are the extra investment costs necessary to achieve that higher level of protection
2. Environmental investment aid for energy saving measures [Article 21]	60% of eligible costs net of operating benefits and costs related to the extra investment *or* 20% of eligible costs without including those operating benefits and costs	+20% for SEs +10% for MEs	Eligible costs are the extra investment costs needed to achieve the energy savings beyond the level required by EC standards
3. Environmental investment aid for high-efficiency cogeneration [Article 22]	45% of eligible costs	+20% for SEs +10% for MEs	Eligible costs are the extra investment costs necessary to realise such a plant as compared to the reference investment
4. Environmental investment aid for the promotion of renewable sources of energy [Article 23]	45% of eligible costs	+20% for SEs +10% for MEs	Eligible costs are those beyond that of a conventional power plant or heating system with the same effective production capacity Biofuels aid only to the extent used exclusively for producing sustainable biofuels
5. Aid for environmental studies [Article 24]	50% of eligible costs	+20% for SEs +10% for MEs	Eligible costs are the costs of the study
6. **Aid in the form of reductions in environmental taxes** [Article 25]	Can be reduced *only* to the minimum tax level set by Directive 2003/96/EC		Duration of no longer than ten years (after which Member States must re-evaluate the appropriateness of the aid measures concerned)

Table 7.1: Environmental aid exempted under Regulation 800/2008/EC[20]

This decision-making process can, over time, lead to the development of a clear position on such issues, even in the absence of formalised, legislative rules at the outset: the history of aid for environmental purposes illustrates this point, moving from individual decisions into guidelines and now appearing in Regulation 800/2008/EC. At the same time, individual notifications allow the Member State to explain in its notification about the specific position (geography, costs, etc) of a sector or even a particular plant, and this allows the Commission to assess local and regional variations in reaching its decision on whether or not to allow the aid to be granted.

[20] N.B. 'SE' stands for small enterprise, and 'ME' for medium-sized enterprise.

Section 4 provides the first empirical attempt to assess whether such support levels would be sufficient to combat carbon leakage concerns: such research would need to assess the extent of cost increases suffered by firms within the EU as a result of auctioning of EU ETS allowances and then establish the relevant eligible cost bases for possible environmental (investment) aid, so as to assess the levels of aid which might be permissible under Regulation 800/2008/EC.

Summary

As a matter of legal analysis, the grant of State Aid to address carbon leakage concerns provides a clear and structured framework for assessing general aid measures, as well as specific sectors and installations. The purpose behind any given aid measure will be crucial in assessing its acceptability, whether by fitting it within categories recognised by a block exemption regulation or via the individual notification process. Such State Aid control may allow some degree of support, but will also follow a stringent analysis of the costs involved and the necessity of such measures proposed by Member States. In some cases, this potential for analysis of the individual circumstances of any given case will be crucial in reaching a solution tailored to the problem at hand.

8. Border Adjustment to Tackle Carbon Leakage

Susanne Dröge

Why border adjustments?

The previous sections have discussed to what extent carbon pricing will create cost increases and thus incentives for trade-exposed, energy-intensive industries to move parts of or full production into regions with lower or no carbon pricing (resulting in carbon leakage). Border adjustments for specific products which are most affected by direct or indirect carbon pricing (section 3), and are trade intensive, could be an option to address these leakage concerns.

Like with the other options to address leakage concerns, the detailed implementation is important and determines which approach might be most suitable for a specific sector. In the case of border adjustments the political interactions with international cooperation on climate policy and trade negotiations need to be carefully considered. Border adjustments can therefore only be pursued if they build on international cooperation that creates a shared understanding of the economic rationale and non-discriminatory nature of the approach. Such cooperation has to ensure a limited scale and scope of border adjustment to address leakage in specific sectors.

What are border adjustments and how do they work?

Border adjustments (BA) are comprised of measures taken at a country's borders when importing or exporting goods and services. There are two major categories of border adjustments for companies covered by the emissions trading scheme (ETS): the application of price-based (tariffs, taxes) or quantity-based (allowances) tools to imported or exported goods.

Border adjustments can address carbon leakage by minimising the carbon price differentials for those firms that trade with countries that have no or lower than EU carbon pricing policies. Importers to the EU would need to adjust to the carbon price in the EU, while exporters would be relieved from higher carbon costs. In the case of a price adjustment, importers would be asked to pay an amount at the border equivalent to the EU producers' cost from carbon pricing; EU producers who export would receive a rebate on their carbon costs. In the case of a border adjustment with emissions allowances, importers would have to buy emissions allowances, while exporters would be relieved from the submission of emissions rights for the share of production that goes abroad.

While this appears to be a simple concept, a number of technical, legal, and not least political details have to be carefully considered (as discussed further in this paper). Regardless of these details, the extent to which EU exports will benefit from rebates is determined by the price firms will actually pay for the carbon allowances; i.e. full or partial auctioning – border adjustments thus will not apply for free allocation or if there is direct compensation for carbon costs through State Aid.

Legal issues around border adjustments

The application of measures at the border touches upon EU and international trade policy regulation. The World Trade Organization (WTO) regulatory framework does not explicitly include all potential border adjustments that could be consistent with an ETS. The only tool that is part of WTO regulation is Border Tax Adjustments (BTA). BTA are used to help balance national tax differences in order to level the fiscal playing field. However, if the tax is based on emissions in a production process abroad, there are a number of criteria that need to be fulfilled in order to guarantee non-discrimination of foreign goods.[21]

Another well-known and well-functioning tool is the border adjustment for Value Added Taxes (VAT), with a refund of the tax in the country of purchase in the case of an export to the country of consumption. This implements the 'destination principle' in international taxation (as opposed to the 'origins principle').

While WTO case law provides a framework for the evaluation of taxes, other price and quantity adjustments following an ETS are subject to interpretation of WTO rules. BA can be modified for a fiscal measure, such as a tax, or for a specific regulation - e.g. the domestic obligation for installations to buy allowances. Moreover, there is room to interpret the costs of buying allowances from the state as a tax equivalent and thus draw on the Border Tax Adjustment rules. A crucial point from the multilateral trade regime is to avoid undue discrimination between trade partners. This is an easily conceivable risk in cases of border adjustments based on carbon contents. Thus, in order to follow the golden rule of non-discrimination, best available technology benchmarks would be needed, based on a common, multilateral understanding.

Besides the above mentioned approach that aims to be compatible with the general WTO framework, the question is also raised as to whether the general exemption Article XX GATT, should be made use of. This exemption allows for trade measures to be taken in order to protect a global resource – the earth's atmosphere clearly falls under this category. This clause would allow border measures if they are deemed to be necessary, under the condition that they have the least trade distorting effects and other attempts to implement alternative measures have been pursued (Howse and Eliason 2008).

Political issues around border adjustments

The application of new border measures is not regarded as a desirable step by many countries. In times where the international community is struggling to conclude a new liberalisation round under the WTO (Doha Round), any new trade-related instrument is viewed as impeding this process. Moreover, many developing countries are concerned that international trade policy is not working in favour of their interests and regard trade measures that relate to environmental policy as disguised protectionism (World Bank 2008). The crucial point thus is to ensure that border measures that adjust for carbon prices based on a best available technology benchmark are also in the interest of these countries (Ismer and Neuhoff 2007). Two examples illustrate this: first, border adjustments could be implemented as export taxes by countries that have not implemented emissions trading or carbon taxes (instead of an import tax), creating revenue for the exporting country while also contributing to a level playing field. Second, where electricity intensive commodities are produced with new renewable electricity not supported by domestic schemes they might be exempt from border adjustments, thus creating incentives for additional decarbonisation.

Only by building trust in a multilateral procedure for the application of border adjustments for carbon-intensive industries is there a chance to proceed with this tool. Any unilateral initiative will not receive support from countries without carbon pricing as this would be conceived as discrimination and protectionism. Moreover, unilateralism would undermine

[21] The US Superfund case, 1987, was the first under the General Agreement on Tariffs and Trade (GATT) where this adjustment for imported goods based on their production method was found compatible with GATT law (Howse and Eliason 2008).

the current process of finding a multilateral agreement on global climate policy under the UNFCCC after 2012.

Benefits of border adjustments for climate policy

The idea behind auctioning is to introduce a price for carbon and to make carbon-intensive goods more expensive for consumers. As long as carbon pricing is not applied at the global level, the differences between trade partners will make it easy for producers and consumers to avoid these costs. Border adjustments would diminish these differences for exports from and imports to the EU, and transfer the costs through the value chain. Thus, the higher the carbon-intensity of production, the higher the prices faced by consumers for specific high-carbon raw or processed goods. This is regardless of whether goods come from domestic or foreign production. From a climate policy point of view, this would send the right price signals to society and would encourage investment in new low-carbon process and consumption strategies.

Would this be applicable to any product imported to / exported from the EU?

There are limits to the application of border adjustments. The level of the value chain at which the BA is applied is important. Regarding homogenous carbon intensive production steps, like clinker production for cement or blast-furnace steel, there is a strong case for keeping the range of potential cost compensations at the border manageable. Information on carbon emissions per production unit and production technology should be accessible. The bureaucratic cost would be very high for application of border adjustments to final products, like cars or concrete construction units as this would for example require a system that keeps track of carbon emitted in every step of production (Houser et al. 2008). Attempts to label goods with their embedded carbon are already being made, but only on a voluntary basis. The sheer amount of information needed on complex industrial production, including the complexity of calculating embedded carbon for goods that have travelled around the globe for their different production stages would be difficult to manage.

Conclusions

Border adjustments can support climate policy if they are applied in a limited and careful way to a small range of traded energy-intensive goods that face high carbon prices under the EU ETS. The bureaucracy could be manageable for sectors with homogeneous, carbon-intensive commodities. Nevertheless, the political framing of the adjustments is the key factor in avoiding protectionist use of this tool.

9. Concerns about Auctions in the Power Sector

Wojciech Suwala, Mariusz Kudelko and Karsten Neuhoff

Short-term impact on power prices

The 'Climate package' puts a price on carbon so that producers and consumers consider the environmental impact of their decisions when deciding on production, investment and consumption choices. Evidence from liberalised power markets has shown that the carbon price is reflected in the wholesale power prices even though allowances were allocated for free.

In an almost fully liberalised and competitive wholesale market the marginal production unit should determine the price level at least in the base load segment where scarcity premiums should be applied in general. The analysis of future contracts for German base load deliveries indicates three phases of CO_2 cost past-through.

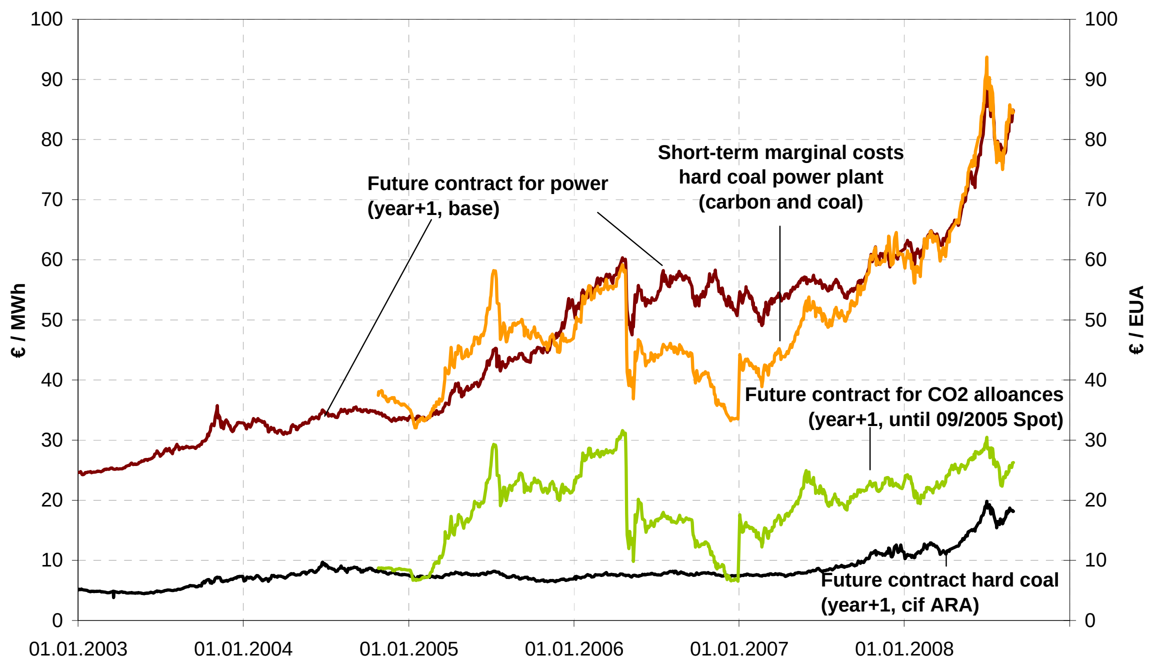

Figure 9.1: Year-ahead future prices for hard coal, base load power, CO_2 allowances and the marginal generation costs of a typical marginal generation unit in the German power market: 2003-2008 (Sources: EEX; PointCarbon; McCloskey; ECB; Öko-Institut calculations).

Immediately after the EU ETS was introduced the base load power contract at the European Energy Exchange in Leipzig followed very closely the movements in CO_2 allowances and the hard coal futures markets. The marginal power generation unit for German base load deliveries is a medium-aged hard coal-fired power plant. From the beginning of 2006 the cost curve for such power plants[22] fits increasingly well with the observed future prices for base load year-ahead deliveries (Figure 9.1). After the crash of the allowance market in April 2006 market turbulence appears to have allowed some short-term profit taking where an in-depth

[22] Typical transportation costs for German hard coal-based power generation sites were used to calculate the fuel costs of the selected marginal base load production unit. The costs include the carbon cost.

analysis is still lacking. However, since autumn 2007 the marginal carbon-inclusive cost of a medium-aged hard coal power plant fits closely with the observed power price. In this context it should be noted that German power plants were granted free allowances covering 80 to 90% of predicted output in the pilot phase of the EU ETS and 50 to 60% from the beginning of the second phase. The rate of free allocation did not affect the pass-through rate which is converging to almost 100%.

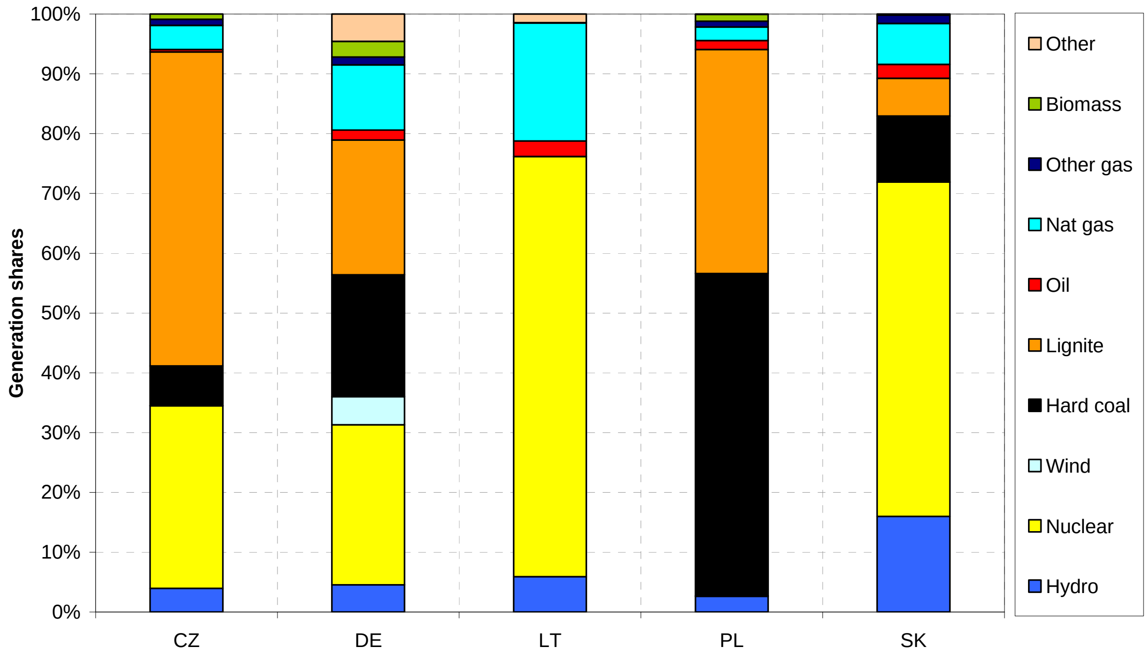

Figure 9.2: Generation shares across some EU countries: 2005.

Recent discussions often point to the large differences between power generation structures across continental European countries (Figure 9.2). Despite very different generation structures, wholesale price levels in continental European countries are very similar. This can be explained by two factors. First, in many countries coal power stations are operating to supply at least some of the power. As coal prices and carbon prices are similar across the EU, countries face similar marginal base load costs and therefore set the base load power price at similar levels. Second, international transmission connections transport energy from countries with cheaper power generation to countries with more expensive generation, thus increasing the power price in the former and decreasing the price in the latter – often resulting in the same price in both countries.

In some of the new Member States the carbon price was initially not reflected in the wholesale power prices because of prevailing long-term contracts. With their expiry in 2007, the price formation drastically changed and wholesale prices in Poland, for example, now reflect both the coal and carbon prices. Thus the wholesale price level is now similar to the price level in neighbouring countries like Germany.

Figure 9.3 anticipates that power prices post-2012 will continue to be set by the generation costs of old coal power stations in continental European countries and therefore will result in similar price levels across countries. Given differing fuel mixes, however, there are differing fuel costs and average costs for carbon allowances between countries. Therefore, the profits of power generation companies will differ across the countries. Generators have to make some profits to pay back the capital costs of their initial investment. Otherwise there would be no incentive for generators to invest in their respective markets, as expected return on investment will not be sufficient. In principle it can be expected that power systems with very capital-intensive generation technologies like nuclear (France) or hydro (Norway) make higher profits to recover the higher investment costs.

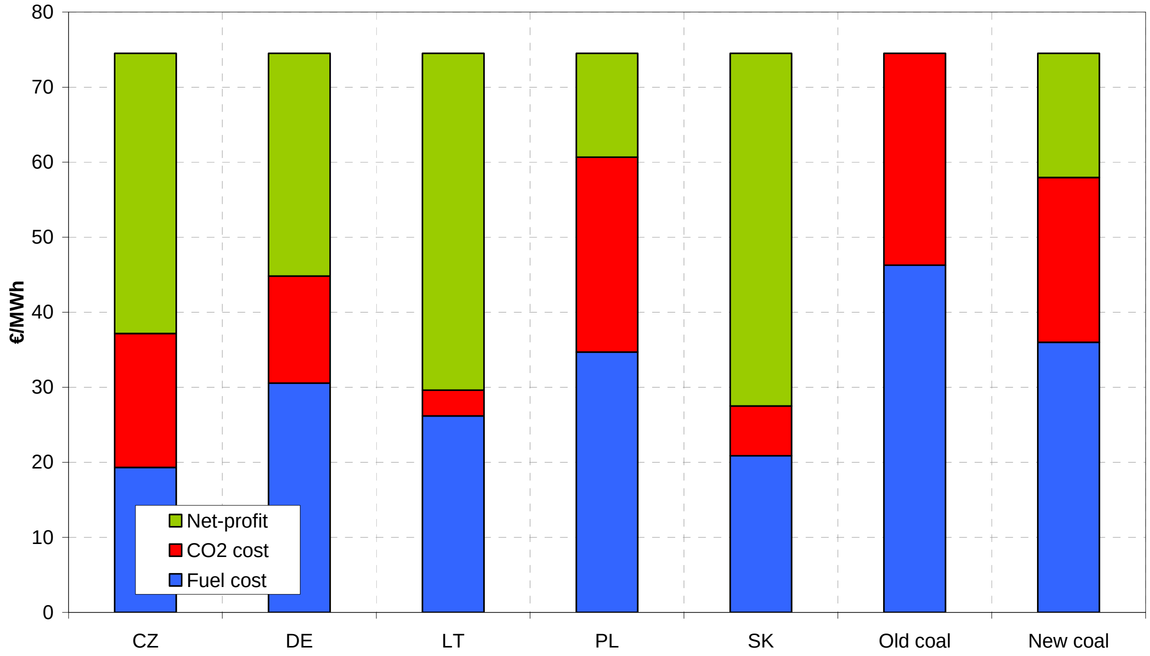

Figure 9.3: Average revenues for power generation - assuming old coal power stations set power price (Based on: generation shares 2005; forward prices for fuel; CO_2 price 30 €/t).

The retail prices in Poland are still regulated, and thus the increase of wholesale price levels has not yet been passed through to retail customers. This is not a sustainable solution and will have to be tackled in 2009 with the opening of retail markets. Thus it can be expected that by 2013 the wholesale prices will be reflected in retail tariffs across Europe.

In addition, for some electricity intensive industrial production processes, like aluminium or copper refining, the electricity price increase can translates into a significant cost increase. Section 3 and 4 discuss to what extent such a cost increase will influence production and investment decisions.

Possible options to respond to power price impacts of EU ETS

The politicians' response to deal with power price increases under the EU ETS was to allocate allowances for free to the sector. While this reduces the average generation costs, free allowance allocation will not by itself alter production decisions of power stations. Theory predicted (Keats and Neuhoff 2005) that free allocation of allowances to the power sector would not change power prices that already reflect the price of CO_2 allowances. This finding was supported by ample empirical evidence across all liberalised power markets (Sijm et al 2006). The free allocation resulted in additional profits for electricity generation companies and did not address impacts on domestic or industrial consumers.

While free allowance allocation by itself does not change wholesale price levels, several mechanisms have been proposed, and are discussed below that allow governments to use the free allowance allocation to distort the price formation process so as to deliver short-term power price reductions:

Allocation proportional to production

One idea is to make the allocation of allowances proportional to the volume of electricity produced in the current, rather than the reference, year. This approach faces strong opposition both from the EU Commission and from the EU Parliament, because it undermines the integrity of the cap system. After all, if the total volume of power generated increases so would the total volume of allowances. This would also set a bad precedent for international negotiations on emissions targets.

It is sometimes proposed that different benchmarks should be defined for the allocation of allowances proportional to actual, rather than base-year, power production. In particular, coal power stations would receive more allowances per MWh of electricity produced than gas power stations, while other generation technologies would receive no allocation. This constitutes a subsidy to fossil fuel generation technologies and undermines the incentive to move from carbon intensive fuels to low-carbon generation technologies. Such an allocation would encourage coal-fired plant to increase their market share, and to delay investment in and replacement by lower-carbon plant, and undermines the emissions reductions required to meet climate objectives.

To avoid the discrimination between different generation technologies, it has been proposed that power generators receive the same amount of free allowances irrespective of the use of generation technology. This approach, however, is difficult to implement in the European context. This is because countries with large shares of power generated from nuclear power stations, like France, have small emissions budgets and can therefore only allocate very few allowances per MWh of electricity produced. In contrast countries with large shares of coal power stations and historically large CO_2 emissions could have many allowances that can be allocated per MWh of electricity produced. This would create a strong perverse incentive to build power stations in countries that already have large shares of coal power stations, in order to receive this increased support and then to export power to neighbouring countries. This situation is obviously not compatible with the principles of the common European market.

A harmonised European benchmark would have to define the volume that will be allocated for every MWh of electricity produced. To implement this benchmark the burden sharing agreement would have to be revisited. Countries that received a larger budget because of historically large emissions due to coal-intensive power sectors would have to pass a significant part of these allowances to countries with large shares of hydro or nuclear generation. It is hard to imagine how governments in countries with carbon intensive power generation would accept this. After all, the allocation of allowances to the country offers the resources to invest in energy efficiency and decarbonising the energy sector. This could be crucial for catching up with countries that already have large shares of low-carbon generation.

Mandating low price contracts

To avoid the drawbacks of formal incentive schemes that subsidise power generation by allocating allowances, governments could impose, or negotiate, long-term electricity contracts between power generators and final consumers that are below commercial rates.

This process could be used to internalise the impact of carbon pricing leading to a reduction in average retail prices.

However, this approach has disadvantages. First, private sector investors may be reluctant to see governments intervene directly in the price formation process. Many private sector agents found it difficult to operate in the uncertain regulatory environments of some developing countries (Gratwick and Eberhard 2007). This approach would undermine any government plans to sell power assets or to attract investment to support a transition to a lower carbon power sector. It would be essential to have a clear and transparent process for any government intervention.

Second, if governments were to intervene to secure reductions in electricity retail prices then countries with intrinsically high power generation costs would have less flexibility than Member States with large shares of cheaper existing hydro or nuclear power since the latter would be in a position to negotiate lower cost power prices.

Third, any deals struck would have to abide by the limits of EU State Aid rules.

Given the economic inefficiencies and political obstacles associated with the different approaches to distort the carbon price signal in order to mitigate power price impacts, alternative policy responses are discussed that ensure environmental effectiveness while addressing equity and leakage concerns.

Recycling of auction revenue

The options to recycle auction revenues are discussed in more detail in section 10, but are explored here using the example of distributional impacts for Polish households.

Figure 9.4 (left) depicts the expenditure of household on electricity in the year 2005 at the example of Poland. A carbon price of 30 €/tCO_2 increases wholesale prices by about 28 €/MWh. Typical low income households in Poland have an electricity consumption of about 1400 kWh (1.4 MWh) per year and therefore have to pay about 40 Euro per year more on their electricity bill, with larger increases for rich households consuming more electricity[23].

Figure 9.4 (right) shows how this increase affects the share of expenditure that different household groups have to devote to their electricity bill. The main insight from this analysis is that poor households are proportionately most affected by increased electricity prices. This suggests targeting any compensation for electricity price increases on poor households.

One compensation scheme would need to offer 13.8 Euro per year per head (2.9 members per household) to compensate poor households fully for the change in retail rates. This could be granted as an explicit payment or could be linked to public benefit programs and/or pension schemes, which might be easier to implement. Additional auction revenues could be employed for investment support in insulation and energy efficiency. This would assist in delivering long-term cost and emissions reductions.

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[23] Our calculations are based on Eurostat (2008) household expenditure data and IEA (2006) Energy Prices and Taxes.

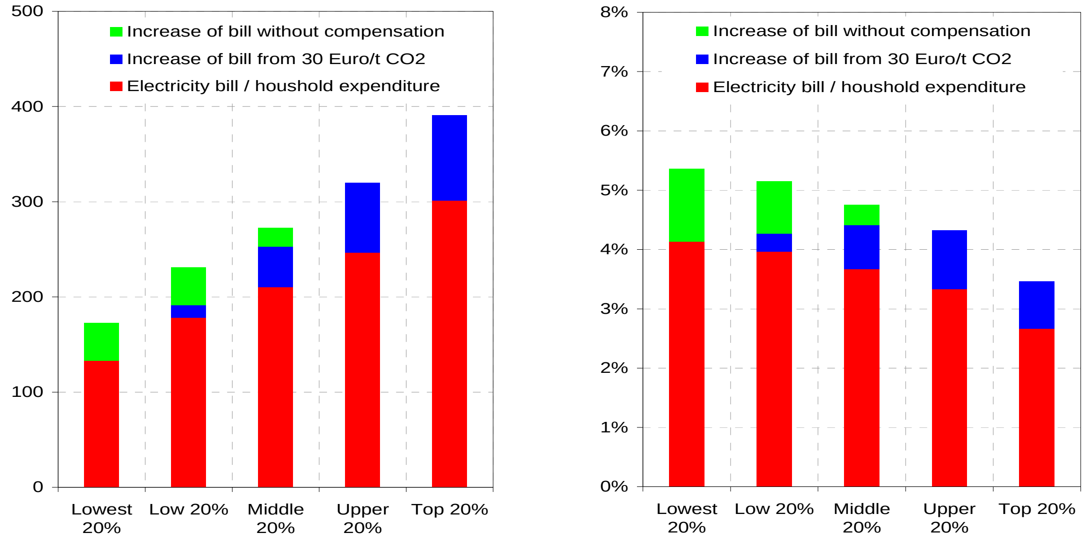

Figure 9.4: Impact on electricity bill and electricity share of expenditure in Poland of an allowance price of 30 €/EUA

The share of auction revenue required to cover such a program is small. In the example above, only half the households need to be compensated. This constitutes 31% of the cost increase for Polish domestic electricity consumption. About 20% of electricity is consumed by private households, therefore about 6% of auction revenue would be needed to cover the cost of the compensation scheme. With continued free allowance allocation the power price increase would be the same, but the government would not have access to the financial resource for such compensation schemes.

Figure 9.5 illustrates why the discussion is particularly lively in Poland. Domestic consumers receive electricity at prices that have been significantly below those in other European countries. This was probably a result of lower charges for distribution and transmission networks, access to cheap domestic coal, and low capital charges on old power stations. Recent power failures, however, highlight the need for investment. Also the increases in the global price of coal from around 70$/t in early 2007 to about 200$/t by September 2008 has resulted in similar price changes within Poland. Thus it is likely that retail tariffs will increase, irrespective of the introduction of carbon pricing. This increases the importance of compensating poor households.

Discussion of the recycling of auction revenues also illustrates the difference between price increases and costs. Higher power prices associated with carbon pricing do not automatically create a cost for an economy because the auction revenue can be used to compensate social impacts and to support economic growth. The Intergovernmental Panel on Climate Change (2007) therefore predicts only a 0.2-2.5% global GDP reduction by 2030, comparing models for similar or more stringent climate polices than those implied by the EU package.

For industrial producers the government could grant State Aid in cases where the power price increases due to carbon pricing creates concerns about relocation of production. The economic and legal analysis of this approach is presented in sections 3 and 6 of this report.

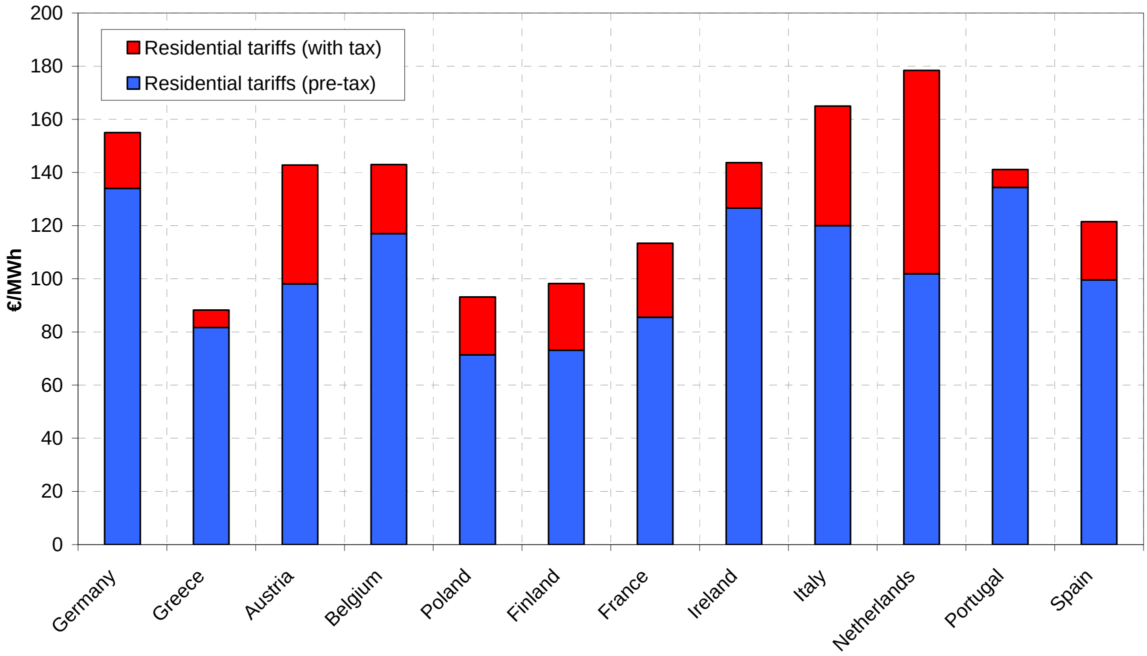

Figure 9.5: Average tariffs for residential consumers in European countries (Source: adapted from IEA 2005).

Leakage of electricity production

For the majority of EU countries leakage of electricity production is not an issue as their neighbours are other EU countries that face the same carbon price. For a country neighbouring a non-EU country, such as Poland, which borders Ukraine and the Republic of Belarus, the implications of differing carbon prices need to be assessed. Both the availability of current or future foreign generation capacity to import into the EU and the availability of current and future transmission capacity to transport the energy are discussed below.

Available generation capacity to import to Poland from outside EU ETS

Lithuania has plans to build a new nuclear power station on the site of the present Ignalina station, which is expected to close in 2009. Polish participation in the new station is agreed and a percentage of production will be exported to Poland. However, this type of project is not the result of EU ETS – as investment from both countries is equally affected by the scheme.

Therefore only power imports from Ukraine or Belarus create the risk of leakage as they are not covered by EU ETS. Building and operating plants in either of these countries would be economical not only due to lower costs, but also because less restrictive environmental regulations and reduced investment lead times minimise the legal procedures required. However, for capital-intensive investment, like power stations, a long-term profitable operation is required. This makes such investments very risky. In the long term, Belarus and especially Ukraine are likely to follow the EU standards on GHG emissions regulations, and the advantage of location might therefore disappear. The time period of differing carbon regimes might thus be too short to justify the investment in a dedicated export plant.

It seems that there are only two projects currently under consideration that could potentially export power to Poland – if linked with additional transmission lines. These are the addition of two units to the existing Khmelnytsky nuclear power station in Ukraine and the proposal of Russian companies to build nuclear power plant in Kaliningrad region. As nuclear power stations do not emit CO_2, these projects would also be viable if they were covered by an emissions trading scheme (and will compete on an equal footing with new nuclear plant in the EU).

This leaves the question as to whether exports from existing power stations could make a significant contribution to the Polish electricity balance. Ukraine is presently exporting 4% of total production, and there is some potential to increase production by 3 TWh using spare hydro capacity for increasing production.

Availability of transmission capacity to import the power

Poland has interconnections of almost 8 GW capacity with Germany, Czech Republic, Slovakia, Sweden, Belarus and Ukraine.

A large part of the capacity is taken over by the flows that result from loop flows from other countries.[24]

Currently only 360 MW and 250 MW of transmission capacity are in place to allow for electricity imports from Belarus and Ukraine respectively. The line from Ukrainian Khmelnytsky nuclear power station and Poland, of 1.3 GW capacity, ceased to operate in the early nineties when Poland joined the UCTE. An initial feasibility study for new transmission lines may suggest that investment would be viable if carbon prices create a big price difference in generation costs between countries. Again, the commercial interest depends to some extent on the risk associated with such an investment. Other factors can play a more important role in constraining potential import capacity from Belarus or Ukraine.

The time taken to build a new transmission line could be as much as 15 years from the conception of a project to operation. Existing regulations require environmental and other impact evaluations. A major time-consuming activity is negotiating the agreements with the land-owners to pass lines through their property. This time constraint could be mitigated in the case of the already existing but decommissioned 750 kV line from Khmelnytsky to Poland. Plans exist for its reconstruction and the addition of converter stations.

A second constraint on the addition of import capacity is the maximum safe share of imported energy and the possible risk of line failures. Limits on the transmission lines, due to security of supply issues, do not allow the import of power to exceed 10% of domestic consumption. Therefore there might be some aversion from government institutions as further imports could result in the threshold of secure level of external supply to be passed. Regardless of who the importer or the exporter is, the major transmission lines will be managed by PSE-OPERATOR SA, which is the state-owned Polish high voltage transmission operator.

A further technical problem of additional transmission capacity is that the systems of Belarus and Ukraine (except for western Ukraine) are not synchronised with UCTE. Therefore

[24] For example electricity from north Germany wind farms flows to south Germany through Poland and Czech Republic, occupying substantial share of transmission capacity.

transmission infrastructure will have to include DC links or back-to-back AC-DC-AC converters.

After recent power failures within Poland, investment in transmission and distribution capacity within the country is receiving increasing attention. It is not certain when new transmission capacity will be constructed. Potential investors expect government support to guarantee viability of the venture.

Longer-term concern – impact on investment

A mid-term development of the Polish energy sector was analysed using a 'partial equilibrium model', which seeks to maximise the sum of producers' and consumers' surplus. The supply side considers deliveries of primary energy from domestic and import sources and their conversion through the technologies of power, combined heat and power, and heat plants. Energy technologies include the typical production characteristics of existing coal-fired power plants and those projected to be implemented in Poland. Due to increasing demand for electricity and carbon limits, nuclear reactors are expected to come online after 2015.

The demand side is represented by the main consumer groups: industry and construction, transport, agriculture, trade and services, households and export. The demand curves were estimated from the historical data on the prices and consumption with the assumption of fixed price elasticity coefficients, both for electricity and heat markets. The international trade of electricity was determined by transmission capacity. As stated in the section on relocation, import from Ukraine and Lithuania was considered.

Looking at the results of the model it is not surprising that the energy production structure for all scenarios does not depend on the system of allowance allocation. This suggests that free allowance allocation is not necessary to enable power investment in Poland. This is because old coal power stations will continue to operate in the power system for some time and as such, set the power price based on their fuel and carbon costs (around 75 Euro/MWh). New power stations are more efficient and save coal and carbon cost of 17 Euro/MWh. This covers most of the costs of new investments and requires only marginal additional benefits, for example during peaky prices in winter.

The results demonstrate that it is economically and environmentally more beneficial to operate new coal power stations than old coal power stations. Free allowance allocation is not required to support new coal power station investment in Poland. However, the results do not tell us whether this choice is compatible with the longer term emissions reduction objectives as the model horizon is too short to asses this question.

Figure 9.6 illustrates that in the model scenarios, hard coal and lignite continue to be the main contributors to the total power generation mix. This might create challenges for the Polish energy system post 2020. By this time the power price in other European countries may have fallen as coal power stations are increasingly replaced by renewable energy and might no longer set the marginal electricity price.

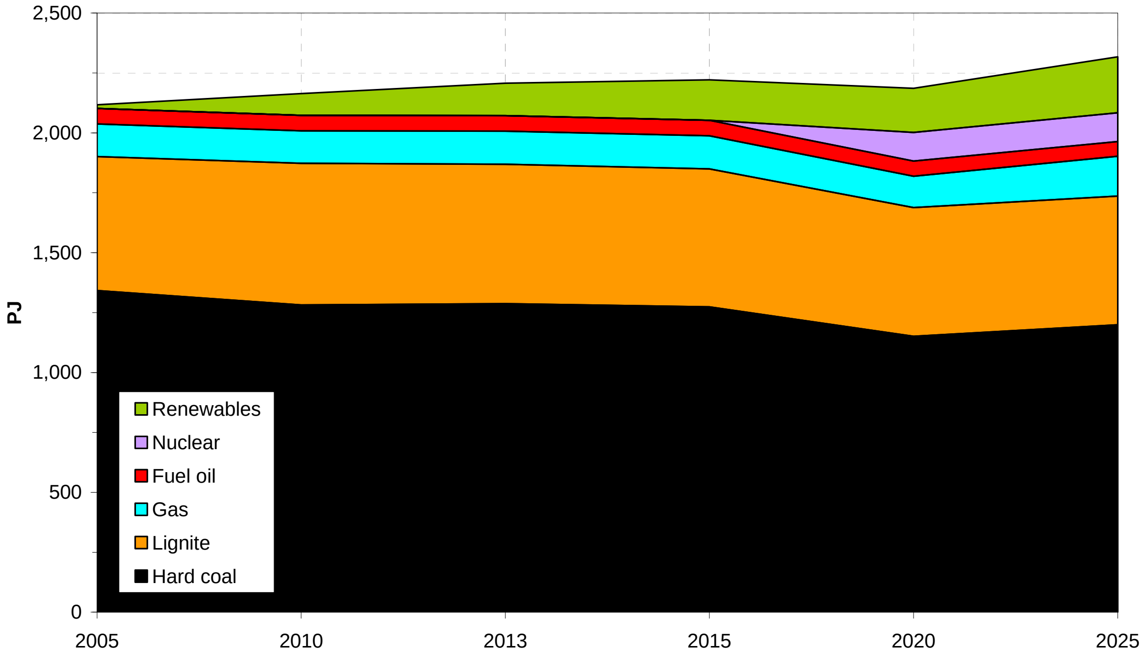

Figure 9.6: Projected share of power generation in Poland.

This can be avoided in Poland with accelerated investment in CCS and renewable energy. Full auctioning can support this transition by providing a clear investment framework and revenues to support investment in energy efficiency to lower overall energy demand. Poland can also make use of its renewable resource potential. Costs for investments beyond the domestic target can be born by EU Member States – as currently proposed under the EU Renewables Directive – and would benefit the Polish power system and economy.

Conclusion

Full auctioning to the power sector does not alter power prices relative to free allowance allocation. In the example of the Polish power system we have analysed concerns about cost increases for domestic households, relocation of power generation and implications for electricity intensive industry. This analysis points to the need for using some of the auction revenue to compensate poor households for higher electricity bills associated with carbon pricing. Because of the physical characteristics of the power system and uncertainties for investors, there is only limited concern about relocation of power generation to countries not covered by EU ETS. Sections 3 and 4 have pointed to a very narrow group of electricity intensive producers for which further analysis is required to see whether power price increases associated with carbon pricing could result in leakage. Analysis in this section cautions about distorting power prices in favour of these sectors. Instruments such as State Aid and border adjustments might be more suitable, should leakage concerns be confirmed. Finally, simulation results for the Polish power system suggest that new investment in power generation is financially viable and does not justify additional subsidies from free allowance allocation.

10. Equity considerations

Regina Betz and Karsten Neuhoff

The method of allocation can have significant distributional impacts and equity issues and may reduce the political acceptability of an ETS in the long-run. Free allocation will mainly make high income households better off compared to low income households, since higher incomes tend to benefit more from higher share values. Auctioning of allowances creates public funds - some of which can be used to compensate poor households for short-term increases of energy and commodity prices associated with climate policy.

A second dimension of equity arises in the global discussion on joint responsibility for global CO_2 emissions reductions. To reduce global CO_2 emissions actions are also required from developing countries. However, because of their different economic situations they can only pursue such actions with support from developed countries. While financial support is provided through the carbon market to individual projects (Clean Development Mechanism), the European experience points to the importance of moving from individual projects to country-wide policies. Auction revenue can provide the necessary resource to support international cooperation on the implementation of domestic climate policies.

The distributional impact of carbon pricing

In order to achieve cost effective emissions reductions the carbon price has to feed through the economy. This enables producers and consumers to make efficient decisions on their input and consumption choices. However, it also implies that carbon intensive commodities and services will be more expensive for households. The impact on each household will depend on its consumption pattern of energy and energy intensive goods. Low-income households spend a larger share of their income than higher-income groups on products whose prices will rise as a result of the emissions trading scheme. Therefore the direct impact is regressive. The regressive effect will be reinforced if permits are handed out for free. They lead to additional profits for companies that receive the allowances, the shareholders of which are mainly high-income households. For example Parry (2004) states that in the US 53% of stock is owned by the top-income quintile while only 3.5% is owned by the lowest-income quintile. This regressive effect could be compensated for by using some of the revenue of auctioned allowances for tax reductions or energy efficiency measures that benefit the entire population.

The first assumption is supported by a study that assesses the effect of a carbon tax in the European Union. It revealed that low income households will face a disproportionately higher impact compared to high income households (see Figure 10.1 and also Wier et al 2005). The regressive impacts vary across the countries and are the highest for Ireland, followed by the UK. The differences between countries reflect the different energy consumption patterns of carbon intensive fuels as well as different energy spending habits and emissions intensity of electricity production (e.g. France is mainly nuclear).

Similar impacts have been predicted for the introduction of an emissions trading scheme in Australia. For example the National Institute for Economic and Industry Research (2007) estimates that low income households in Australia will face a 2.3% increase in total expenditure, which can be compared to high income households who will face only a 0.4%

increase at a carbon price of 20 US$/t$CO_2$ (25 Australian $).[25] Similarly, in the US a study has estimated that the lowest household quintile will have 3.3% increase in expenditure compared to 1.7% for high income households for a carbon price of 100 US$/metric t CO_2 (Dinan and Rogers 2002, Table 4, p. 21). The direct comparison of studies is difficult not only because carbon prices and reduction targets vary but also because some studies, for example, take the effect of the embodied carbon in goods into account (US and Australia) while others, like the EU studies, focus only on direct domestic fuel and motor fuel consumption. Only one study took the effects on shareholders into account. However, all studies show that emissions trading may have regressive impacts and as Parry (2004, 366) states "the distributional effects are less pronounced at higher levels of abatement".

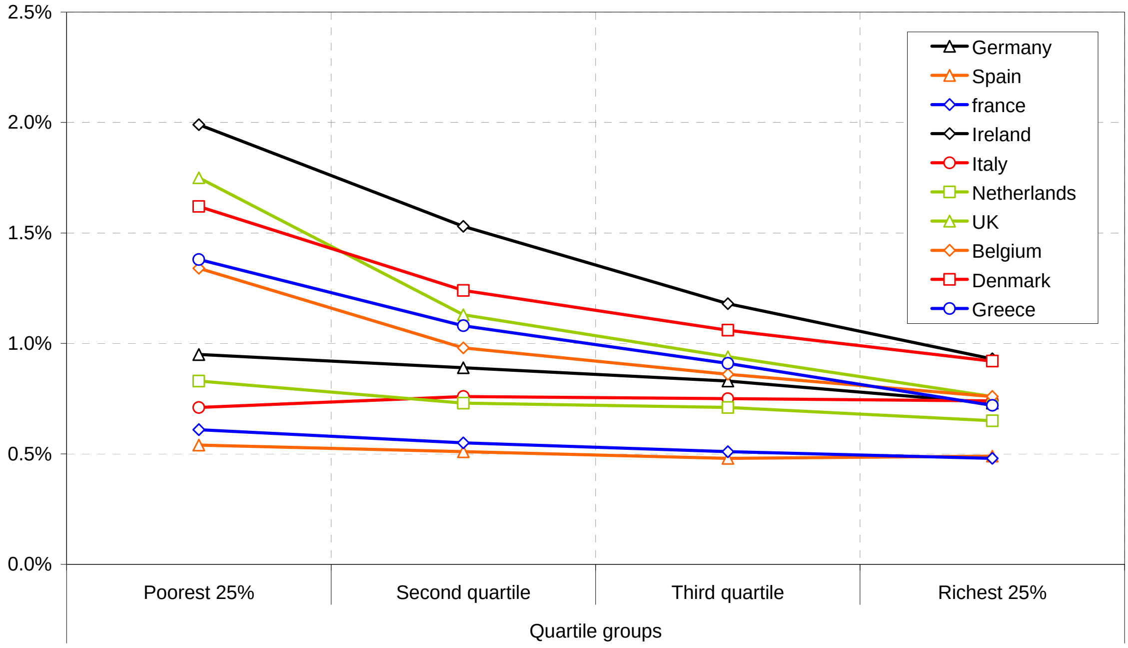

Figure 10.1: Impact of carbon prices (10 US$ in 1991 values) on different households groups (Source: adapted from Smith 1992).

Different approaches to using public funds for addressing equity concerns

These distributional impacts of the introduction of an emissions trading scheme can be addressed if permits are mainly auctioned to industry and the revenues are recycled back to households. Thus, the final distributional impact of the emissions trading scheme will depend on how well recycling serves to reverse the regressive effects. Many different ways exist to recycle auction revenue:

1. lump-sum payment to households
2. decrease in income tax
3. decrease in corporate taxes,
4. rebates through social security payments.
5. improvement in energy efficiency of low income households.

Lump-sum rebates reflect the idea that each individual has the same right to emit carbon emissions and therefore every individual is entitled to receive the same share of auction

[25] This study takes the embodied carbon in goods into account as well as a carbon price on petrol as the Australian scheme will most likely cover transport emissions.

revenue. A study for the US has shown that full auctioning combined with lump-sum payments has a progressive effect. Low-income households would be better off by US$310 in average real income per year than in the absence of the scheme (Dinan and Rogers 2002). Thus the households' lump-sum rebates would be larger than their cost increases as a result of the policy which illustrates that not all of the auction revenue is required to compensate poor households to a level at which they are not negatively affected by emissions trading.

Another option is to lower the income tax and make labour cheaper. This would also be in line with the "double dividend" discussion that suggests revenues should be used to reduce other distortional taxes such as income tax, which would also improve the overall efficiency of the economy (Goulder 1995). The distributional impact from this revenue recycling option depends on the existing income tax system and mechanism by which the tax is reduced. The impact will be neutral if each tax bracket is cut by the same share, or it will be progressive if the rates of lower tax brackets are cut to a greater proportion.

Recycling the auction revenues through a cut in corporate taxes again would improve the efficiency of the economy (double dividend) but would be supporting the regressive impact on households. As Dinan and Rogers (2002) have shown low-income households would lose around 3% of their income while high income households could gain 1.5%.

It is also possible to use the revenue to improve social security systems. This includes higher payments (above automatic adjustment to inflation) to people in receipt of pension, care, senior or allowance benefits, as well as to beneficiaries and recipients of family assistance. This would mitigate the overall impacts of the increase in the cost of living resulting from internalised carbon costs.

The detailed implementation in Central and Northern European countries is straight forward. Existing social security systems have means tested components to target the poor, e.g. job seekers allowance in the UK, Sozialhilfe in Germany and RMI in France. They can be increased without additional administrative effort and allow for a targeted allocation of the support. In contrast, in Southern and Eastern European countries many of the social security systems are linked to past income, and therefore benefit the middle income groups more than the very poor. To set up a new means tested system for the purpose of allocating the relatively small support required for the compensation would create disproportional administrative costs. An alternative is to target support at groups who are likely to be poor. This may include increasing child benefits and payments to elderly – building on instruments that are likely to be available in all countries, and for which only the level would have to be increased. In addition, to address impacts for working age poor that do not have children, support for deprived communities can be increased. For example the LEADER companies for rural development in new Member States exist in most rural communities and urban partnerships offering suitable interface.

Auction revenue can also be used to support investment in energy efficient transport, housing and appliances by low income households. Thus it reduces their energy consumption and expenditure on energy.

It is likely that countries will pursue a combination of the above, reflecting different national circumstances and preferences. The draft EU Commission proposal so far only envisages apportioning 20% of the auction revenue for low-carbon technologies and energy efficiency measures both in Europe and developing countries.

In Australia a study commissioned by the State and Territory Government suggests 50% of the auction revenue should be spent on compensating households, with most of this directed to those households at the bottom half of the income distribution. The two ways advocated are energy efficiency improvements or through changes to the tax and social security systems (Garnaut 2008, 477).

Under the Regional Greenhouse Gas Initiative (RGGI) at least 25% of permits have to be auctioned – most states will auction 100% - and the revenue of this part should be used to finance “consumer benefit or strategic energy” initiatives. These include energy efficiency measures, to directly mitigate electricity ratepayer impacts, to promote renewable or non-carbon emitting energy technologies, and to stimulate or reward investment in the development of innovative carbon emissions abatement technologies (RGGI 2005).

The international equity dimension

To deliver global CO_2 emissions reductions the actions of developed countries alone will not be sufficient to pursue active climate policy; increasing action from developing countries is necessary. However, the economic and technological situation limits the ability of developing countries to act, whilst the poverty of large shares of the population creates other pressing policy objectives. Thus developing countries have so far not committed to delivering emissions reductions.

Developing countries are part of any solution to climate change. With growing emissions levels and the increasing impact of climate change there is both the need and the motivation to engage these countries in active climate policy. Currently the Clean Development Mechanism (CDM) represents the main channel for financial transfers from developed countries to support the decarbonisation effort of developing countries. Firms in developed countries invest in projects in developing countries and the emissions reductions they achieve are credited against the emissions of the firms in their home countries. CDM projects have been developed across a range of countries and technologies, and have created stakeholders and expertise in developing countries.

However, the CDM mechanism can only be one part of international cooperation on climate policy. While in principle a common carbon price that is paid for all CDM credits is economically efficient, the mechanism inflates the required funding stream because projects with lower costs still receive the full carbon price. Also, the CDM approach subsidises individual low-carbon projects and thus increases the resources available in energy intensive sectors. Thus it can contribute to an overall increase of the activities in the sector, rather than a shift towards less carbon intensive processes, products and services. The European experience points to the importance of moving from individual projects towards the implementation of domestic climate policies.

International cooperation can support the implementation of domestic climate polices with technical assistance, financial support and technology cooperation. This will require close cooperation between governments in bilateral or multi-lateral settings. Auctioning of CO_2 allowances can provide the necessary resources that allow European governments to make a credible commitment towards such cooperation.

Conclusions

Free allowance allocation will enhance the regressive impact of an emissions trading scheme indirectly as the high income households are more likely to own shares of companies that will benefit from the allocation. Therefore by reducing the share of free allocation the regressive impacts are lowered in two ways: first by reducing shareholder revenue, and second by making more revenue available which can be used to compensate for the regressive impacts. It also creates resources to support poorer countries in their implementation of adaptation and mitigation policies and measures and thus enables them to contribute to global carbon emissions reductions.

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