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CLIMATE POLICY AND INDUSTRIAL COMPETITIVENESS:
TEN INSIGHTS FROM EUROPE ON THE EU EMISSIONS TRADING SYSTEM

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Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System

Climate & Energy Paper Series

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Executive Summary

The U.S. Congress is in the midst of a debate on regulating greenhouse gas emissions. The Waxman-Markey bill was passed by the House of Representatives on June 26, 2009, and the Senate is likely to probe even more extensively the appropriate design and implications of a system to regulate emissions. Europe has accumulated a rich experience with designing and implementing a cap-and-trade program, and U.S. policymakers have an opportunity to look at this experience on key issues that continue to challenge consensus. Foremost amongst these are issues surrounding allocation of emissions permits, costs, and competitiveness.

This report examines the experience of the European Union's Emission Trading System (EU ETS) and suggests key lessons relevant to current U.S. debates, with associated recommendations, as follows:

1. **Emissions trading works**

   MIT estimates that the EU ETS has cut European emissions by 120–300 million metric tonnes of carbon dioxide ($MtCO_2$) during its first, highly imperfect phase—up to 5 percent of emissions from the covered sectors, despite excessive allocations of emissions allowances. It captured private sector attention like no other climate initiative, and its rapid introduction and impact contrasted with a decade of dispute over (failed) attempts to introduce a European carbon tax.

   Recommendation: Develop an emissions trading system that learns from and improves upon the EU experience.

2. **Everyone will learn**

   Cutting carbon is a complex business subject to heavy lobbying; not all analysis, and not all design choices, will be right at the beginning. Not only government but also industry and other participants will learn in ways that enable the system to be improved over time. The EU ETS has benefited enormously from its design as a series of phases, each of which has allowed improvements on the previous one, particularly concerning scope and allocation.

   Recommendation: Build in a capacity to strengthen the system if and as experience supports this.

3. **Prices can be volatile and affected by numerous unforeseen factors, which to date have reduced prices below expectations**

   EU ETS prices have been quite volatile and after initial peaks have been lower than expected. This was partly due to incomplete data and intrinsic problems in emission projections. Other direct policies, on energy efficiency and renewable energies, also reduced the CO_2 price. While this means it costs less than projected, beyond a certain point the lower-than-expected price reduces incentives for low-carbon innovation and investments. Debate continues about whether improved data and the use of "banking" will bring sufficient stability to the market to boost investor confidence.

   Recommendation: Consider carefully the lessons from the EU experience on price volatility around unavoidable uncertainties in emission projections, the contribution of other policies, and systematic tendencies to underestimate the abatement and innovation responses.

4. **GDP impacts are small**

   Thus far, the EU ETS has been able to achieve its environmental objectives at costs significantly below those projected, a small fraction of 1 percent of EU gross domestic product (GDP). Moreover, if auction revenue is used effectively to reduce distortionary taxes and to fund low-carbon investments, the cost impact on the economy can be eliminated or even create positive economic impact.

Recommendation: Don't let concerns about macroeconomic impacts dictate the environmental targets. Economic impacts have been consistently less than projected.

5. **Industry can profit**

Emissions trading does not inevitably impose net costs on industry. Indeed, despite initially opposing the EU ETS, all participating industrial sectors in Europe have in aggregate profited from its operation to date—perhaps excessively. Whether or not a sector profits, loses, or is neutral depends upon design choices, particularly around allocation (see Recommendation 7).

Recommendation: Resist inevitable pressures from industry to maximize free allocation, but engage companies more constructively in designing and understanding the full implications of the system.

6. **International competitiveness impacts are limited to a small number of industry sectors**

For most manufacturing sectors, cost differentials due to labor and other inputs far outweigh those induced by international differences in the cost of carbon. The cost uncertainty induced by emissions trading is correspondingly very small compared to those arising from, for example, fluctuating exchange rates and energy costs. As a result, most sectors can accommodate carbon costs without significant impacts to their profits, sales, or competitiveness. However, a handful of carbon-intensive industrial activities face genuine competitiveness concerns, often very specific to their sectorial characteristics.

Recommendation: Concerns about competitiveness impacts should focus on a few potentially exposed industries. For these, tailored solutions should be pursued.

7. **Free allocation introduces risks of windfall profits**

Although political reality, driven by distributional or competitiveness concerns, requires some free allocation, it comes at a real economic cost. Some economic inefficiencies can be avoided by basing allocations on historical data or benchmarks, but this can generate windfall profits and may not prevent international leakage.

Recommendation: Design to minimize net impacts on the aggregate profitability of incumbent sectors, while boosting the profitability of cleaner technologies and innovators. Consider possible parallels between electricity production and upstream allocation to refineries.

8. **Free allocation can also degrade program efficiency**

In contrast to allocations based on historical data, output-based allocation or compensation makes the opposite political trade-off: reducing windfall profits and protecting production levels, but at the cost of further reduced efficiency. EU policymakers consistently rejected industrial pressures for output-based allocation or rebates on a mix of practical, environmental, and efficiency grounds.

Recommendation: A balance between absolute and output-based free allocation should strive to minimize economic distortions as well as windfall profits. The balance between these two negatives should reflect each sector's ability to pass through prices, its exposure to international leakage, and its potential for emissions abatement through radical innovation, product substitution, or demand reduction.

9. **There is a compelling economic rationale to maximize auctioning**

   Auctioning ensures that price signals remain intact to drive efficient corporate and private decisions on consumption, innovation, and low-carbon investment. It also provides revenues that could be used for public goals—such as low-carbon technology development, to help compensate consumers as carbon costs start to be reflected in product prices, and/or for international programs for technology transfers or economic assistance for adaptation.

   Recommendation: Maximize auctioning.

10. **Unilateral border adjustments may be a politically appealing way to respond to domestic pressures from special economic interests, but they risk serious problems in the international trading system**

    The possibility of adopting border adjustments has been widely discussed in Europe, but so far resisted. Although they appeal to particular industries and associated interests, they risk being abused as disguised trade protectionism. This provokes correspondingly strong suspicions that could disrupt multilateral trade agreements. Some types of border adjustments under discussion would not prevent emissions leakage, which should be the principal criteria for their use. International agreements including mitigation commitments and multilateral trade rules have the potential to be more effective and equitable while limiting international fallout.

    Recommendation: Negotiate multilateral arrangements to contain or structure the use of border adjustments, focused upon minimizing emissions leakage, as and when specific problems can be demonstrated.

These are ten key recommendations from the evolution of the EU ETS. At the same time, there are important areas in which the EU ETS experience cannot offer guidance to U.S. policymakers. For example, the EU ETS focuses upon regulating at point of emissions from well-monitored sources, meaning that it cannot offer direct insight into the consequences of broadening the system "upstream" to cap the carbon in oil and gas flowing into the economy (though possible parallels with capping the carbon going into electricity production should be considered). The EU has no parallel to the U.S. proposal to allocate a proportion of electricity-related allowances to distribution companies, and its rejection of output-based compensation means EU experience cannot directly illuminate the consequences of that choice. Perhaps in its fourth phase (post-2020), the EU ETS will in turn be able to learn from U.S. experience in these areas.

1 Introduction

The "American Clean Energy and Security Act of 2009," commonly known as the Waxman-Markey bill, is stimulating intense interest in the options for designing a greenhouse gas emissions (GHG) cap-and-trade program. As the bill passes from the U.S. House of Representatives to the Senate for consideration, even more attention is likely to focus on the economic implications for particular industries and regions, as well as their consequences for the effectiveness of the system in reducing greenhouse gas emissions.

Questions about the effects on the international competitiveness of U.S. industry have been central. These concerns acquire a particularly sharp edge if there is a prospect of companies relocating to other countries without similar regulations. Concern understandably focuses on potential loss of jobs. Of course, a key challenge and objective is also to build jobs in low-carbon industries, but concern about incumbent industries acquires additional force if policy drives industries abroad, with products imported. This results in international leakage not only of jobs but of emissions, offsetting the environmental benefits in that sector.

These are not new questions. Competitiveness impacts of CO_2 controls were debated in the 1990s, when both the United States and the European Union considered carbon taxation and some countries implemented such taxes. The debate sharpened in Europe as the European Union Emissions Trading System (EU ETS) was developed and began operation in 2005.

Many U.S. analysts and politicians know about the EU ETS, but not the analysis that shaped it, the stages of its evolution, or what has been learned. Yet the history of the EU ETS is rich in lessons. This report presents some of these insights, with a particular focus upon the issues around allocation of emissions allowances, costs, competitiveness, and carbon leakage impacts of a cap-and-trade system. It draws upon a large number of studies by experts in recent years on the economic and environmental implications of the EU ETS. It also provides basic information about the ETS and a brief comparison of its main features with the Waxman-Markey bill.

The iterative, sequential design process of the ETS has enabled the EU to learn from its early experiences and avoid some of the mistakes from its first phase (Phase I). It also enabled the EU to focus on just CO_2 from well-monitored key sectors at the outset, and gradually add other sources to the ETS over time. Some emerging lessons from Phase II can still be incorporated when the design of Phase III is reviewed in 2010, following the Copenhagen climate conference.

The purpose of this report is to reflect on Europe's experience with the ETS and offer some recommendations to U.S. policymakers as they contemplate the design of a U.S. cap-and-trade program.

- Section 2 outlines broad lessons concerning costs and cap-setting in the design of a cap-and-trade system.
- Section 3 analyzes in greater detail the implications of allocation methods for industry, particularly incentive effects.
- Section 4 focuses on which industries are most vulnerable to the international competitiveness impacts of cap-and-trade systems, in theory and in practice.
- Section 5 discusses the policy tools that are available to address the competitiveness and leakage issues.

The Conclusion synthesizes the lessons and presents recommendations based on them.

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2 Caps and Costs

Key issues for U.S. legislation

Setting the cap, or the number of emission allowances, is one of the most important decisions in the design of any cap-and-trade program. It is also one of the most contentious. It determines the environmental outcome, but tighter caps will tend to necessitate more expensive technologies and faster retirement of existing capital, increasing the cost of the legislation as a whole. The EU experience to date is that cost projections are frequently overstated and caps have proven easier to achieve than anticipated.

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As U.S. policymakers have become more familiar with the costs and benefits of climate policy, the technologies available to provide abatement, and the projected impact of climate change, they have become bolder in setting their targets. The emission targets outlined in the Waxman-Markey bill as passed by the U.S. House of Representatives on June 26th are some of the most aggressive GHG goals of any proposal seriously considered by Congress in recent years.

It is hard to compare the ambition of Waxman-Markey vis-à-vis the EU ETS for many reasons. Relative to 1990, EU emissions had declined by 2005 while those in the United States rose sharply (see Charts 1 and 2). The EU ETS regulates strictly at point of emissions, capping only direct emissions from large facilities, notably power generation and heavy industry. The trading system in the Waxman-Markey bill, by contrast, aims to regulate fossil fuels used in the transportation, commercial, and residential sectors upstream, and in so doing will eventually cover approximately 87 percent of U.S. emissions.

Box 1. Emission caps in Waxman-Markey and the EU ETS

Chart 1. Proposed emission reductions under the Waxman-Markey bill

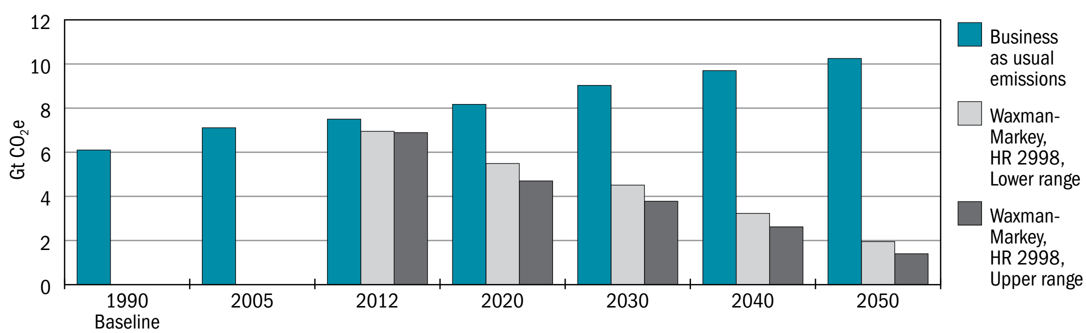
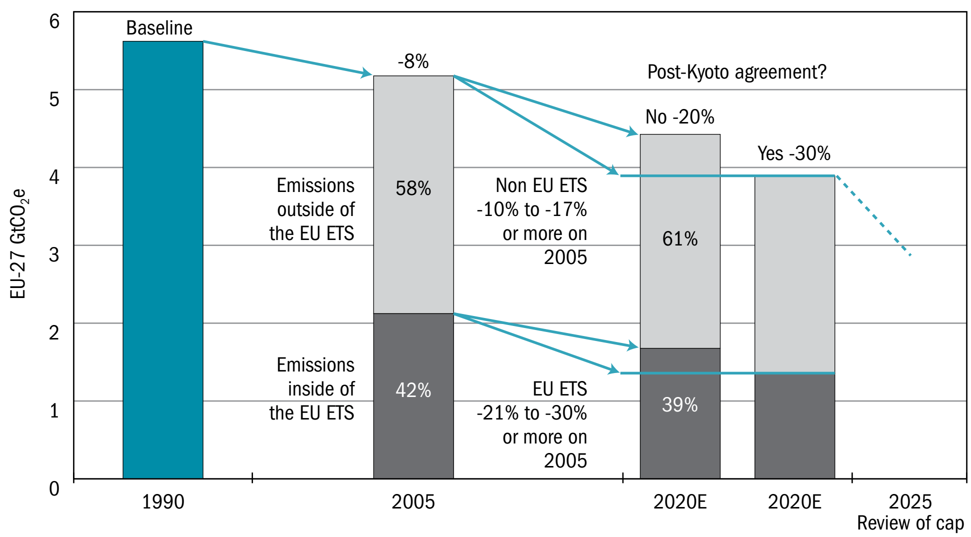


Chart 1 shows U.S. emissions in 1990 and 2005, and the reductions proposed in the Waxman-Markey bill. These targets would cover most of the U.S. economy. By contrast, the EU ETS caps industrial emissions (including electricity production), representing about half of the EU's CO_2 emissions and over 40 percent of total greenhouse gas emissions (see Chart 2), and other sectors are addressed through different policies.* Emissions from the EU ETS sectors have been declining, and are generally projected to be cheaper to control, while those covered by other policies have been rising. Chart 2 shows this division and the proposed total caps for 2020, which are set within EU goals to achieve 20 percent reductions (relative to 1990 levels) by 2020 unilaterally, or 30 percent if there is an effective international treaty.

* For example, transport sector emissions are already subject to gasoline taxes at levels far higher than any expected equivalent carbon prices, and emissions from domestic and service sectors are addressed through a patchwork of largely national policies. The European Climate and Energy Package establishes targets for each Member State governing these other sources. Source: Climate Strategies

Chart 2. EU greenhouse gas emissions, 1990–2020, and the EU ETS component



Source: Carbon Trust, "Cutting carbon in Europe: The 2020 plans," June 2008

The emission targets outlined in the Waxman-Markey bill as passed by the U.S. House of Representatives are some of the most aggressive GHG goals of any proposal seriously considered by Congress in recent years.

The most recent developments of the EU ETS set caps to 2020, but to a level of ambition made conditional upon international progress. The EU ETS sets as a default continuing this rate of decline beyond 2020, but with a review in 2025. The Waxman-Markey bill proposes caps through 2050.

In terms of design, other intrinsic points of difference between the EU ETS and the Waxman-Markey proposals are important to note:

- The EU ETS is an international trading system, spanning the 27 member states of the European Union. Like the current situation in the United States, its development as a harmonized system was provoked in part by the recognition that in the absence of coordinated action, Europe would end up with a patchwork of incompatible designs. But particularly in its early stages, the EU ETS fell far short of a centralized system, and each member state was responsible for allocations to its own industry, in "National Allocation Plans," subject to oversight by the European Commission.

- The EU ETS was from the outset designed to operate in phases. Phase I, from 2005–07, was in many respects a start-up period and insulated from subsequent phases so that any major problems would not carry over into subsequent periods. Phase II, from 2008–12, coincides with the commitments of EU countries under the Kyoto Protocol and represents a cornerstone of their implementation plans. Phase III has now been defined to operate from 2013–20. The main architectural features, including abandonment of the National Allocation Plans in favor of centralized allocation, are defined in an EU Directive agreed in December 2008.

- Within each phase, allowances are fixed except for special provisions around plant closure and new entrants. For example, neither allocations nor any possible rebates are adjusted in proportion to production levels.

Despite these differences in the two systems, it is possible to draw a variety of lessons from the EU experience.

Caps have been easier to achieve than originally projected

By definition, the EU ETS delivers an emissions cap. The best indicator of how easy or difficult it is to meet the cap is found in the carbon price. Chart 3 traces the prices and volumes in the market for European Allowance Units over the past four years.[1]

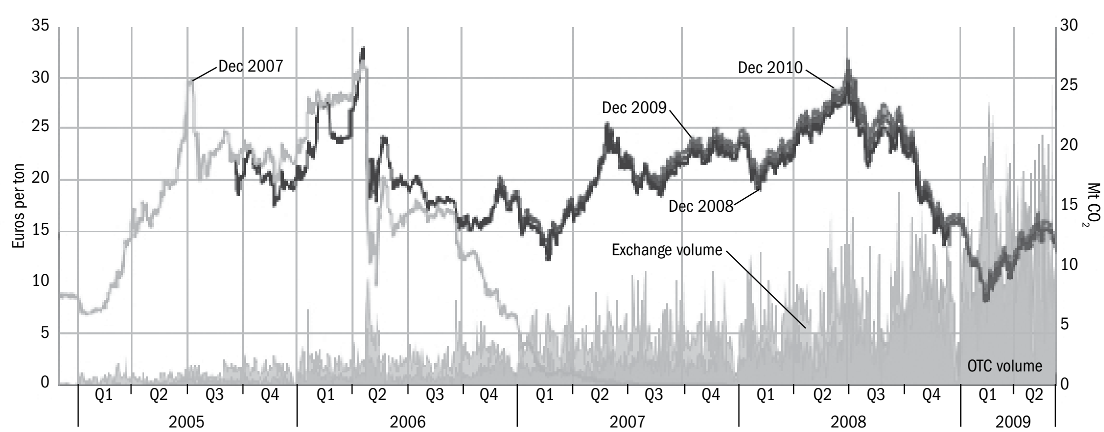
In Phase I (2005–07), carbon prices first rose on the back of rising natural gas prices, but then declined sharply after the first verification reports revealed a substantial surplus of emissions allowances. Phase I had been insulated from subsequent phases (with no banking of allowance allowed) in case of difficulties in this start-up phase. As it became more clear that Phase I was in overall surplus, the price declined toward zero.

However, there was already an active market in forward trades for Phase II (2008–12) allowances and this took over. Phase II sustained a substantial price during 2008, its first operational year, before a sharp fall during the first two months of 2009.

These patterns echo those of some other trading experiences. The U.K. had in 2002 launched a pilot emissions trading scheme, in which incentives were paid to the companies offering the most significant cutbacks; trading prices collapsed after about a year's operation as it became clear that the targets were being easily met and, indeed surpassed. The U.S. Regional Greenhouse Gas Initiative (RGGI) emissions trading program, only a couple of months into its operation, is also trading at very low price levels, reflecting a growing perception of surplus.

[1] In many of the charts, the data have been expressed in euros to maintain a constant numeraire. Otherwise, in the text, monetary amounts are expressed in U.S. dollars, converted at $1.4084 per euro (market rate as of June 26, 2009) and rounded to the nearest dollar.

Chart 3. European Allowance Units prices and volumes 2005–09



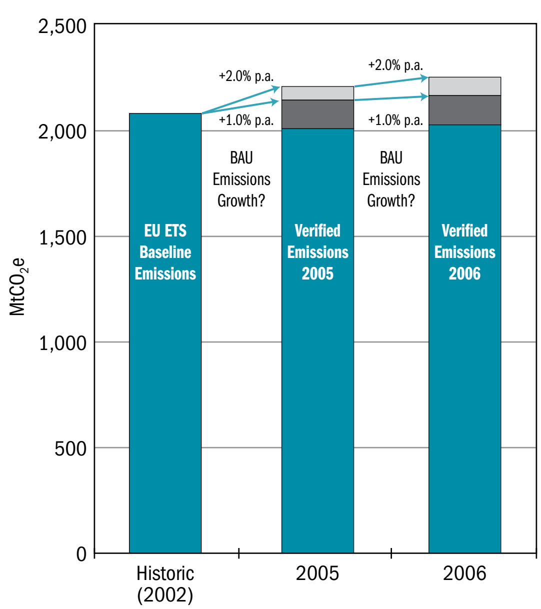
Source: Point Carbon

There has been both over-allocation and significant emissions abatement

The collapse of the U.K. ETS and EU ETS Phase I prices can be reasonably apportioned to excessive allocations combined with a greater than expected abatement in response to the price. Separating these factors requires careful study. The most detailed estimates are those in a MIT-led study by Ellerman and Buchner (2008), who used two approaches. They constructed a "counterfactual" estimate of trend emissions in the absence of the EU ETS (Chart 4), which suggests that during its first two years the EU ETS turned an expected increase of 1–2 percent per year into a small absolute decline.

As additional evidence, they also compared the aggregate surplus of allowances at country or sector levels against the distribution of surplus and shortfall among facilities.[2] Both approaches suggested that the EU ETS had achieved real emission reductions.

Chart 4. Potential emissions and the impact of the EU ETS



Source: Ellerman and Buchner (2008)

This is not surprising. It is not plausible that companies would have faced carbon prices above \$20–30 per tonne of CO_2 (tCO_2) and not acted. Another study (Delarue, Voorspools, and D'haeseleer, 2007) estimated that the EU ETS cut power sector emissions by 88 Mt and 59 Mt in the power sector during 2005 and 2006, respectively, within the range estimated by Ellerman and Buchner. There is also clear evidence of abatement from changes in cement sector operations. A reasonable overall estimate is that the EU ETS in its first two years cut emissions by 50–100 $MtCO_2$/yr, or by around 2.5–5 percent, and the most recent analysis by Ellerman and Buchner concluded that the EU ETS cut EU emissions by 120–300 $MtCO_2$ over the three years of its first phase, despite the price collapse.

Studies suggest that the EU ETS in its first two years cut emissions by 50–100 $MtCO_2$/yr, or by around 2.5–5 percent.

EU ETS prices in Phase II have halved since 2008. Again, this appears to be due to a mix of inflated projections and abatement, and other factors. The extraordinarily high energy prices up to mid 2008 drove a surge of investment in energy efficiency. Economic recession has led to further emissions cuts. Also, the supply of emissions offsets from the Clean Development Mechanism (CDM), the Kyoto Protocol's program for emission offset projects in developing countries, has been much greater than originally anticipated.[3] The U.S. RGGI market has

[2] It may be possible that a sector is overall short/long of allowances but several facilities have a surplus/shortage. If an installation/sector/country has more allowances than needed to cover its emissions, it has a surplus—it is said to be in long position. On the other hand if an installation/sector/country lacks allowances to cover its emissions, it has a shortage—it is in short position.

[3] Despite downward revisions due to performance problems and recent sharp declines in project investment, estimated project credit delivery over the Kyoto period (2008–12) is 1800 +/– 200 $MtCO_2$—the great majority of this from projects already registered and operating. See Carbon Trust (2009), *The Global Carbon Mechanisms: Evidence and Implications.*

In stark contrast to the strong industrial opposition to the EU ETS before it was launched, the evidence is that companies in all participating sectors have actually profited to date.

similarly experienced very low prices due to net oversupply of allowances and offsets.

All participating industrial sectors have profited from the EU ETS

In stark contrast to the strong industrial opposition to the EU ETS before it was launched, the evidence is that the EU ETS has increased overall profitability in all participating sectors, though impacts on individual companies may vary. This is for two reasons. One is that most sectors have surplus allowances. All except power generators have thus in principle been able to sell their allowances, with the value of these sales exceeding the cost of any abatement efforts (see Box 2).

Profits have not been derived only from excessive allocations of allowances, however. The other factor is that the full carbon costs tend to be passed through to prices anyway, particularly (but not exclusively) in competitive power markets (see Box 2).

The Waxman-Markey bill would avoid such windfall profits by giving power sector allowances to distribution companies, which then sell these to generators and have an obligation to use the revenues in part to support energy efficiency programs. This should prevent windfall profits, but the full implications of shielding consumers from the full cost of carbon in this way remains to be determined.

However, the Waxman-Markey provisions to regulate emissions upstream through oil and gas flows could have some parallels with the EU ETS experience with the power sector (and their feed-through of carbon costs to electricity consumers). The EU ETS allocated free allowances for inputs for generating electrical power; Waxman-Markey would allocate free allowances for inputs to producing gasoline and natural gas. The possible relevance of the EU experience in the power sector should be considered.

Robust institutions with a legal basis have been required to strengthen the system

The allocations for Phase II of the EU ETS (2008–12) were negotiated against the realization that there was a great deal at stake, with Phase I having shown the huge financial value of emission allowances, potentially more than €200 billion ($280 billion) in total over the five years of Phase II. Not surprisingly, governments were subject to huge lobbying pressures. Most of the National Allocation Plans (NAPs) were led by industry ministries and negotiated with energy intensive sectors before the Phase I surplus became evident in Spring 2006.

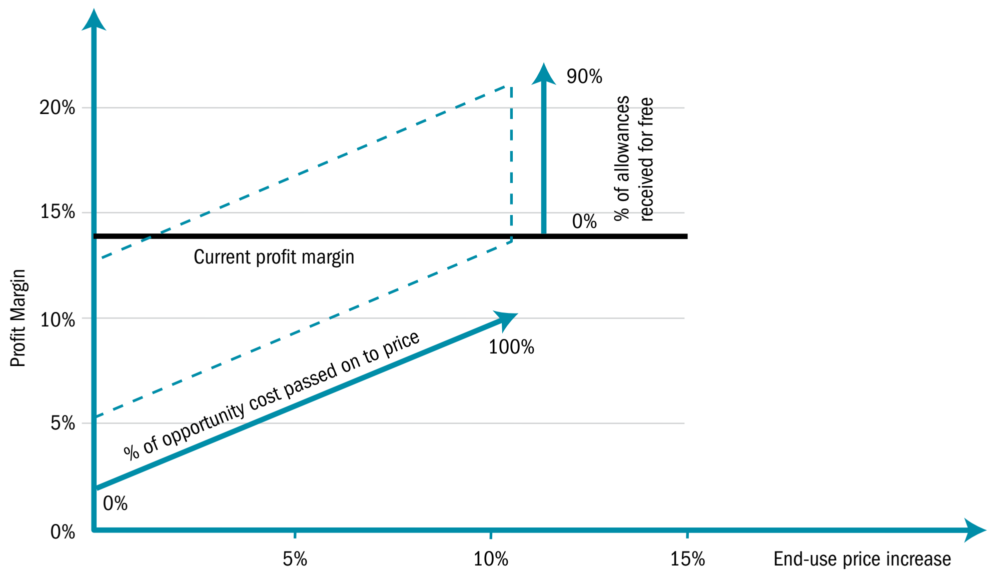
Under the terms of the EU ETS Directive, the European Commission is empowered to reject NAPs if they over-allocate allowances and are inconsistent with the Kyoto emission targets. The proposed Phase II NAPs were both inconsistent with Kyoto targets, and would also have left a precariously thin margin below business-as-usual emission projections. In November 2006, the Commission rejected most of the NAPs as inadequate. By rejecting allocation plans en masse and proposing a specific allocation formula for all member states in their place, the European Commission raised the stakes in the allocation debate enormously. This decision turned a proposed aggregate emissions increase of 5 percent from 2005 levels into a 5 percent cut. In the end, key member states backed down from threats to pursue legal actions that could have destroyed the EU ETS. In aggregate, the Commission's decisions cut total allocations in Europe by 10 percent as compared to the initial NAPs.The final allocations of emissions allowances totaled almost ten billion tonnes of CO_2 during Phase II or two billion tonnes annually.

The most recent assessments suggest that Phase II allowances will, like Phase I, be in overall surplus, and the allowance price is now sustained mainly by the prospect of banking allowances forward into the much tougher Phase III of the scheme.

BOX 2. Windfall profits and opportunity cost

Emissions trading can either increase or reduce firm profits, depending on the extent to which a sector (i) has free allocation, (ii) passes through costs to product prices, and (iii) undertakes abatement. The power sector in the EU ETS Phase 1, for example, profited considerably by passing through CO_2 prices to consumers while receiving allowances for free. This increased revenues far more than any allowance shortfall raised costs. The EU ETS experience has thus confirmed a general economic principle illustrated in Chart 5 below: companies may profit from emissions trading, to a degree that depends on the extent of free allocation (vertical axis) and how much carbon costs are passed through (horizontal axis).

Chart 5. Profit and loss as a function of free allocation and cost pass-through (profit margin and price increase correspond to steel in Europe at €30/tCO_2)



In competitive markets, profit-maximizing companies will tend to set price in relation to short-run marginal operating costs. In such markets, the cost of producing an extra unit is balanced against the value of the additional sales. Emissions trading increases this marginal cost, since companies either have to buy allowances or forego the opportunity to sell allowances, to cover the extra emissions. Providing all directly competing companies face the same incentive, they will tend to raise prices to reflect this opportunity cost. In the absence of any output-based compensation, this will tend to the full carbon price.

It is much as if energy prices rose and fed through the economy, but governments then compensated companies with cash transfers. However, irrespective of free allocation, companies will still then strive to reduce their emissions as long as the costs of doing so are lower than the market price of an emissions allowance.

A foundational report on this topic (Carbon Trust 2004), which included modelling of five industrial sectors, first predicted that most sectors would profit from the EU ETS; this has been borne out by experience. Capping carbon means that emitting it is no longer free: emitters and consumers can and should pay for it. The impact on firm profits and competitiveness will depend upon who gets the resulting economic rents, and free allocation enables business to benefit from this (Grubb and Neuhoff, 2006, explain the mechanisms further). It is estimated that power generators in Europe have profited by many billions of euros from the EU ETS, and this reality has underpinned a wholesale move to auctioning allowances to generators in Phase III of the scheme. The underlying principles however apply to any competitive market, subject to constraints of competition from countries without carbon pricing.

The sequential design of the EU ETS, as the world's first major greenhouse gas trading scheme, enabled policymakers to revise the design in light of experience.

Learning by both policymakers and businesses has been extensive and valuable and has led to major improvements in design for Phase III

The sequential design of the EU ETS was a weakness in the sense that it reduced long-term certainty for business, but it had the immense benefit that, as the world's first major greenhouse gas trading scheme, it enabled policymakers to revise the design in light of experience. Phase I proved the basic market mechanics and verification systems and enabled business to gain familiarity with emissions trading, but revealed serious problems around cap-setting, allocation, and windfall profits. Phase II toughened the cap, though again the emerging lesson is that delivering the emission reductions required now looks easier and cheaper than expected, and not just because of recession.

With a five-year Phase II, the EU has had time to take stock of a wide range of lessons learned. The redesign for Phase III includes the following:

- ***Steeper emission cutbacks—***particularly in the event of a global deal, whereby the European Union has pledged to reduce its overall emissions by 30 percent below 1990 levels. Moreover, the cap is set to continue declining at a default rate after 2020, with a review clause in 2025. European industry knows the future is decarbonizing: after the final decisions in the light of the Copenhagen conference, it will know whether the level of ambition is further toughened and by how much.
- ***Centralized allocation rules—***to avoid inconsistencies and remove the need for separate and interdependent negotiations in EU member states. Given the enormous political importance originally attached to preserving national authority in this area, the unlamented demise of national allocation plans is striking. The lesson is that in a fully integrated trading market, allocation by diverse jurisdictions is a needless and costly complication which introduces gaming and distortions. Both member states and most industries have been happy to see the back of them and to focus instead upon more consistent, EU-wide rules.
- ***A move to auctioning as the default, with no more free allowances for the power sector—*** With the temporary exception of some East European member states, power generators will have to buy all of their emissions allowances from 2013. The scale and terms of free allowances to other sectors is to be defined on the basis of criteria set in the Phase III directive, the interpretation of which is still being debated, as indicated in section 5 of this report.

In addition, the EU ETS coverage of gases and sources has been optimized to increase the scope, reduce transaction costs and minimize distortions vis-à-vis sectors outside of the program. The provisions concerning international linkages and the use of international offsets have also been refined.

3 Allocation and Incentives

Once a cap is set, policymakers must determine how the allowances are introduced into the economy. As witnessed in the EU, decisions surrounding allowance auctioning and allocation are intrinsically complex, contentious, and subject to intense lobbying pressures. Although allocation procedures under a fixed cap will not in the short run compromise the environmental impact of an emissions trading program, they do have the potential to drive up costs and create distributional inequities. Missteps in the EU have highlighted the benefits of auctions, as well as the potential pitfalls of free allocations. While full auctioning provides the most economically efficient method of distributing allowances, the need for political consensus has resulted in a different reality in both the EU and the United States.

Allocation methods need to be adapted to sector-specific characteristics

As policymakers strive to craft an effective program, they will want to minimize distributional impacts, such as windfall profits, and yet maintain incentives for improved efficiency. The EU ETS provides important lessons not only for who receives allowances, but also how they receive them. While a specific allocation method may be appropriate for one sector, it may have more adverse consequences for distribution, efficiency or incentives for innovation in another.

Allocation of emissions allowances under the EU ETS has evolved through its different phases. In Phase I, few member states differentiated between sectors at all. Power companies profited enormously as they received a large volume of allowances for free, and also by increasing the electricity prices to reflect the opportunity cost of CO_2. In Phase II, reflecting public outcry over the reaping of billions of euros of windfall profits by the generators, free allowances to power generators were cut more than other sectors. Phase III takes this to the logical conclusion of full auctioning in the power sector, and introduces a differentiation between allowances for general manufacturing and those for sectors at risk of carbon leakage (see Section 5). Further refinements to the allocation approaches for different sectors are likely over the next year, as thresholds are estimated and allocation benchmarks developed.

The Waxman-Markey bill attempts to craft rules for the allocation and use of free allowances that would avoid some of the outcomes experienced in the EU. Specifically:

- For the power sector, allowances would be given to distribution companies rather than generators and strict regulatory oversight would ensure that the value of the free allowances is passed through to consumers, preventing price increases, rather than pocketed by businesses. Ideally, this will avoid the windfall profits experienced in Europe's competitive power markets.
- Output-based formulas for allocation to merchant coal plants and energy intensive industries would vary the number of allowances a regulated entity receives in line with changes in production. This reduces the risk of windfall profits, whether through price effects or through over-allocation.

However, while U.S. policymakers have tried to avoid the windfall profits experienced in the EU, the output-based approach to allocating allowances creates other problems. It is pro-cyclical (more allowances during boom years, less when times are hard) in contrast to the counter-cyclical feature of fixed allocations. In addition, it exacerbates efficiency problems discussed below. The EU consciously and consistently avoided both output-based allocation, and regulating the pass-through of the allowance value to consumers in power generation, for fear that these would undermine

While a specific allocation method may be appropriate for one sector, it may have more adverse consequences for distribution, efficiency or incentives for innovation in another.

Losing such opportunities for low cost abatement and incentives for innovation will increase the overall cost of the program.

both the environmental objective and the economic efficiency of the system.

The Waxman-Markey bill's allocations to both the power sector and manufacturers are intended to moderate price increases on consumers. However, these electricity price increases help drive consumers to conserve energy and other lower-emitting investments. The legislation asks that the allowance value be used to reduce the fixed-cost portion of utility bills, rather than the cost per kWh, but many consumers may not recognize this distinction in their energy bills. Similarly, allocations to energy-intensive manufacturers are intended to keep their prices from rising, which discourages substitution toward imports but also deters alternative products that may be less carbon intensive. Losing such opportunities for low-cost abatement and incentives for innovation will increase the overall cost of the program. Policymakers must be aware of the nature and scale of these distortions as they balance this risk with other political concerns.

Efficiency matters and perverse incentives are possible

Tackling climate change is a profound, broad-ranging and long-term challenge. While macroeconomic costs may be modest in the short and medium term, there are still hundreds of billions of dollars at stake, and deep reductions will require radical changes and innovative solutions. Inducing such change at least cost to the overall economy requires carefully designed and consistent policies. This is important as the design of policies, if not aligned with economic efficiency, can also raise the cost of carbon controls and undermine incentives to innovate, and thereby also make deep cuts more difficult over time.

In simple economic theory, allocation methodology—whether the allowances are auctioned or distributed free through grandfathering (based on some historic measure) or otherwise—should not affect the economic efficiency of an emissions trading scheme (Montgomery, 1972). Even if firms receive free allowances, they still have an incentive to cut emissions because any unused allowances can be sold on the market for a profit, so the price of carbon is still internalized in operational and investment decisions. With evidence from the U.S. SO_2 and NO_x trading schemes providing support for this theory, free allocation seemed to offer an attractive solution for addressing industry concerns about the potential costs of regulating greenhouse gas emissions.

Although this theory may hold well for small programs focused on local pollutants, it does not recognize the additional challenges posed by regulating GHGs. First, with fossil fuels endemic in all economies, the national value of emission allowances are orders of magnitude larger than seen in conventional pollutant markets, representing a significant opportunity for revenues that could displace other burdensome taxes—charging "bads" instead of "goods." Second, GHGs are global pollutants, and in the absence of globally comparable carbon pricing, carbon leakage to unregulated sectors and countries can limit the effectiveness of a cap. Thus, in the debates over carbon regulation, other forms of free allocation, namely benchmarking based on output or capacity and tailored by sectors, have been added to the policy mix.

Moreover, the EU debate highlighted that, in practice, there are many ways for free allocations to distort the market, making emission reductions more expensive for society overall. Grandfathered allocations offer windfalls, exacerbate public finance challenges, and since they do not affect variable production costs, they may not avoid carbon leakage or mitigate consumer burdens. On the other hand, any method in which allowance allocation depends upon factors under a firm's ongoing control carries a risk of perverse incentives. The political unacceptability of plants closing so as to cash in their allowances is matched by the drawback that withdrawing allowances for facilities that close (or cut production) provides a perverse incentive for them to continue operating and emitting. Giving free allowances to carbon-intensive new facilities may remove the incentive for low-carbon investments instead. Even for existing facilities, free allowances may distort their incentives, particularly if they expect to receive future allowances in proportion to their emissions or output.

Thus, inherent in free allocation is a risk of perverse incentives, summarized in terms of a pyramid of inefficiencies in Table 1. Auctioning, in which all actors face the full cost of carbon, offers the purest incentives. Grandfathering free allowances based on historic capacity (including closure and new entrant rules) may distort closure and investment choices, but not operational decisions. However, if allowances are "updated" to reflect production or emissions, this starts to take the carbon price incentive out of operational decisions.

Benchmarking can retain incentives for firms to invest in energy efficiency measures, but is complex

If the level of grandfathered allocation is linked to the capacity of a plant, multiplied by a benchmark factor (such as a standard emissions per unit of power generated or best available technology), plants have an incentive to improving carbon efficiency. This is in contrast to grandfathering that is linked to the plant's technology, emissions

Table 1. Pyramid of inefficiencies from free allowance allocation

	Impacts on	Increase plant operation		More expenditure on extending plant life relative to new build		Less Energy efficiency investments and demand substitution	
Allocation Method	Distortions	Bias toward dirtier plants	Encourages operation	Discourage plant closure	Bias toward dirtier plants	Reduces incentives for consumers	Reduces incentives for producers
Auction							
Grandfathering with Benchmarking	Capacity only			X			
	Capacity by fuel/ plant type			X	X		
Grandfathering with updating from previous periods	Output only		X	Y		X	
	Output by fuel/plant type*	X	X	X	X	X	
	Emissions	X	X	X	X	X	X
Output-based * (undifferentiated) allocation or rebates	Final product		X	X		XX	
	Intermediate product (e.g. clinker)		X	X		XX	XX

Source: Adapted from Neuhoff (2008)

* Output-based allocation, which varies allocations or rebates in proportion to sector output, reduces risk or scale of windfall profits.

Notes: X indicates a direct distortion arising from the allocation rule.

XX indicates magnified distortions.

Y indicates indirect distortions if allocation is not purely proportional to output/emissions.

Efforts to avert windfall profits risk solving one problem at the expense of creating another– reduced economic efficiency.

or production. In the power sector, the fact that all power stations produce the same product (electricity) makes it easy in theory to make such allocations efficiently, if all generators receive the same benchmarked allocation. Several EU member states used benchmarking for power sector allocation in Phase II of the EU ETS.

However, benchmarks in manufacturing can become much more complex, given the wide range of products and production processes. Complexity and distortions increase when recent data is taken into account to give a moving baseline, and rules are narrowly differentiated by fuel or technology type for older plants to protect the value of existing assets.[4] This starts to remove the flexibility offered by a market-based instrument and undermine dynamic incentives for technological innovation. Despite aspirations, few member states succeeded in introducing benchmarks during Phase II, and the EU is currently locked in intense and complex debate over how to benchmark allocations in Phase III.

Free allocation based on outputs poses different issues.

Different issues arise if free allocation is based on output (e.g. a tonne of cement), or equivalent rebates are given, as proposed in the Waxman-Markey bill. The firm still faces incentives to improve the carbon efficiency of the plant by making energy efficiency improvements to existing plants. Providing the rebates are "benchmarked" to sector average, there is still incentive to shift production from older toward newer more efficient plants and less carbon-intensive energy sources, but it still obscures incentives downstream of the product concerned. Since higher production is rewarded with more free allowances, output-based allocation provides no added incentive to adjust production or consumption decisions to reflect the cost of carbon. By foregoing these conservation or substitution opportunities, output-based allocation directly reduces economic efficiency, increasing the overall cost of meeting carbon reduction goals.

Interestingly, these inefficiencies have become the primary selling points for output-based allocations. Suppressing carbon costs can be politically attractive. In addition, since industry doesn't have any incentive to reflect the cost of carbon in its products, this ameliorates impacts relative to less carbon intensive substitutes or foreign producers. The desire to protect politically important industries from reductions in output, and the role of output-based allocations in doing so, are explored further in Sections 4 and 5.

The unavoidable tradeoff points to a bigger role for auctioning

Of all the lessons learned from the EU ETS, the risk of windfall profits has been most widely recognized in the United States. The resulting efforts to avert windfall profits, however, risk solving one problem at the expense of creating another– reduced economic efficiency. If sustained, this risks increasing long-term costs for everyone. The scale of the distortions remains a subject of debate, and can only be assessed with models that reasonably represent both production processes and the potential for consumers to substitute one product for another.

The underlying lesson from the EU is not that allocations must be based on output to avoid windfall profits (which can also be addressed by removing free allocation). Rather it is that free allocation in general can carry a real cost, either

[4] The different allocation decisions that emerged in across EU Member States in the first two phases of the EU ETS suggest that definition and scope of benchmarks are driven by the political power of incumbent firms as much as by economic rationale.

in terms of reduced efficiency or distributional fairness (or both).

Consequently, there is an underlying economic rationale to maximize the role of auctioning as a default to create a robust, fair, and transparent market framework. Auctioning ensures price signals remain intact to facilitate efficient corporate and private decisions on consumption, innovation, and low-carbon investment. It also provides revenues that could be used for public goals. Some may be directly related to climate policy, such as low-carbon technology development, to help compensate consumers as carbon costs start to be reflected in product prices, or for international expenditures to help poor countries adapt and alleviate the damage inflicted as a result of climate change. But more generally, using revenues to improve the overall efficiency of the economy by reducing tax burdens while spurring education, investment, and innovation can minimize the net economic effects of carbon regulation.

Although regional disparities and transitional and competitiveness concerns make it unlikely that 100 percent auctioning will be politically feasible in the early years of the program, policymakers should be aware of the risks that free allocations pose and ensure a good understanding of the conditions under which they may be appropriate. The interesting innovation in the Waxman-Markey bill is to allocate a large share of allowances to entities that are not direct emitters (such as the distribution companies). In effect, outside the energy-intensive industries, many of the allowances allocated for free by the government still have to be paid for by those who have to surrender allowances. This should help to preserve the incentive effects, providing the revenues are not directly rebated back to the emitters.

Once carbon is recognized as a cost that should be internalized, there are only two sound economic reasons for considering free allocation or equivalent direct rebates to producers. One is to compensate incumbents that invested in plants before climate change was an issue, in cases where stranded assets arising from changing circumstances might be a legitimate concern. Another is if other factors, notably foreign competition, might undermine the ability of companies to pass through carbon costs.

Consequently, there is an underlying economic rationale to maximize the role of auctioning as a default to create a robust, fair, and transparent market framework.

4 Competitiveness: Who's at Risk?

Cost differentials due to labor and other input costs for most sectors far outweigh any international differences in the cost of carbon.

Macro-level GDP impacts are modest

Stringent targets and carbon prices drive concerns about the possible impacts on the competitiveness of domestic industries. Several studies have now examined this issue in Europe and the United States. This leads to a clear understanding that the major economic issues for the emission reductions being considered over the next decade or so concern a limited number of specific sectors, rather than the wider national economy.

Specifically, the European Commission (2008) estimates that the EU ETS caps to 2020 might cost 0.3–0.7 percent of GDP, the equivalent of a few months of economic growth deferred. Moreover, if auction revenue is used effectively to reduce distorting taxes and fund low-carbon investments (for example), the cost impact on the economy can be moderated further or potentially create positive economic impact.

Numerous other factors have a bigger impact than carbon prices. Even at a sector level, cost differentials due to labor and other input costs for most sectors far outweigh any international differences in the cost of carbon. The cost uncertainty induced by emissions trading is also less than that, for example, due to energy cost and exchange-rate fluctuations. Numerical analysis is key to bring a sense of proportion in the debate, and therefore also to an assessment of solutions.

There are wide variations in impacts across specific sectors

The competitiveness concerns arise because industrial greenhouse gas emissions are heavily concentrated in a few primary resource–based sectors. Thus, only a very few industries stand out for their potential cost exposure. Chart 6 illustrates this by ranking U.S. manufacturing activities in terms of the potential impact of carbon costs, in the absence of any free allocation, relative to the economic value added of each activity—roughly, its contribution to GDP. (The Appendix compares this to equivalent analysis conducted for U.K. and Germany.)

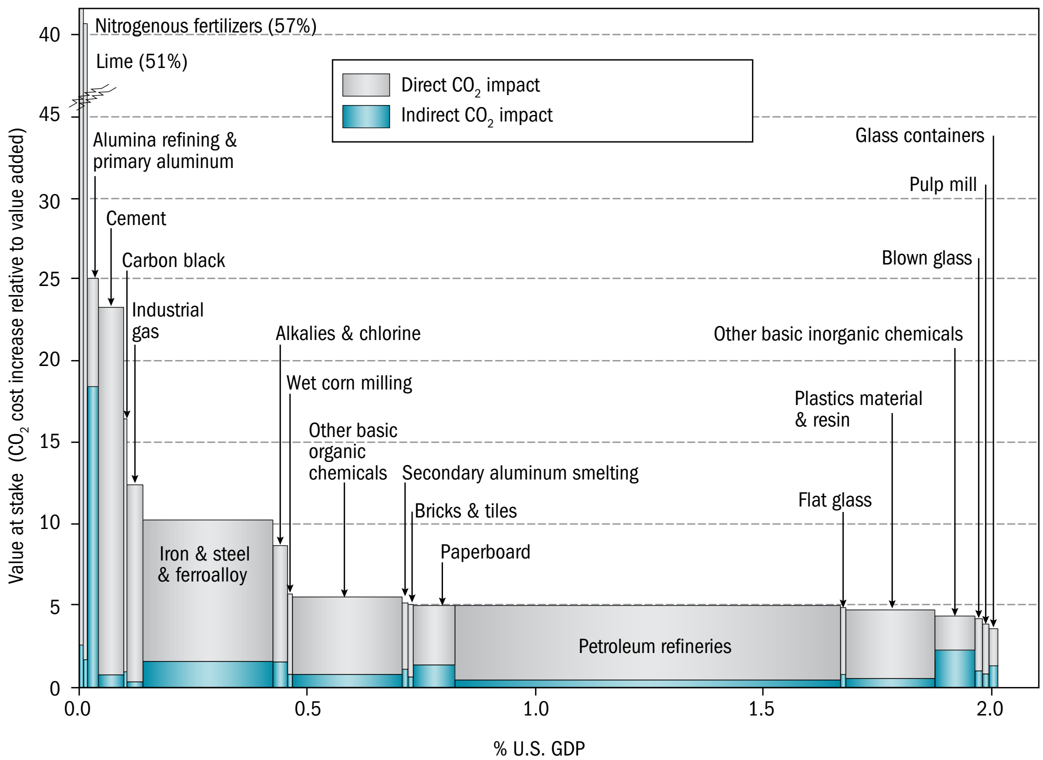
There are differences between countries in terms of ranking, but in general the most cost-affected activities are consistent across the various country studies. The competitiveness impact in turn depends on the degree of exposure to foreign production that can be readily traded. Based on these combinations of factors, the Carbon Trust (2008a) identified six main sectors as being either significantly or plausibly of concern in the island, trade-intensive U.K. economy:

- Iron and steel
- Aluminum
- Nitrogen fertilizers
- Cement and lime
- Basic inorganic chemicals (principally chlorine and alkalines)
- Pulp and paper

In both the U.S. and U.K. studies, these sectors account for less than 0.5 percent of GDP together. The shares are slightly higher in Germany, but still well below one percent of GDP. For the most sensitive sectors, each \$20/tCO_2 in carbon prices they pay could increase production costs by more than 10 percent of their value-added.

Beyond these sectors, a significant GDP contribution generally comes from refining and other petrochemical activities, particularly in the United States. However, not only is the relative cost impact lower for these activities, but also the trade issues are complex. A cost of \$20/tCO_2 imposed on refinery emissions is small compared to fluctuations in crude oil prices and compared to international differences in tax structures. Other factors may constrain international trade in refined products. The Carbon Trust (2008a) study placed refining in a second tier,

Chart 6. Relative cost-sensitivity of U.S. manufacturing activities to CO_2 pricing (6 digit NACE sectors)



Source: Data from Houser, Trevor, Heilmayr, Robert and Werksman, Jacob, Peterson Institute for International Economics and World Resources Institute, forthcoming.

Notes: The vertical axis shows the implied cost increase if sectors pay the full cost of CO_2 at \$20/tCO_2 as a percentage of the sector value added. The horizontal axis indicates the scale of the activity's contribution to U.S. GDP. The area of each column is proportional to total CO_2 emissions. The blue bars show the cost of carbon that would be paid through higher electricity prices (the majority of CO_2 costs are passed through by the electricity companies, which would be largely avoided under the Waxman-Markey proposals). The gray bars show the direct cost due to the carbon emitted through direct fossil fuel consumption and manufacturing processes.

concluding that some refineries could be exposed at higher carbon prices, along with a range of activities like glass, tires, and some other chemical processes.

The corresponding increase in product price to cover this cost varies according to the cost structure of the industry and the degree of free allocation, but only in exceptional cases exceeds one percent for each \$10/tCO_2. (See Table 2 for data on key sectors from the U.K. studies.)

Even small shifts overseas are politically sensitive, and all the more so if they are associated with carbon leakage and thus undermine the environmental benefits of the cap and trade program.

Table 2. Impact of a €20/tCO_2 carbon price on major U.K. energy-intensive products

	Maximum value at stake at €20/tCO_2	Minimum value at stake at €20/tCO_2	Trade intensity (non-EU)	Employment	Implied average product price rise to offset €20/tCO_2	
Manufacturing Activity	**0% free allocation**	**100% free allocation**	**%**	**% UK**	**0% free allocation**	**100% free allocation**
Cement	33.9%	2.0%	1.8%	0.02%	14.54%	0.86%
Basic iron & steel and ferro-alloys	26.4%	2.4%	17.4%	0.08%	4.28%	0.39%
Refined petroleum products	12.3%	1.4%	19.3%	0.04%	1.07%	0.12%
Fertilizers & nitrogen compounds inc. ammonia	11.6%	5.7%	13.2%	0.01%	1.96%	0.96%
Aluminum	10.4%	9.3%	23.2%	0.04%	2.07%	1.85%
Other inorganic basic chemicals	9.0%	5.8%	20.6%	0.02%	2.36%	1.52%
Pulp, paper & paperboard	8.8%	3.4%	15.1%	0.06%	1.98%	0.76%

Source: Carbon Trust (2008), EU ETS Impacts on Profitability and Trade, Table 2.

International trade effects are immaterial for most sectors

Except in a few cases, therefore, carbon cost impacts will have very little impact on international trade. Carbon costs for other activities would be very small compared to differences in international labor, energy, and other input costs. The euro-to-dollar exchange rate, for example, appreciated by more than 50 percent between 2001 and 2006, with a much bigger impact on costs for most sectors than would be created by projected carbon prices to 2020.

For the identified key activities, the impacts of emissions trading are complex, and not always negative. As described in Section 2, the net effect of the carbon cost impact depends upon the extent to which a sector (i) has free allocation, (ii) passes through costs to product prices, and (iii) undertakes abatement. Sectors with substantial free allocation have incentives to profit in the short term by passing through carbon costs, but the more they add these costs to their product prices, the more they risk losing market share to foreign competition. Profits and competitiveness are not synonymous. They can be opposites, if higher product prices generate profits from free allocation but attract imports.

In most sectors, multiple impediments to greater trade mean that some carbon costs may be passed through. For example, the cost of producing industrial gases is sensitive to carbon prices, but transport cost and safety considerations impede import substitution. Flat glass is similarly not cheap to transport. A given company may produce specialized products not matched by foreign competition or have local networks that favor local production. The availability or composition of local raw materials is also an important driver for production and trade patterns (e.g. scrap metal for electric arc furnace steel and barley for malt).

Evidence of impacts to date is nebulous

It is still early to evaluate directly the impact of the EU ETS, but the evidence base is enriched by the fact that several EU countries sought to impose carbon taxes much earlier. World Bank (2008) analysis examined the evidence and concluded that cement is the only sector for which the data suggests any loss of EU production due to carbon controls. Indeed, the World Bank analysis concluded that most other industrial sectors had increased output in regions that had imposed a carbon cost, probably due to over-compensation of these sectors through free allocation or other means. This would correspond to the pattern of over-allocation to most sectors in the EU ETS to date.

However, the scale of costs for the six key sectors suggest that there could be some impact on trade, with consequent carbon leakage, as the systems toughen up. Modeling impacts on EU production in the two biggest sectors, cement and steel, suggests that the overall leakage of EU emissions is unlikely to be bigger than one percent, but could be significantly higher in these sectors (Carbon Trust 2008a). An equivalent analysis of the United States that has been recently published (Aldy and Pizer, 2009) reaches similar conclusions:

> "…pricing CO_2 at \$15/tCO_2 would lead to an average production decline of 1.3 percent across U.S. manufacturing, but also a 0.6 percent decline in consumption. This suggests only a 0.7 percent shift in production overseas. There is no statistically discernible effect on employment for the manufacturing sector as a whole … industries with energy costs exceeding 10 percent of shipment value would expect output declines of about four percent and consumption declines of three percent, suggesting a one percent shift overseas."

However, even small shifts overseas are politically sensitive, and all the more so if they are associated with carbon leakage and thus undermine the environmental benefits of the cap-and-trade program. This fuels debate about the options for addressing trade and leakage effects, considered in the next section.

5 Options and Prospects for Tackling Carbon Leakage

Many solutions have been proposed to address competitiveness concerns. Where potentially significantly impacts are identified, these need to be considered. However, it is useful to note that, in fact, there are only three fundamental options. In the limited number of sectors for which a problem is identified, logically, every option falls into one of these three categories. Policy can (1) try to take out the net carbon costs from domestic production; (2) add similar carbon costs to production of equivalent goods globally; (3) or deal with the differential at the border.

There are only three fundamental options to address competitiveness concerns.

Leveling up is the best option in principle

An important aim of climate policy internationally should be to move toward "leveling up," that is, a world in which all major producing regions impose a cost of carbon on economic activities, particularly goods for international export. This would create a global incentive for low carbon innovation while addressing concerns about competitiveness. However, this is not practical at present. Politically, the industrialized world has yet to deliver adequately upon its promise to lead global efforts—and could in principle benefit by providing incentives to its industries to innovate in decarbonizing first. Moreover, many developing countries do not yet have the institutional infrastructure to deliver carbon pricing. A world that waits for all to move at the same speed, is a world that will never solve the climate problem.

Thus, unless industrialized countries are willing to ignore issues of competitiveness and leakage, then the other two approaches (leveling costs down, or dealing with cost differentials at the border) need to be considered, at least for a transitional period.

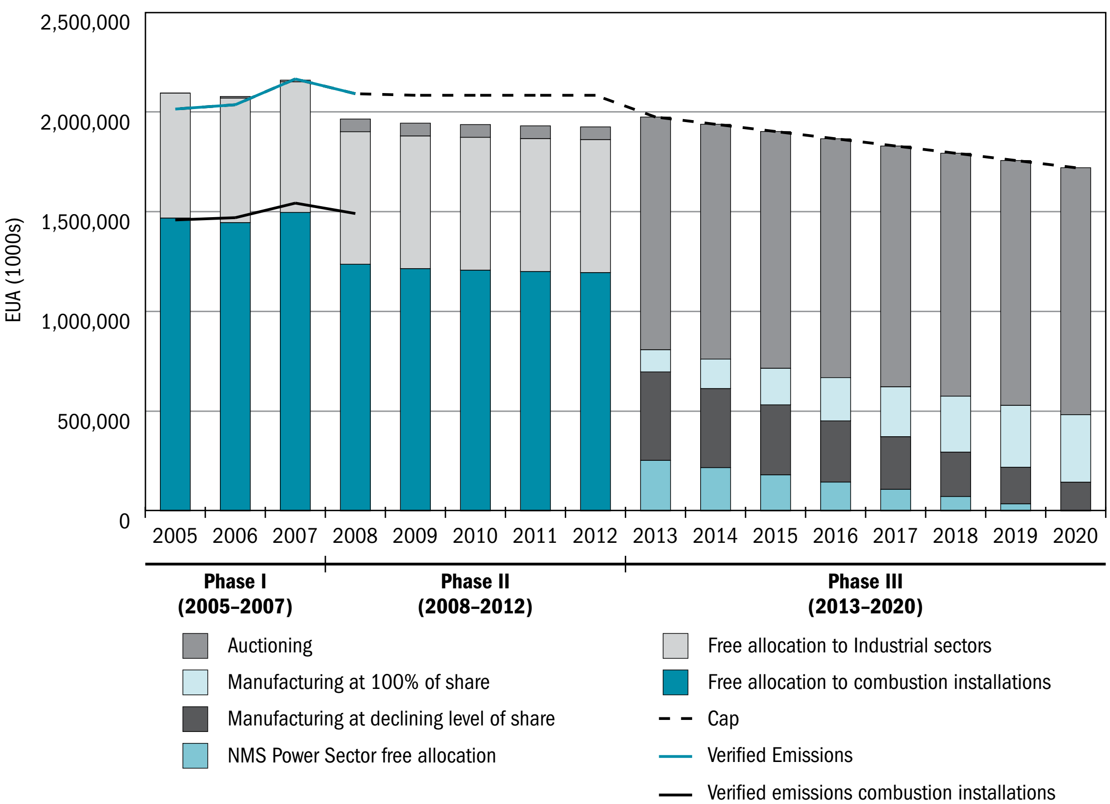
Free allocation has been the default option in the EU, but it is being drastically reduced in Phase III of the ETS

The default approach in the EU to date has been defined by free allocation. In Phase I for most sectors, and Phase II for manufacturing, this was the default mode. Most manufacturing sectors received free allocations close to projected needs (which in practice frequently turned out to be excessive, as outlined) and this was assumed to be sufficient to deal with leakage concerns. However, industry pointed out that the risk of future carbon costs could still deter investment, and economists increasingly pinpointed the limitations and drawbacks of free allocation, as outlined in Section 3. This research (e.g. Grubb and Neuhoff 2006) helped to increase the level of auctioning in Phase II, and influenced major reforms for Phase III.

A fundamental change in Phase III was a reversal of the underlying allocation philosophy. It was acknowledged that the ideal form is auctioning, to ensure that all participants face a full carbon cost without distortion, and that from a pure economic perspective there are only two grounds for avoiding this: transitional costs, particularly associated with sunk investments; and (potentially) carbon leakage. The directive for Phase III, from 2013, represents a radical departure, as illustrated in Chart 7. Within this, there are significant variations in treatment across industry sectors:

- ***Power generation*** moves to full auctioning as the default, though the new member states of Eastern Europe have a degree of declining opt-out derogations (they are unlikely to use this to the extent illustrated as the implications for continuing windfall profits become clearer).

Chart 7. Allocation and emission in the EU ETS



There are no direct measures to protect consumers (domestic or industrial) from the impact on power prices, which are considered to be part of an appropriate strategy for carbon prices to flow through the economy. However, where electricity-intensive consuming industries can demonstrate a risk of adverse impacts, they may be considered for direct support to offset carbon costs, subject to scrutiny under the EU's procedures for limiting state aid.

- ***Manufacturing*** industry, in contrast, receives some free allocation, defined as a share of the declining cap based on 2005–07 emission levels. The default for manufacturing industry starts with them in 2013 receiving 80 percent of that historical share for free, declining to 30 percent by 2020. This allows for some declining transitional relief in manufacturing sectors.

- ***Sectors*** classified as being at significant risk of carbon leakage may receive 100 percent of their historical share of the declining cap. Chart 7 illustrates the impact on overall free allocation depending on the coverage of this provision.

The net effect is a big reduction in the overall volume of free allowances, marking the reversal of the allocation philosophy: the EU ETS will auction

Leveling down costs is either ineffective at tackling carbon leakage, if it is not aligned with production and investment decisions, or it starts to negate more of the incentives to decarbonize along the economic system.

60 percent its allowances from 2013, rising to 70–85 percent auctioning by 2020. A key outstanding question is the classification of sectors at risk of leakage, based on how thresholds in the directive are interpreted.[5]

However, a fair comparison with the Waxman-Markey bill is complicated by the latter's proposal to distribute many allowances to non-emitters.

But free allocation may not solve the leakage problem, or may do so at a high cost

The fact that the EU system involves absolute allocations (without output-based compensation) has important implications for the effectiveness of free allocations in tackling carbon leakage. Withdrawal of allowances if a plant is closed deters plant closure. The availability of free allowances for new entrants, new investments, helps to take the carbon cost out of investment decisions. But since the amount a company receives will not vary with its production decisions from existing or planned plant, a company could get free allowances and still choose to reduce production in favour of imports, selling its surplus allowances. This differs from the output-based rebates of the Waxman-Markey bill.

[5] The Directive establishes thresholds based on both carbon costs, and trade intensity. Many small sectors may be classified as being "at risk" based purely on their trade intensity, but manufacturing emissions are dominated by the few carbon-intensive sectors of cement and lime, iron and steel, and refining. The treatment of these sectors by 2020 will have a strong bearing on the overall degree of free allocation to European manufacturing, and the initial classification will depend in part upon whether the carbon cost threshold takes account of the fact that manufacturing sectors would anyway start with 80 percent free allocation in 2013. On this approach they would only be assessed as being "at risk of carbon leakage" once their level of free allocation had declined to a point at which real costs took them above the threshold. This offers more time to work out solutions and appears to be the logical and consistent interpretation, but this has yet to be confirmed (Neuhoff 2009).

This underlines the fundamental dilemma. To tackle carbon leakage by leveling costs down, the free allocations or rebates must be linked to the activities the policy is trying to keep at home. But the more completely the compensation is aligned in this way, the greater the loss of the carbon price signal, and hence the lower the efficiency overall. There is no way out of the conundrum: leveling down costs is either ineffective at tackling carbon leakage, if it is not aligned with production and investment decisions, or it starts to negate more of the incentives to decarbonize along the economic system. Cement provides an extreme and problematic illustration of this (see Box 3). This is a general fact, and no amount of playing around with different ways of compensating for carbon costs changes that fundamental reality.

Unilateral border adjustment measures are problematic and potentially counterproductive

Discussion of border adjustments in Europe has been accompanied by extreme nervousness about their potential political impact, both on the world trade system and on the international climate negotiations. The issue was greatly down played in the negotiation of the EU ETS Phase III in favor of free allocation to exposed sectors (though a clause in the EU Directive could provide a basis for enacting border adjustments in the future). However, recognizing the imperfections of free allocation as a solution, the French government in particular has raised the issue again, particularly as a way of protecting the integrity of an international environmental treaty. Border measures could thus be on the EU agenda if the EU ETS Phase III is to be toughened up in the light of a Copenhagen agreement in late 2009.

The underlying problem is that the prime objective of border adjustments, as a way of tackling concerns about industrial migration, potentially conflict with the fundamental principle of non-

BOX 3. Cement: A chunky problem

Cement production in the EU emits about as much CO_2 as steel, and much more than international aviation. It has received relatively little attention, but it poses a thorny problem for CO_2 control that illustrates key dilemmas in policy design.

Cement is a relatively simple product involving a few key steps. The basic process bakes limestone in a kiln to produce nodules called clinker; the combination of raw fuel and CO_2 driven off from the limestone accounts for most of the CO_2. The clinker is then crushed and blended to produce cement.

Studies with U.K. and German data find that carbon costs have a higher impact on U.K. cement costs, relative to value added, than for almost any other activity (Climate Strategies 2008; see Appendix). Cement is not cheap to transport overland, but it can be shipped in bulk, and carbon costs of $20/t$CO_2$ would create differentials sufficient to start overcoming international transport costs.

The impact of CO_2 controls on cement may be corresponding diverse. Current European proposals to classify cement as a sector at risk of carbon leakage, correspondingly granted 100 percent of its potential share of the EU cap, would probably result in large windfall profits to inland producers protected by overland transport costs. Yet at the same time, coastal producers could choose to reduce output from cement plants, import cement instead, and cash in their allowances. The result would be windfall profits combined with carbon leakage.

The Waxman-Markey bill proposals for output-based compensation are intended in principle to address problems of both windfall profits and carbon leakage. Unfortunately the fact that most of the CO_2 comes from production of clinker, as an intermediate input, risks making this ineffective. Cement producers could produce cement so as to claim their compensation, but if they are near ports, they could still displace domestic clinker production by imports and sell the resulting surplus allowances, again combining windfall profits with carbon leakage.

Changing the provisions to compensate on the basis of clinker production would solve this, but exacerbate the efficiency losses further. After power production, the cement sector has been the biggest source of emission reductions in Europe, largely because operators have found ways to produce cement with less clinker input. Radical innovations that would cut out the need for clinker entirely, including using some of the waste products from steel mills, and wholly new chemical processes, are at the pilot stage. Compensating clinker production would undermine all these potential sources of emission reductions. This is an extreme form of the underlying principle that output-based compensation negates incentives to use the product efficiently.

Practical options for the cement sector will be discussed in a forthcoming Carbon Trust report (Tackling Carbon Leakage, September 2009).

discrimination, which is at the core of the World Trade Organization (WTO) and many other international trade and investment agreements, seeking to minimize impediments to free global trade. Moreover, decades of experience have led developing countries to be suspicious of many trade-related measures by developed countries, measures which have frequently been either motivated by, or distorted into, protectionism as a result of domestic lobbying pressures.

There is a crucial difference between pursuing border adjustments unilaterally, by regions seeking to protect their industries, or though multilateral engagement.

The concern is frequently presented as a legal one, namely that border adjustments for climate change purposes would conflict with GATT provisions overseen by the WTO. In practice, this is not clear-cut. Trade law is complex and the principles and commitments of some sections are set against other clauses that can be used to justify exceptions and exemptions. Like domestic law, interpretation ultimately comes back to processes, in this case WTO Appellate Panels, to make rulings in case of disputes. The balance of judgement would depend in large part on a combination of how measures were designed (to maximize compatibility with WTO rules), the practical consequences, and related judgements about the motivations.

Border adjustments may take different forms

Different types of border adjustment by carbon-capped regions

There are several different types of cost adjustment measures that can be used. These different approaches have different characteristics in terms of their likely effectiveness and WTO-compatibility. The broad overall conclusion is that there are ways to design border adjustments that could be plausibly argued as WTO-compatible. Crucial features would be that they be non-discriminatory, be targeted to protect the environmental objective, and consequently focus on allowances not tariffs (Climate Strategies: Dröge et al, 2009). However, if pursued unilaterally, this still may not preclude the likelihood of political challenge and the consequent invocation of dispute-settlement procedures.

A crucial and often overlooked point about border measures is their interaction with free allocation decisions

Border adjustments could only be plausibly defended if they compensate for actual costs incurred. To give companies free allocation, and then levy border adjustments, would appear indefensible in terms of WTO principles. Thus, if cement production receives free allocation, whether absolute or output-based compensation, border cost adjustments could not be used to deter clinker imports.

Use of export adjustments by exporting regions

It would also be possible in principle for developing countries to agree to add carbon costs to their exports through an export border measure. Indeed China and some other developing countries have made VAT adjustments, and levied taxes on exports of energy-intensive goods, at various times for various reasons. Such charges are entirely compatible with WTO. However, the obstacles to relying on this for tackling carbon leakage concerns are formidable. Moreover, this would not address the impact of domestic carbon costs on exports from industrialized countries to developing countries.

Unilateral versus multilateral

There is a crucial difference between pursuing border adjustments unilaterally, by regions seeking to protect their industries, or though multilateral engagement. A key recommendation of a Climate Strategies report on "Tackling Carbon Leakage" is that border adjustments should be pursued in the context of a multilateral approach that would define the boundaries on acceptable border adjustments. This has greater potential benefits, and far less risk of challenge under the WTO. The recent French proposal places the full emphasis upon a multilateral approach. Obviously, however, this is more complex and could take a number of years.

Comparative approaches

Finally, the approach to border adjustments may well be linked to the approach taken by the EU and United States, respectively, to compensation:

- Because free allocation (as per the EU ETS) may not actually eliminate competitiveness impacts and carbon leakage in some sectors, and can (if allocation is moderately generous) generate windfall profits, it creates some pressures to find other solutions. However the extent of either problem may be quite sector-specific, as it depends on the capital, operating, and market structure characteristics of the sector. The pressure in the EU may thus incline toward sector-specific consideration of the case for border adjustments, linked to its processes for identifying sectors-at-risk under the Phase III directive.

- Output-based rebates, as per the Waxman-Markey bill, are less prone to generate windfall profits and will reduce competitiveness impacts as long as free allocations or rebates are high enough. However, they erode incentives for downstream product substitution and radical innovation. These problems get more serious over time as "quick wins" in production efficiency are used up, and incentives for product substitution and broad innovation become more important. These problems will tend to accumulate across the board of an output-based approach, which can only be a temporary fix if the system is to achieve its long-term objectives. Consequently, the pressure under the Waxman-Markey approach would drive toward more broad-based border adjustments.

The challenges of developing good solutions where there are competitiveness and carbon leakage concerns are formidable and strong U.S.-EU cooperation would be highly desirable. Fortunately, the scale of adverse competitiveness or leakage impacts are clearly limited, by sector and time, in ways that should make the challenge manageable.

The scale of adverse competitiveness or leakage impacts are clearly limited, by sector and time, in ways that should make the challenge manageable.

6 Insights and Recommendations

As set out in the Executive Summary:

1. **Emissions trading works**

   Recommendation: Develop an emissions trading system that learns from and improves upon the EU experience.

2. **Everyone will learn**

   Recommendation: Build in a capacity to strengthen the system if and as experience supports this.

3. **Prices can be volatile and impacted by numerous unforeseen factors, which to date have reduced prices below expectations**

   Recommendation: Consider carefully the lessons from the EU experience on price volatility, around unavoidable uncertainties in emission projections, the contribution of other policies, and systematic tendencies to underestimate the abatement and innovation responses.

4. **GDP impacts are small**

   Recommendation: Don't let concerns about macroeconomic impacts dictate the environmental targets, Economic impacts have been consistently less than projected.

5. **Industry can profit**

   Recommendation: Resist inevitable pressures from industry to maximize free allocation, but engage companies more constructively in designing and understanding the full implications of the system.

6. **International competitiveness impacts are limited to a small number of industry sectors**

   Recommendation: Concerns about competitiveness impacts should focus on a few potentially exposed industries. For these, tailored solutions should be pursued.

7. **Free allocation degrades efficiency and introduces risks either of windfall profits…**

   Recommendation: Design to minimize net impacts on the aggregate profitability of incumbent sectors, whilst boosting the profitability of cleaner technologies and innovators. Consider possible parallels between electricity production and upstream allocation to refineries.

8. **… or additional inefficiencies**

   Recommendation: A balance of free allocation between absolute and output-based should strive to minimize economic distortions as well as windfall profits. The balance between these two negatives should reflect each sector's ability to pass through prices, its exposure to international leakage, and its potential for emissions abatement through radical innovation or demand reduction.

9. **There is a compelling economic rationale to maximize auctioning**

   Recommendation: Maximize auctioning.

10. **Unilateral border adjustments may be a politically appealing way to respond to domestic pressures from special economic interests, but they risk serious problems in the international trade system**

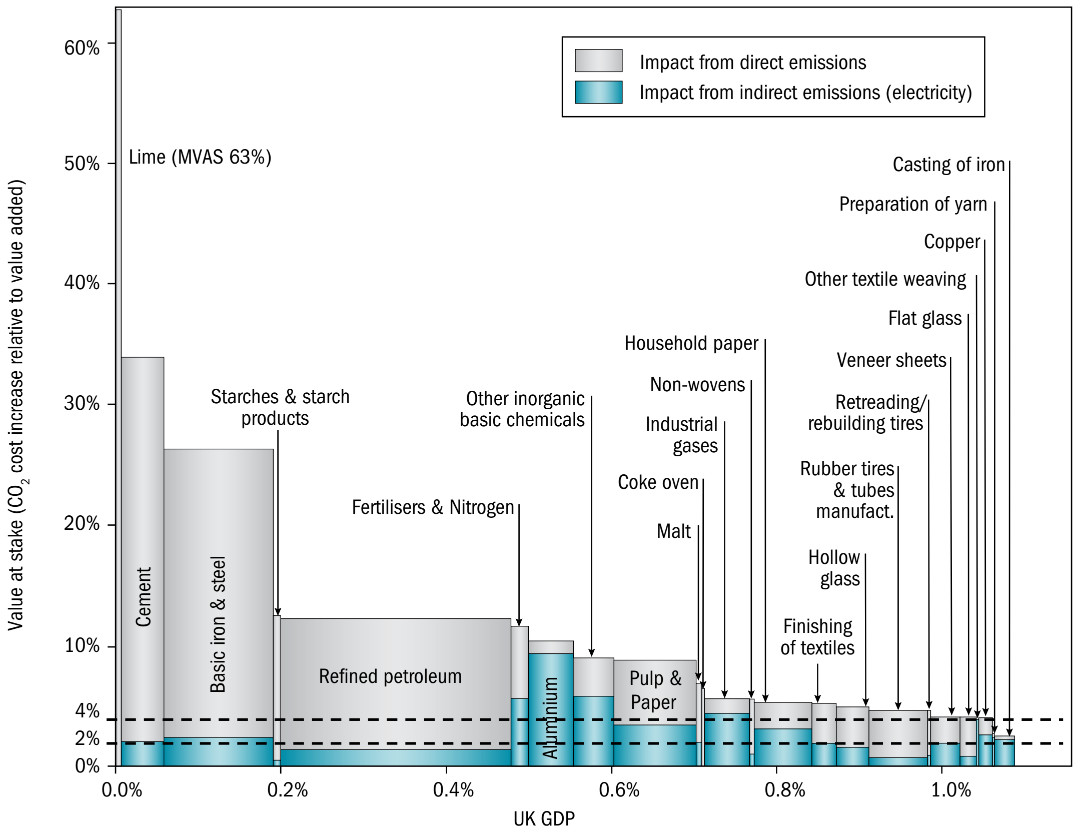
    Recommendation: Negotiate multilateral arrangements to contain or structure the use of border adjustments, focused upon minimizing emissions leakage, as and when specific problems can be demonstrated.

7 Appendix: Comparative Data on European Industries' Exposure

This technical appendix presents basic data on the economic characteristics of sectors in European industry and potential impacts of carbon costs, as a basis for comparison and fuller understanding of the issues covered in the main report. Chart 8 shows the results of a foundational study of the U.K. industry. The lower bars show exposure to indirect (electricity-related) costs on the U.K. system; the upper the potential range of costs arising from direct emissions. Exhaustive work was conducted in consultation with U.K. industry to ensure accuracy of data including all process-related emissions as covered by the EU ETS.

In this study, cost impacts were calculated for altogether 159 sub-sectors (defined using Standard Industrial Classification at 4-digit level). Both direct CO_2 emissions (combustion and process) and indirect emissions from the consumption of electricity were considered. Key findings, as

Chart 8. U.K. Manufacturing activities most cost-sensitive to CO_2 pricing



Source: Climate Strategies: Hourcade, Neuhoff et al. (2007)

Notes: The vertical axis shows the implied cost increase if sectors pay the full cost of CO_2 at €20/tCO_2 as a percentage of the sector value added. The horizontal axis indicates the scale of the activity's contribution to the U.K.'s GDP. The area of each column is proportional to total CO_2 emissions. The blue bars show the cost of carbon that will be paid through higher electricity prices (equivalent to €10/MWh at €20/tCO_2). The gray bars show the cost due to the carbon emitted through direct fossil fuel consumption and manufacturing processes.

mentioned in the main report, reflect the fact that manufacturing carbon emissions are highly concentrated in a few primary production activities. At a price of €20/tCO_2, 20 sectors would face a cost increase amounting to 4 percent or more of their value-added (difference between total output and input prices) if they had to buy all their allowances (100 percent auctioning), and these 20 activities represent about one percent of U.K. GDP and 0.5 percent of employment, but 50 percent of U.K. manufacturing emissions.

The analysis also applied an index of trade exposure to these top 20 activities as illustrated in Chart 9. Six sectors were identified as being subject to combination of high costs and potential trade exposure that could drive competitiveness concerns. As the U.K. is an island and trade-intensive nation, it is presumably more exposed than most.

Five of the key six sectors are exposed mainly through their direct carbon emissions; thus free allocation directly reduces their cost exposure. Aluminum smelting stands out for its electricity-related exposure, which is generally 5–10 percent of gross value added (GVA) for each $10/t$CO_2$, if carbon costs feed through to electricity prices. The corresponding electricity-related increase would be less than half this for fertilizers, inorganic basic chemicals, electric-arc steel, and pulp and paper; and negligible for primary (blast furnace) steel and cement.

A similar analysis of cost impacts on the German manufacturing sector (Chart 10) shows comparable results in terms of sector total production cost effects, although the ranking order may differ slightly and Germany has a somewhat larger share of GDP concentrated in these primary activities.[6] Also, German industry is relatively more cost-affected by electricity because its power generation is more carbon intensive (coal forms the marginal plant, rather than gas).

In both Germany and the U.K. aluminum smelting stands out for its electricity-related exposure, but electricity price increases would also increase sector input costs by 3–6 percent of GVA for fertilizers, inorganic basic chemicals, and pulp and paper.

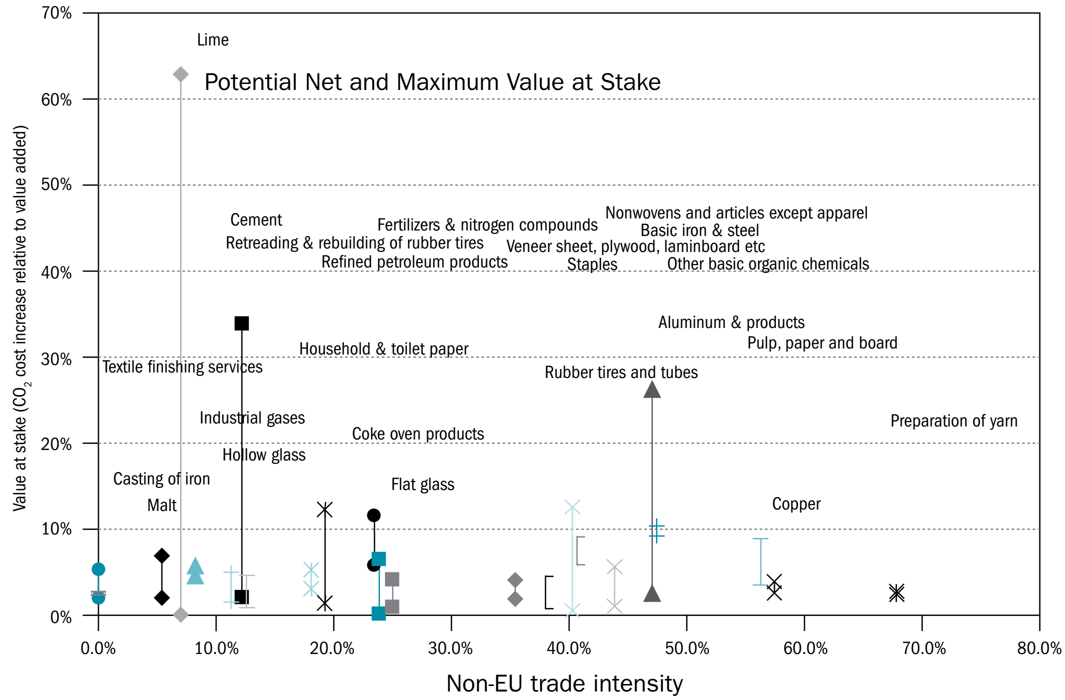
To offset such carbon costs, these latter sectors would have to raise average product prices by about one percent for each $14/t$CO_2$ paid, which may become significant for highly tradable products—particularly at higher carbon prices or if other costs (such as extension to non-CO_2 gases) are added.

To understand the potential impact of free allocation and pricing effects, Table 1 gives specific data including the average product price increase required to offset €20/tCO_2 under different conditions, but assuming full pass-through of electricity costs. The product price increase required to offset these electricity costs is less than one percent except for the exceptionally electricity-intensive processes, for which it is still less than two percent. Given a high degree of free allocation, it is thus relatively easy for most sectors to generate net profits either through abatement, or just by passing through some portion of the opportunity cost of carbon, and reaping revenues that exceed any residual cost of purchasing allowances.

Combining assumptions on carbon price, demand sensitivity, trade sensitivity allows the estimation

[6] Note that due to data availability, there are some differences in the level of sector disaggregation. For example, Coke, refined petroleum products and nuclear fuel (SIC 23) is included at 2-digit level for Germany. Similarly, pulp, paper and board (SIC 21.1) is represented at a 3-digit level for the U.K.

Chart 9. Trade intensity and value at stake (relative to GVA) for top 25 U.K. sectors in 2004



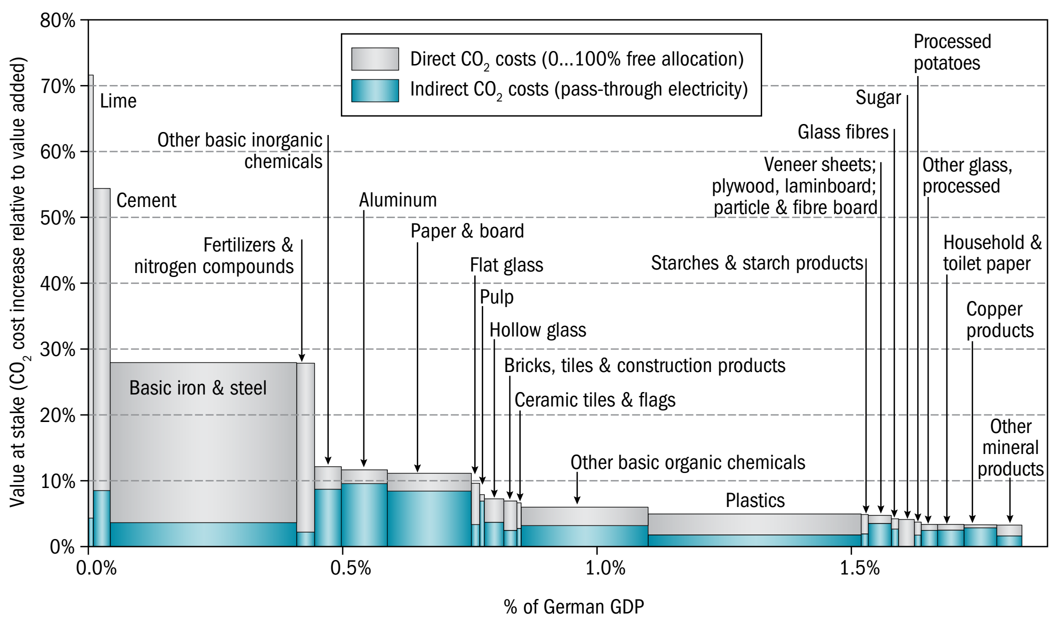
Notes: Trade intensity here is defined as (value of exports to non-EU + value of imports from non-EU)/(annual turnover + value of imports from non-EU).

This data reflects U.K. data in the context of the EU ETS. The vertical axis shows potential impact of carbon costs on sector input costs as a proportion of sector value-added, prior to any mitigation or other response. The upper end of each bar shows impacts with no free allocation of allowances (maximum value at stake). Under the Waxman-Markey bill output-based compensation would tend to drop the top of the bar towards the lower end to a degree that depends on the degree of overall free allocation to the sector. Here, the lower end corresponds to free allocations covering all direct emissions, leaving residual impact of increased electricity costs (net or minimum value at stake). Under Waxman-Markey the electricity price impact (bottom of bar or NVAS) would be largely removed. Here, data are shown for an allowance price of €20/tCO_2, a corresponding €10/MWh electricity price increase, and negligible impact on other input costs.

The horizontal axis shows U.K. non-EU trade intensity, defined as (value of exports to non-EU + value of imports from non-EU)/(annual turnover + value of imports from EU + value of imports from non-EU).

For consistency given incomplete availability of more recent data, trade data are mostly for 2004.

Chart 10. Germany industry cost impacts and GVA



Source: Graichen et al (2009)

of leakage rates.[7] For EU steel, assuming 50 percent pass-through of carbon costs at the equivalent of approximately $42/t$CO_2$, domestic steel consumption declines by about two percent but EU production declines by 2.5–9 percent across the range of trade sensitivities considered; this would yield net profits if the sector receives significantly above 50 percent free allocation (*Carbon Trust, 2008)*. The results of more recent modelling of leakage potentials in Europe are carried in *Climate Strategies:* Droege et al (2009).

Quantifying leakage rates is complex both because trade sensitivities are uncertain (and may accumulate over time), and also because they depend on whether and how much carbon costs (especially with free allocation) are fed through. Chart 10 illustrates the range of potential cost impacts (relative to GVA) by the height of each bar. In general, the more that a sector passes through carbon costs, the higher it will be on the bar, the higher its profits (or the less its losses), and the faster it will start to drift to the right (increasing trade intensity).

[7] In terms of the environmental impact of changes to trade patterns, increased imports and/or loss of exports may represent of emissions leakage from within the EU to outside the EU. Yet this does not necessarily mean global emissions will increase, e.g. importing electricity-intensive products may reduce global emissions if they come from largely carbon-free electricity systems such as in Norway or Iceland. Focusing on leakage helps to align economic and environmental goals and keeps the focus on issues around the emissions trading scheme, rather than on other trends and influences on trade and competitiveness.

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