Tackling carbon leakage

Sector-specific solutions for a world of unequal carbon prices

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CARBON TRUST

Climate Strategies

This Carbon Trust report draws in part on research by Climate Strategies*, an international network organisation that develops and delivers rigorous, independent academic analysis to meet the needs of international climate change policymaking. The Carbon Trust is a founding supporter of Climate Strategies.

*Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

Preface

By committing to an 80% cut in greenhouse gas emissions by 2050, the UK has placed itself firmly at the forefront of the global effort to address climate change. The European Union Emissions Trading System (EU ETS) is central to this effort in the UK and across the EU, providing an essential incentive for cutting emissions in industry at the lowest possible cost. But this environmental leadership has raised worries that curbs on emissions will harm the competitiveness of UK and EU businesses, especially heavy industries facing a carbon price under the EU ETS.

Our previous studies on the EU ETS have explored this issue of competitiveness and found that the overall risks to the UK economy are small. However, a few key sectors could lose market share and investment to producers outside the EU, allowing emissions and economic activity to 'leak' overseas.

This 'carbon leakage' is a real concern in these sectors, for many of the companies we work with, and for UK business more generally. We are keen to leverage our experience in this area to suggest potential solutions that firstly ensure an effective EU ETS, and secondly that minimise any likelihood of leakage.

In the aftermath of the Copenhagen conference, it is clearer than ever that forging ahead with climate change policy will be a complex process in which different parts of the world move at different speeds, in an evolving web of domestic actions. The EU will continue the EU ETS after 2012 as a core part of its unilateral commitment to achieve 20% reductions by 2020, and will be considering strengthening this as negotiations continue through 2010.

Consequently, the issue of what to do about sectors that are considered to be exposed to potential competitive disadvantage and carbon leakage remains as potent as ever. In December 2009 the EU adopted a lengthy list of sectors deemed to be potentially 'at risk of carbon leakage', and 2010 is the year in which it must decide what to do about them. Similar debates will also be played out in the US and other countries as they move to adopt domestic cap-and-trade legislation.

This study builds on our earlier work on competitiveness impacts and carbon leakage (see inside back cover for full list of these previous publications). It contains more detailed analysis reinforcing the conclusion that the problem is limited in scope and scale, but it nevertheless could undermine the effectiveness of the EU ETS in key and high-emitting sectors.

We are grateful to Climate Strategies who provided much of the underlying research that we used to develop this report.

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March 2010

With special thanks to Susanne Dröge, leader of the Climate Strategies project on 'Tackling Carbon Leakage in a World of Unequal Carbon Prices', and to Tom Brewer and Dora Fazekas for additional assistance.

Key findings

The ultimate 'first best' approach to tackling CO_2 emissions from manufacturing would include all countries introducing equivalent carbon costs into production of all traded goods. However, the climate negotiations in Copenhagen underlined the difficulty of getting 180 countries to agree to equal and simultaneous action; it is increasingly clear that national and regional climate policies cannot wait for global action if we hope to solve the climate problem. Yet differential action generates concerns that carbon-intensive producers might move outside of regions imposing a carbon cost, causing carbon emissions and economic activity to 'leak' outside of these regions.

Such carbon leakage is a real concern for some strategically important sectors in the UK and broader EU, but tackling the issue while preserving the strength and effectiveness of policies like the European Union Emissions Trading System (EU ETS) is difficult. The European Commission has classified 164 sectors – representing over three-quarters of manufacturing emissions under the EU ETS – as 'at risk of carbon leakage'. If all of these sectors were granted free allowances to compensate them for this risk, the economic incentives to invest in low carbon manufacturing would be greatly weakened.

To uphold the strength of the carbon price signal in the EU ETS, its design should reflect that the scale of any leakage will actually be small, but concentrated in a few sectors. For instance: implementing the current EU ETS Phase III targets to 2020 without any free allocation of allowances or protection would drive less than 2% of emissions abroad, but this average disguises that, for instance, 5-10% of cement or steel emissions (and production) might leak, and leakage from coastal areas may be greater than those that are landlocked.

Most sectors should be expected to adapt to full carbon costs over time without protection, to incentivise more efficient practices, technologies and companies that can then diffuse internationally as global action develops. The EU's list of 164 sectors includes many sectors that our previous work has shown are unlikely to suffer significant leakage. This amplifies the need to pay careful attention to the proposed countermeasures that are due to be decided during 2010.

Measures to tackle leakage should be limited to specific exposed sectors because both the main approaches to tackling carbon leakage carry serious drawbacks:

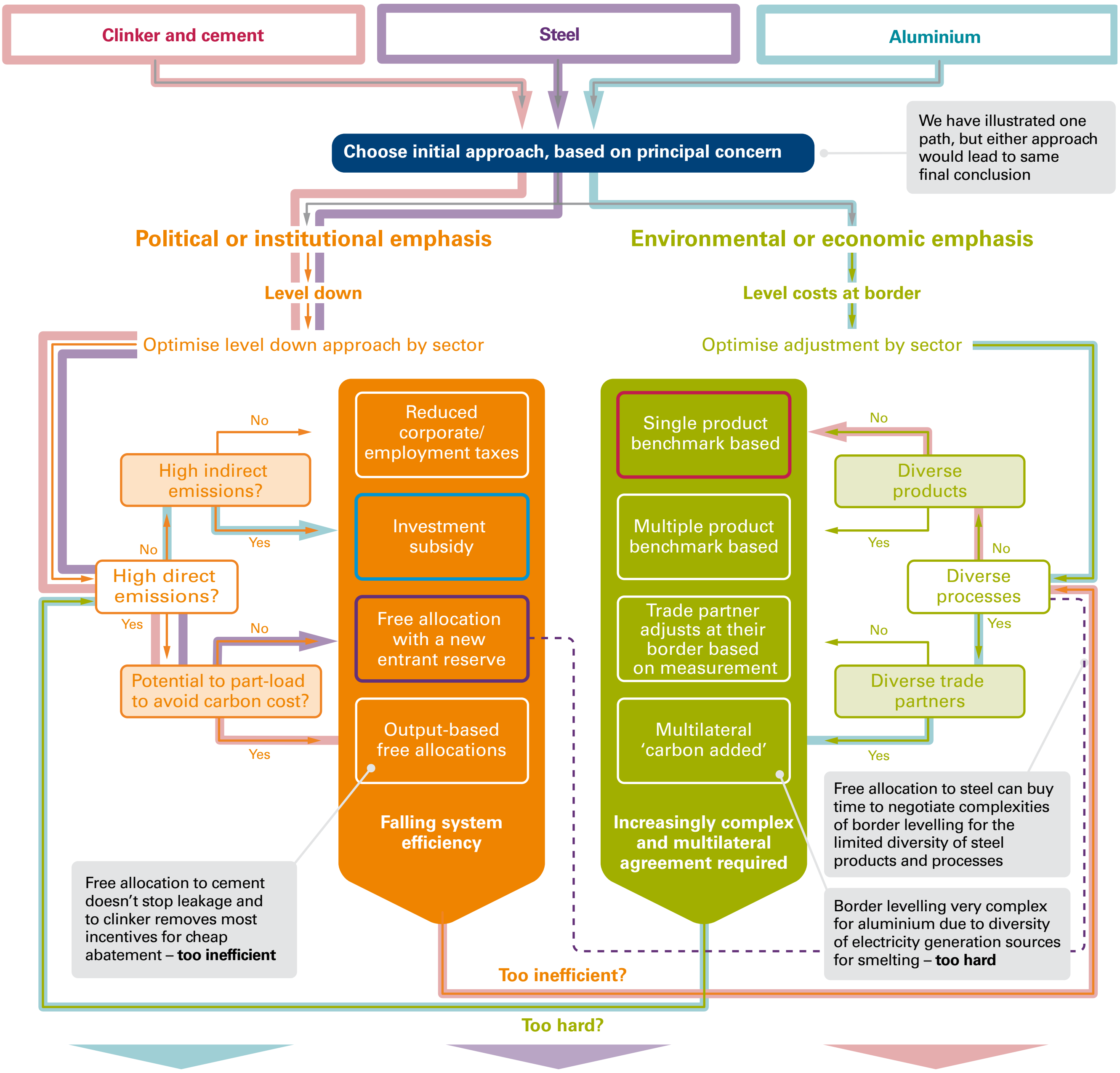
- 'Levelling down' the carbon cost a sector faces, for instance through free allocation, is a potential option. However, this approach may not prevent carbon leakage and could retard low carbon investment and innovative solutions for the exposed sectors, increasing the cost of meeting carbon targets for the rest of the economy. Given the current EU emissions target, granting free allowances to cement, steel and aluminium could increase the carbon price faced by the rest of industry by 10-30%; whilst cement sector profits could rise by £0.7bn – £3.4bn annually during Phase III, depending on how the sector responds, without necessarily preventing leakage.
- Adjusting for cost differentials at the border of the carbon pricing zone is more effective and efficient than free allocation and for some sectors can be made automatically World Trade Organisation compliant. But it is potentially complex, and unilateral measures risk hostile reactions on the part of trade partners and increase the prospect of a WTO challenge – though free allocation could also be subject to WTO challenges as an implicit subsidy.

The broad debate on border adjustments encompasses a wide range of proposals, some of which have potential to be discriminating, punitive, or protectionist. The EU should clearly distinguish these from the specific objective of border levelling, which aims to include importers so as to avoid discriminating between domestic and foreign production of particular, exposed carbon-intensive products consumed in the EU. Extending the scope from production to consumption of key products in this way is intrinsically non-discriminatory. The key is to develop response measures in discussion with trade partners that are demonstrably focused upon tackling carbon leakage and designed to minimise trade distortions arising from carbon controls.

All options within the two main approaches introduce some complexities, economic distortions and trade-offs. Where action is required, the 'least worst' solution should be adopted and this requires measures tailored to the needs of a specific sector and not generalised across industry. This implies a screening approach as illustrated in Chart ES-1 opposite.

This report includes in-depth analysis of the three sectors that our previous studies identified as most likely to be most exposed, namely steel, cement and aluminium. Together – including their electricity consumption – these three sectors account for approximately a third of emissions capped under the EU ETS. We identify clear and powerful reasons why different approaches are required for each of these sectors, as illustrated by the specific recommendations detailed on Chart ES-1.

Chart ES-1 *Choosing an approach to tackling leakage based on the characteristics of the sector concerned*



Aluminium – investment subsidy: Consider on a case-by-case basis consistent with EU State Aid restrictions and intensify efforts to decarbonise EU power generation, including review of options to facilitate long-term contracts for low carbon based power. Pursue full carbon-added accounting procedures around aluminium and other electricity-intensive processes globally. Use product labelling both to facilitate consumer pressures for 'low carbon' aluminium and to provide the basis for possible border levelling that reflects actual embedded carbon and rewards low carbon intensive manufacturers wherever located.

Steel – free allocation with new entrant reserve: Complement transitional allocation of free allowances to steel producers (which provides a temporary but incomplete solution) by close monitoring to establish the potential extent of operational leakage from facilities receiving free allowances. Work with US and others on mutual recognition of climate change action and the options for designing border levelling for specific steel products. The core objective should be to move from free allocation to one of three options that reflect full carbon costs by 2020: import levelling, export adjustments by producer countries, or a carbon-cost-reflective global sectoral agreement.

Clinker and cement – benchmarked border levelling: Pursue multilateral negotiations prioritised to ensure that all cement consumed in the EU pays a carbon cost irrespective of origin, by requiring importers of clinker and cement to purchase EU ETS allowances or surrender matching credits. The starting point, analogous to excise taxes already applied to petroleum, should be to establish a fixed 'benchmarked' requirement to purchase per tonne of product, based on emission levels from best available technology.

Executive summary

Different carbon prices between regions are likely to persist for many years. Even with full auctioning of allowances out to 2020, the scale of leakage will not be sufficient to undermine the overall benefits of the EU ETS but it will pose a risk in a few key sectors. In these sectors, measures to tackle leakage may improve environmental effectiveness and political acceptability. However, all solutions have drawbacks and the least bad solution will need to be tailored to each sector's situation and be modified over time.

Differences in carbon regulation and prices between regions drive concerns about the possible impacts on competitiveness, and associated international 'leakage' of greenhouse gas emissions from those with controls to those without. Such fears have already affected the design of the EU ETS for its third phase (2013-20) and have become central in US proposals to create a national cap-and-trade system. The possibility of unilateral attempts by the EU and/or US to address these issues through border adjustments have prompted warnings from other countries about possible implications for international trade relations.

Beyond a wide range of policy issues for government, there are many implications for business. Price differences may have a short-run impact on the operations of existing plants in some sectors. Without free allocation or countervailing measures, there could be a significant impact on the location of new investment. Countervailing measures such as border adjustments could, however, equally complicate the landscape for business – particularly if they provoke retaliatory measures.

Potential scale of the problem

Our previous studies[1] identified steel, cement (particularly clinker production) and aluminium as being the sectors potentially most at risk from carbon leakage. If EU actions were to remain entirely unilateral, but with no free allocation or other measures to address leakage, then a modelling approximate estimate[2] is that by the middle of Phase III (2016):

- This 'maximum exposure' case could result in 5-10% of EU steel and clinker being replaced by foreign production – maybe around 15 million tonnes of CO_2 ($MtCO_2$) and 10$MtCO_2$ respectively, with considerable uncertainty. Total volume effects for aluminium are smaller and even more uncertain, being more plant- and contract-specific.
- The three sectors could, in total, leak up to 30$MtCO_2$ allowing for electricity used by the sectors. Compared to total EU emissions, this is less than 2%.

As a fraction of projected emission reductions in the affected sectors, up to 40% of emission reductions in EU steel production could be attributable to such leakage, and about 20% in both aluminium and cement; around 10% of the projected emission savings under the EU ETS could in fact be due to such 'offshoring'.

These estimates are EU averages and effects in some countries and locations could be bigger. They reflect the carbon price required to achieve the cap, which under the reference conditions modelled is only €14.5/tCO_2 by 2016; higher prices without other changes would increase leakage. However, in practice, decisions already taken in relation to free allocation could reduce leakage (though they would also increase the carbon price). Also trading partners' (such as the US) actions to incorporate carbon costs would tend to reduce leakage, depending in part on the design of their schemes.

[1] Carbon Trust (2008) 'EU ETS impacts on profitability and trade: a sector by sector analysis'.

[2] Monjon, S. and Quirion, P. (2009) Addressing leakage in the EU ETS: Results from the CASE II model. Working paper available from www.climatestrategies.org

A case study of Polish electricity[3] suggests that fears of 'carbon leakage' in power production itself, particularly due to electricity imports across the EU's eastern borders, are largely unfounded due to the constraints on both transmission capacity and foreign generation. However, we did not separately study cross-EU-border electricity trade in south-east Europe.

The relatively small scale of the aggregate problem implies that carbon leakage is not an obstacle to the continuation of the EU ETS, nor does it provide a sufficient case to exempt any sectors, but it does nonetheless lessen its effectiveness in key sectors and creates an important political barrier to strengthening and deepening carbon controls. If the EU ETS targets were tightened after the current round of post-Kyoto negotiations, driving up the carbon price, both the absolute and relative (to abatement) scale of leakage would increase (without countervailing measures) unless the deal did succeed in broadening the breadth and depth of carbon commitments elsewhere.

Indirect international effects, mediated through energy prices and innovation, could either amplify or offset the direct effects of carbon leakage arising from competitiveness impacts (see main text, *Chart 2a*). These could become more significant over time and raise different policy issues.

Overview of options

The clearest and simplest incentives to decarbonise will flow from declining free allocations, coupled with diplomatic efforts to broaden the range of countries taking effective action. The best long-term solution ('first best') is levelling up carbon costs, in which all countries impose carbon costs on production in the relevant sectors. Most proposals for 'sectoral agreements' fall far short of this at present and the outcome of the Copenhagen conference in December 2009 did not secure such a global level of action. Global adoption of carbon pricing is unlikely to be politically or even administratively feasible during the next decade, and a world which waits for all countries to act simultaneously will never progress to a solution.

This report consequently focuses upon the measures that can be developed unilaterally, or bilaterally with other major commodity exporting countries. The default option should simply be to accept cost differentials, which for most sectors are minor[4], thereby encouraging the sector to adapt and innovate. The net cost difference can also be ameliorated by using auction revenues to reduce other costs such as corporation taxes. However, where carbon leakage is deemed sufficient to justify other action, there are only two basic options:

1. *Levelling down*, by taking the carbon cost out of investment and/or operational decisions within the controlled regions. This can be achieved through investment subsidies, or free allocation in various forms.

2. Maintaining the internal price by adjusting for cost differentials, through treatment that applies to imports (and potentially exempts exports) as well as domestic producers. Through the remainder of the report we refer to this specific form of border adjustment as 'border levelling'. Some forms would be automatically WTO compliant, others might require exemptions to be negotiated (under the terms of General Agreement on Tariffs and Trade (GATT) Article 20).

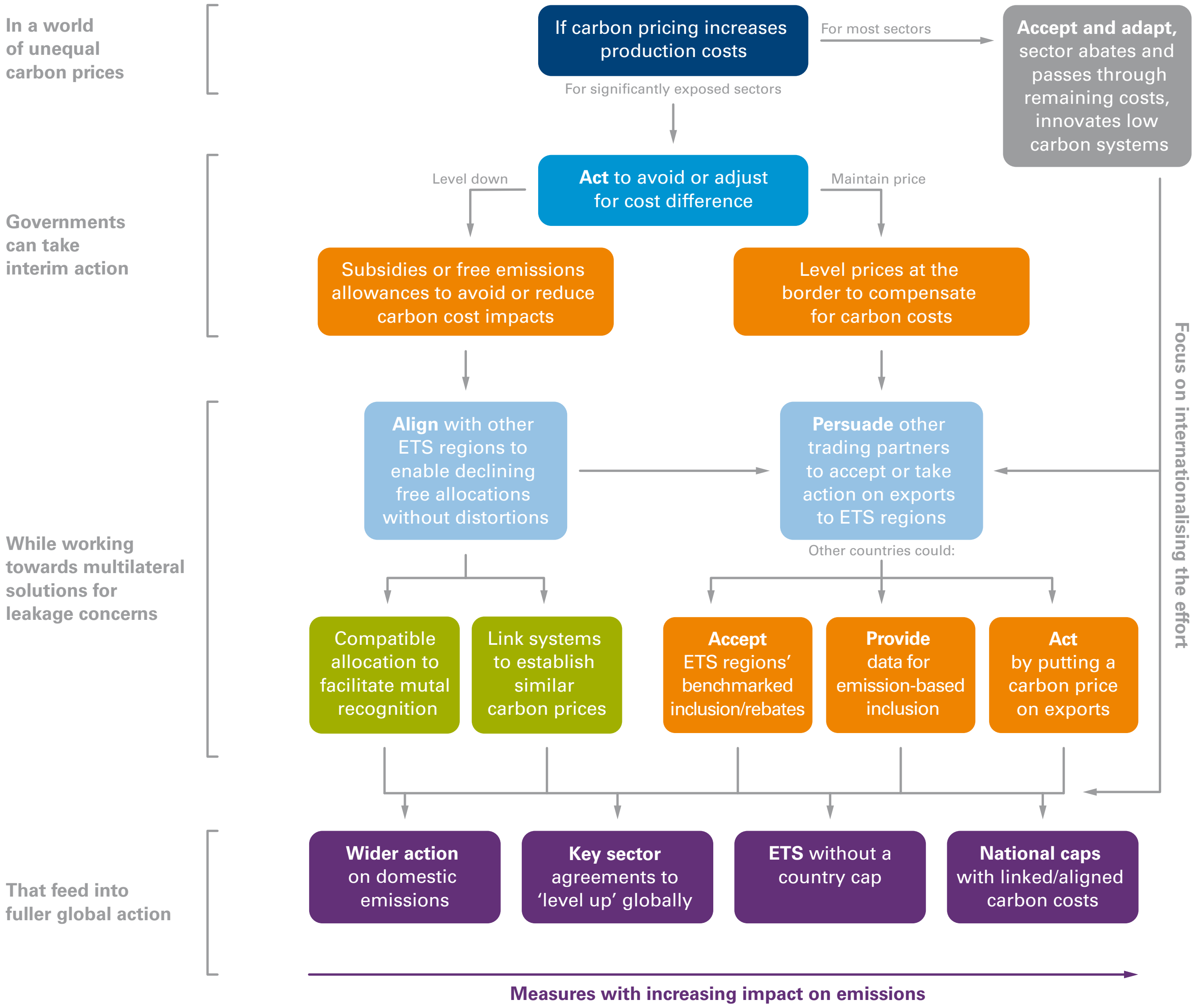
At a technical level, border levelling is in principle both more effective and more efficient than free allocation, but it is also more complex and controversial and consequently carries other risks and challenges. There are relevant precedents however. No one disputes excise taxes levied on petroleum imports as well as domestic production, and VAT has elaborate treatment for cross-border trade. Some developing countries already impose taxes on the exports of energy-intensive goods.

The overall options and variants differ partly in the nature and degree of international coordination required as illustrated in Chart ES-2. In each case, the impact of measures on emissions increases as one moves from left to right on the chart. However, this is set in the overall context in which policy should strive to move from the top left, towards the bottom right – the most effective actions, adopted across the widest range of countries possible.

Despite all the complexities, two stark realities cannot be avoided. One is that charging carbon has trade implications. The other is that failing to charge for known damaging emissions itself undermines the most basic assumption of market theory, that economic liberalisation and free trade should improve human welfare.

[3] Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org
[4] Minor compared with other cost differentials in labour, raw materials, taxes and currency fluctuations.

***Chart ES-2** Carbon leakage: structuring options in the wider context*



Note: this study covers the options highlighted in orange. The challenges around aligning and linking emission trading scheme are addressed in Carbon Trust (2009): 'Linking emission trading schemes'.

Levelling down: options and impacts

For investments where carbon costs are dominated by direct emissions, free allocation to new entrants can prevent *investment leakage* – that is relocation for sectors with high carbon costs like steel and cement. The alternative of investment subsidies (potentially funded through the auctioning of emission allowances) requires case-by-case assessment and carries obvious risks associated with government subsidy; for these reasons in the EU it is reserved for electricity-intensive industries and will be subject to strict State Aid scrutiny. For electricity-intensive sectors there may also be a big difference between tackling competitiveness concerns, and genuine leakage concerns: importing aluminium from countries where it is produced with low carbon electricity does not involve international relocation of carbon emissions (though under a given ETS cap, it does relieve the pressure on other sectors).

The extent to which incentives for cleaner investment and innovation are undermined by such measures will depend in part upon whether free allocations are strictly benchmarked towards 'best available technology' levels. Closure rules (which withdraw allowances if a facility closes) may risk artificially extending the operation of uneconomic plant.

Fixed free allocation, whether to new entrants or incumbents, may not deter operational leakage if plants can economically reduce output in favour of imports. If a plant can generate higher returns by selling their freely-allocated allowances instead of their core product, they may choose to decrease production (within limits to avoid closure rules) and sell their allowances instead. The likelihood of this will depend on capital intensity, operating characteristics and market structure of the sector, as well as the carbon price. The EC assumed carbon price of €30/tCO_2 would make it optimal for cement to pass through some carbon costs, irrespective of free allocation or import substitution.

A sector can also profit in the same way that the power sector has profited, by passing through the full 'opportunity' carbon costs, which with free allocation is likely to be a greater portion of carbon costs than they bear themselves (even if this causes demand to fall).

In either case, the producer profits from free allocation, and the displacement of production in the capped region results in leakage. The Climate Strategies analysis[5] suggests that both effects could operate in the cement sector and, in addition to the leakage illustrated below, estimates that cement sector profits would increase by a total of €10bn-20bn over the 8 years of Phase III.

If, instead of the assumed free allocation corresponding to a 'sector at risk', the cement sector was given 80% (of benchmark) free allocation in 2013 and this declined to 30% in 2020 – as is proposed for industrial sectors not considered at risk of leakage – then these windfall profits would halve, with little impact on the actual degree of operational leakage, but greater impact on closure and new investment decisions.

Compensation that varies in proportion to industrial output ('output-based allocation') is proposed in US legislation. This can tackle operational leakage – though incompletely – but further reduces economic efficiency and thus increases the overall societal cost of reducing emissions. Measures in the present legislation intended to prevent pass-through of electricity costs may also suppress the incentive for consuming industries to improve their electricity efficiency.

Taking the case of cement, output-based allocation would not resolve the risk of leakage because clinker, the key and most carbon-intensive ingredient in cement, may be imported instead of finished cement. Output-based allocation to clinker production itself would largely negate incentives to cut emissions through the more efficient use of clinker, which the EU ETS experience has demonstrated to be one of the biggest sources of industrial emission reductions.

Free allocation thus provides only a partial solution, and reduces economic efficiency. Protecting carbon-intensive activities inevitably places more burden on the rest of the economy and this drives up the carbon price required to achieve a given target. Modelling suggests that output-based free allocation to cement, steel and aluminium could certainly cut leakage, but would increase the carbon price required to achieve the EU ETS Phase III targets by around a third (see *Chart ES-3* overleaf). The EU approach of fixed allocation would have less impact on the carbon price (though it would also be less effective in tackling leakage). An opposite extreme tested in the modelling also gave output-based free allocation to power generators, to prevent carbon costs being passed through to electricity consumers; this (which is not compatible with the EU ETS and not shown in the Chart) resulted in a doubling of the carbon price required to still achieve the target.

In general, such 'levelling down' is a third-best approach to the problem. One way or another, it seeks to take the carbon cost out of a system that was designed to impose a carbon cost, and this undermines the economic incentives that the system was initially intended to create.

[5] Cook, G. (2009), Climate Change and the Cement Industry: assessing emissions and policy responses to carbon prices, working paper available from: www.climatestrategies.org

Adjusting for cost differentials: technical options and impacts

Carbon leakage can be addressed by border levelling measures that reduce carbon price differentials in goods traded between countries that do, and do not impose carbon costs. Import tariffs are one form of border adjustment but may be particularly prone to challenges in the World Trade Organisation (WTO) as being unacceptable violations of non-discrimination principles. The main options that could be introduced by regions adopting emission trading schemes are to require that importers buy and surrender allowances or credits, and/or to exempt exporters from surrendering allowances. The three broad options are as illustrated in *Chart ES-2*.

Adjustments that are applied at a flat rate – a standardised 'benchmark' of emissions associated with a given tonne of product – could be automatically compatible with world trade law (see box at the end of the executive summary). In principle they could thus be adopted unilaterally, but international discussion with trade partners would reduce the risk of challenge or retaliation. The simplest forms would be analogous to excise taxes applied to petroleum and this should ease acceptance.

Negotiation and cooperation could moreover open up additional, more targeted options. For example, an import 'benchmark' could be set at a default level of average sector emission intensities, but with a discount to importers that provide evidence of lower-than-average emissions. Supplying information on the carbon emitted during manufacturing would thereby enable adjustments to reflect actual emissions, increasing effectiveness and creating interesting incentives, but this also would increase complexity.

The most effective form of border levelling could be to negotiate actions by exporting countries to ensure their exports of carbon-intensive products face equivalent costs. For example, requiring exporters to purchase Clean Development Mechanism (CDM) credits would achieve this, whilst the revenue would go to support emission reduction projects in developing countries, which again may increase political acceptance. Such options could build upon existing VAT adjustments, and taxes imposed by some developing countries on the exports of energy-intensive goods. At present there is no certainty about the longevity of such export taxes or their consistency with ETS carbon costs, and addressing this would require extensive negotiation to embed such measures in a globally agreed framework.

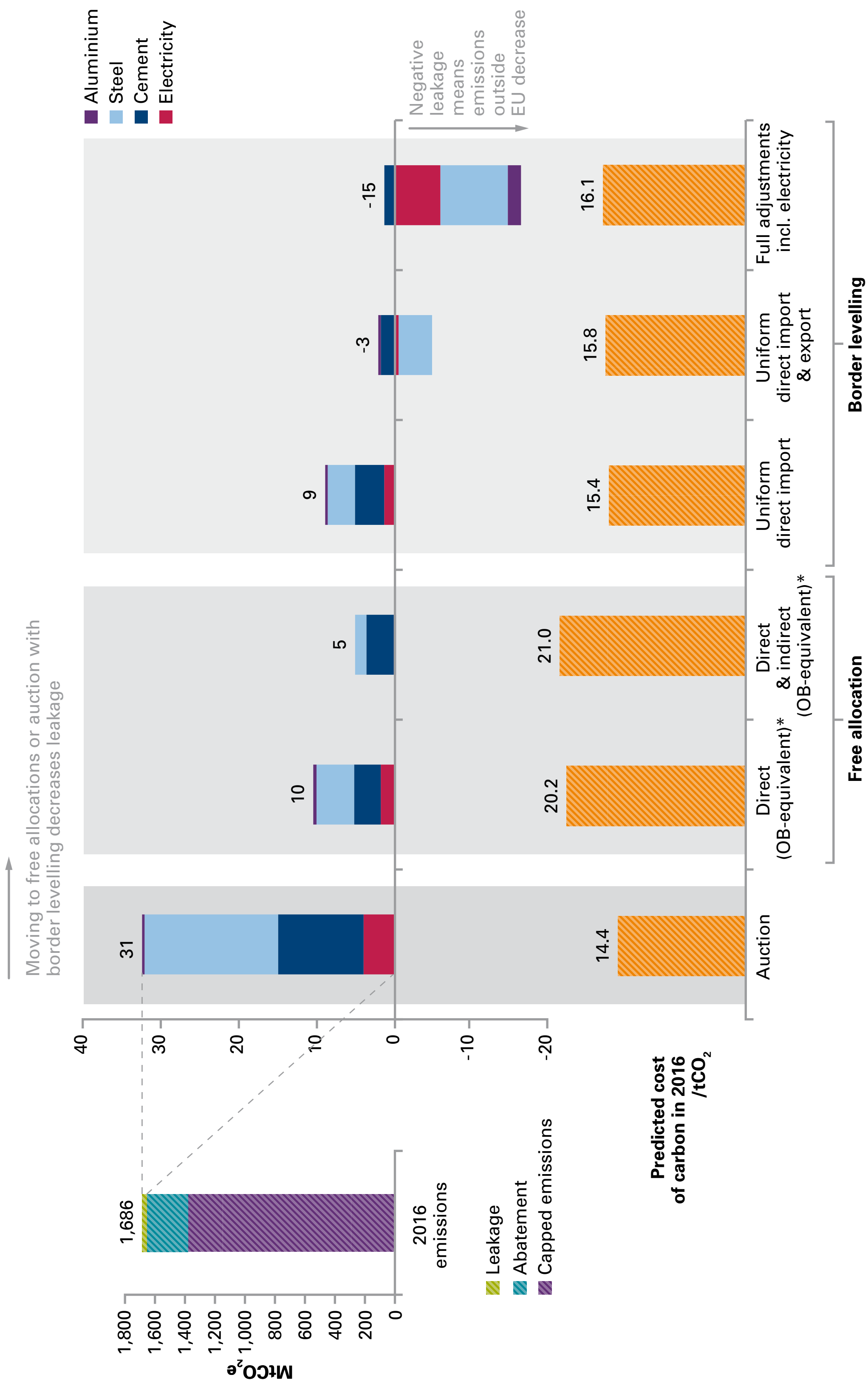
Reimbursing carbon costs for exports from ETS regions raises different sets of legal issues (see box at the end of the executive summary). However since the EU has largely exhausted cheap domestic supplies of energy and ore, it has little inherent advantage in carbon-intensive commodities particularly vis-à-vis developing countries; its main energy-intensive exports are to the US (steel and refined products) and other industrialised countries. Particularly if these can be addressed bilaterally in the context of US developments (that could impose a carbon price through the proposed cap-and-trade legislation), there is little case for the EU to consider export adjustments.

As with free allocation, the potential effectiveness of border levelling mechanisms depends upon how fully they could be aligned with the various sources of cost (direct and indirect) and channels of leakage (import and export). 'Full' border levelling could greatly reduce leakage in cement, and reverse it in other sectors. Such 'negative leakage' is driven by the impact of more comprehensive inclusion of carbon costs, particularly in steel and aluminium, which through its impact on consumption would serve to amplify the emission savings from within the EU by reducing imports – and hence foreign production – as well as domestic production.

This reflects the fact that border levelling is one way of starting to extend responsibility for emissions from producers to consumers, and to this extent they also respond to concerns expressed, for example by China, that the industrialised countries should accept more responsibility for emissions in developing countries that are driven by 'western' consumption.

Adjusting the system to retain carbon-intensive activities inevitably drives up the carbon price required to achieve the (domestic) cap, partly by eliminating relocation as an option – but border levelling does so much less than free allocation. This is because free allocation also reduces incentives for the associated sectors to reduce emissions, shifting the burden of a given cap on to other sectors. *Chart ES-3* compares key options. Border levelling may increase the carbon price required to deliver the EU cap by up to 10%, whilst most options largely eliminate or even reverse carbon leakage. Free allocation tagged to output of the manufacturing sectors drives up the carbon price required to meet the cap by around 30%, with less impact on leakage. The EU proposals for fixed free allocation would tend to result in less impact, both in reducing prices and leakage and in raising prices on the rest of the economy, than the more comprehensive 'output-based' approach modelled in *Chart ES-3*. However, the differences between different scopes and ways of implementing both free allocation and border levelling are also large.

***Chart ES-3** Impact of border levelling and conditional free allocation on abatement, leakage and carbon price – EU ETS current proposals (2016)*



- 'OB-equivalent' means that free allowances are given in proportion to actual production.
- Direct gives free allowances to cover onsite emissions. Indirect also gives free allowances to cover offsite emissions from electricity production.
- The EC approach is similar to the 'direct' case but is not output based. Therefore it is likely to result in higher leakage and a lower carbon price.
- 'Uniform' means that the levelling does not vary according to the exact location where the goods were produced: all exports of a good are treated as if they emitted EU average emissions to produce the good. All imports are treated as if they had the rest of the world average.
- 'Direct' means adjustments are made for emissions generated onsite during the production of the good. 'Full' means adjustments are also made for the emissions from electricity used to produce the good.

Source: Monjon, S., Quirion, P. (2009), Addressing leakage in the EU ETS: Results from the CASE II model, working paper available from: www.climatestrategies.org

*OB equivalent = Allocation modelled as varying in proportion to the volume of goods produced (i.e. output based).

Note: the chart illustrates the impact of various Border Levelling and Free Allocation options on both carbon leakage (from the sectors modelled) and the price of CO_2 given the EU ETS Phase III target. These compare to a 'base case' of pure auctioning with no ameliorating measures (1st column), in which the carbon price required to deliver the cap in mid Phase III (2016) is 14.4€/tCO_2, and leakage is around 30MtCO_2, of which steel accounts for half and cement for most of the remainder. Free allocation is modelled in the way most effective in tackling leakage, namely fully output-based. Note that the EU ETS structure would only allow free allocation to be made conditional on investment and closure decisions, not actual output, which would have a smaller impact on price but also do less to tackle leakage than full output-based allocation.

Screening the options

The choice between free allocation and border levelling tends to raise very entrenched opinions, reflecting in part starting assumptions and perceptions. However, the analysis here implies that there is a rational choice to be made that may depend strongly on the characteristics of an individual sector/product, and the type of allocation or adjustment considered.

This is illustrated in *Chart ES-1*. Free allocation is harder to sustain for a sector that has low capital intensity or other characteristics which mean that free allocation may be ineffective, unless it is linked to output which is much more complex and more seriously degrades efficiency. Border levelling may be impractical for a sector with high trade value and diverse processes and products, making implementation extremely complex and highly controversial, raising the spectre of trade retaliation.

The best way of tackling leakage, in other words, requires a pragmatic, informed and open analysis of how these relative pros and cons apply with respect to the principal sectors of concern, if and as they are plausibly considered to be 'at risk of carbon leakage'. This pragmatic perspective leads to the following specific conclusions for the main categories, and sectors we have studied.

Highly trade-intensive sectors with relatively low direct and indirect cost exposures, which may still be classified as 'at risk of carbon leakage' under the EC proposals:

- Any residual impacts on such 'trade but not carbon-cost-intensive' sectors can be addressed by reducing other costs the businesses face (e.g. corporate or labour taxes), with any Treasury revenue losses being offset by auction revenues.
- There is no case for invoking border levelling until costs become far more substantial.

Sectors with high indirect carbon costs (very electricity-intensive) which also tend to be capital-intensive:

- Direct investment support, funded from auction revenues and subject to case-by-case State Aid scrutiny, offers the best option for **aluminium smelters**, and possibly **electric arc steel**. Auction revenues and policies should be targeted to support low carbon electricity investments and research, development and deployment.
- The wide range of CO_2e intensities of electricity production across and within countries means that costs cannot feasibly be adjusted at the border without extensive international cooperation to establish verified 'carbon added' content of the product, which should be a core goal of future multilateral negotiations.

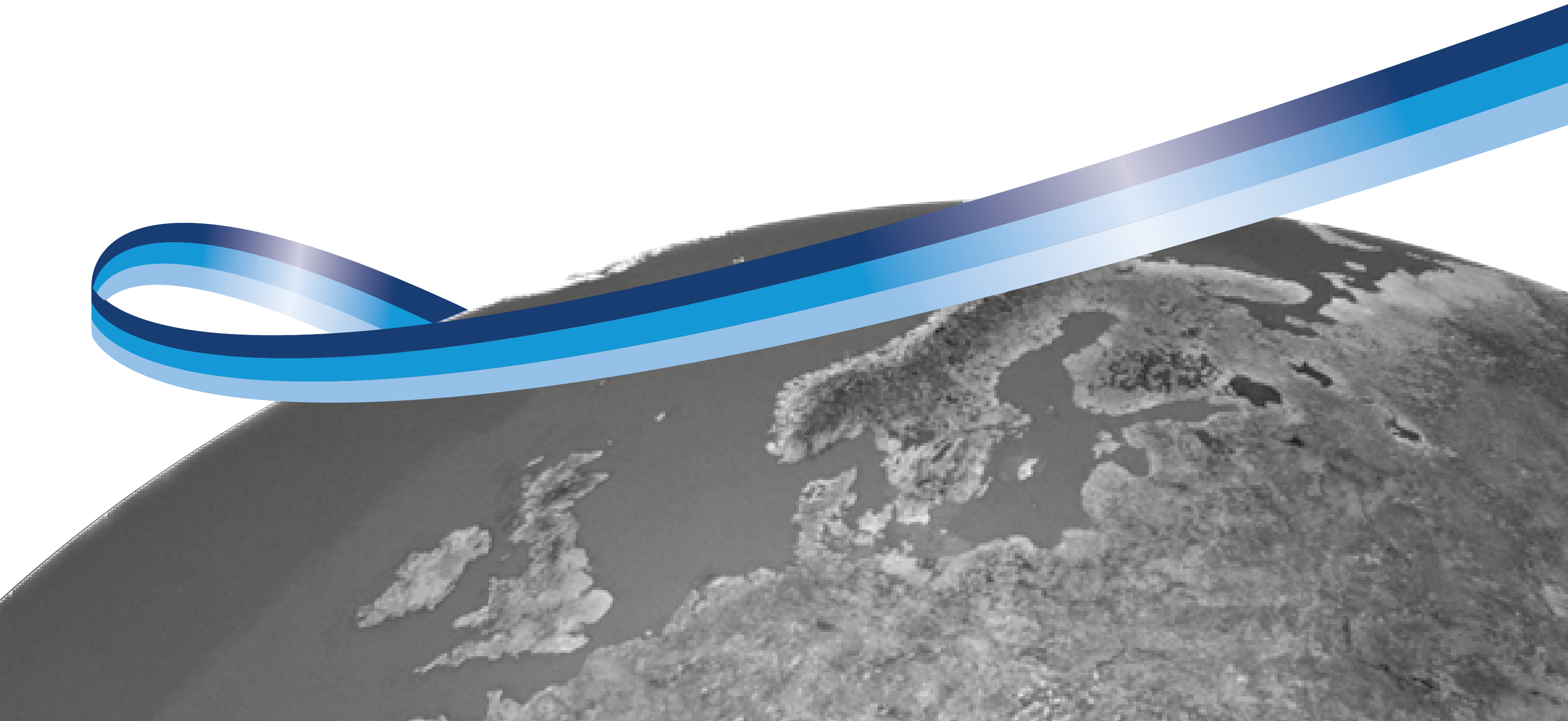
Sectors with high direct carbon costs (very carbon-intensive) that are also capital-intensive may be addressed transitionally through allocation decisions, but this carries drawbacks that accumulate over time:

- Free allocation for **blast furnace steel** production is a viable mid-term fix to retain capital investment and jobs, provided allocations are benchmarked. It risks creating perverse incentives that not only reduce the overall efficiency of emissions trading (thus raising costs to other industries) but can also 'over-subsidise', leading to windfall profits or retention of old plants that could be more efficiently replaced by new investment, here or overseas.
- The strategic goal should thus be to use the time bought by free allocation to negotiate and implement WTO-compatible border levelling appropriate to the key product classes.

Sectors with high direct carbon costs that are less capital-intensive cannot reliably be addressed by free allocation, but WTO compliant border levelling is relatively straightforward particularly where products and processes are relatively homogenous:

- Fixed free allocation may not deter operational leakage, and output-based allocation would need to focus on the most carbon-intensive part of the production chain (e.g. clinker production in cement) which may seriously degrade economic efficiency and undermine incentives to radical innovation.
- Border levelling based on 'best available technology' benchmarks for **cement** are clearly consistent with existing WTO constraints and offer a far more appropriate policy response, basically analogous to excise taxes; policy should focus on negotiations to gain acceptance of and implement such measures.

Experience of adopting appropriate policies in this way will also help to lay groundwork for factoring in carbon costs more widely over time, which should be the ultimate goal of current efforts to establish emission trading schemes.



Supporting information: Border adjustments and levelling: legal and political dimensions

Making any adjustment at a border can involve considerable administrative and technical complexities. Despite this, various tariffs are widespread and some measures, such as VAT adjustments and excise tax structures, are already accepted norms in international trade. Other forms of adjustment, however, may raise serious concerns about potential legality, political fallout and risk of retaliation, and associated regulatory uncertainties.

The climate change debate is now raising several different kinds of proposal. One is to use border adjustments to create incentives for stronger action in other countries – or potentially, to 'punish free riding'. This would imply that some countries make adjustments at the border based on their view about the adequacy of action in others. Although this has been endorsed very occasionally in international agreements (notably, the Montreal Protocol on Ozone Depleting Substances) this is exceptional, since it is not compatible with the general principle of non-discrimination laid down in GATT. Consequently such proposals provoke great concerns in the trade community.

Addressing carbon leakage does not require such measures, but rather a focus on *levelling* carbon costs in particular products. In principle this is nondiscriminatory, but expands the regulatory focus from purely production to include consumption of carbon-intensive goods. Such measures may be compatible with fundamental GATT principles: specifically 'most favoured nation treatment' (any measure applicable to one WTO Member should apply equally to all), and 'national treatment' (the adjustment does not favour domestic over imported like products). Exemptions to these constraints are also possible.

There are a number of potential variants of border levelling.

Benchmarked import levelling. Requiring all importers of the same or like products to acquire emission allowances or credits on the basis of best available technology (BAT) performance, in ways not less favourable than domestic allocation, in principle automatically meets the core GATT principles. Economically this is much like excise tax treatment, e.g. for petroleum. In practice, BAT standards will be simpler and less controversial to define for relatively simple, discrete products with relatively homogenous production processes. The justification will also be clearer where carbon volumes and costs are demonstrably significant. Cement fulfils these criteria.

The complexities arise with diverse production processes and multiple products. Different production processes or different electricity grid emissions intensities may generate very different emission levels. Political challenge is also more likely for higher trade values. Steel has moderate diversity in both processes and products but a very high trade value; aluminium faces the complexities associated with its high electricity consumption.

Export levelling. Reimbursing carbon costs for exports (rebates) can be compatible with the international agreement on Subsidies and Countervailing Measures providing carbon controls take the form of a charge or energy-related cost (for which ETS would probably qualify), not as a regulatory measure, and the adjustments are applied equally to all like products. In practice this may be complex and contentious, particularly for indirect costs such as those related to electricity. However, free allocations may be equally subject to challenge as an implicit subsidy. For reasons outlined in the text there is little need for the EU to address the technically difficult and politically loaded issues around explicit export rebates.

Emissions based levelling. Trying to level carbon costs for products in which the carbon intensity of production may vary widely would require tracking actual emissions. Treating imports on this basis could embroil climate policy in long-running debates about trade measures linked to production processes and methods, which remain contentious, and would require cooperation.

Unilateral actions are likely to be driven by domestic industrial interests and may be viewed with extreme suspicion internationally. Where there is legitimate need and the technical and legal issues are clear, it should be possible to reach agreement with trade partners. It may help first to pursue a broader, high-level political agreement about the appropriate use of border measures in relation to tackling climate change.

International negotiation also opens up additional options. As a step beyond accepting the use of a simple 'benchmarked' levelling on imports to ETS regions, higher emission benchmarks could be accompanied by discounts for importers that provide an audited trail of emissions, so that more efficient producers would pay less. Beyond this, producer regions could impose carbon-related duties on exports (an extension of export taxes already levied by China and some other countries). GATT does not prohibit export taxes, and countries could establish these as a basis for exemption from import levelling by ETS regions, and as a contribution to the global effort, to give them more stability.

Part A
The nature and scale of the problem

1. Why the cost of carbon will vary

Even if all the current legislative proposals are fully implemented, the coverage of emission trading schemes will still be very patchy and even those regions implementing cap-and-trade may have different carbon costs and/or design features which mean that industries face different costs.

Since the adoption of the UN Framework Convention on Climate Change and then its Kyoto Protocol in 1997, capping emissions and establishing a carbon price has been a goal of an increasing number of governments. The creation of the EU ETS, establishing a single cap-and-trade system that now spans 27 Member States, was a step of international importance. Many governments are now developing cap-and-trade schemes, and share a broad aim of trying to create a wider international carbon market. The European Commission has proposed establishing an OECD-wide carbon market by 2015, with the ambition to integrate with trading systems in economically advanced developing countries by 2020.

There are at least two distinct motivations behind this effort. One is to broaden action on climate change: the EU accounts for less than 15% of global emissions, and emissions from the industrialised world overall form a declining share, likely to be surpassed by developing countries within a decade or two. The climate problem cannot be solved unless far more countries constrain their emissions.

The other motivation has more to do with the cost, effectiveness and political sustainability of domestic efforts. Any individual region will face resistance to taking action without others. In the case of measures that impose a tangible cost on industry, this is amplified by the fear that industries might move abroad to escape the controls – potentially, leakage of business, jobs, and emissions as well. Building upon our diverse earlier studies, this report examines not only how serious the problem is, but what might be done about it.

If all the world took action simultaneously, of course, the problem would not arise. The current situation, in contrast, is marked by the relatively small proportion of global emissions that fall under existing national caps or otherwise face a carbon cost. As surveyed in our companion study on linking emission trading schemes[6], the state of development of schemes can be summarised as follows.

European Union: The EU Emissions Trading System entered into force in 2005 and is currently in its second phase. The European Energy and Climate Package (December 2008) extends the system to 2020, broadens its scope, and tightens the emission cap in Phase III (2013-2020), largely along the lines laid out in the Commission proposals earlier in the year[7]. This implies that EU industry will face a rising carbon price for at least the next decade, irrespective of actions in other countries and while other schemes are still developing their preferred design and price signal.

USA: During the second term of President George W. Bush, a number of US states started to develop emissions trading schemes: the Western Climate Initiative (WCI) covers seven US states[8] and four Canadian provinces[9], and the Regional Greenhouse Gas Initiative (RGGI) covers 10 Eastern states[10]. RGGI started auctioning emission rights in September 2008 but it only covers electric power producers.

Excepting RGGI, these regional ETSs have not yet started operating, but have prepared the ground for federal efforts, offering precedent and a political bottom-up process for action against climate change. In July 2009 the US House of Representatives passed the Waxman Markey bill that included as a core element the creation of a Federal US cap-and-trade scheme. The intent is to secure passage through Congress during 2010.

[6] Carbon Trust (2009), 'Linking emission trading systems: prospects and issues for business'.

[7] As explained in Carbon Trust (2008), 'Cutting carbon in Europe: the 2020 plans'.

[8] Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington.

[9] British Columbia, Manitoba, Ontario, and Quebec.

[10] Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

Australia: Almost the first international act of the new Australian government in December 2007 was to ratify the Kyoto Protocol, and it followed this up with rapid development of domestic cap-and-trade legislation, proposed to start operating in July 2011, initially with a fixed price of A$10 (US$7.40) before moving to a fully capped structure. The Australian Senate has rejected the proposal, but the government has indicated its intent to resubmit the bill.

New Zealand: New Zealand has been developing a domestic scheme which passed into legislation just before the Copenhagen conference.

Japan: In October 2008, the voluntary Japanese Emissions Trading Scheme (JETS) scheme was introduced. Industry associations and individual companies can choose to adopt an absolute or relative emissions target and freely determine the level of their target. Verification of participants' emissions is not required unless a company wishes to sell excess allowances. Transition to a mandatory cap-and-trade scheme is now planned for 2013 by the new government.

Other countries in which emissions trading schemes are already being actively considered include Mexico, South Korea and South Africa. In addition, emerging economies, especially India and China, host a large number of projects under the Clean Development Mechanism (CDM) that create Certified Emission Reductions (CERs). These reward low carbon investments, but do not create a carbon price on existing production.

This situation, combined with analysis of the structure of the schemes being developed, reveals three crucial facts. First and most obvious, even if all the current legislative proposals are fully implemented, the coverage of emissions trading schemes will still be very patchy, and not include several key industrial economies like Russia, or emerging industrial powers in Asia and Latin America. Second, capping greenhouse gases involves major political struggle, which can be a source of uncertainty and delay and lead to weakening of key features.

Third, and less obvious, even those regions implementing cap-and-trade may have different carbon costs and/or design features which mean that industries face different cost structures. Linking different schemes will not prove either easy, or a panacea to differences in design and cost structures.

All efforts to create national carbon markets, and the ultimate goal of creating a global trade in certificates, are essential steps for achieving emission mitigation through carbon pricing. However, the short-term picture shows fragmented markets with different carbon prices.

Moreover, as first national steps in scheme design will probably lead to low prices (over-allocation; generous offsetting; learning costs; concessions or exemptions to accommodate powerful interests), it is expected that the EU ETS will be the tightest scheme for a while, with a higher price than those found in other countries. There is likely to be an interim period of different carbon prices without significant linking among cap-and-trade systems; even if an OECD-wide carbon market evolves by 2015, there will be an interim period of several years during which EU ETS carbon prices are likely to stand alone or be above those in other regions.

The outcome of the Copenhagen conference in December 2009 only reinforces these conclusions. EU hopes of securing a strong global deal were dashed against the geopolitical realities: US reluctance to commit to much in advance of Senate resolution or in the absence of legally comparable Chinese commitments; and huge diversity in the willingness of developing countries to consider stronger action in a context of negotiations which were founded on the principle that industrialised countries should first demonstrate leadership by reducing their own emissions. The outcome – a high-level political deal that set terms of continued negotiations without committing to a legally binding outcome – underlines the extent to which different parts of the world continue to have different perceptions, expectations and intentions about their actions on climate change.

Thus it remains very likely that even if industrialised countries can fulfil their commitments to action, with a broadly unified carbon market by 2015, there will still be many non-OECD countries without comparable carbon constraints. Yet, like China, they will be increasing their share of international trade in goods and services with the ETS regions. These trends contribute to a short to mid-term constellation of different carbon prices in different, but economically integrating world regions. These regions are closely linked through international flows of goods and capital but are unlikely to have significant linking of their cap-and-trade or other GHG mitigating measures by 2015. Even on the very optimistic scenario painted by the ambition to secure a wide carbon market by 2020, there will be at least a decade in which carbon costs may vary widely between different parts of the world. This study examines the implications.

2. Channels of international spillover effects

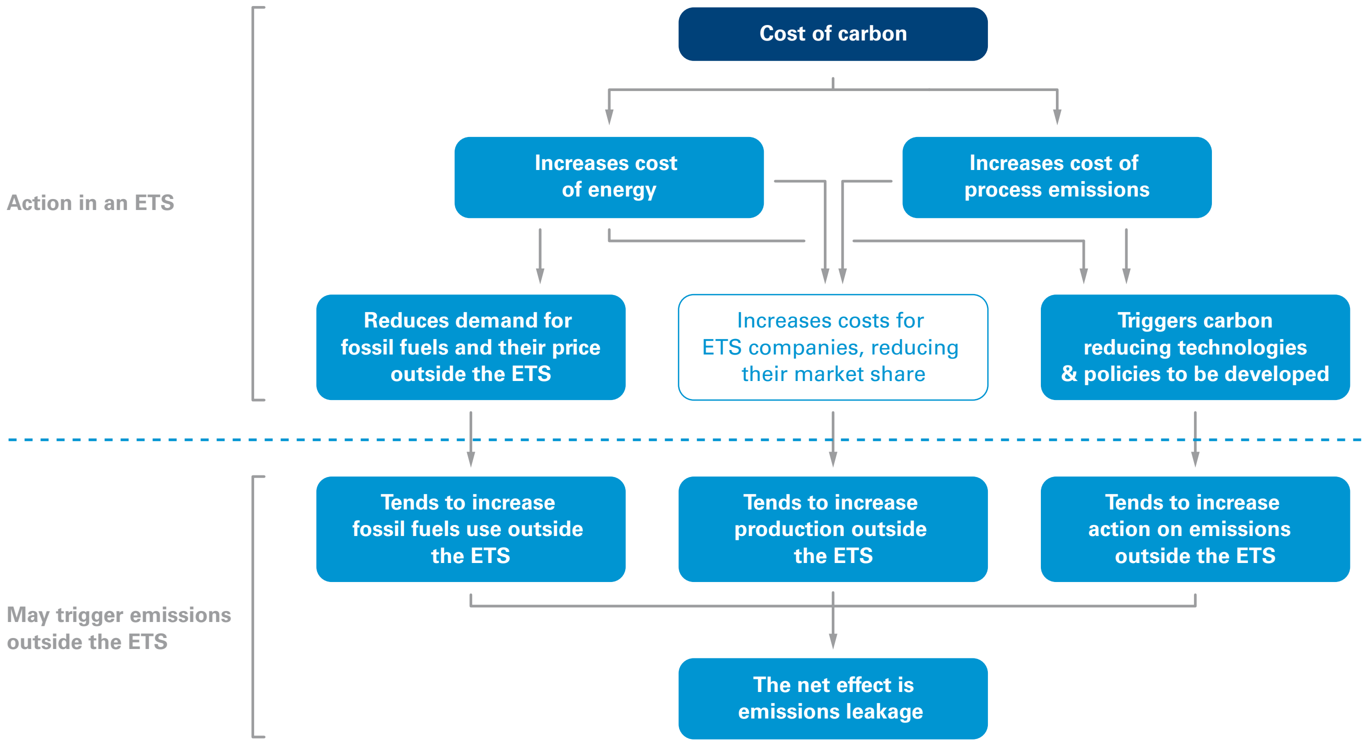
A cost of carbon creates a number of desired and undesired effects: on fossil fuel prices, on jobs, on investment and on technology development and deployment. Some of these effects are triggered outside the jurisdiction of the emissions trading system.

There are three channels through which carbon pricing in one region may affect global emissions outside the region, as illustrated in *Chart 2a*:

1. Energy markets: Reduced fossil fuel use in the controlled region will lessen its fossil fuel imports; this may be attractive in terms of energy security, but the reduced pressure on international energy markets may reduce fossil fuel prices globally and this could stimulate increased demand elsewhere.
2. Industrial migration: Increased production costs for energy-intensive firms could affect competitiveness and lead to changes in operation and investment that move some production abroad[11].
3. Technology and policy spillover: The incentive to innovate may over time improve systems and technologies, that might diffuse internationally; the example of some regions acting also increases the chance that others will.

The first channel may partially offset the domestic reductions, and the third will tend to amplify them. Both are extremely hard to quantify and the net combined effect could be in either direction. The impact of the first channel ('fossil fuel rebound') is less for the sectors where carbon costs are due largely to process emissions, or coal consumption (like steel and cement).

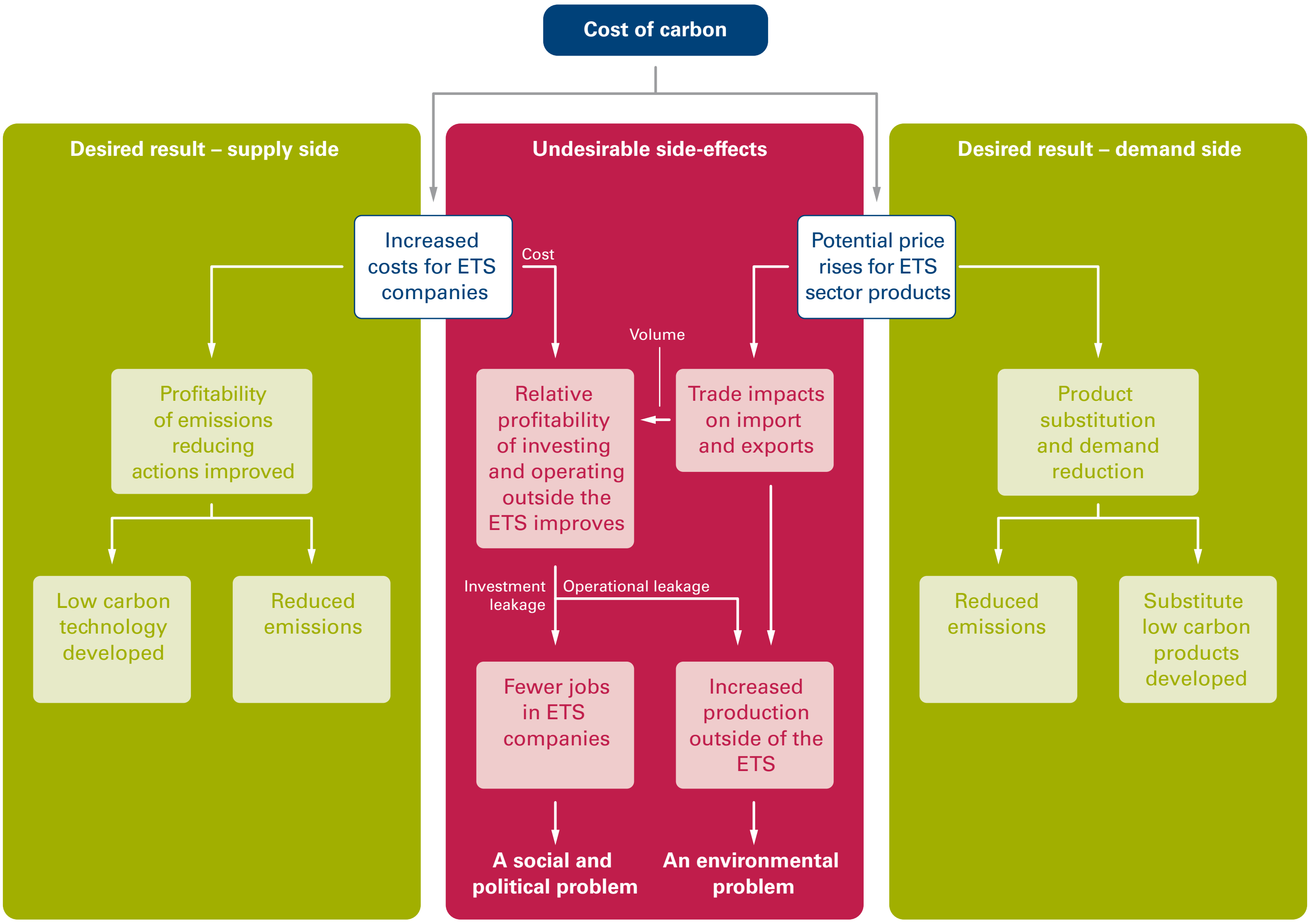
Chart 2a *International spillover channels from a regional carbon price*



Note: industrial leakage relates to the centre part of the flow chart. The energy channel is illustrated on the left-hand side, the technology and policy diffusions on the right-hand side.

[11] Competitiveness is most easily defined at the firm level. The term is also sometimes used to refer to macroeconomic performance and national productivity. Our focus is at the firm or sector level; there is little evidence that climate policy risks affecting national economic competitiveness more generally.

Chart 2b *Potential mechanisms of industrial impact from a regional carbon price*



However the main political debate, and the focus of this study, is on the second channel of industrial competitiveness and leakage effects. *Chart 2b* illustrates how the desirable impacts of carbon pricing in increasing the profitability of emission reductions, on both the supply side (left hand) and demand side (right hand), may also have undesirable side-effects on investment and trade:

- Production costs for carbon and electricity-intensive sectors will increase, potentially improving the relative profitability of operation and investment in these activities outside the ETS.
- If carbon costs are fed through to product prices, this may restore (or indeed increase) profits, but depress exports and attract imports.

These in turn feed through to both operational, and investment decisions. Operating abroad instead of at home is an environmental problem, because it means emissions are generally not reduced (and could increase). However the potential for 'job leakage' associated with investment (and closure/relocation) decisions is probably a bigger political issue. If companies struggle to pass costs through, a small absolute cost could have a disproportionate impact on returns, triggering a decision to locate new investment outside the ETS. In particular a multinational company with a high degree of international competition and high carbon costs will screen locations to optimise new investment (of course logistics and vertical integration matter as well). Some sectors, like steel, are often treated by governments as a core industry that needs to be sustained.

There will also be, of course job creation in new industries. Seeking to preserve an existing industry structure rather than allowing structural changes to create employment in new sectors is ultimately a political more than economic issue – but no less important, particularly if the structural changes are driven by government policy.

3. Which sectors may be exposed?

The impact of carbon prices on the direct and indirect costs of a company has been subject to a number of studies, including investigations by the Carbon Trust[12]. For the UK, the cost impacts were found to be particularly large for *cement*, and *iron and steel*. Such analyses have now been carried out in several countries and confirm the broad pattern of findings.

There are some differences between the ranking in these studies, but in general the most cost-impacted activities are consistent with the six main sectors identified by the Carbon Trust as being either 'significantly' or 'plausibly' of concern, namely primary production of:

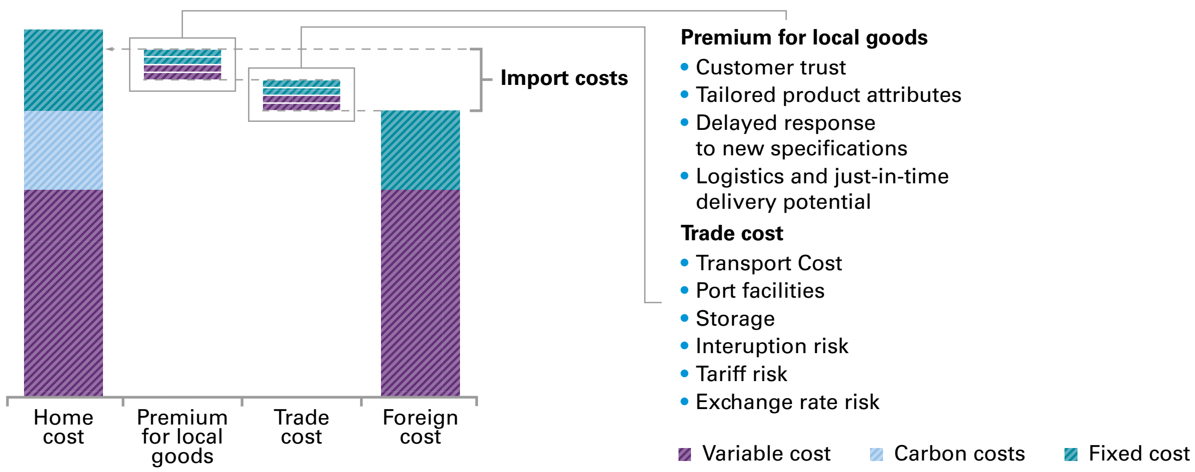
- Iron and steel
- Aluminium
- Nitrogen fertilisers
- Cement and lime
- Basic inorganic chemicals (principally chlorine and alkalines)
- Pulp and paper.

In both the US and UK studies, in total these sectors account for less than 0.5% of GDP. The share of GDP is slightly higher in Germany and Japan, but still well below 1% of GDP[13]. In the most sensitive sectors, each \$10/tCO_2 carbon price they pay could increase production costs by more than 10% of their value-added. Refining and other petrochemical activities form a big sector, particularly in the US where refining is more often identified as potentially impacted. However, the carbon cost relative to the value-added is generally (though not always) lower than for the six sectors listed to the left, and trade issues can be more complex and specific to individual refineries.

In addition to cost impacts, various factors determine the potential for trade and investment effects. These include various factors that affect the costs of trade, and others that represent a premium that can be charged in local markets, as illustrated in *Chart 3a.* The combination of factors determines the hurdle for extra cost from carbon pricing which, if met, could trigger a shift in favour of imports.

The actual premium based on product quality, long-term customer relations and political factors makes some recovery of carbon costs possible without losing market share, even if carbon costs equal trade costs. For existing facilities, fixed sunk investment costs may be a further important factor in delaying leakage, though times of recession might also squeeze margins further and make companies consider closure.

Chart 3a *Carbon cost impact, local premium and trade cost*



Source: adapted from Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

[12] Carbon Trust (2006), 'Allocation and competitiveness in the EU Emissions Trading Scheme: Options for Phase II and beyond': Carbon Trust (2008), 'EU ETS impacts on profitability and trade. A sector by sector analysis', 2008; www.carbontrust.co.uk

[13] See Climate Strategies (2009): Grubb, M. et al., Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System' for the German Marshall Fund of the United States; and for Japan 'Climate Strategies (2009): Grubb, M. et al., Ten (plus one) insights from the EU Emissions Trading Scheme: with references to emerging systems in Asia', reports available from: www.climatestrategies.org

4. How big is the problem?

New modelling suggests that on the one hand, for the EU as a whole, less than 2% of emissions will 'leak' while on the other hand, in the steel sector 40% of its expected emissions reductions may be delivered by shifting production outside the EU ETS – if there is only pure auctioning with no free allocation or border levelling.

A sensible policy response requires some effort to quantify the possible impacts. This section presents estimates of potential leakage that could arise in implementing the EU ETS Phase III cap for three of the most impacted sectors: steel, cement and aluminium, based on a detailed model that represents these specific sectors, together with power generation, including their market and trade characteristics[14]. These account for three-quarters of emissions capped under the EU ETS, and within that, electricity (for all uses) accounts for about three-quarters of the emissions covered in the model. This is illustrated in *Chart 4a(i)* which also shows the portion of electricity attributable to these energy-intensive sectors; including attributed emissions from their electricity consumption, steel, cement and aluminium production together account for 34% of emissions capped under the EU ETS. The model separates cement from the production of clinker, the carbon-intensive input to cement production that can also be separately traded.

The analysis explores the implications of different approaches to delivering the currently proposed EU ETS Phase III cap in the middle of Phase III (2016)[15]. A base case illustrated in *Chart 4a* explores the impact of purely unilateral action by the EU (no carbon pricing elsewhere in the world), with no free allocation or protection measures – i.e. maximum exposure (for the given cap). The cap would turn slight emissions growth into a significant decline as illustrated, but a part of the reductions (around 10%) might be due to leakage rather than action to reduce emissions.

Chart 4b shows the division between emissions, domestic abatement and leakage for clinker, steel and aluminium in 2016 for these 'maximum exposure' conditions. The biggest percentage emission reductions occur in clinker production, where emissions reduce to 70% of the reference level. This is driven by a combination of reduced carbon intensity in producing clinker (e.g. improving efficiency and using biomass); reduced need for clinker through all the subsequent stages (less clinker input to cement, and reduced cement production); and offshoring of clinker production. Of the 30% overall reduction, about one sixth (16%) is due to leakage of clinker production; the corresponding leakage-to-reduction ratio for cement overall is 19%.

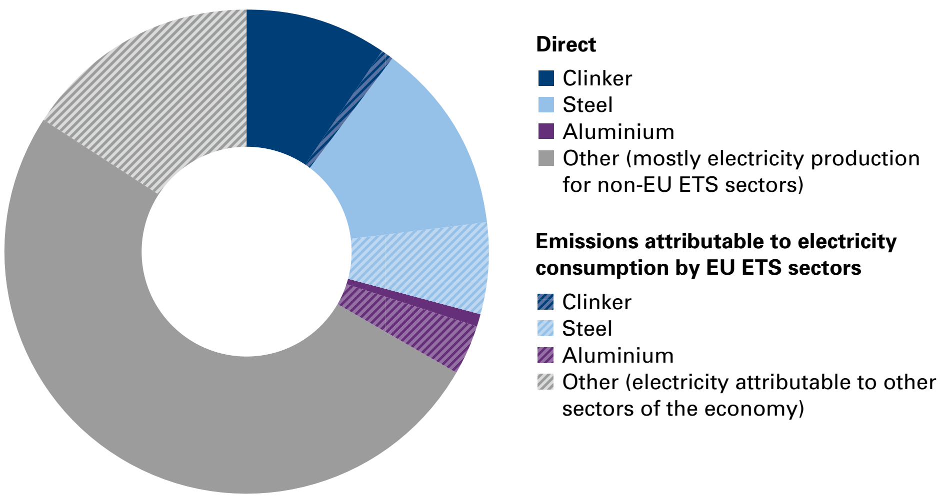
Steel production shows the highest leakage of all three sectors; emissions from steel production in the EU fall by over 15%, but almost 40% of the reduction is attributable to leakage. The leakage-to-abatement ratio in aluminium (21%) is similar to that in cement, but the absolute impact in aluminium is far smaller.

[14] For the four sectors covered, the model (CASE II) includes most of the key factors relevant to an assessment of carbon leakage: impacts of carbon costs on overall cost structures; basic market structure of the sector (within EU and trade), including to allow capital cost recovery; regional markets; transport costs; abatement costs; and key product and process differentiation, including representation of clinker production as a separate industry that inputs to cement production. It also of course models international trade between the EU and the rest of the world in cement, aluminium and steel.

[15] i.e. uses the linear decline of 1.74% required to deliver the 21% EU ETS sector reductions by 2020.

__Chart 4a__ Sectoral shares and base simulations for 2016

(i) Share of total EU ETS emissions by sector



(ii) Modelling of leakage in 2016 under full auctioning

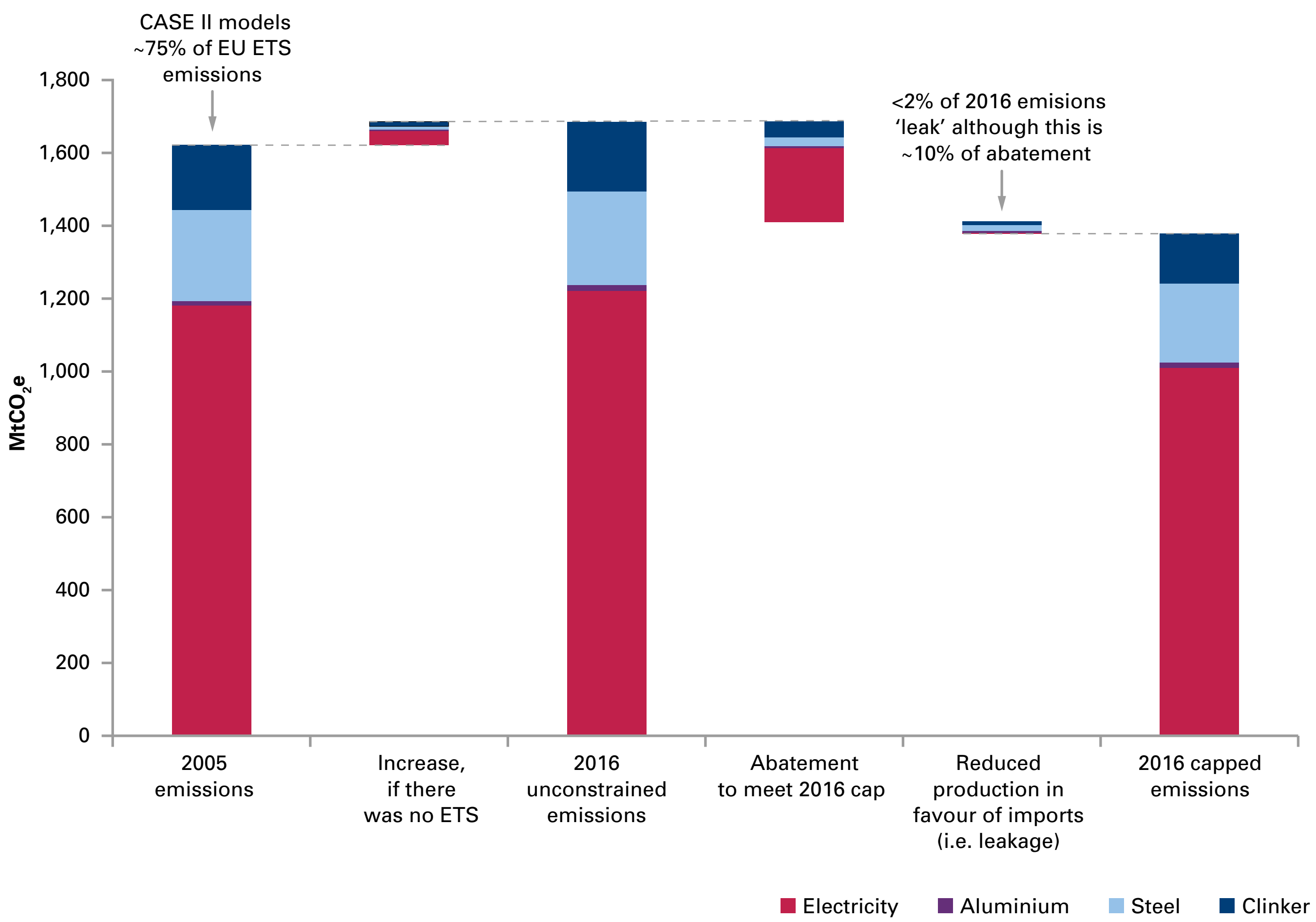
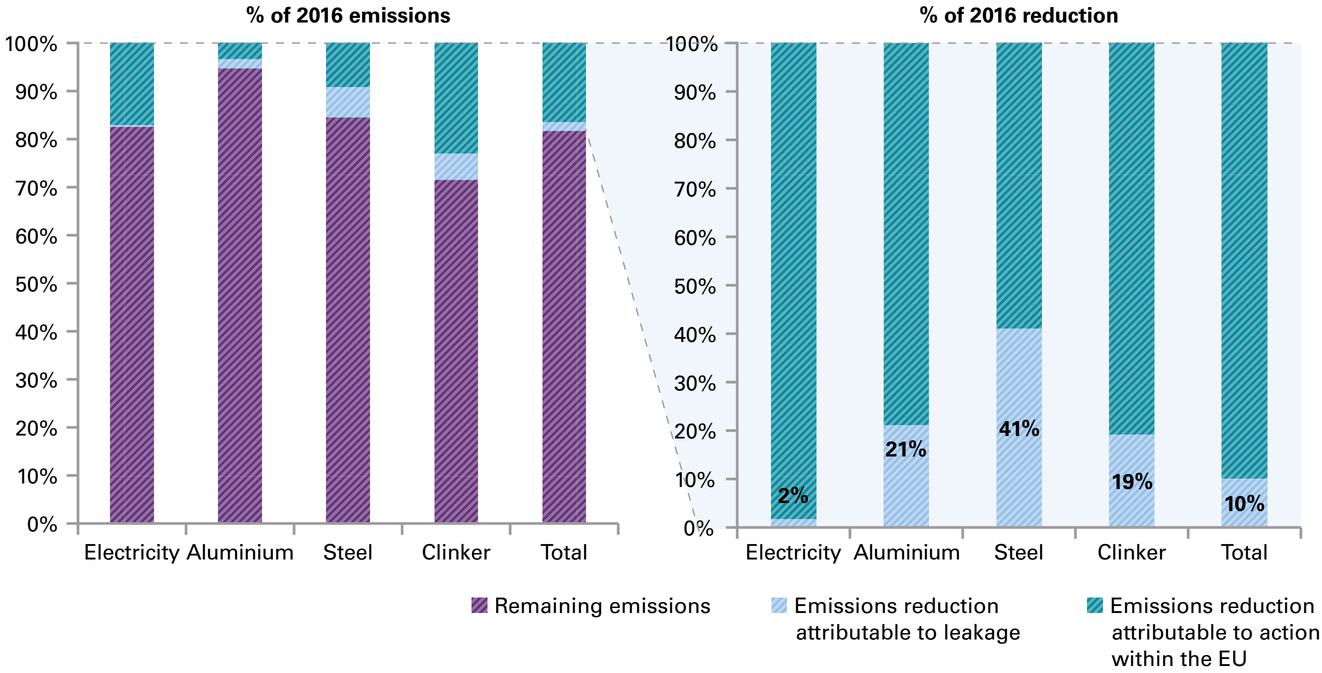


***Chart 4b** Percentage abatement and leakage-to-reduction ratios by sector*



Source: Monjon, S., Quirion, P. (2009), Addressing leakage in the EU ETS: Results from the CASE II model, working paper available from: www.climatestrategies.org

It is ultimately a matter of political judgement as to whether such leakage rates matter. In absolute terms, the emissions leakage under these conditions represents less than 2% of EU emissions. However, relative to the scale of individual sectors, it represents about 5% of production in steel and cement across the EU, and of course this would tend to be much more concentrated in some countries (and regions) than others. Particularly if this were reflected as relocation of investment, this could make it a big political issue. In environmental terms, the aggregate effectiveness of the EU ETS is not much undermined – but if 20-40% of the apparent abatement in the most exposed sectors is actually leakage, that clearly weakens the effectiveness of the instrument in these sectors.

If carbon prices were higher than the results modelled (perhaps with the EU moving to tougher cutbacks), these 'base case' impacts would be increased. Other studies of cement find leakage-to-reduction ratios of up to 40% for a carbon price of €50/tCO_2 (though the authors acknowledge this result as quite extreme), and around 50% for carbon prices of €100-150/tCO_2 for EU action alone, reducing to 25% 'North-South' leakage if the industrialised world acts together[16]. The debate about carbon leakage is thus logically a debate about the sequencing and duration of policies if and as carbon controls tighten, and contingent upon how action expands internationally.

Of course, in practice, the EU has already agreed measures to alleviate impacts on all manufacturing sectors to some degree (with transitional free allocation), and established a process for special treatment of 'sectors at risk of carbon leakage'. To this we now turn.

[16] Cook, G. (2009), Climate Change and the Cement Industry: assessing emissions and policy responses to carbon prices, working paper available from: www.climatestrategies.org

5. The EU approach to classifying 'sectors at risk'

The default approach to allocation in the EU to date has been defined by free allocation. Debate in the development of the Phase III proposals led to a change in the underlying allocation philosophy, recognising the benefits of auctioning in principle but 'risk of carbon leakage' is widely deemed to negate this for 'exposed' sectors.

The specific decisions in the Energy and Climate Package (December 2008), which defines the basic structure of Phase III, represent a partial move to reflect a preference for auctioning over free allocation, with particular exceptions proposed for sectors considered as being at risk of carbon leakage:

- *Power generation* moves to full auctioning as the default. 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 free allocation, defined as a share of the declining cap based on 2005-7 emission levels. To provide transitional relief, the default for manufacturing industry starts with them in 2013 receiving allowances for 80% of the emissions that a 'best practice' producer would emit for free, declining to 30% by 2020.
- Sectors classified as being '*at significant risk of carbon leakage*', on the basis of cost and trade thresholds supplemented by other considerations (see box right), may receive allowances for 100% of the emissions that a 'best practice' producer would emit for free, adjusted for the declining cap, or alternatively, importers may be required to buy allowances.

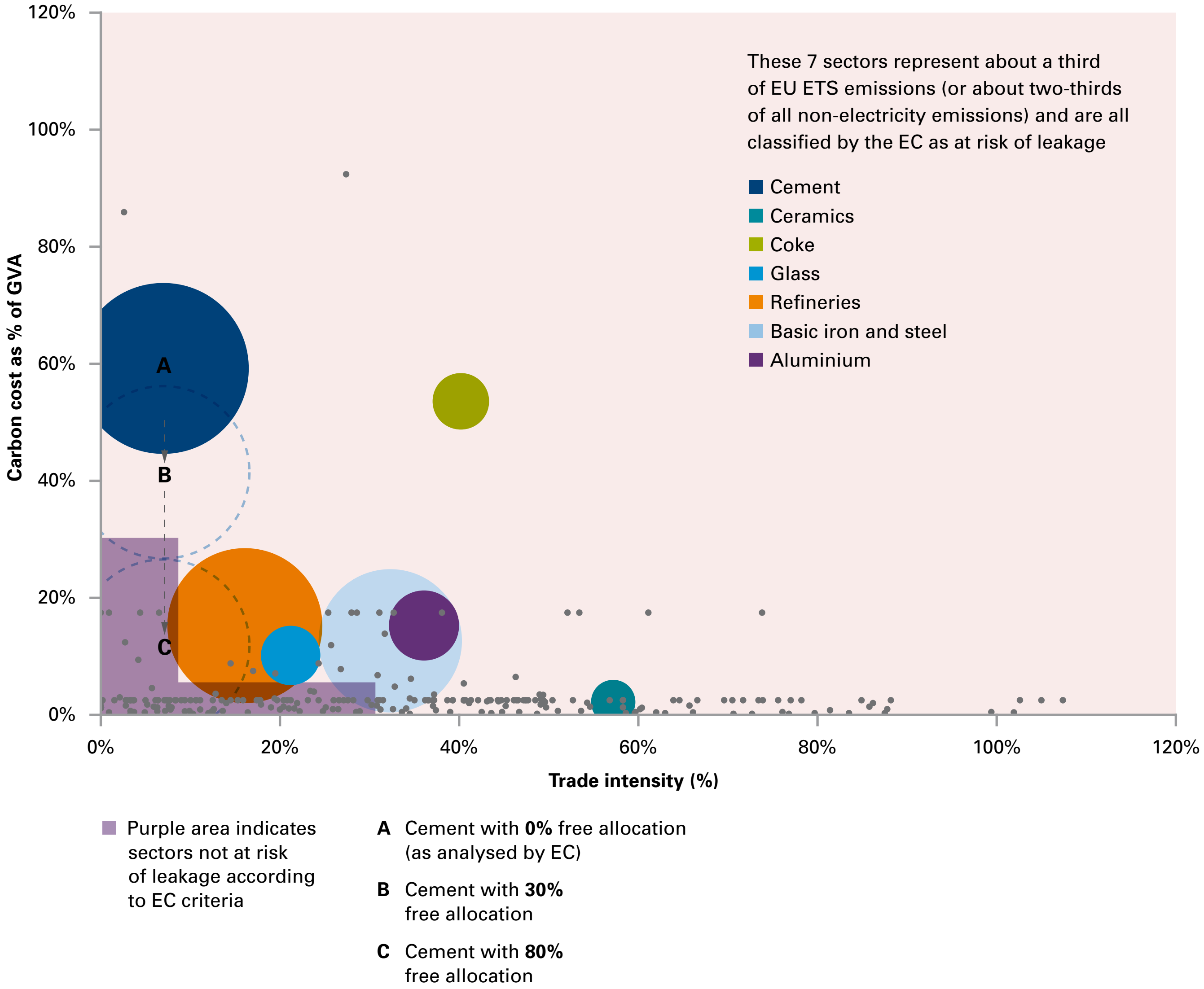
Thresholds for classifying sectors at risk

The identification of 'sectors at risk of carbon leakage' starts with a quantitative assessment of the sectors' exposure to carbon costs in comparison to 'value added' and to international trade intensity. Specifically, the EU Emissions Trading Directive states that 'a sector or sub-sector is deemed to be exposed to a significant risk of carbon leakage' if:

- The sum of direct and indirect additional 'costs induced by the implementation of this directive' is at least 5% of the Gross Value Added and the Non-EU Trade intensity is above 10%; or
- The sum of direct and indirect additional costs is at least 30% of Gross Value Added; or
- The non-EU trade intensity is above 30%.

Those sectors that do not qualify for free allocation based on any of these criteria, or for which there is a severe data problem, may also be considered as at risk based on a qualitative assessment. This, and the overall process, is set out as a one-way process: sectors classified under the quantitative criteria do not have to pass any other tests, the list of 'sectors at risk' can be added to on the basis of qualitative assessment, primarily in subsequent (5-yearly) assessments.

Chart 5a *EC classification of sectors at risk of carbon leakage*



Note: the chart illustrates the agreed EU thresholds for defining sectors at risk of carbon leakage in terms of carbon cost impacts alone (above 30% of value added), trade intensity alone (above 30% trade intensity), or combined (above 5% cost and 10% trade intensity). Dots illustrate the position of all sectors covered in the EC provisional assessment, with the relative emission scale of main sectors illustrated by the size of bubbles. The chart also illustrates for the case of cement the impact of the proposed 'default' level of free allocation that sectors would receive if NOT classified as being at risk, in 2013 (80%) and 2020 (30%). All calculations at the standard price assumption of €30/tCO_2.

The first step in the process of assessing sectors 'at risk of carbon leakage' was a first list of sectors against the thresholds of trade-exposure and cost-exposure, produced by the European Commission in July 2009. This was adopted, largely unchanged, in December 2009. The results of this, together with the thresholds, are illustrated in *Chart 5a*.

Most sectors qualify on the basis of the trade intensity threshold alone. Many of these are minor sectors with specialised products – the trade being often driven by such specialisation and facilitated by low transport costs relative to value. These tend not to be very carbon-intensive sectors. However, the bulk of emissions are associated with sectors that do not exceed the trade threshold on its own, and depend on cost assessment.

For this, the Commission numbers apply a full 'opportunity cost of carbon' that would be incurred if an installation paid to cover all its emissions (i.e. they had no free allocation), using a standard price of €30/tCO_2. On this basis, many of manufacturing emissions would be classified as being as 'at risk of carbon leakage' – accounting for more than three-quarters (77%) of total emissions from manufacturing, and one-quarter of overall EU ETS emissions[17].

However, 'the costs imposed by this directive' start in 2013 with all manufacturing sectors receiving 80% of their allowances for free. This creates an inconsistency. Either:

A. If free allowance allocation is proposed as a solution to carbon leakage, this reflects a belief that it affects relevant decisions e.g. on investment, operation and closure. In this case, the default condition (starting at free allocation of 80%) clearly needs to be taken into account when applying the agreed criteria. Or,

B. If free allowance allocation does not reduce the additional costs induced by the Directive, then it does not alter decisions compared to no free allocation – in which case it cannot address potential leakage.

An alternative interpretation of the directive would thus assess the costs against the default case, which starts with 80% free allocation and declines to 30% by 2020. *Chart 5a* also shows the implications of such treatment illustrated with respect to cement (the impact on all sectors would be similar in proportion). With 80% free allocation, cement would clearly not initially pass the threshold[18]. However, it might do so in the subsequent periodic re-assessments, if and as the combination of declining free allocation and rising carbon prices brought it above the threshold, or indeed if rising cement trade took it across the trade threshold.

A case can be made for either approach to classification:

A. The main justification offered for the EC's current approach is that, in fact, carbon leakage may be driven by the 'opportunity cost' of carbon – the impact on marginal production decision – not the average cost. The 'opportunity cost' approach captures the maximum theoretical impact of carbon costs on both investment and operational decisions. Or,

B. The more incremental approach implied by average costs (with costs rising as free allocation declines) would lead to gradual inclusion of sectors as and when justified by evidence, and would allow time for learning about the implementation of measures to address leakage, and to negotiate and evaluate the adequacy of action in other regions. The overall volume of free allowance allocation would be more restricted, increasing revenue, and reducing the windfall profits and economic distortions from repeated free allowance allocations.

[17] Note: this does not equate to the amount of allowances given out for free, which would be substantially lower due to the impact of declining overall cap and the use of benchmarking.

[18] This also seems reasonable in the light of the modelling estimates in the previous section. If free allocation is taken to reduce the costs that drive leakage, 80% free allocation would correspondingly reduce the estimates of leakage there, from around 5% of cement emissions to around 1% at the price estimated. Also the Commission's choice of €30/tCO_2 against which to assess the thresholds is twice the carbon price estimated in the CASE model under the current cap.

Whilst the former (i.e. proposed) approach is possible and is the one that has now been adopted it is not consistent with then proposing 100% free allocation as a solution to carbon leakage. As explained later in this report, this combination could generate windfall profits and not actually stop carbon leakage. The logically consistent approach would be to link the EU's approach to classification with the option to include importers under Article 10b of the Directive.

At minimum, to allow an informed debate and consistent choice, the Commission should generate results based on average costs (taking account of free allocation), as well as the published marginal (opportunity) cost basis; enabling debate about solutions to be aligned with the relevant choice of indicator. The debate in Europe about how to tackle carbon leakage, in other words, is far from over. If the EU is serious, it is only just beginning.

Part B
Solutions

6. Potential solutions: an overview

Many solutions have been proposed to address competitiveness concerns. However, as noted in our previous reports, in fact there are only three fundamental options. Policy can (1) try to negate the net carbon costs from domestic production; (2) deal with the differential at the border; or (3) seek agreement to add similar carbon costs to production of equivalent goods globally.

An important aim of climate policy internationally should be to move towards 'levelling 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 investment whilst addressing concerns about competitiveness. However, this is not practical at present. Politically, the industrialised world has yet to deliver adequately upon its promise to lead global efforts. Moreover, most developing countries do not yet have the institutional infrastructure to deliver carbon pricing. The introduction to this report traced the patchy development of ETS systems even in the industrialised countries. A world which waits for all to move at the same speed is a world which will never solve the climate problem.

The results of our previous studies, coupled with the modelling in the previous section, suggest that in many sectors the problems are not big enough to justify protective action: cost impacts remotely comparable to those faced by steel and cement are confined to half a dozen or so manufacturing sectors that account for under 1% of GDP. For others, the best approach is simply to phase down free allocation, without other measures. This carries the reasonable expectation that low carbon innovation will keep pace with any minor leakage effects, whilst concentrating diplomatic efforts on expanding the range of countries taking equivalent action. In terms of ETS policy, this is the right-hand channel shown on *Chart 6a*. It combines with a diplomatic policy that can contain elements of encouraging countries to evolve through some or all of the steps shown along the bottom, expanding the scope and impact of their domestic actions including in relation to traded goods.

However, where sectors are considered to be at risk, the other two approaches – levelling costs down, or dealing with cost differentials at the border – need to be considered at least for a transitional period. 'Levelling down' can involve free allocations or direct subsidies, as analysed in the next section (7), and border levelling can also take many forms as considered in section 8.

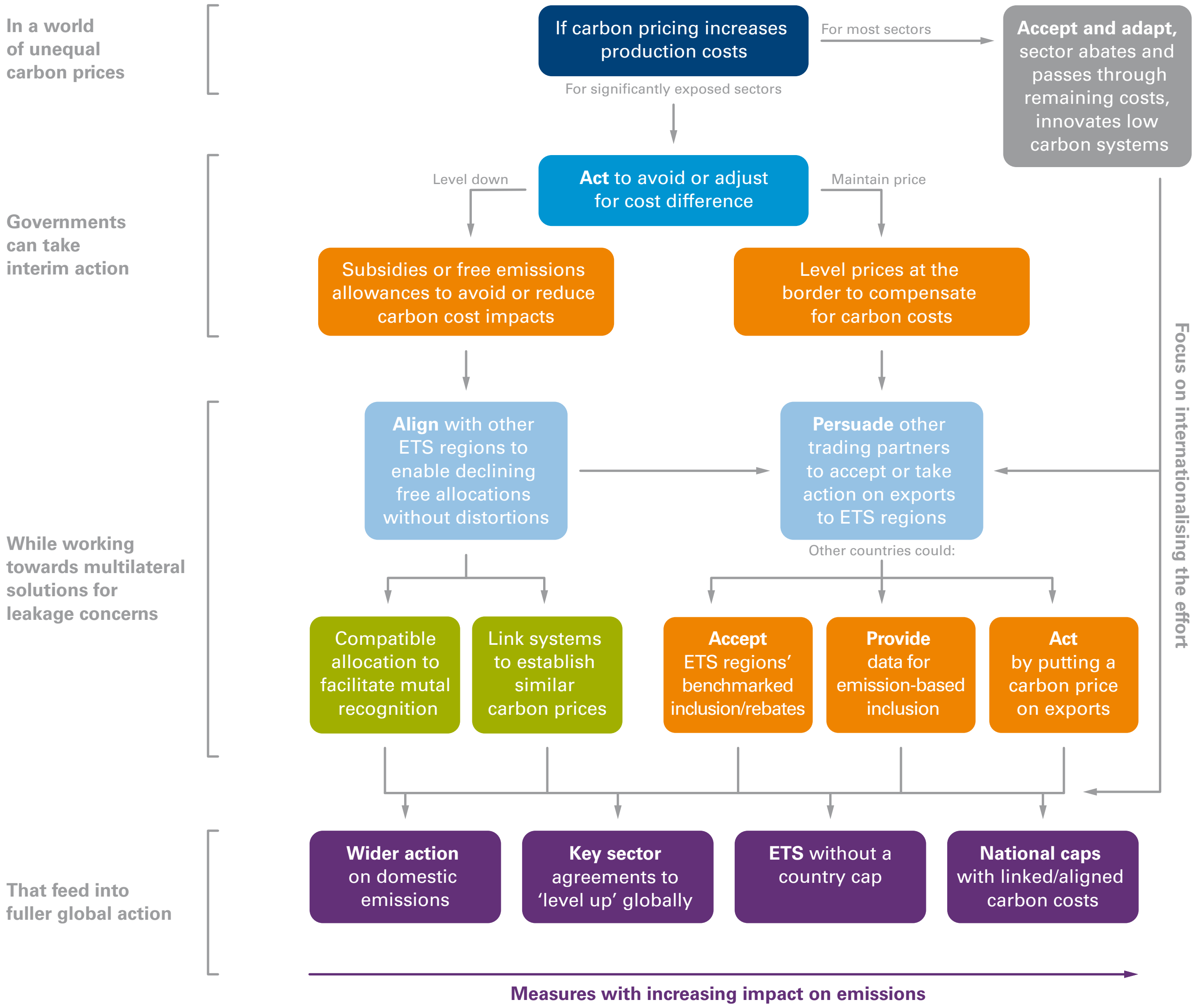
In theory, either of these can be adopted unilaterally. In practice, there are limitations to unilateral action. 'Levelling down' involves compensation for carbon costs, which could in principle be challenged by others if excessive, and different ways of allocating allowances for free could still introduce distortions even between trading schemes. Working with other regions adopting trading schemes to align free allocation approaches would reduce distortions, and linking such schemes, directly or indirectly, would help prices to converge. These issues are considered in our report on *linking emission trading schemes*[19].

The value of international collaboration with respect to border levelling is more obvious and substantial, and could take several different forms as indicated in *Chart 6a*. These are considered in analysing border levelling in section 8.

The international toolbox can of course include sectoral agreements, on technological standards or benchmarks and on carbon cost equalisation. Extensive work is ongoing on these possibilities, but the Copenhagen outcome gave short shift to hopes for sectoral agreements, least of all ones that would incorporate a carbon price globally.

[19] Carbon Trust (2009) Linking emissions trading systems: prospects and issues for business.

***Chart 6a** Carbon leakage: structuring options in the wider context*



Note: this study covers the options highlighted in orange. Global, long-term solutions to climate change will involve working from the top-left to the bottom-right of the chart.

With respect to carbon pricing, the underlying dilemma is the tension between trying to globalise action (which could include subsidising poor countries to adopt advanced or alternate technologies), and protecting competitiveness (for which subsidising potential competitors to improve their performance is the last thing one would do). It is unclear whether or how the debate on sectoral agreements will navigate this fundamental tension; and it is possible that solutions might need to include agreements on free allocation and/or adjustment at the borders in key sectors. Sector agreements will be studied in future work, this study focuses on the generic structural elements of 'levelling down' and 'border levelling'.

The overall political challenge of tackling climate change through carbon pricing is to work from the top left, with carbon pricing in some regions largely offset by 'levelling down' for sectors considered to be at risk of leakage, to the 'bottom right', in which most countries have adopted effective national emission caps implemented to levels that impose a similar carbon cost. As indicated in the introduction, this is a huge political challenge. The choice between 'levelling down' and 'border levelling' – and how these options are approached – may also have implications for the world's progress on this journey.
It will be important to ensure that approaches to tackling carbon leakage do not lock us on to the wrong path, but rather create incentives to move the world faster towards more effective, global action.

7. Levelling down: free allocation and other approaches

Various options can be used to 'level down' costs: labour taxes or other costs can be lowered to compensate for a cost of carbon; subsidies for specific investments can be given, or emissions allowances can be allocated for free.

The most general option to level down costs would be to adjust other costs, e.g. labour costs or taxes, to compensate for carbon costs. In principle this could at least address investment leakage, by offering compensation attractions for industrial investment. These could be funded, indirectly, by the revenues associated with auctioning emission allowances. This forms the basis of a wide literature associated with carbon taxation, and explains why carbon pricing is not necessarily bad for 'national competitiveness' overall. However, its fundamental characteristic is that it cannot target the sectors of concern – which by definition face an exceptionally high carbon cost impact, which would tend to swamp the scale of benefits from reduced employment or corporation taxes that spread much more widely across manufacturing industry.

To address specific investment costs and the impact on electricity-intensive industries of cost pass-through in power generation, governments can provide investment subsidies. This has the pros and cons of any instrument that operates on a case-by-case basis: it can be well targeted, but may have high administrative costs and would be heavily subject to lobbying at the level of individual investment decisions. In the EU, the well-developed structure of State Aid procedures can help to manage these pressures.

The most direct instrument is free allocation of emission allowances. This obviously offsets the direct cost of emissions. However as explained below, it may only be effective in protecting relevant operating and investment decisions if the allocation is conditional upon those decisions (such as closure, investment in a new facility, or operating decisions). The allowances can be distributed on the basis of benchmarks, to preserve some of the key incentives, a method which is prioritised in the revised emissions trading Directive of the EU. Free allocation is the approach which, since it comes closest to preserving 'business as usual', dominates the political process in both the EU and US at present.

Investment subsidies

Direct compensation in the form of investment support can be used to ensure investment and re-investment in low(er)-carbon technology is undertaken in the ETS territory. This may be effective for sectors with high capital costs, particularly if new investment is needed and could be adversely affected by carbon costs. Direct compensation on a case-by-case basis could address such investment leakage, and direct payments for new or (re)investment could be made conditional on specific carbon efficient technologies or on specific carbon-related standards. Investment subsidy is obviously a sensitive topic and if taken to excess could undermine the basic carbon price signal.

Ideally such measures should be accompanied by strong policies to decarbonise EU electricity. Structures to facilitate such companies investing in, or striking long-term contracts for, low carbon power generation would be an obvious goal to align such support with wider climate objectives.

It will be important to find criteria that are closely linked to the level of innovation and carbon intensity of a new production site for State Aid approval of such subsidies; indeed the purpose behind any given aid measure will be crucial in assessing its acceptability under EU law, 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 for such measures proposed by Member States.

In practice, the complexities and uncertainties associated with such procedures drive a general desire for a simpler approach that can be more widely and generally applied – namely, free allocation.

Effectiveness of free allocation in tackling leakage

Free allowance allocation can compensate for carbon costs but does not automatically address leakage if allowances freed up by cutting production can be sold (and revenues even used to finance relocation). Preventing this would require free allocations to be linked to the existence, availability or production of an installation. The EU ETS allows for allowances to be withdrawn upon closure of facilities, and establishes a generous reserve for free allocations to new entrants, but each carries some limitations as a tool for tackling carbon leakage:

- Closure rules may create an excessive incentive to keep a plant operating; it carries a risk of perpetuating the operation of an old inefficient plant, even when it might make good economic and environmental sense to close it down in favour of a new plant, whether in the EU or abroad. It may also involve complex rules and monitoring to minimise the extent of running a redundant plant at a low level purely to avoid losing its emission allowances.
- New entrant reserves would effectively offset the carbon cost from new investment decisions, but since these may be planned to operate for decades, industry is likely to want assurances of continuing protection well beyond the 2020 end-point of Phase III – amplifying the dilemmas around the parallel closure rules and other problems outlined below.

The US proposals avoid these complexities by linking free allocation to the level of industrial output, with implications considered below.

Free allocation in proportion to emissions is of little benefit to electricity-intensive manufacturing sectors. For these, the US Waxman-Markey bill proposes to give free allowances to distribution companies, that are then subject to regulations that prevent pass-through of opportunity costs. This ingenious approach has the obvious drawback that it removes the carbon price signal to all electricity consumers. This may be popular politically and represents a general desire to protect consumers from higher prices. But it represents a sledgehammer to crack the nut of potential carbon leakage from the electricity-intensive manufacturing industry.

The potential for excess profit

The intent of an emissions trading system is for firms to be able to profit through reducing the emissions required to meet their consumers' needs. Free allocation creates three routes by which firms may potentially increase profits without reducing emissions:

1. Any *allocations that exceed 'business-as-usual' needs* can simply be sold.
2. *Increasing product prices to reflect the 'opportunity' cost of carbon* may still make sense even with free allocation. In a fully competitive market firms may still add to all sales the cost of carbon associated with incremental production decisions – the need to buy emission allowances (or opportunity to sell them), depending upon whether output is increased (or reduced). If the cap is fixed this reflects the 'opportunity' cost of carbon, but free allowances mean that companies only pay part of that cost and they profit on the remainder. This has happened in some parts of at least the electricity sector under the EU ETS. Giving out free allowances in proportion to output (output-based allocation) reduces the scope for such profit-making.
3. *Reducing production to sell more allowances*. It may be profitable for a firm to cut some production – potentially in favour of imports – and sell the allowances freed up, providing it does not have to surrender the allowances back to the government, and the value of allowances exceeds the profit margin on goods sold. The drop in commodity prices surrounding the 2008/9 economic crisis may mean that margins are low enough to encourage some firms in the EU ETS to sell some of their free allowances, although in this case it is unlikely to result in windfall profit, just smaller losses compared to the case if they had not been part of the EU ETS.

Of course, potential to profit from an emissions trading system is not necessarily a bad thing (and healthy profits could help companies invest in low carbon solutions) – but it has distributional and trade implications, and the political furore over windfall profits in the EU electricity sector illustrate some of the dangers. Other sectors can, have, and potentially will continue to profit from the some of the mechanisms illustrated above.

The cost of free allocation

Any method in which allowance allocation depends upon factors under a firm's ongoing control carries a risk of perverse incentives that reduce efficiency. The political unacceptability of plants closing so as to cash in their allowances, is as noted 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. We summarised these in terms of a 'pyramid of inefficiencies', discussed in a previous Carbon Trust report[20] and extended elsewhere to consider the impact of output-based allocation[21].

Benchmarking can retain incentives to improve carbon efficiency, but is complex

The EU Energy and Climate Package seeks to minimise efficiency losses by allocating allowances on the basis of 'benchmarks'. If the level of allocation is linked to the capacity of a plant, multiplied by a benchmark factor (such as a standard emissions per unit of power generated) plants have an incentive to improve carbon efficiency. However, benchmarks in manufacturing can become complex, given the wide range of products and production processes. Complexity and distortions increase when recent data are 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[22]. This starts to remove the flexibility offered by a market-based instrument and undermines 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.

Benchmarking also could reduce the overall level of free allowances in each sector. The efficiency criterion for benchmarks is set in the Directive as the top 10% of producers in a sector. The extent to which sectors or installations are short of free allowances in Phase III will depend upon their growth prospects and these benchmarking decisions. Obviously, there is some potential trade-off between the realised degree of cutback, and the effectiveness of free allocation in tackling leakage. However, many details remain to be determined; the main benchmarking decisions are due to be taken during 2010, but final allocations in each of the categories and each sector may not be finalised until 2012. Whilst the broad implications are reasonably clear, free allocation will not give industry the specific, early certainty on plant allocations that it seeks.

Benchmarking free allocations is no panacea: by at least partially taking the carbon cost out of investment decisions, it undermines the incentives for low carbon investment and innovation at all points downstream of the allocation point. The perverse effects are particularly striking in cement, as discussed in Part III of this report.

Free allocation based on output exacerbates efficiency losses

Different issues arise if free allocation is based on output (e.g. a tonne of cement), or equivalent rebates are given, as proposed in US legislation. 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 towards 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 reduces leakage and windfall profit potentials, but provides no incentive to adjust production or consumption decisions to reflect the cost of carbon.

In effect, benchmarked free allocation foregoes some of the demand side benefits on the right-hand side of *Chart 2b;* output-based allocation (if the level is high enough) foregoes all of them. By losing these conservation or substitution opportunities, the reduced economic efficiency increases the overall cost of meeting carbon reduction goals.

[20] Carbon Trust (2007): 'Allocation and competitiveness in the EU ETS: options for Phase II'.

[21] Climate Strategies (2009): Grubb, M. et al., Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System.

[22] 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.

Chart 7a *Impacts of free (output-based) allocation on leakage and carbon price required to achieve target*

	Carbon price required to achieve target €/tCO_2e	Leakage-to-reduction ratio (%)		
		Steel	Clinker	Aluminium
No free allocation	14.4	38.9	16	21.2
All sectors (including electricity) given free allocation in proportion to their production	27.0	4.6	14.9	1.6
Electricity generation given no free allocation. Manufacturing sectors given free allocation for direct emissions in proportion to their production	20.2	12.9	13.6	23.4
Electricity generation given no free allocation. Manufacturing sectors given free allocation for direct and indirect emissions in proportion to their production	21.0	4.2	14.8	0

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

Note: full auctioning presents one extreme, output including electricity the other. The proposed treatment under the EU Climate and Energy Package will be between these two extremes.

Estimating impacts of free allocation

This is illustrated by the fact that free allocation increases the carbon price required to achieve a given target. The CASE model does not distinguish directly between investment and operational decisions and so cannot separate the different kinds of free allocation, but *Chart 7a* gives a sense of the potential scale of distortions. It uses output-based allocation as a 'proxy' for a compensation structure which offsets carbon-related costs in proportion to industrial output, to the extent consistent with the overall cap and is thus more extreme than EU rules which adjust for entry and closure but not production levels.

Complete output-based allocation extended to power generation, to remove the downstream impact on electricity costs, would almost double the carbon price required to achieve the EU target; it would in effect shift much of the abatement effort away from increasing the efficiency with which electricity is used. Retaining full auctioning for the power sector, but applying output-based compensation to the three manufacturing sectors in the model increases the carbon price required to deliver the target by around 30%. The impact of the proposed treatment under the EU Climate and Energy Package, which addresses investment but not operational decisions, would not be as big as this; but the underlying message remains that free allocation does not come for free, in terms of its wider implications.

The results also reveal surprising patterns in terms of leakage impacts. None of the free allocation approaches reduce clinker leakage by much: the higher carbon prices arising from a less efficient approach overall have a disproportionate impact on cement, offsetting the gains. Steel leakage is much reduced, though less so if only its direct emissions are compensated. Aluminium leakage is almost entirely eliminated if policy can compensate for impacts on electricity costs, but its leakage rate actually increases if the system only compensates for direct emissions, since other sectors gain protection whilst aluminium suffers the consequences of higher carbon price impacts on electricity prices.

The results thus illustrate why 'levelling down' carbon costs cannot be the only long-term option for tackling carbon leakage, and hence the need to consider other options.

8. Border levelling: WTO-compatible options for preserving the incentive

Levelling carbon costs at the border could in principle respond to the various challenges posed by carbon leakage. However, while this is attractive in theory, there are very important caveats and constraints.

The concept of border levelling is simple. Trade-exposed industries with a high carbon cost impact could be compensated at the border for the impact of carbon costs. By eliminating differences for exports from, and imports into the EU, the carbon cost would be limited to the territory of the ETS. The price facing consumers for specific high-carbon goods inside the EU would reflect carbon costs, irrespective of the country of origin.

The caveats reflect concerns that border measures could be applied in ways inconsistent with basic world trade principles. This is partly because the debate has mixed up two quite different issues: the use of trade measures in pursuit of wider objectives such as encouraging countries to take stronger action on climate change (or deterring 'free riding'); and the specific objective of implementing carbon costs in ETS regions in ways that don't discriminate between domestic and foreign production of particular, exposed carbon-intensive products, as seen by the domestic consumer. The former objective is potentially discriminatory, as it seeks to raise costs for countries that don't take comparable action, on the basis of judgements that are yet to be specified. But simply levelling for carbon costs is explicitly not discriminatory, and in principle should be entirely consistent with world trade principles.

This distinction is particularly important because developing countries fear that protectionism lies behind the climate change debate in industrialised countries. Proposed US legislation, empowering border measures to be taken against countries judged (presumably by the US) not to be taking 'comparable action', inflames suspicions that protectionism lies behind these proposals. Application of measures specifically to tackle carbon leakage should avoid risk of trade conflict, or risks to a global climate deal, by focusing clearly and specifically on measures to level the costs of domestic legislation, as seen by consumers of key products within the region. Moreover, they could and should do so through a process of clarification and finding common ground through negotiations, perhaps leading to an international agreement on the matter.

Despite the political nature of the debate, border adjustments of some kinds are commonplace: VAT and excise taxes are just two examples of policies that involve charges or reimbursements at the border. Border adjustments for safety or environmental purposes have also been accepted in several WTO cases. The 'Superfund' case allowed in principle the US to extend taxes on chemical feedstocks (already accepted) to 'certain imported substances produced or manufactured from taxable feedstock chemicals', though this has yet to be implemented in practice.

In terms of possible applications to carbon, key distinctions are made between import and export measures, and between *benchmarked adjustments* – which would apply to imports on a standardised basis (per tonne of product), and *carbon-embodied* adjustments that seek to base the adjustment on actual carbon emitted. Also, in general it is far easier to apply adjustments for direct carbon emissions, rather than for the indirect emissions and costs associated with electricity consumption. The practical options are outlined after showing first the potential impacts.

Economic and emission impacts of border levelling

In principle, border levelling can achieve the objective of preserving a level playing field within an ETS region, without the efficiency losses associated with 'levelling down' through free allocation. *Chart 8a* shows results of the CASE model that illustrate this, in terms of the impact of different forms of border levelling on the carbon price required to achieve the EU target, and on leakage. It is evident that border levelling represents a much more efficient tool than free allocation. It still increases the carbon price compared to pure auctioning without adjustments, because it largely removes leakage as an 'abatement option' and ensures that the cap is delivered by real abatement efforts in the EU, without displacement abroad. However, the impact on price is small compared to the inefficiencies of output-based allocation noted previously.

Chart 8a *Impacts of border levelling on leakage and carbon price required to achieve target*

	Carbon price required to achieve target €/tCO_2e	Leakage-to-reduction ratio (%)	
		Steel	Clinker
No border levelling	14.4	38.9	16
Full border levelling: Imports pay and exports are refunded the cost of carbon for all emissions in their production, including indirect electricity emissions	16.1	-25.5	4.9
Import only border levelling: As for 'Full border levelling', but without refunds for exports	15.7	3.1	4.5
Direct only border levelling: As for 'Full border levelling', but no change for indirect electricity emissions	15.8	-12.1	5.4
Direct import border levelling: As for 'Direct only border levelling', but no refunds for exports	15.4	9.3	5
EU Average border levelling: As for 'Full border levelling' but imports based on EU benchmark, not actual emissions	15.7	-4.1	5.1

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

*Aluminium not included, because impact of different options would be dominated by the indirect effects on electricity as indicated in the text. Furthermore, the most plausible border levelling options (direct emissions only) would have negligible impact for aluminium.

Border levelling for clinker production reduces its leakage-to-reduction ratio by about two-thirds. The effect is not complete primarily because of the complexities of the relationship between clinker and cement (cement is assumed not to have a separate adjustment, and thus is affected with knock-on effects on clinker). There is little difference between the different border levelling cases.

The impact on steel is bigger, due to its much higher trade flows, and differs substantially between the different cases. 'Full' levelling (including electricity) has a much bigger effect than 'direct only' levelling, because the sector is modelled as an EU average that includes significant output from electricity-driven electric arc furnaces. Even more striking is the potential for border levelling to turn carbon leakage into an amplification (negative leakage). This is for two reasons. One is that the impact of carbon costs (with full auctioning) on EU steel exports is considerable; export levelling would neutralise this. This allows the second effect to dominate: the overall levelling means that imports (as well as domestic production) reflect a carbon price, thus reducing steel imports and the associated emissions abroad.

Finally, if the import levelling is made at the level of the EU average carbon intensity, rather than the higher 'rest of world' carbon intensity, the environmental benefits are reduced, but remain sufficient to turn leakage into a small degree of 'amplification'.

These results suggest that border levelling could be a valuable tool – but only if it is practical and politically acceptable, without disrupting international relations around both climate negotiations, and the international trade system that has not only underpinned economic growth for fifty years, but can also contribute globally to the efficient use of natural resources. These fears, however, have to be offset by a recognition that international trade can also amplify damages, if these are not properly factored in: and thus an international trading system in which environmental costs are not factored in has no theoretical basis for assuming it improves welfare.

From theory to practicality: consistency with world trade law

The concept behind the international trade rules of the General Agreement on Tariffs and Trade (GATT), and a number of other agreements under the World Trade Organization (WTO), is to reduce trade barriers such as tariffs, quotas, and other non-tariff barriers (e.g. standards or national regulation), and in particular to prevent discriminatory measures that could provoke trade wars that damage all.

These objectives find expression through a few simple principles. To comply with world trade law, border levelling for climate policy purposes needs to meet two major criteria: it should neither constitute illegal discrimination, nor be prohibited subsidies.

The underlying principle of non-discrimination applies through two key clauses:

- The *national treatment* principle under Article III of the GATT states that measures should not discriminate against foreign producers, i.e. treatment of imports must be at least as favourable as that accorded to domestic producers.
- The *most favoured nation principle* under Article I of the GATT requires that privileges applied to any WTO Party should be accorded to all.

A country can introduce trade-related measures that comply with these principles; the onus is on other countries to challenge this if they believe it violates these principles, which would then invoke elaborate dispute resolution procedures. Prior discussion with WTO partners can usually negate risk of dispute over measures that are demonstrably WTO-compatible.

In addition, exceptions to these strictures are allowed; Article 20 of the GATT lists the main potential categories, which include that the trade rules could be suspended if this is necessary 'for the protection of a global resource'. Such an exception requires prior agreement among WTO Parties.

The need for such an exception would be clear, if trade measures were to be deliberately used as an inducement to stronger climate action (e.g. to deter 'free riding' in a climate agreement). For the narrower purpose of tackling carbon leakage, the first focus is upon ensuring measures that are WTO-compatible and do not require a case to be made for exception.

Export-related measures face a different set of hurdles including the need to comply with the 1994 Agreement on Subsidies and Countervailing Measures. There is a good case that reimbursing carbon-related costs upon export could be compatible with this. However, the analysis in Part III of this report concludes that there is little case for the EU to invoke these complexities (though other regions may have a stronger case to do so). The major exports of carbon-intensive goods are to other industrialised countries and the focus should be on ensuring that industrialised countries collectively are taking comparable climate action. Therefore the EU should focus any consideration of border levelling on import-related measures.

***Chart 8b** Different border levelling mechanisms and their trade and climate policy implications*

Policy instrument	Trade policy aspects	Climate policy aspects
	I: Taxes/tariffs	
Tax/tariff on carbon-intensive imports (based on a benchmark for emissions from producing that product)	Levelling of carbon costs vis-a-vis third parties based on national treatment; similar to VAT destination principle; revenues remain with importer	Basis for carbon intensity benchmark needed If applied differentially, potential incentive for engaging non-participants ('free riders')
Rebates for carbon-taxed exports		No carbon price effect for consumers abroad
Export taxes	Levelling, revenues remain with exporter	Mitigation effects. Address financial needs of major exporters from emerging and developing countries
	II: Allowances	
Importers need to buy and surrender allowances	Application with benchmark based on national treatment: as for tax/tariff Mandatory rule based on actual carbon would involve extraterritorial application of national/ regional climate policy	Which allowances are eligible? International offsets, allowances from other ETS?
Exporters are exempt from surrendering allowances	Legitimate if considered as a charge (as per VAT) not a regulation	Relates to free allocation (III)
	III: Other cost adjustments for exports	
Exporters receive reimbursement for allowances	Subsidy?	Undermines incentive to internalise carbon costs
Free allocation for trade-exposed exporters	Subsidy?	Undermines incentive to internalise carbon costs

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

Making import levelling WTO-compatible

Border adjustments include tariffs, taxes, quotas, subsidies or legal standards (see *Chart 8b*). To meet the 'national treatment' principle, the broad form of border adjustments would have to be the same as for domestic production. Thus, importers would have to buy emissions allowances or credits, rather than being subject to a charge (which might vary from the market carbon price). In addition, since the EU ETS applies to direct emissions, it may be difficult to make a case for any import adjustment to include electricity-related emissions or costs, even though these are borne (indirectly) by EU industry.

This reflects a crucial difficulty for climate policy purposes, namely that whilst emissions arise from production, WTO law relates to products, and specifically, non-discrimination of 'like products'. How a product is made cannot constitute a basis for discrimination (unless an exception is sought). The simplest route to avoid the need for such an exception is then to require importers to purchase allowances based on a 'benchmark' associated with a given product. There are two important variants:

- A 'best available technology' benchmark, defined as the best in Europe, would ensure that the measure could not discriminate against foreign producers (but it would mean that importers only paid that 'Best Technology' level of overall emissions). The effect on EU producers emitting more than the 'Best Available' level would be similar to that arising from a free allocation benchmark at this level.
- An 'EU Average' benchmark would have the potential for better-than-average EU producers to benefit compared to importers, but might be WTO-compatible if importers had a 'right to refute' by producing evidence that their emissions were lower than the benchmark. This has the advantage of starting to create incentives for lower carbon production abroad – but this is undoubtedly more complex than a simple 'best available technology' adjustment.

While this appears to be a simple concept, a number of technical, legal and, not least, political details have to be carefully considered. Some of these relate to defining the product precisely, defining the benchmark, and implementing the resulting measure:

- A 'best available technology' benchmark will be easier, technically and politically, where the *production process* is relatively homogenous: a diversity of processes, with very different carbon intensities, could greatly complicate the task and imply that any benchmark would have widely diverse impacts on different producers.
- In addition, the exercise will be much simpler where a sector has relatively few end and interim *products*. This will limit the number of products that need to be precisely defined, and for which benchmarks need to be developed and negotiated, and alleviate also the administrative load, for companies and customs agencies, of monitoring and applying the charges.

Since the EU is engaged in a huge effort at present to define benchmarks for Phase III allocation, this has the potential to resolve a number of the technical issues. However, the application would then be different: a clear cut decision would be needed that full auctioning or partial auctioning is applied to all sectors that potentially qualify for border levelling. Border levelling could not apply alongside free allocation or direct compensation for carbon costs through state aid, since it would clearly be illegal to protect EU industry against carbon costs already avoided through such measures. The purpose has clearly to be to 'level', to protect a clear carbon price incentive – not to seek competitive advantage in sectors for which policy already 'levels down' the carbon costs.

Making border levelling WTO-compatible is thus possible, but avoiding the potentially complex and politically loaded process of seeking exemptions does limit the nature and scope of the measures that can be chosen. International discussion to seek consensus, on simple adjustments as a starting point and potential expansion, is still important – and it could open up some interesting additional options.

Possible actions in uncapped countries

There are at least three tiers of actions through which major commodity exporting countries – notably, developing countries not ready to consider carbon caps themselves but which export carbon-intensive commodities – could contribute to addressing the problem of carbon leakage.

One is purely diplomatic. They could engage constructively in negotiations about what kinds of border levelling by importing countries would be acceptable. A logical objective of this would be to agree what has been dubbed a 'peace clause', setting out at a high political level what WTO Parties (in particular) consider reasonable types of border levelling in relation to climate change. This would avoid the risk of fundamentally political issues, about the relationship between climate policy and the world trade system, being swept into the detail of WTO dispute panels which are not suited for such high-level decision-of-principle.

A second is that countries could agree to provide data on actual carbon emissions associated with their energy-intensive exports. China has already indicated its concern that it is 'blamed' for emissions that are driven largely by Western consumption, through such exports, and developing countries more generally reject the notion that their industries are less efficient and more polluting than those in the industrialised countries. Providing verified data on emissions associated with exports would provide evidence around both points, and establish the information to facilitate border levelling that could reflect actual emissions on a non-discriminatory basis, increasing the leverage on global emissions.

A third option would shift the focus towards export taxes (or equivalent emission credit/allowance requirements) levied by the exporting countries. Export taxes are already used by several large countries including China[23]. The list of policy arguments is long, including the potential benefits to them relating to terms of trade effects, infant industry, and inflation stabilisation arguments. Environmental aspects have not played a major role so far, but China has pointed to these elements and they could form an international benefit to such actions[24]. Under WTO law export taxes are not prohibited. Export taxes can be translated into equivalent carbon pricing on production, thus indirectly contributing to GHG emission reduction and levelling the playing field with respect to regions imposing a domestic carbon price. China's taxes on energy-intensive exports are already significant in terms of carbon-equivalence for key products[25].

There are obviously limitations to such an approach. To provide confidence that such taxes really 'level the playing field' in primary commodities would require some form of international commitment to the level and durability of the measures. In addition, it is unlikely that China will extend export taxes to major wealth-creating manufacturing sectors.

But the option opens another avenue for international discussion, and could produce interesting variants. One example is that if such exporters were required to purchase CDM credits to match their emissions, this would increase demand for such credits, amplifying international funding for supporting mitigation in developing countries, and (through an automatic levy) for adaptation funding. Indeed in the context of climate change, one of the major political attractions to export adjustments by producers, as compared to import adjustments by consuming countries, is that the revenues associated with carbon pricing on traded goods would not go to the industrialised countries (as they would with import adjustments), but rather stay within the developing world.

The potential to tap the revenue associated with border levelling for international benefit may thus be key to unlocking otherwise extreme suspicion from most developing countries.

[23] Sectors and sub-sectors of iron/steel, aluminium, copper and several other non-ferrous metals were charged an export tax rate set between 5 and 25%. The export tax was also used to increase domestic supply on sectors facing protracted deficit. For example, the export tax rate of coal and coke increased from 25% in 2008 to 40% in 2009 and the export rate of fertilizers ranged, across products, between 100 and 150% in 2008.

[24] The Circular Fa Gai Jing Mao (2005) No.2595 clearly states that one major use of the export taxes was to further curb the export of highly polluting and energy-intensive products, should the withdrawal of the export VAT refund already in place for these purposes fail.

[25] Wang, X., Voituriez, T (2009), Can unilateral trade measures significantly reduce leakage and competitiveness pressures on EU-ETS –constrained industries: The case of China export taxes and VAT rebates, working paper available from: www.climatestrategies.org

9. Screening the options

Issues of competitiveness and carbon leakage need to be understood as sector-specific concerns not only in terms of who may be at risk; the choice of response also must reflect sector characteristics.

The European Union is still a frontrunner and a role model on emissions trading. The EU ETS has been continuously improved and made more consistent with environmental goals – a process which will continue. Part of this process must be to take care of effects that are not intended. If the full cost impact hits some carbon-intensive sectors, there are competitors in the world market who deliver lower prices.

Current production and substitution effects are only one issue that could occur if there are no measures taken that address detrimental competitiveness effects from CO_2 prices. The other is where production will locate in the future. It is not clear how far the relocation trends which already exist (in particular in steel) may be reinforced by carbon pricing. In particular after the global credit crisis and recession of 2008-2009, there will be restructuring in manufacturing. New investment in times of recovery will consider future cost impacts from the ETS. The turmoil from the business cycle will add to the potential relocation for 'footloose' sectors – those without strong vertical links or product differentiation.

The analysis in this part of the report indicates that issues of competitiveness and carbon leakage need to be understood as sector-specific concerns not only in terms of who may be at risk; the choice of response also must reflect sector characteristics. Investment support is the obvious tool for a sector with high exposure to electricity costs. Benchmarked free allocation may help address leakage in a capital-intensive sector with high direct carbon cost, but this has the drawbacks noted; and if plants can be economically run at part load to avoid carbon costs, it may be ineffective unless it is tagged to output. Similarly, the legality, feasibility and effectiveness of different border levelling options will reflect sector characteristics. Overall the analysis of options thus suggests a 'screening approach' that is summarised in *Chart 9a*.

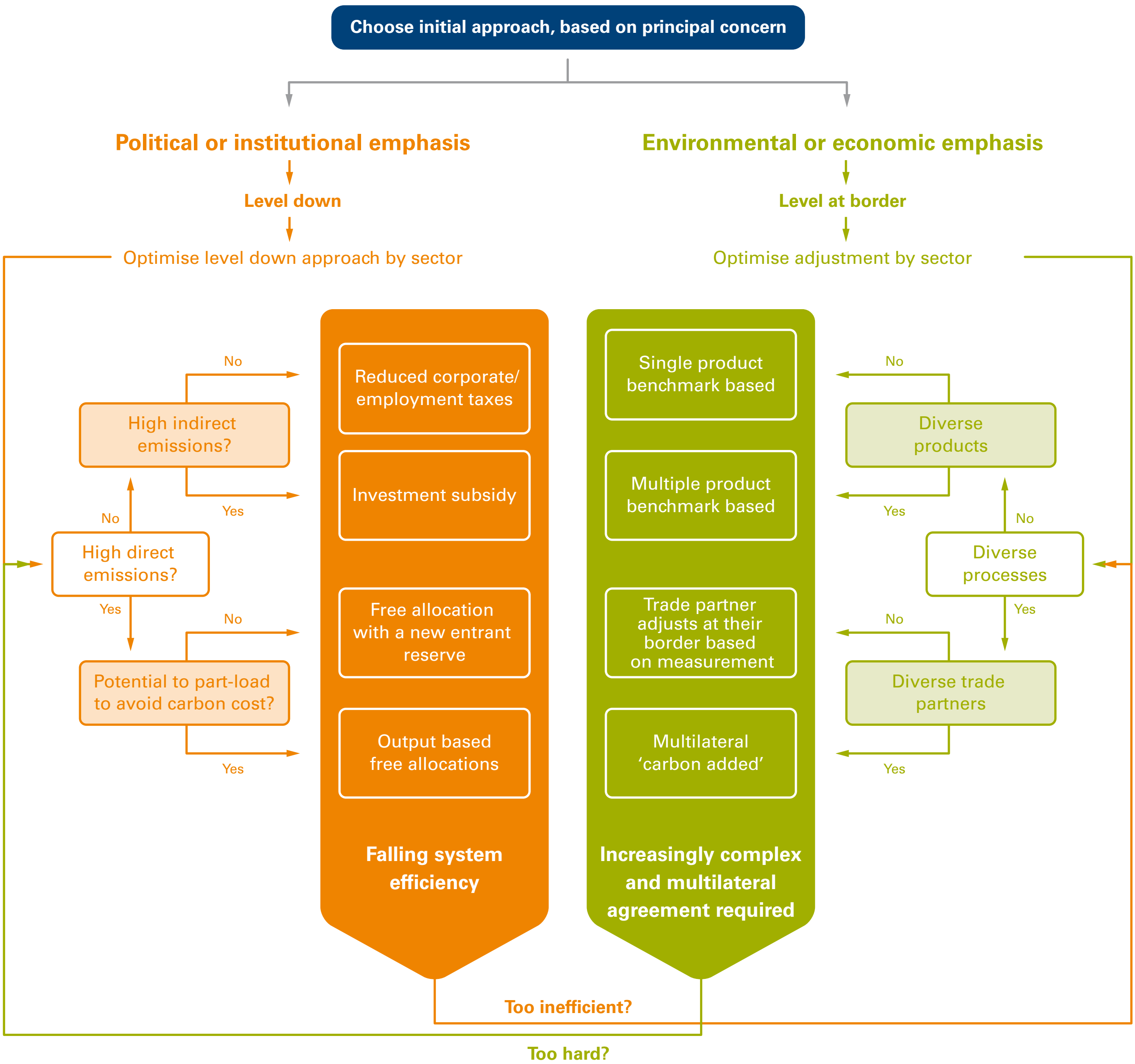
The underlying emphasis in this Chart is to encourage a pragmatic, solutions-oriented approach to what has become a highly politicised debate. People tend to start with a bias towards one option or other: those involved politically or looking at the institutional dimensions tend to regard 'levelling down', usually through free allocation, as the obvious approach; it involves minimal disruption and most easily meets the interests of powerful industries.

Following through the left-hand side of the chart may clarify the extent to which 'levelling down' may (or may not) undermine the basic objective of establishing an efficient incentive to tackle climate change and reward low carbon investment. If free allocation turns out to be either too ineffective, or too inefficient, for a given sector, this should drive consideration of the alternatives.

Conversely, those with an initial focus on environmental integrity or economic purity will gravitate toward border levelling as a way of preserving a carbon price signal in the face of carbon leakage concerns. Pure economists tend to incline towards this as the obvious solution to protect carbon prices in a world of unequal action. However, closer consideration of how sector characteristics may influence the practical options for border levelling may again reveal problems; if border levelling is too hard for the present, free allocation may be a reasonable interim fallback.

To really tackle carbon leakage thus requires a pragmatic and fact-based approach to the needs of the specific sectors of concern. That is the focus of the final part of the report.

***Chart 9a** Screening approach to selecting options*



Reconsider approach on a sector by sector basis

This final part of the report focuses upon the three sectors identified as being most ‘at risk’ in a previous Carbon Trust study – namely steel, cement and aluminium. It also sketches how national circumstances may affect options, and the associated developments in a few key regions.

The underlying question is whether, having identified potential sectors at risk, the form of any action taken should differ by sector. The answer – contrary to the current thrust of policy in both the EU and US – is yes.

Part C
Applying solutions in sectors and regions

10. Cement

The simplest option is to require importers to buy allowances corresponding to 'best available technology' emissions on the same basis as domestic producers. This complies with all relevant WTO provisions, without the need for any exemptions.

Cement is a relatively simple product – albeit with a crucial twist that has profound policy implications – produced from a basic process of crushing limestone and baking it in a kiln to drive off CO_2. This produces nodules of clinker, the raw material which is then crushed and blended to produce various types of cement. This low-profile but carbon-intensive production process accounts for more CO_2 than all the world's aviation, by a large margin, and in Europe for about 10% of all the emissions covered by the EU ETS.

It is also a sector in which substantial emission reductions are possible at modest carbon prices, as illustrated in *Chart 4a,* using well established processes. In addition, more radical innovations – spanning from carbon capture and storage through to fundamentally different processes based on magnesium rather than calcium – offer the promise of much deeper cuts in the future.[26]

Trade trends. Due to its bulk and weight in relation to value added, transport costs are relatively high and cement is not heavily traded. However, trade volumes have been growing *(Chart 10a)* and this may be partially due to the early years of the EU ETS. In 2007 about 7% of global cement production was traded and the EU imported a similar fraction, with imports from China at €450m representing more than half the total (all data include clinker). Cement trade is quite volatile, however, driven partly by short-term fluctuations in regional supply-demand balances, and imports declined in 2008. At less than €1bn/yr, the economic value of cement trade with the EU region is much lower than many other commodities.

Chart 10a *Cement imports into Europe, 2003-7*

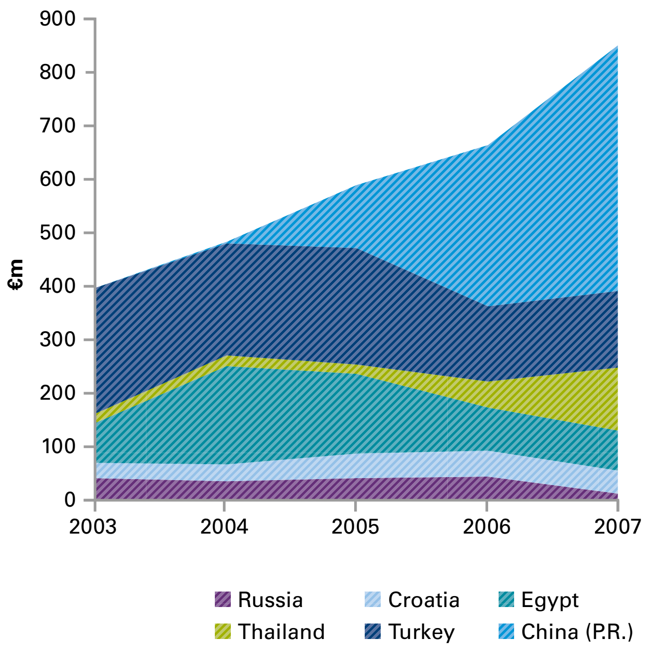


Chart 10b *Cement trade in million € current prices, 2007*

Trade partner	Imports	Exports
Turkey	143	22
China (P.R.)	459	1
Egypt	76	8
USA	1	63
Croatia	42	16
Russia	13	30
Total top 6 importers:	**734**	**140**

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

[26] Cook, G. (2009), Climate Change and the Cement Industry: assessing emissions and policy responses to carbon prices, working paper available from: www.climatestrategies.org

Economics dominated by relatively high operating & carbon costs. Despite increasing technical sophistication in the industry, the basic technology is relatively simple, cement plants are not particularly capital intensive and their operation is dominated by the variable costs of energy and other inputs. When conditions demand, they can readily be run at part load (or individual kilns on a site can be turned off for periods).

An earlier Carbon Trust study[27] indicated that carbon costs have a higher impact on UK cement costs, relative to value added, than for any other sector except lime; Climate Strategies[28] found the same to be true with German data, by a larger margin and with no exceptions. The extent to which this may overcome barriers to trade, notably transport costs, depends on the exposure of local markets particularly to seaborne trade, and of course the carbon price.

Estimates of leakage from the CASE model suggest potential for modest carbon leakage (about 5% of production, 15-20% of actual reductions) at the (relatively low) carbon prices required to deliver the EU's current Phase III target. This would be concentrated on coastal areas notably in Mediterranean countries, UK and some of North Sea, also through river systems such as the Rhine and Danube. Other estimates show carbon leakage-to-reduction ratios rising up to around 50% if EU unilateral action sustained carbon prices around €50-100/tCO_2, without any offsetting measures (i.e. full auctioning).

Free allocation is not an effective solution

Following the left-hand side of the screening *Chart 9a* questions the potential for tackling leakage through 'levelling down'. Free allowances through the EU system (or indeed equivalent investment subsidies) might retain any new investment. However, it would not address the potential impact of carbon costs on existing cement plants – nor indeed, on how any new ones might be operated. A volume of free allocation fixed for Phase III of the EU ETS – 2013-2020 – could invite two perverse effects, given the dominance of inland transport costs in cement markets:

- Plants located inland and protected by transport costs could behave in similar ways to the power sector, with substantial profits arising from passing through incremental carbon costs ('opportunity costs') into local cement markets despite the free allocation.
- Plants located near the coast might profit substantially by shutting down (or running at much reduced output, to avoid being caught by closure rules), selling their surplus emission allowances, and servicing their local markets through imports.

It remains hotly contested how much cement markets would actually maximise profits by passing through 'opportunity' costs in this way. There is limited evidence of pass-through in EU ETS Phase 1 (in the range 10-40% of the carbon price), but there was little time for the industry to adjust its prices before the carbon price collapsed anyway, so this is not a good guide. Theoretical models[29] suggest the industry would pass through anywhere between 33-90% of opportunity costs, depending on market structure and location.

[27] Carbon Trust (2008), 'EU ETS impacts on profitability and trade. A sector by sector analysis', 2008; www.carbontrust.co.uk

[28] Climate Strategies (2007): Hourcade, JC., Demailly, D., Neuhoff, K., Sato, M., with contributing authors Grubb, M., Matthes, F. and Graichen, V., Differentiation and dynamics of EU ETS industrial competitiveness impacts, final report available from: www.climatestrategies.org

[29] Carbon Trust (2004) 'The European Emissions Trading Scheme: Implications for Industrial Competitiveness'; www.carbontrust.co.uk; and Cook, G. (2009), Climate Change and the Cement Industry: assessing emissions and policy responses to carbon prices, working paper available from: www.climatestrategies.org

Chart 10c *EU ETS impacts on the European cement sector costs, prices and profits*

Carbon cost pass through rate (carbon price €30/tCO_2)	Typical cement price (€/t cement)	Typical operating profit per tonne cement sales (€/t cement)	Increase in the sector's profits under the EU ETS (€m/yr)
0%	€60	€9.9	-€754
30%	€66	€15.9	€697
50%	€70	€19.9	€1,632
70%	€74	€24.0	€2,542
90%	€78	€28.0	€3,426
100%	€80	€30.0	€3,858

Source: Cook, G. (2009), Climate Change and the Cement Industry: assessing emissions and policy responses to carbon prices, working paper available from: www.climatestrategies.org

Chart 10c indicates that a carbon price of €30/tCO_2 (the price used for the EC assessment), equates to about €20 per tonne of cement. Thus if plants have an operating margin of more than €20 per tonne of cement, it would not make sense to reduce output; however, the combination of varying cement prices and locations with varying carbon costs could easily lead to conditions under which individual plants could increase their profits by cutting production and selling the allowances. Obviously in practice, individual plants would be in different circumstances and supply must match demand. For pass-through rates in the range 30-90%, compared to the situation without the ETS the overall profits of the EU cement industry would rise by around €0.7bn-3.4bn/yr, or more with a combination of mitigation efforts and leakage that frees up additional allowances for sale.

Leakage rates at these prices would still be modest (€20/t cement is a lower estimate of the costs of shipping clinker); the point is that free allocation may not stop leakage. At the higher levels of pass-through, and particularly with higher carbon prices, companies could reap additional profits by selling allowances and importing cement instead. Irrespective of short-run profit maximisation, operators would have to pass through more and more of the carbon cost to make it worth keeping plants running, instead of selling the allowances. Cement production in the EU is projected anyway to remain flat or slightly decline; with the level of free allocations implicit in the current EU approach, the combination of abatement and leakage might then leave the industry with substantial surplus allowances throughout Phase III.

The net effect of all this could thus be to increase cement prices and profits without stopping carbon leakage. Indeed, emissions associated with servicing coastal cement markets would increase, due to production from less efficient overseas plants, the loss of the significant price-induced abatement in EU production, and the transport emissions associated with shipping this bulky commodity.

There is one other option for 'levelling down' – but it hardly works. The above problems would logically drive 'levelling down' policy to the last step in *Chart 9a*, of output-based allocation, as proposed in the US Waxman-Markey bill. This has the intrinsic drawbacks in terms of reduced efficiency, but in the case of cement this is eclipsed by fact that if companies receive free allowances per tonne of cement they produce, they could still import the clinker from which cement is made – cutting their own emissions and still selling the surplus allowances. Since clinker is the most carbon-intensive part of the process by far, the net effect would still be carbon leakage, combined with windfall profits.

Short of drastic steps (like banning clinker imports), the obvious fix for this problem would be to grant free allowances per unit of *clinker* produced, rewarding clinker production itself. Unfortunately companies would then face no incentive to be more efficient in their use of clinker in mixing cement – yet reducing clinker use in cement production has been shown to be one of the most extensive and cost-effective mitigation options adopted by EU companies in response to the EU ETS. Moreover, allocating free allowances to clinker production would remove any incentive for the radical innovation through technologies that avoid the carbon-intensive clinker process altogether, such as some of the magnesium routes. Free allocation is not an effective solution.

Border levelling is possible

Following the opposite side of the screening *Chart 9a* leads to more promising options. Whilst there are of course different types of kiln, cement production globally is converging towards the more efficient dry kiln processes and the fundamentals don't vary much. Of course there are different types and grades of cement, but cement remains a relatively homogenous process and product. Cement could thus follow a relatively straightforward line to the top-right of *Chart 9a*. The CASE modelling of different border levelling options shows little variation between different options – reflecting the dominance of direct emissions, and the relative lack of exports.

This would enable policy to focus on the simplest option, namely a requirement for all importers to purchase EU emission allowances. Benchmarking the requirement (i.e. per tonne of product) would clearly make it compliant with the GATT Article III principle of non-discrimination (all imports treated the same); and setting the benchmark at a level of 'best available technology' utilised in Europe would comply with the GATT Article 1 National Treatment requirement, assuming that any free allocation accorded to domestic producers is similarly extended to importers[30].

This would effectively tackle the problem of carbon leakage from impacts on imports into the EU and retain the incentive for EU producers to cut their emissions through all the economic options available. Moving towards auctioning (otherwise, there would be nothing to charge importers anyway) would also address the problem of windfall profits.

This approach avoids any need for the EU to probe into how cement is produced elsewhere ('process and production methods' form a complex and difficult terrain in the WTO). Other variants could be considered to start creating related incentives, in which efficient producers could make a case for a lower level of adjustment to be applied, providing an incentive to maximise efficiency and provide an audited trail of carbon emissions[31].

In practice, the sector would probably require two benchmarked border levelling mechanisms, one for clinker and one for cement itself. The relative homogeneity of the product would make such levelling relatively simple to implement on a basis of default benchmark carbon intensity.

[30] Border levelling is incompatible with extensive free allocation, since obviously making importers pay costs that are not incurred by domestic producers violates the GATT National Treatment principle.

[31] An important variant could be to set the benchmark at an 'average' EU level, and allow importers to provide audited evidence of emissions lower than this benchmark. However, this would obviously complicate the system.

Conclusion for cement

The characteristics of cement make it hard or impossible to 'level down' carbon costs without losing many of the relevant incentives on the industry to decarbonise. At the same time, it is not hard to design a system that includes a basic level of carbon cost in all cement sold in the EU, wherever it is produced. The simplest option, requiring importers to buy allowances corresponding to 'best available technology' emissions on the same basis as domestic producers, complies with all relevant WTO provisions, without the need for any exemptions.

Moreover, cement is not (yet) very heavily traded and the value at stake is not huge – indeed, a number of developing countries have themselves imposed export tariffs to prevent cement exports 'overheating' domestic production on the basis of volatile export markets. All these factors greatly reduce the risk of any country attempting to invoke WTO dispute procedures or counter measures.

Finally, policymakers could choose to ignore the issue for cement, classify it as a sector not exposed to carbon leakage and subject it to steadily declining free allocation without any border levelling. This option unfortunately would have highly unequal consequences across the EU, with particularly severe impact on cement industries in the Mediterranean region, but also the UK, and some east European countries exposed to imports across the border or through imports from the Black Sea and up the Danube. This is hardly an attractive political, or indeed environmental, proposition.

A policy of free allocation that creates windfall profits in some regions, and industrial losses in others, without solving the leakage problem, is hardly attractive. Therefore, the particular characteristics of cement appear to make the best – maybe the only effective – option to include cement importers in the EU ETS.

11. Steel

Free allocation is a plausible short-term response for steel, and border levelling would be complex and contentious. But to prevent steel getting 'locked in' to the suboptimal incentives created by free allocation, no later than the second half of this decade, one of three other options will need to be negotiated, for implementation by about 2020.

Steel is a bigger emitter than cement, accounting for 8% of global CO_2 emissions and almost 20% of emissions covered by the EU ETS, about two thirds of this being direct and the remainder due to its equally prodigious electricity consumption. It is also a huge and powerful industry in all the major industrial regions.

Steel has over recent years become a highly traded product – sufficiently so that its trade level in 2007 exceeded even the 'trade intensity alone' threshold for sectors at risk classification in the EC. Consequently, it is inevitably classified as a sector at risk. It is also a high-value commodity. Combined, these are reflected in the trade values in *Chart 11a*. The value of imports from the top 6 approached almost €20bn, with China and Russia together accounting for over half of this. Exports exceed €12bn, principally to the US and Turkey.

Chart 11a *Basic iron & steel and ferro-alloys EU trade in million € current prices, 2007*

Trade partner	Imports	Exports
China	6,547	1,902
Turkey	2,306	4,254
Russia	5,280	720
USA	1,355	3,411
Ukraine	3,054	262
Switzerland	729	2,126
Total top 6 importers	**19,271**	**12,675**

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

The trade trends reflect consolidation of the international industry that has heightened fears about the potential impact of carbon costs on the industry. The CASE results find steel to have the highest carbon leakage-to-reduction ratio, twice that of cement or aluminium. Steel is a high emitting, powerful industry with a lot at stake, even more so in other regions like the US and Japan. Ignoring leakage is not a viable option.

Economics dominated by capital costs and two main production routes with varied products

The principal means for manufacturing steel are blast oxygen furnaces (BOF), and Electric Arc Furnaces (EAF) for recycling scrap metal. These plants are highly capital intensive, lasting for decades, and the direct impact of any given carbon cost on BOF operating cost is amongst the highest of any sector. The high capital cost means that the operating margins are usually high (to recoup capital investment), making it less likely that plants will be run below capacity to minimise (or maximise) carbon-related costs (or profits).

Electric arc furnaces, used for scrap metal processing, are much less carbon-intensive but constrained by scrap metal supply. A third route of production is direct iron reduction, with variable emissions depending on the energy source (coal or gas); these tend to be smaller and are used extensively in India for example, but only account for a small proportion of global steel production.

Primary steel products fall into two main classes, 'flat steel' (e.g. for vehicles) and 'long steel' (e.g. for construction), usually but not exclusively associated with the two main corresponding processes (respectively blast furnace, and electric arc). There are many different types and grades of steel, though various trade-related measures (such as EU quotas) have successfully defined particular product types for regulatory purposes.

Emissions from electric arc plants obviously vary according to the source of electricity used, as well as other factors. Blast furnace plants are more homogenous but the emissions intensity of plants still varies considerably within Europe and around the world. There are various abatement options, ranging from incremental to radical. A full analysis is being undertaken for a subsequent Carbon Trust study, but the basic characteristics sketched above enable primary insights into how steel fits into the screening process of *Chart 9a*.

Free allocation for blast furnace, and investment subsidy for electric arc, may tackle the core problem for a limited period

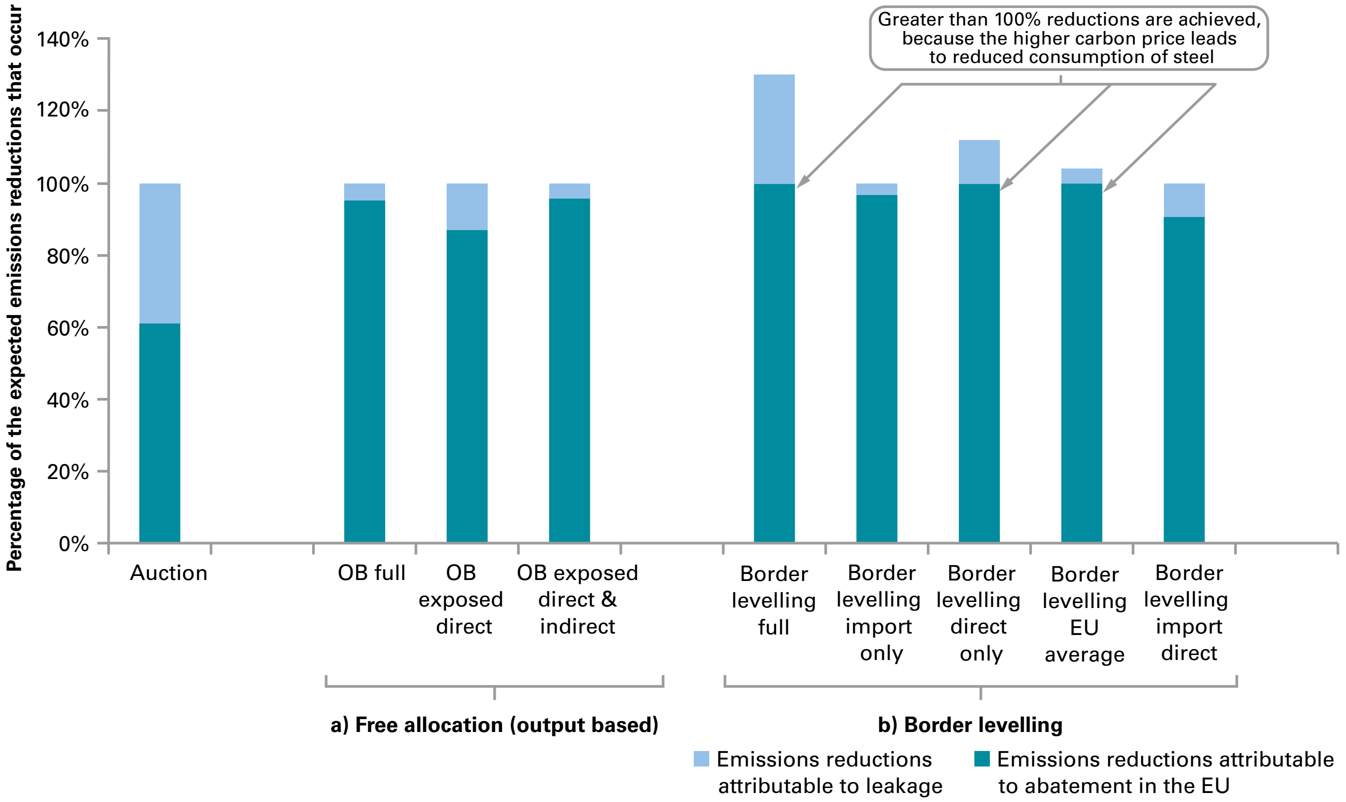
Following the logic of *Chart 9a*, the capital intensity of steel plants implies a focus upon capacity – the risk of plant closure and the location of new investment. The dominant political problem is a risk of induced closure leading to investments going abroad, in a sector already under strong pressure to compete with lower cost outputs, notably in regions close to iron ore deposits.

In the absence of carbon pricing in competing regions, this risk can be addressed by free allocation for new entrants and closure provisions. Direct compensation (subject to state aid constraints) could in theory deliver the same effect, but in a much more complex way; the case for such support for Electric Arc plants deserves scrutiny, but the primary leakage problem is from blast furnace steel.

If investment leakage is the primary route, *Chart 11b* suggests that free allocation could greatly reduce – though not entirely prevent – this, even though focused on direct emissions only. The added impact of addressing indirect costs, or also addressing exports through full reimbursement of carbon costs appear modest in comparison.

To ensure that any new facilities are 'state of the art' in terms of energy and carbon efficiency, it is important that any such allocations be benchmarked on the basis of steel output, rather than plant-specific. This will not be easy, given different types and grades of steel output, but if not, even more of the desired incentives will be lost.

Chart 11b *Steel sector leakage-to-reduction ratios under free allocation and border levelling*



Important additional complexities arise partly from the existence of alternate production processes. Free allocation to blast furnace plants may amplify the case for direct compensation to electric arc plants to prevent a perverse incentive. This illustrates one generic drawback with free allocation: it tends to have knock-on effects that create additional complexities elsewhere, as one form of subsidy is needed to level conditions in the face of another.

It remains unclear the extent to which free allocation might lead to windfall profits and operational leakage, with steel plants passing through the opportunity cost of carbon, cutting back their production in favour of imports, and selling allowances. Certainly the scope for this appears much more limited than for cement; the higher trade intensity will place much more pressure to keep prices down, and the much higher value-added of the product will deter part-loading. However, if and as carbon prices rise, this would become a problem at some stage. Output-based allocation would address this but introduce the other problems noted. The likelihood of this approach in the US could cause friction and this should be 'on the table' of discussions about coordinating their trading systems.

From a carbon perspective there are also other significant drawbacks to free allocation which would tend to accumulate, in addition to the general loss of efficiency due to protection of 'downstream' markets from carbon prices in steel. Most notably, the historic decline in EU steel production reflects the fact that Europe has neither iron ore nor cheap energy; it has no natural advantage. Migration of steel production to other regions is a perfectly natural economic process, reflecting their comparative advantages, which in the long run can both reduce costs to the rest of EU industry and probably global emissions as well. There is a real risk of free allocation providing an inappropriate level of incentive to retain steel production in Europe. If old plants that should close remain open (at low operating levels) to retain their allowances, and if new investments lasting for decades are promised protection from carbon costs over such periods, this will not only reduce incentives for efficient investment, but impede appropriate and beneficial restructuring of the EU economy.

To avoid accumulation of such problems and retain the longer term signals, it is therefore important that any policy of free allocation is of limited duration, beyond which the industry does face the real cost of carbon. This will remain problematic if there is not global action.

Border levelling faces serious complexities – and high politics

On the surface therefore, border levelling mechanisms appear more attractive. *Chart 11b* illustrates their theoretical potential not merely to tackle carbon leakage, but to exert leverage that amplifies EU reductions with reductions elsewhere; full scope levelling could both lower EU steel demand and create incentives for foreign producers to decarbonise their production for EU markets. However, the least difficult option – on direct emissions for imports only – appears little more effective than the equivalent output-based free allocation.

Part of the advantage of the 'full border levelling' option is that it avoids displacement of EU steel exports. However, because major exports from the EU are to the US, there would be no case for the EU to consider the complexities of export compensation/levelling providing the EU and US can align allocation and leakage measures. The EU could address any issues around the similarly large exports to Turkey and through Switzerland as part of regional integration (e.g. Switzerland is already on track to join the EU ETS).

Yet considering the right-hand side of the screening *Chart 9a* suggests that even the simplest option – requiring importers to purchase allowances associated with direct emissions – faces serious complications due to the co-existence of different production processes and the diversity of types of steel products. A single 'flat rate' benchmarked border levelling mechanism on all steel would have profoundly diverging effects on different importers. A benchmark set at the emission level of electric arc furnaces would also do little to harmonise the costs compared to blast furnace steel production. To be effective, the benchmark would either have to be set at blast furnace levels – risking trade disputes on the grounds of giving EU electric arc furnaces preferential treatment – or have to be differentiated according to the production process used in other regions, an even more contentious proposition at this stage.

The different products would also create huge pressures to create a diversity of border levelling. It might be possible to adopt one adjustment for long steel produced from electric arcs, and another for flat products produced from blast furnaces; this could be studied more closely. But there is clearly a risk that, at least in the absence of a clear framework of verified carbon flows, attempts to differentiate processes and product benchmarks could be complex and contentious.

These challenges tend to confirm the likelihood that policy will gravitate to free allocation, notwithstanding its technical complexities and efficiency losses. This tendency would be reinforced by the fact that steel trade is large in terms of economic value and border levelling would be politically extremely sensitive (though the same could apply to output-based compensation if other countries sought to challenge this as a production subsidy).

Nevertheless, it is the relative diversity of process and products that would increase the value of effective action, if this leads major steel producers to take account of carbon costs. An effective international agreement would reward investment in lower carbon facilities and production choices, including increased recycling. This would apply first with respect to new investment – for example, if major companies agreed to apply 'shadow carbon costs' for investment appraisal – but also increasingly over time, in actual operation. Given the large scale of steel sector emissions, progress towards a meaningful international action in steel could yield significant environmental (and ultimately economic) benefits. The challenge is in devising an effective interim strategy, and creating the incentives for all producers ultimately to reach an effective agreement.

Conclusions for steel

Free (fixed) allocation with new entrant reserve and closure rules may tackle the majority of the leakage problem and offers a plausible interim approach for the EU (perhaps to 2020), but it will provide an incomplete solution, and result in increasing problems the longer it is sustained. To prevent steel getting 'locked in' to the suboptimal incentives created by free allocation, no later than the second half of this decade, one of the following three options will need to be negotiated, for implementation by about 2020:

- Border levelling for steel imported into regions imposing a carbon cost possibly together with carbon rebates on steel exported to countries not taking equivalent action.
- Specific agreements with principal producer regions (e.g. Russia, Ukraine, Kazakhstan, Brazil, South Africa) for them to impose carbon charges on steel exports.
- A global sectoral agreement imposing carbon costs on steel production in all significant producer countries.

Establishing the most attractive and plausible of these options is beyond the scope of this study, but it should be clearly established that free allocation is a temporary fix that should be withdrawn as soon as a better alternative is in place – and no later than about 2020.

12. Aluminium

The only effective way to reduce emissions from aluminium while avoiding carbon leakage may involve investment support. While helping to offset carbon costs in new investment, the main focus should be upon supporting upgrading to best technology and encouraging the use of low carbon electricity, without deterring appropriate restructuring of the sector.

The third of the three sectors studied, aluminium is very different again. The industry has made strong efforts to reduce the exceptionally long-lived process emissions, leaving the dominant emissions from modern aluminium plants as the CO_2 associated with the electricity that such plants consume in prodigious quantities; at the current EU grid average, the two together account for around 85MtCO_2e, or around 4% of EU ETS emissions.

Chart 12a *Aluminium EU trade in million € current prices, 2007*

Trade partner	Imports	Exports
Norway	4,307	324
Russia	2,474	406
Switzerland	1,016	889
USA	540	1,054
China (P.R.)	633	678
Mozambique	1,169	1
Total top 6 importers:	**10,139**	**3,352**

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

Europe imports a high and growing proportion of its aluminium; domestic production is extensively based on recycling, but with a number of primary smelters. Carbon costs will impact mostly through electricity prices and in the short term this will vary considerably according to how smelters get their electricity – some own power plants (nuclear or coal), others have power purchase contracts with specific stations or with the grid, but most contracts will expire during the 2010s.

Although the impact of carbon costs on primary smelters, as a fraction of value added, is smaller than for cement or steel, it is much harder for aluminium to pass through any costs; as outlined in our previous report, aluminium is a homogenous, high-value product with a price largely set globally. This makes the industry potentially very exposed.

There is only one viable option for 'levelling down' in the EU

Due to its high electricity intensity, aluminium follows the branch of the screening *Chart 9a* that leads to investment subsidies as the main option for taking out the cost of carbon. Like steel, aluminium plants are relatively capital intensive, and there are more severe technical constraints on part-loading. There is little prospect that plants would run below capacity for extended periods and no risk of windfall profits.

As with steel but more so, the EU has no international comparative advantage in producing aluminium, which naturally gravitates towards regions with very cheap energy. This includes regions like Norway and Iceland where emissions are very much lower. Consequently, for this sector concerns about competitiveness are *not* closely tied to carbon leakage. If an aluminium smelter powered by a brown coal-based station closes in favour of a hydro-based plant abroad, that is an entirely appropriate and natural consequence of tackling CO_2 emissions. So long as the EU ETS cap is reduced as a consequence, then no leakage will occur.

The main risk indeed is that of inappropriately supporting continued production in the EU. However, without the blanket support of free allocation and closure rules, and with relatively few smelters and little prospect of major new capacity, the case-by-case scrutiny of State Aid support probably provides a reasonable safeguard against abuse of the system, and it also affords an opportunity to ensure that smelters receiving such support adopt the best technologies available, and in some circumstances might be tied to the use of low carbon electricity.

Border levelling and 'carbon added' regulation

The relative homogeneity of aluminium as a product would apparently facilitate border levelling, but the dependence on electricity – implicitly a wide divergence of production processes from a carbon standpoint – would require this option to enter new territory to be of much relevance.

Specifically, since 'best available technology' would include aluminium produced from zero-carbon electricity, such a benchmark approach would have little impact – either on the predicament of EU producers, or on the incentives for foreign producers. Yet, aluminium is also produced abroad in very carbon-intensive ways, based on coal or in some cases natural gas. Thus border levelling based on a simple benchmark would miss the point.

Trying unilaterally to discriminate between aluminium imports on the basis of point and process of origin would be extremely problematic. The only option that might in principle really have impact on the problem would be if producers tracked the emissions associated with aluminium production, and aluminium came with certificates indicating the emissions embodied. It would in principle then be possible to require importers to buy allowances to cover these emissions. An EU-average benchmark 'default' could be considered, providing an incentive for low carbon aluminium producers to provide such information.

Such treatment would be just as relevant for steel in principle, but in aluminium there would be far greater potential for support from the industry globally, encompassing both recycling plants and other low carbon producers that could benefit; high carbon aluminium producers are economically trivial compared to blast furnace steel production. For some smelters in developing countries it might even be possible to offer international support for them to move towards low carbon power sources.

Such 'carbon added' accounting for aluminium could represent an important step towards a more comprehensive global regulatory structure that provides incentives for producers to decarbonise, and information enabling consumers and consuming countries to help foster this. It relates to a broader debate about the balance between production and consumption-based approaches to regulating emissions, and the proper apportioning of emissions incurred predominately in developing countries, but driven largely by Western consumption. Such developments are unlikely to happen quickly, however.

Conclusions for aluminium

In general, therefore, the only effective way to reduce emissions from aluminium whilst avoiding carbon leakage may involve investment support, not so much to reimburse new investments for the cost of carbon, but rather to ensure that any such subsidies are tied directly to investment in low carbon electricity. This is not perfect, but if it can help to ensure that additional resources are applied to accelerate the growth of low carbon power in Europe, the net effect will be positive, and it would buy time for the development of fuller carbon flows accounting that could genuinely start to reward low carbon aluminium producers worldwide.

13. Beyond Europe: developments in US and Asia-Pacific

The approach to leakage in the EU ETS differs from the approaches under consideration in North America and the Asia-Pacific region.

US

US debate has been driven more overtly by concerns about competitiveness impacts rather than carbon leakage per se, and includes two components that have not been significantly considered in Europe, namely output-based compensation and border adjustments (BAs).

The latter came to the forefront in the US in 2007; various bills proposed in the US Congress have included border adjustments, although with different design details. While the 2008 Climate Security Act by Senators Boxer, Lieberman and Warner contained detailed provisions for border adjustments, earlier drafts of the Waxman-Markey bill focused more on output-based compensation for trade exposed sectors. However, a late amendment re-inserted trade provisions which, whilst not as detailed as the earlier proposals, were much tougher in proposing that border adjustments should come into force automatically by 2020 unless both the President and Congress determined otherwise. Whilst this has alarmed many in the trade community, the shaping of the proposed measures is much more closely aligned to the problem of carbon leakage, rather than protectionist measures, and thus in principle has a higher chance of being judged WTO-compatible. It remains one of the controversial features in the bill as it moves from House to Senate consideration, but ten Democratic senators whose votes would be essential to final passage have indicated they will not consider supporting a bill without such measures.

Although it is difficult to predict the particular features of any border adjustment provisions that will make it into US cap-and-trade legislation, it is reasonable to expect that any legislation will include some such provisions. However, the provisions concerning border adjustments are likely to defer their entry into force for several years, during which time there will presumably be negotiations between the US and foreign governments in an attempt to avoid the actual implementation of the border adjustments.

Not all business actors, labour unions and NGOs agree on the desirability of border adjustments. Some companies fear retaliatory measures if these measures are adopted, while other companies are afraid that they will be affected because they depend on the import of covered goods.

Alternatives have been discussed, but none has received as much attention as an allowance purchase requirement for importers. For example, none of the bills raises the option of adopting border tax adjustments. Another option that has been raised in the policy discussion is the use of output-based export rebates. Finally, one existing alternative, the use of transitional assistance to energy-intensive industries in the form of free allocations of allowances has been used as a complementary protection measure in many of the bills proposing border adjustments. However, free allocation may become more important in comparison to border adjustment measures because of: 1) the latter's effect on exporters; 2) the difficulty of covering finished products; 3) the uncertainty that implementation would be effective; and 4) issues related to WTO compliance.

In addition to the factors related to domestic politics, progress (or lack thereof) in the UNFCCC negotiations could influence the adoption of border adjustment measures. If countries like China and India take a positive stance in the negotiations and/or agree to taking on some kind of corresponding commitment, one of the main rationales of border adjustments would be (partially) removed. Especially if the President considers that the adoption of a unilateral trade measures is a deal-breaker in the UNFCCC negotiations, Congress may reconsider such a measure.

Even if a border adjustment provision was included in cap-and-trade legislation, the question remains what its level of detail would be. One option could be to provide sufficient detail on some aspects of the provision (e.g. coverage of goods; entry into effect), while leaving discretion on important decisions (e.g. on comparable action). Furthermore, if the effective date were set some years after the bill is enacted, it would buy time for the US Administration to conclude negotiations with major emitters.

Japan

A carbon tax was discussed in 2004 and 2005 as a means of reaching Japan's Kyoto target, but not implemented. The impact assessment conducted by the relevant authorities fuelled fears of negative impacts on the competitiveness of Japanese industries; the steel and ceramics industries were assessed to incur the highest financial burden amounting to 1.9% and 0.7% of total production cost for a tax of 3.400 JPY/tC (equivalent to approximately €7/tCO_2). The Japanese Emissions Trading Scheme (JETS), launched in October 2008, could build an alternate basis for mandatory carbon pricing.

The Japanese steel and cement sectors are big emitters, ranking third and fourth compared to the same sectors in other countries. Other sectors facing similar production cost increases include pulp and paper producers (0.7%) as well as producers of oil and coal products (0.5%), thought these are not traded so intensively. Some energy-intensive products, such as aluminium, are not even produced in Japan and the migration of power production is not an issue as electricity interconnectors with neighbouring countries are unlikely given the distances involved.

Overall, steel is the dominant industry and is likely to define the Japanese stance on tackling carbon leakage. Its main platform to date has been to oppose mandatory cap-and-trade constraints, arguing that it is already the world's most efficient steel industry and has delivered on emission targets previously negotiated with the government. Tentative consideration of border adjustment options was dropped in the light of assessed difficulties and the lack of significant carbon cost drivers.

However, the overall situation may change rapidly with the new government elected in September 2009, which represents a break with the 50-year dominance of the Liberal Democratic Party, and which within a couple of weeks of its election had declared a much more ambitious Japanese emissions target for 2020. As a result, the new government is bound to face intense pressure as to how this can be achieved without damaging the Japanese manufacturing industry.

Australia and South Korea

The severity and vulnerability of Australia's climatic conditions have helped to make climate change a top-level political issue, but it is unique as a country actively pursuing a cap-and-trade system whose economy is oriented towards energy-intensive exports. The option of ignoring impacts on such exports, which makes sense in the context of a European economy that has no natural advantage in resource-based industries, is untenable in Australia.

The government's Commonwealth Pollution Reduction Scheme (CPRS) provides output-linked free allocations of permits to the most energy-intensive industries. The baseline used for the output calculations will be historic industry averages. Free permit allocations are to be provided in relation to both direct emissions and indirect emissions from electricity. The most emissions-intensive industries will initially receive 94.5% of allowances for free, while moderately emissions-intensive industries will receive 66%. The level of free allocation will reduce each year by 1.3%.

As the other OECD country in the region, South Korea has indicated that it is willing to take on mandatory emissions targets in the next round of global negotiations and is working actively on designing an emissions trading scheme as part of a comprehensive environmental policy. However, as an equally manufacturing-intensive economy, it will face some of the same challenges, and design is not far advanced.

China

The Chinese perspective obviously is very different, as a major exporter that is not expecting to adopt cap-and-trade commitments for some years (though Chinese analysts are already examining the options). Its main concern in the area is with the possible protectionist sentiment, particularly in the US, hijacking climate change concerns in ways that raise barriers to Chinese exports.

Chinese nervousness about the issue is, however, tempered by several other considerations. It is concerned about climate change and is keen to find some accommodation that could assist a global deal. Its economic strategy is oriented more toward manufacturing than primary commodities; indeed China is not a major exporter of most primary commodities, finding itself frequently importing them to supply its manufacturing base. Measures that reduce competing Western demand for such commodities are thus not necessarily anathema to China. Moreover, China has on several occasions implemented export taxes on energy-intensive commodity exports, to deter exports that could overheat the economy and drive up domestic prices. Finally, China has expressed concern about being blamed for emissions that are incurred in manufacturing goods for export to the West, and suggested that such emissions should actually be attributed to consumers, not producers. This in effect would imply a transfer of emissions not unlike requirements for importers into ETS systems to buy emission allowances.

Such positions are not universally shared across developing countries, but suggest a more nuanced picture about the politics than often assumed. Moreover, the simple fact that border adjustments by importers would raise revenues, could well lead developing countries to engage in discussion about the options if the revenues associated with imposing such adjustments could instead be used to contribute to the global effort to tackle climate change.

14. Conclusions

Maintaining an effective incentive for manufacturing industry to decarbonise whilst preventing carbon leakage entails a difficult balancing act. The long-term objective to 'level up' carbon costs globally is just that – a long-term objective. It does not obviate the need to develop effective policies in a world of unequal carbon prices, which is likely to be the case at minimum for the next decade and probably much longer.

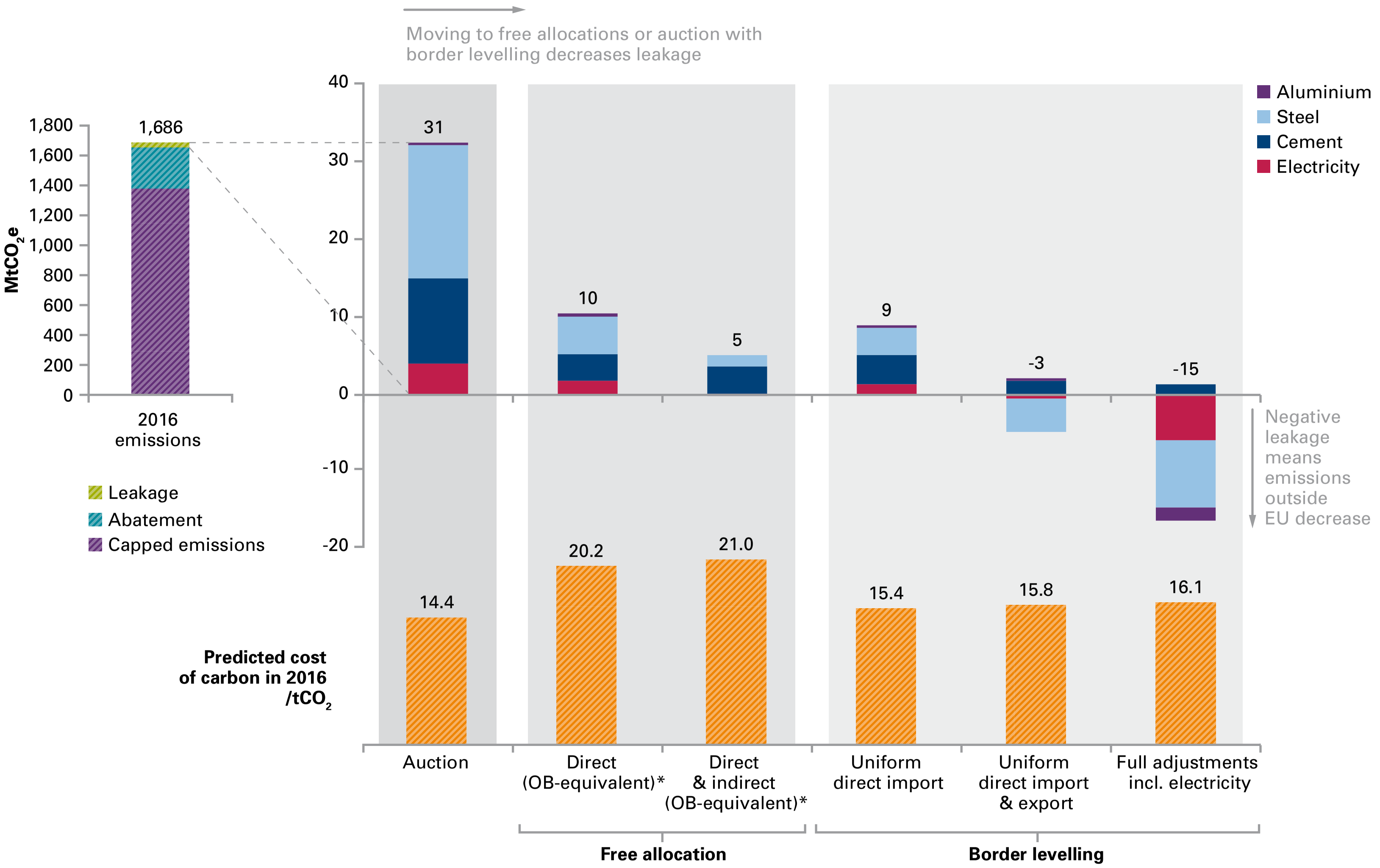
This reality does raise the question of how decisions now can not only maintain incentives on our own industries, but also support efforts to broaden and deepen the scope of carbon pricing, and avoid getting locked into 'levelling down' as the only solution for traded industries.

Our quantified analysis – combined with policies that are already in place and others under consideration – suggest that the leakage and competitive impacts of the ETS will be much lower than some industries fear. Concerns about potential leakage in East European power generation appear largely unfounded. The scale of leakage we estimate from some of the most impacted manufacturing industries even without any exemption or protection does not negate the fundamental contribution of the EU ETS to reducing EU carbon emissions. Governments should not over-react to the challenge, and the current EU classification of 'sectors at risk' can reasonably be described as generous to the point of excess.

For sectors so identified, the choice between levelling down/free allocation, and maintaining incentives through border levelling, is partly a balance between political feasibility and economic ideals. This is underlined by *Chart 14a*, which brings together the impact of the various options modelled on both carbon leakage and the carbon price required to achieve the EU's present target. Free allocation is unambiguously both more costly and less effective at tackling leakage; the ideal border levelling mechanisms have little effect on carbon prices but can turn carbon leakage into positive leverage that reduces emissions elsewhere.

This, however, is at present purely theoretical, and does not correspond to the political reality of most industries and regions pressing for free allocation, and concerned about the complexities and risks of border levelling. Our most central conclusion is that rather than engage in an almost ideological and highly politicised battle on the generalities, the way forward lies in considering pragmatically the effectiveness and feasibility of specific options for the key sectors of concern.

Chart 14a *Impact of border levelling and conditional free allocation on abatement, leakage and carbon price – EU ETS current proposals (2016)*



- 'OB-equivalent' means that free allowances are given in proportion to actual production.
- Direct gives free allowances to cover onsite emissions. Indirect also gives free allowances to cover offsite emissions from electricity production.
- The EC approach is similar to the 'direct' case but is not output based. Therefore it is likely to result in higher leakage and a lower carbon price.
- 'Uniform' means that the levelling does not vary according to the exact location where the goods were produced: all exports of a good are treated as if they emitted EU average emissions to produce the good. All imports are treated as if they had the rest of the world average.
- 'Direct' means adjustments are made for emissions generated onsite during the production of the good. 'Full' means adjustments are also made for the emissions from electricity used to produce the good.

Source: Monjon, S., Quirion, P. (2009), Addressing leakage in the EU ETS: Results from the CASE II model, working paper available from: www.climatestrategies.org

*OB equivalent = Allocation modelled as varying in proportion to the volume of goods produced (i.e. output based).

Note: the chart illustrates the impact of various Border Levelling and Free Allocation options on both carbon leakage (from the sectors modelled) and the price of CO_2 given the EU ETS Phase III target. These compare to a 'base case' of pure auctioning with no ameliorating measures (1st column), in which the carbon price required to deliver the cap in mid Phase III (2016) is 14.4€/tCO_2, and leakage is around 30MtCO_2, of which steel accounts for half and cement for most of the remainder. Free allocation is modelled in the way most effective in tackling leakage, namely fully output-based. Note that the EU ETS structure would only allow free allocation to be made conditional on investment and closure decisions, not actual output, which would have a smaller impact on price but also do less to tackle leakage than full output-based allocation.

Implications for business

The policy approach of handing out generous free allocation does not necessarily shield these industries from all consequences: carbon costs will still affect operational decisions and the longevity of free allocation is unlikely to be assured on timescales relevant to key investments, and generous treatments are unlikely to be sustainable as overall caps decline. Moreover, the rest of business pays a price in terms of higher carbon prices required to achieve any given target, if the biggest emitters are shielded in this way. Whatever form it takes, businesses will undoubtedly face increasing carbon constraints internationally over time.

Thus whatever the approach to carbon leakage, investing in cleaner production is paramount for businesses to stay competitive if their operation is energy-intensive and international, whilst carbon price differentials will remain a challenge due to the slow process of establishing national ETSs and of step-by-step linking and alignment of the systems. The focus of responses should be on the limited number of sectors where carbon cost impacts are high, and steel, cement and aluminium are conspicuous in this regard. For such sectors, the most effective approaches will reflect the actual role of carbon costs in operation and investment decisions, and constructive engagement between business and government is likely to lead to better and more predictable outcomes. The analysis shows there is no 'one-size fits all' solution.

Moreover, a lock-in of measures against carbon leakage over the long term could be counterproductive. While industry needs a reliable policy environment, the carbon pricing issue is dynamic. One government or region alone will not be able to deliver stability or certainty of international prices for industries, which compete in the international markets. Business needs to support multilateral arrangements to address the issues.

Principles for policy

Policy needs centrally to deal with trade-offs between choices, but three common principles can be observed.

1. Strive to maintain carbon price signals within an emission trading system. 'Levelling down' needs to maintain as much of the carbon incentive as possible; this implies benchmarks for free allocation, or investment subsidies complemented with conditions that relate to technological performance. The signal sent to industry should be that policymakers take the carbon leakage issue seriously, but will not adopt generic exemptions that conserve high-carbon production structures.

2. Maintain transparency. Free allocation with benchmarks should not include too many benchmarks; border levelling should be applied only to homogeneous products at the lower end of the value chain; investment subsidies should be carefully governed against a clear set of criteria (as under EU State Aid legislation).

3. Make approaches consistent with international developments. Leakage reduces environmental effectiveness; free allocation risks potential for a subsidy race as once more emissions trading systems emerge around the world; border levelling is complex, potentially disruptive and most effective when fully cooperative. Thus the principle of coordinated approaches for ETS design is added to the list, for all the options.

Whilst preserving these general principles, the most appropriate way of implementing them differs by sector. Applications of the screening process represented by *Chart 9a* yields quite different assessments of the relative advantages/disadvantages of the policy tools for each industry. A policy approach that is generalised across industry sectors and is not tailored to the conditions of specific industries will not be cost-effective and could be counter-productive.

The box opposite summarises how these principles apply for the instruments mapped out in *Chart 9a* and to the sectors in this study.

Recommended approach to adapting policy to industry characteristics

The core conclusion of this study is that effective policy needs to adapt to the characteristics of different sectors, which can be usefully grouped into four main types.

Highly trade-intensive sectors with relatively low direct and indirect cost exposures, which may still be classified as 'at risk of carbon leakage' under the EC proposals:

- Any residual impacts on such 'trade but not carbon-cost-intensive' sectors can be addressed by reducing other costs the businesses face (e.g. corporate or labour taxes), with any Treasury revenue losses being offset by auction revenues.
- There is no case for invoking border levelling until costs become far more substantial.

Sectors with high indirect carbon costs (very electricity-intensive) which also tend to be capital-intensive:

- Direct investment support, funded from auction revenues and subject to case-by-case State Aid scrutiny, offers the best option for **aluminium smelters**, and possibly **electric arc steel**. Auction revenues and policies should be targeted to support low carbon electricity investments and research, development & deployment.
- The wide range of CO_2e intensities of electricity production across and within countries means that costs cannot feasibly be adjusted at the border without extensive international cooperation to establish verified 'carbon added' content of the product, which should be a core goal of future multilateral negotiations.

Sectors with high direct carbon costs (very carbon-intensive) that are also capital-intensive may be addressed transitionally through allocation decisions but this carries drawbacks that accumulate over time:

- Free allocation for **blast furnace steel** production is a viable mid-term fix to retain capital investment and jobs, provided allocations are benchmarked. It risks creating perverse incentives that not only reduce the overall efficiency of emissions trading (thus raising costs to other industries) but can also 'over-subsidise', leading to windfall profits or retention of old plants that could be more efficiently replaced by new investment, here or overseas.
- The strategic goal should thus be to use the time bought by free allocation to negotiate and implement WTO-compatible border levelling appropriate to the key product classes.

Sectors with high direct carbon costs that are less capital-intensive cannot reliably be addressed by free allocation, but GATT-constrained border levelling is relatively straightforward particularly where products and processes are relatively homogenous:

- Fixed free allocation may not deter operational leakage, and output-based allocation would need to focus on the most carbon-intensive part of the production chain (e.g. clinker production in cement) which may seriously degrade economic efficiency and undermine incentives to radical innovation.
- Border levelling based on 'best available technology' benchmarks for **cement** are clearly consistent with existing GATT constraints and offer a far more appropriate policy response, basically analogous to excise taxes; policy should focus on negotiations to gain acceptance of and implement such measures.

Experience of adopting appropriate policies in this way will also help to lay groundwork for factoring in carbon costs more widely over time, which should be the ultimate goal of current efforts to establish emission trading schemes.

Applying a multilateral approach

The need for a multilateral approach does not imply that all steps have to be hostage to global negotiations under the UN. This is emphasised by *Chart 14b*, which shows for a number of key sectors the principal trade partners. Just six countries represent a huge share of the EU's trade relations in these sectors. One (Norway) is already linked in the EU ETS and another (Switzerland) is expected to, whilst the US is itself developing cap-and-trade legislation. The EU's numerous ties with Turkey provide a helpful political context for negotiations on appropriate measures. This would leave core and cross-cutting negotiating challenges focusing particularly on two major powers, namely Russia and China, plus smaller countries important in particular sectors (such as the role of Ukraine in steel, and Mozambique in aluminium). Negotiations that focus first upon such major trade partners could not provide a satisfactory global solution, but they could unblock the most likely sources of political challenges to effective action.

The aim would be to secure full multilateral agreements that offer a way to resolve, at least partially, carbon leakage and competitiveness issues. This agenda will need to craft the combination of facilitating appropriate measures, but also act to restrain the impulse to unilateral action which can prompt hostile reactions on the part of trade partners, are more likely to provoke challenges under WTO rules, and exacerbate administrative complexities in their implementation.

Therefore governments should pursue multilateral agreements that define the scope of appropriate action and restrict the use of unilateral measures to address competitiveness and leakage concerns. These multilateral agreements should include both environmental and trade agreements and incorporate both leakage and competitiveness issues.

Such a multilateral approach also holds the key to the possibility of addressing the 'free rider' problem, which is not possible without exemptions to general GATT principles of non-discrimination. These would need to be agreed amongst a wide body of countries, building upon bilateral and regional agreements, to help foster action in countries that hold out against broadly agreed progress in tackling climate change. Through this route, the world can indeed move towards the final level of action set out in *Chart 6a* – broad-based action which factors in carbon costs across all key sectors in all the world's major economies. But we can only get there if countries first work out the transitional path for sustaining and expanding action in a world of unequal carbon prices.

***Chart 14b** EU's major non-EU-trade partners in selected energy-intensive sectors: ranking*

	USA*	Russia	China	Norway*	Switzerland*	Turkey
Aluminium	4	2	6	1	3	
Basic iron & steel and ferro-alloys	4	2	3		6	1
Other basic inorganic chemicals	1	4	2	3	(7)	
Fertilizers & nitrogen compounds	3	1		2		
Paper & paperboard	1	3	5	4	2	6
Cement	4	6	1			2

*Countries with cap-and-trade (implemented or planned)

Source: Climate Strategies (2009): Dröge, S. et al., Tackling Leakage in a World of Unequal Carbon Prices, Cambridge, UK, available from: www.climatestrategies.org

About Climate Strategies

Climate Strategies is a not-for-profit, academic membership organisation. The UK's Carbon Trust provided an initial core funding grant at the start of 2008 that enabled the creation of an executive secretariat function based at Judge Business School, University of Cambridge, UK. Since then funds have been granted by a number of international governments and foundations.

We are an international network of leading academic specialists on economic and policy issues concerning climate change with a mission to assist governments in solving the collective action problem of climate change.

We aim to help government decision makers manage the complexities both of assessing the options, and of securing stakeholder and public consensus around them by providing a bridge between research and international policy challenges.

We convene international groups of experts to provide rigorous, fact-based and independent assessment on international climate change policy, and connect this capacity to the policy process and public debate.

To effectively communicate insights into climate change policy, we work with decision-makers in governments and business, particularly, but not restricted to, the countries of the European Union and EU institutions. In 2009, Climate Strategies increased its reach, particularly with projects spanning research in North America and the Asia Pacific region.

Collaborating research institutions

- Australian National University, Australia
- Cambridge Centre for Energy Studies, UK
- Cambridge IP, University of Cambridge, UK
- Center for Climate Change and Sustainable Energy Policy at Central European University, Hungary
- Centre for Energy, Environment and Engineering Zambia (EECG), Botswana
- Centre for Environmental Policy, Imperial College UK
- Centre for European Economic Research, Mannheim, Germany
- CIRED Centre International de Recherche sur l'Environnement et le Développement, France*
- Climate Advisers, USA
- Corvinus University, Hungary
- Ecologic Institute, Washington DC*
- Electricity Policy Research Group, Cambridge University UK*
- FICCI Federation of Indian Chambers of Commerce and Industry, India
- Finnish Institute of International Affairs, Helsinki
- Fraunhofer Institute for Systems and Innovation Research, Germany
- Fridtjof Nansens Institute, Norway
- Georgetown University, Washington DC*
- German Marshall Fund of the United States
- IDDRI Institut du Development Durable et des Relations Internationals, France*
- IEEE Institute for Energy and Environmental Economics, Tsinghua University, China
- IGES The Institute for Global Environmental Strategies, Japan
- IISD International Institute for Sustainable Development, Canada
- Indian Institute of Technology Kanpur, India
- International Institute of Economics and Management, Ghana
- IVM VU University Amsterdam Institute for Environmental Studies, Netherlands*
- Javdapur University, Kolkata, India
- Joanneum Research, Austria
- Margaree Consultants, Canada
- MEERI Mineral and Energy Economy Research Institute and AGH-University of Science and Technology, Poland*
- Ministry of Science and Technology of Brazil
- National Institute for Environmental Strategies, Japan
- Öko-Institut, Germany*
- Office of the Parliamentary Commissioner for Future Generations, Hungary
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- Point Carbon, Norway and Japan
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- SWP German Institute for International and Security Affairs, Berlin*
- The Carbon Trust, UK
- University of Erlangen-Nürnberg, Germany*
- University of New South Wales, Australia
- University of Zürich, Switzerland
- Wuppertal Institute for Climate, Environment and Energy, Berlin, Germany

*Institutions directly contributing to Climate Strategies' research on tackling leakage.

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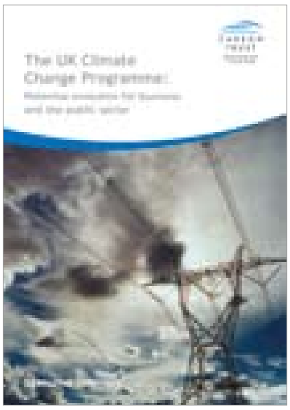

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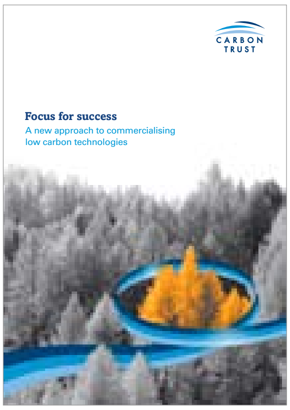

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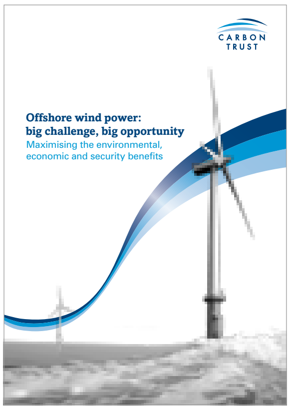

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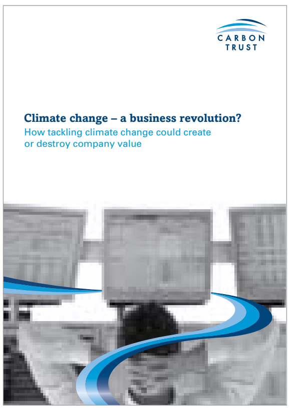

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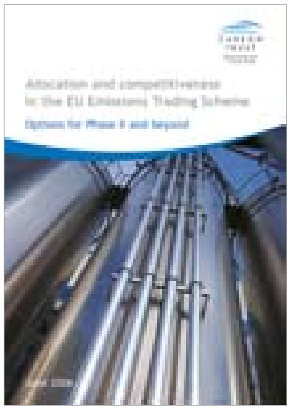

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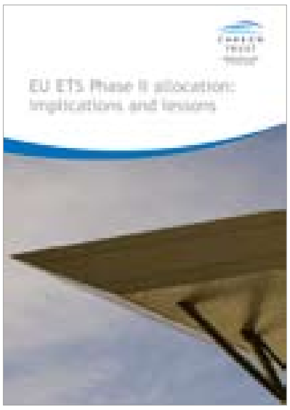

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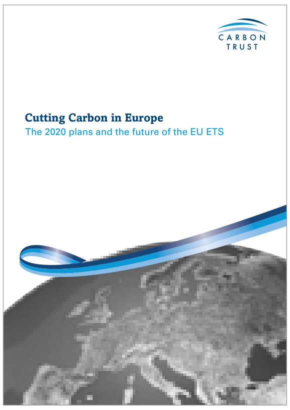

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CTC728

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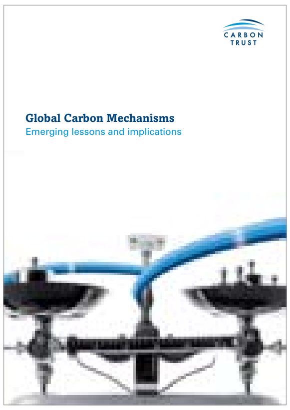
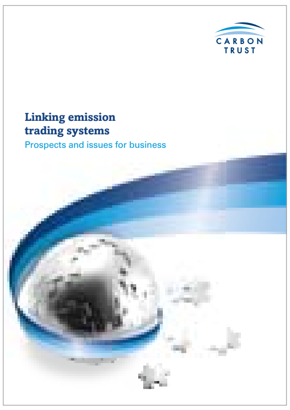


CTC748

Global Carbon Mechanisms: Emerging lessons and implications – 2009



CTC759

Linking emission trading systems: Prospects and issues for business – 2009

The Carbon Trust is a not-for-profit company with the mission to accelerate the move to a low carbon economy. We provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. By stimulating low carbon action we contribute to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

We help to cut carbon emissions now by:

- providing specialist advice and finance to help organisations cut carbon
- setting standards for carbon reduction.

We reduce potential future carbon emissions by:

- opening markets for low carbon technologies
- leading industry collaborations to commercialise technologies
- investing in early-stage low carbon companies.

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ACT ON CO_2 is the Government's initiative to help individuals understand and reduce their carbon footprint. Visit actonco2.direct.gov.uk for more information.

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