UK Carbon Trust Insights Publications

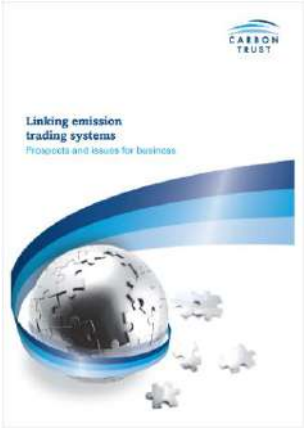
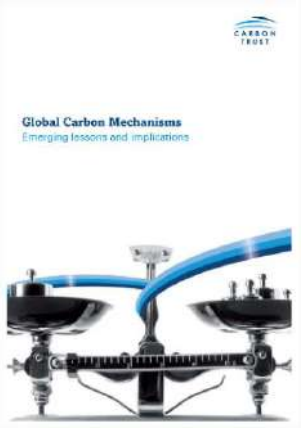
Topics: Carbon Pricing; Regional Studies

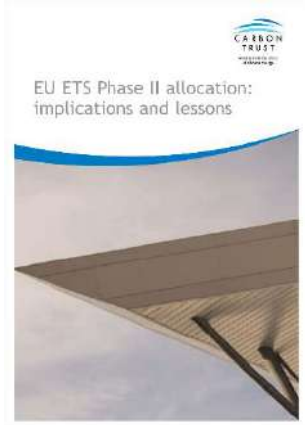
The Carbon Trust was set up in 2001 to help UK business decarbonise, with around £50m/year public funding rising to £100m/yr to accelerate low carbon innovation, and support enhanced energy efficiency in the business and public sectors.

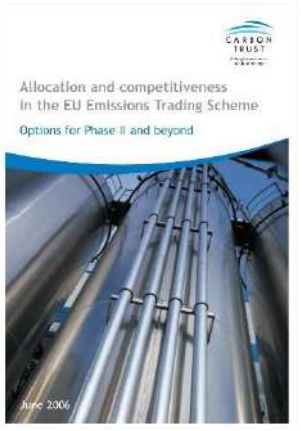
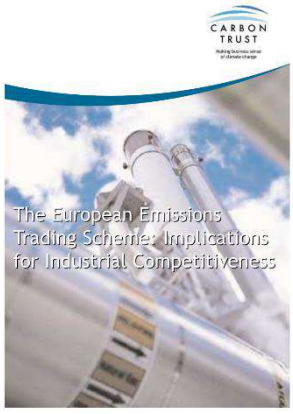
It rapidly became clear that the effectiveness of its delivery programmes would also hinge on the policy environment. As Associated Director of Policy and then Chief Economist, from 2002-2010, Prof Grubb led a range of projects resulting in the following publications (see also Innovation tab).

Many of the findings remain surprisingly relevant to debates in the 2020s. Several projects reflected the intense corporate interest in the design, implementation and impacts of carbon pricing mechanisms, with resurgent interest given the trends in European carbon prices and debates around CBAM. Others examine the practical realities of innovation. Click on the links below for the Executive Summaries. The full reports, along with many others since, are mostly available on the Carbon Trust website.

Title (each is a link to cover materials including Executive Summary & Contents)	**Topic**	**Cover Page**
Policy, Innovation and cost reduction in UK Offshore Wind – 2020	A joint Carbon Trust – UCL study in 2020, exploring how the UK achieved major cost reductions in offshore wind. **The full version of this report can also be found at: https://profmichaelgrubb.com/publications/**	
Tackling carbon leakage: sector-specific solutions for a world of unequal carbon prices - 2010	The culmination of the Carbon Trust series on carbon costs, competitiveness, and leakage: mapping out the need for tailored measures appropriate to the different characteristics of cement, steel, and aluminium, as part of an evolving international strategy towards effective industrial decarbonisation.	

Linking emission trading systems: Prospects and issues for business - 2009	At a time of high expectations, a critical examination of the challenges facing linking emission trading systems between different jurisdictions.	
Global Carbon Mechanisms: Emerging lessons and implications - 2009	A study of the emerging lessons from the global carbon mechanisms established under the Kyoto Protocol and the EU ETS, with suggestions for reform and acknowledgement of some of the challenges and limitations to these mechanisms alongside evidence of their achievements.	
Low Carbon Technology Innovation and Diffusion Centres: Accelerating low carbon growth in a developing world – 2008.	An exploration of potential for a network of low carbon innovation centres, including consideration of the rationales, potential approaches, and mapping of eight potential areas of activities. The establishment of the UNFCCC's Climate Technology Centre Network (CTCN) was partly informed by this analysis.	

EU ETS impacts on profitability and trade: A sector by sector analysis – 2008.	One of the very fist studies to map out the detailed sectoral implications of carbon pricing, in terms of cost exposure across 159 manufacturing sectors	
Cutting Carbon in Europe: the 2020 plans and the future of the EU ETS - 2008	".. sets out: to describe the EC package (for 2020) particularly in relation to the proposals for the future of the EU ETS; to analyse its implications for business; and to consider a range of complexities that have yet to be fully addressed... Our overall conclusion .. a big and bold step in the right direction – but that some of the toughest roads still remain to be travelled."	
EU ETS Phase II allocation: implications and lessons - 2007	An analysis of the economic implications of proposed allocations under Phase II of the EU ETS (2008-2012), including the at-the-time highly controversial (but proven correct) conclusion that the power sector would make many billions of pounds / Euros profits from the free allocations.	

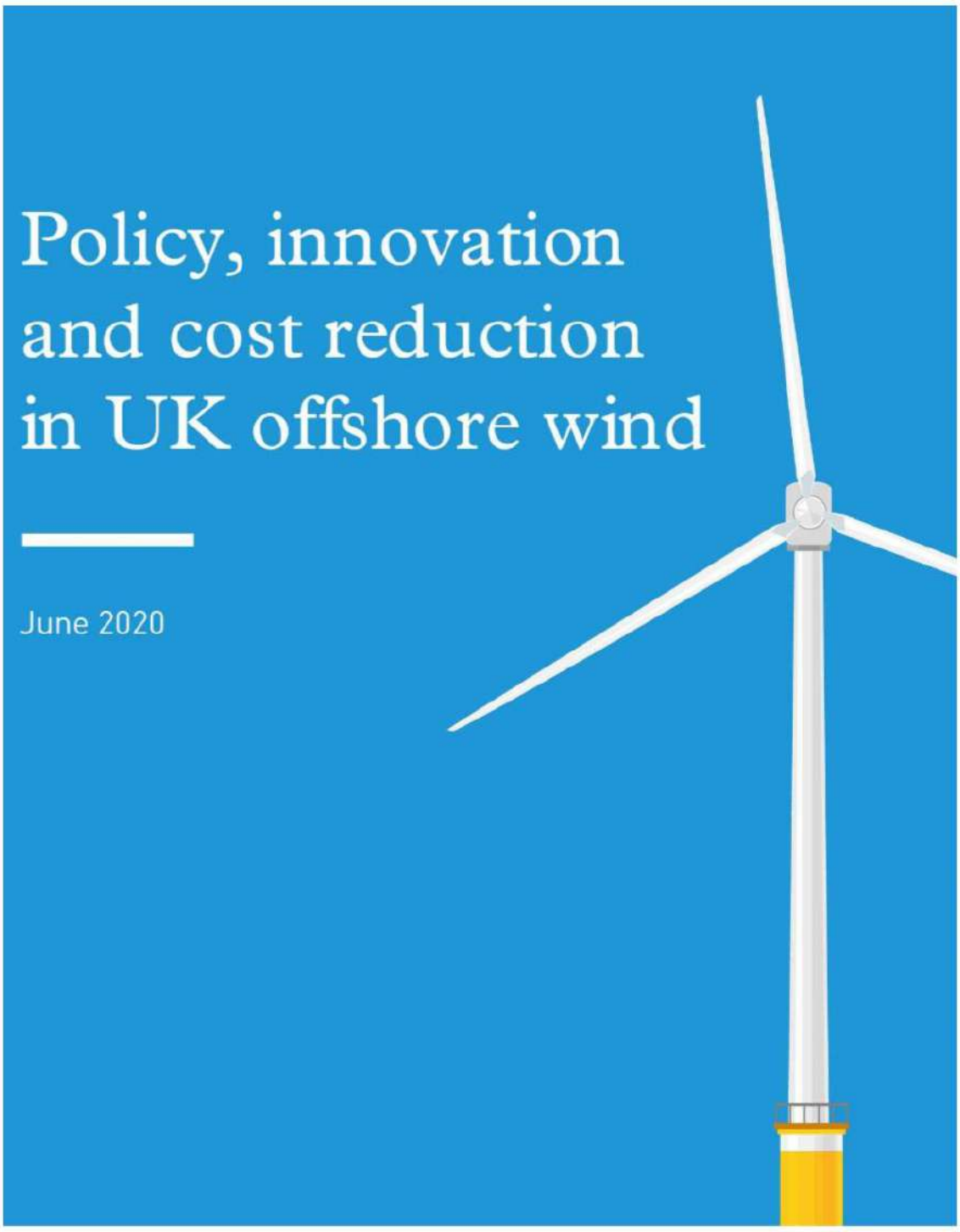
Allocation and competitiveness in the EU Emissions Trading Scheme: Options for Phase II and beyond June – 2006.	An analysis of the emerging lessons from the first phase of the EU ETS, and potential implications for allocations under Phase II, also recommending a move from the 'grandfathering' approach of Phase I to increased use of sectoral benchmarks.	
The UK Climate Change Programme: Potential evolution for business and the public sector – 2005	A major review of the first UK Climate Change Programme and identification of key gaps and weaknesses in its coverage of business – analysis which led to establishment of a whole new policy instrument targeted at less energy intensive business and public sector organisations.	
The European Emissions Trading Scheme: Implications for Industrial Competitiveness – 2004	The seminal UK Carbon Trust study of the potential competitive implications of the EU ETS at its point of formation – the first study to articulate sector-level economic impacts and the determinants which could lead to either profits or losses, based on classical Cournot mechanisms of oligopolistic price setting.	

The Climate Change Challenge - 2003	A primer on climate science for UK business	

The practical experience of Carbon Trust research activities also provided strong empirical input for the subsequent book on *Planetary Economics: energy, climate change and three domains of sustainable development.*

The Carbon Trust was from the beginning established as an independent legal entity; after core government funding was withdrawn, following the 2010 UK general election, the Carbon Trust rapidly developed tailored implementation and international advisory services, building on its decade's experience, and expanding subsequently into new areas including the UK's Offshore Wind Accelerator, and product carbon foot-printing services. See www.carbontrust.co.uk.

Policy, Innovation and cost reduction in UK Offshore Wind – 2020



The Carbon Trust's mission is to accelerate the move to a sustainable, low carbon economy. It is a world-leading expert on carbon reduction and clean technology. As a not-for-dividend group, it advises governments and leading companies around the world, reinvesting profits into its low carbon mission.

Part of UCL's Bartlett School of Energy, Environment and Resources (BSERR), the ISR is a world-leading centre of research and teaching on some of the major challenges facing societies today, including climate change, resource efficiency, environmental protection and sustainable development.

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The Carbon Trust has prepared this report for BEIS and FCO. The report has been written using impartial analysis of primary and secondary sources. For the avoidance of doubt, this report expresses the independent views of the authors.

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Executive summary

Offshore wind in the UK has been a remarkable green growth success story. The price of offshore wind is less than a third of what is was a decade ago (Figure 1). It is now cost competitive with fossil fuel generation. The Government is no longer subsidising new offshore wind; indeed, at the recently agreed prices, HM Treasury will be earning revenue instead. In parallel, the industry has grown and matured to a point where oil and gas companies are clamouring to enter the market and pension funds are comfortable in investing billions of pounds into construction.

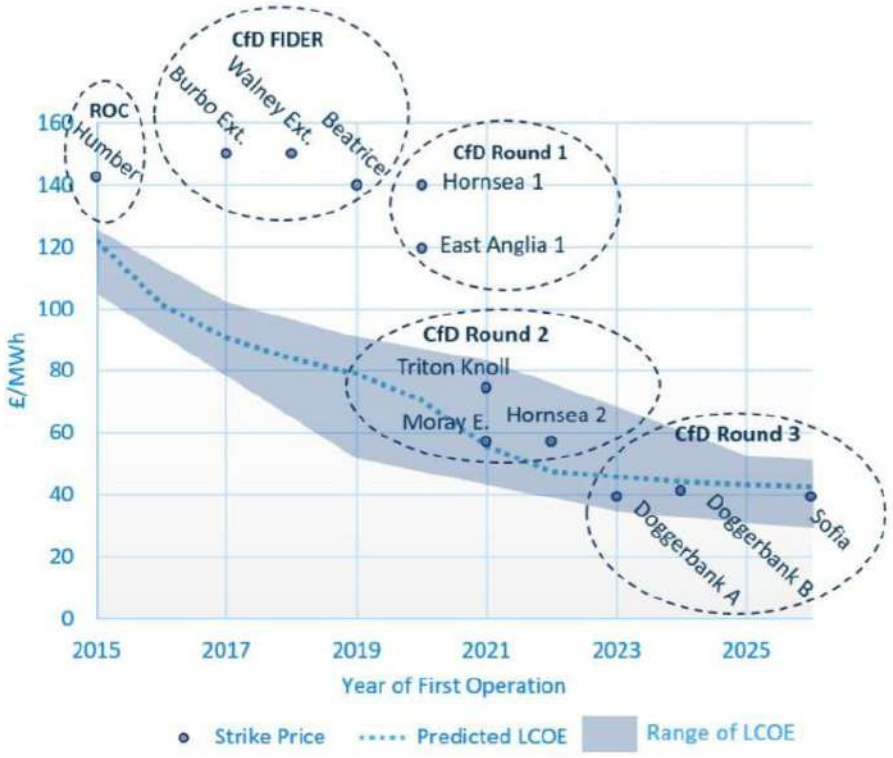

Figure 1 Strike price and estimated LCOE of operational wind farms (dark blue) and predicted average LCOE for Round 3 offshore zones (light blue)[1]. Prior to the establishment of fully-competitive CfD auctions, the Final Investment Decision Enabling for Renewables (FIDER), was run as an application process.

[1] (Aldersey-Williams, Broadbent, & Strachan, 2019) (Offshore Renewable Energy Catapult, 2019) (4COffshore, 2019)

This report shows how policy has been central to this success - particularly "demand-pull" policy. As a technology develops it moves along the "innovation chain" (see Figure 3), from its initial invention all the way to maturity. Policy acts at either ends of this chain. "Technology-push" policy acts on the left-hand side, earlier in a technology's journey. These policies directly fund research and development (R&D) through mechanisms such as R&D grants. "Demand-pull" policy acts on the right-hand side, developing the market for the technology through the likes of incentive mechanisms. It is UK "demand-pull" policy that has been at the heart of this decade's offshore wind success story.

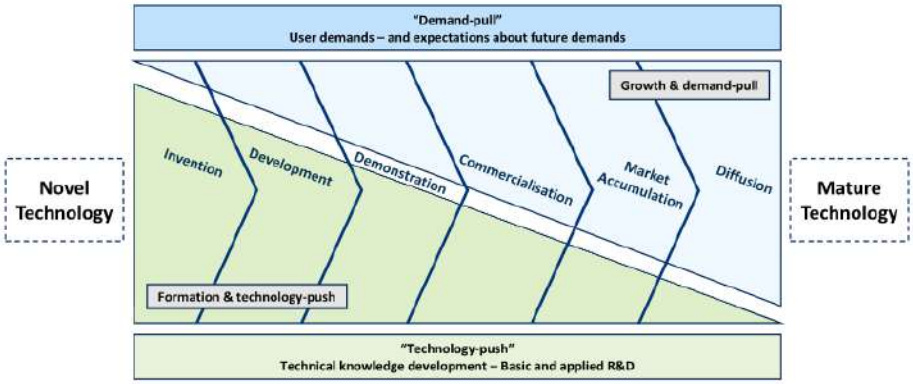

Figure 2 Technology commercialisation R&D pathway[2]

Part B of the report analyses the role of policy in two steps. The first step assesses the underlying cost reduction drivers. The second step assesses the extent to which policy has induced these cost reduction drivers, through its influence on different 'functions' of innovation systems, which drive the technology along the innovation chain.

[2] (Grubb, McDowall, & Drummond, 2017)

Cost Reduction Drivers

This work draws on a cost framework, adapted from Kavlak *et al* (2018), that enables cost reduction to be attributed to seven cost drivers:

1. R&D – public
2. R&D – private
3. Learning-by-doing
4. Financing costs
5. Economies of scale
6. Material costs & exchange rates
7. Other, including spillovers from other industries

We asked the leading offshore wind companies and their government counterparts to attribute cost reduction over the last decade to these seven drivers. They all agreed that the increase in size of the turbines was the single largest contributor to cost reduction. Interviewees then attributed turbine size differently across learning-by-doing, R&D (private) and economies of scale. We suggest that all three contributed to larger turbines. Furthermore, confidence in each generation/size of turbine also drove down finance costs. These cost drivers all feed into and from each other in a mutually reinforcing manner as illustrated in figure 3 below.

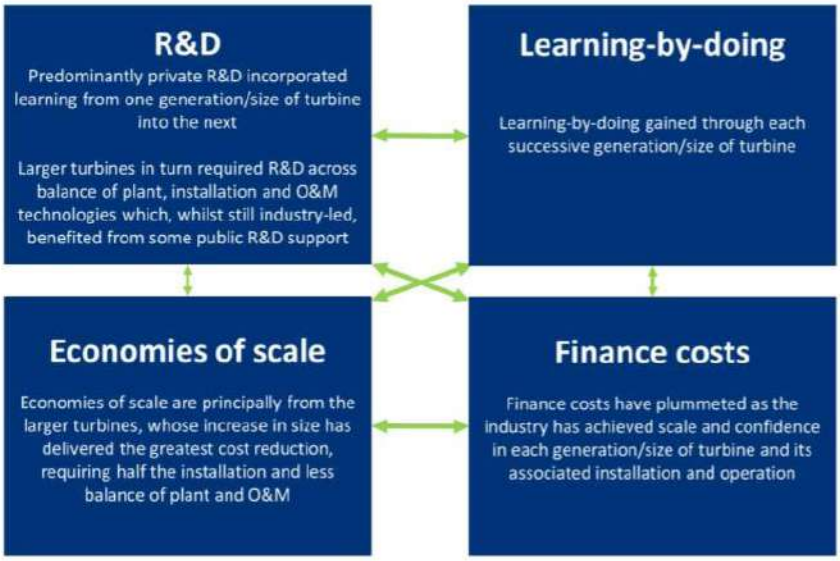

Figure 3 Cost drivers and their role in each generation/size of offshore wind turbine

Beyond larger turbines there were a number of other key contributors to cost reduction as the industry matured. Our assessment by each cost driver is summarised below.

R&D (public & private)

Larger turbines have mainly been developed through commercially-funded new product design, testing, and increasing fabrication and manufacturing scale. The development of direct drive turbines represents a more fundamental change in turbine design and required more R&D. R&D has also been critical to setting new standards that have in turn led to cost reduction; monopile foundations and 66kV cables are two key examples. Finally, R&D has been critical to the development of new balance of plant technologies. Notable examples include jacket foundations, suction buckets, access vessels, and floating LiDAR.

Learning-by-Doing

There are at least three ways in which learning-by-doing has driven cost reduction. Firstly, successful design, manufacture and deployment of each generation of wind farm, particularly each generation of turbine, has generated the learning and associated confidence to move rapidly to the next generation. Secondly, greater certainty has led to lower contingencies and associated cost margins. Thirdly, the supply chain has improved productivity through learning-by-doing, particularly in better and faster installation. Learning-by-doing was also cited as having supported UK companies taking an increasing role in the offshore wind supply chain and the clustering of industry.

Economies of Scale

Although increasing deployment, project size and long-term security of demand has allowed component manufacturers to offer bulk-buying discounts, economies of scale have largely been achieved through the development of increasingly large turbines. Wind farms that use larger turbines require half the installations, fewer balance of plant components, and less downtime for operations and maintenance (O&M). 50% of levelised cost of energy (LCOE) cost reduction in coming years is expected to come from the scale-up from 8 MW to 12 MW turbines.

Financing Costs

As the industry learned from experience, major risks such as extended installation time, low turbine availability, and high O&M requirements became better managed. This reduced the risk profile of the investment and the returns required by investors. The WACC[3] offered to developers has reduced from over 10% in 2010 to below 7% by 2020. This has had a significant impact on cost reduction; a 1% reduction in the WACC reduces the LCOE by approximately 7%[4].

[3] The weighted average cost of capital (WACC) is the average rate that a company pays to finance its assets.

[4] (BVG Associates, 2020) (Charles River Associates, 2018)

Policy accelerated the innovation that drove cost reduction

Technology-push policies to support R&D supported the early development of offshore wind in the UK, but it has been demand-pull policies that created a viable UK offshore wind market by driving cost reduction over recent years, through their impact on the functions of the offshore wind innovation system. Interviewees attributed 80.5% of cost reduction to demand-pull policies, 12.5% to technology-push, and 7% to non-policy factors. The most significant policy instruments for UK offshore wind have been the Renewables Obligation (RO) and Contracts for Difference (CfDs).

Government commitment enabled investment and growth

The UK government has made a visible, long-term commitment to offshore wind, manifested most recently in four rounds of CfDs over the last seven years. Prior to CfDs, the RO gave industry the right level of support to commercialise an emerging technology. The transition between the RO and CfDs did create a hiatus that created supply chain shocks and some cancelled projects but, overall, policy stability and clear government commitment has given industry the confidence to make large-scale investment.

Competition has driven down cost, but change is needed to support disruptive innovation

The CfD auction mechanism has driven intense competition and this has created significant cost reduction as developers now compete on price. This cost pressure has driven incremental innovation but has arguably not supported more disruptive innovation. Less mature technologies, such as floating offshore wind, will be necessary to meet long-term decarbonisation goals; the government is currently consulting on a mechanism within CfDs to ensure floating wind can access support whilst maintaining the element of competition[5].

The right policy at the right time helped a market to form

Both the RO and CfDs have played an important role in enabling the UK market to form. The RO, through a generous and stable level of subsidy that adapted to the maturity of different technologies, gave early investors confidence and kick-started the market. CfDs took that legitimacy and confidence and introduced competition to grow the market and reduce costs.

A strong project pipeline has strengthened the supply chain

CfDs have generated a strong pipeline of projects, further strengthened by the 2019 Offshore Wind Sector Deal, which includes a commitment to CfD auction rounds every two years until at least 2030. This pipeline has enabled the supply chain to prepare and scale up as they have visibility of developments several years ahead. It has enabled the growth of the UK offshore wind workforce, both in terms of size and skills. This has attracted investors, who see a pipeline of increasingly low-risk projects.

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[5] (Department for Business, Energy & Industrial Strategy, 2020)

Knowledge development has been good, but more fundamental innovation is needed

Both the RO and CfDs have effectively supported knowledge development. The RO created space for the early knowledge development and fundamental innovation necessary for an emerging technology and industry. CfDs then forced developers to seek a competitive edge, which they have partly achieved through knowledge development. As mentioned above, CfDs have not supported fundamental innovation and the newer technologies that will be necessary to meet UK decarbonisation targets, but proposed changes to CfDs should address that.

Knowledge sharing has decreased, but good examples still exist

Knowledge sharing has decreased with the competition generated by CfDs, but there are still pockets of cooperation. The Offshore Wind Accelerator (OWA) brings together nine offshore wind developers collaborating on innovation to achieve cost reduction, whilst still competing against one another in the market. Since 2008, the OWA has enabled research across thematic research areas in access systems, cable installation, electrical systems, foundations, wake effects and wind resource, as well as undertaking a number of discretionary projects[6].

[6] https://www.carbontrust.com/our-projects/offshore-wind-accelerator-owa

Tackling carbon leakage: sector-specific solutions for a world of unequal carbon prices - 2010

CARBON TRUST

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.

Michael Grubb
Adviser and former Chief Economist, the Carbon Trust

Thomas Counsell
Strategy Manager, the Carbon Trust

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:

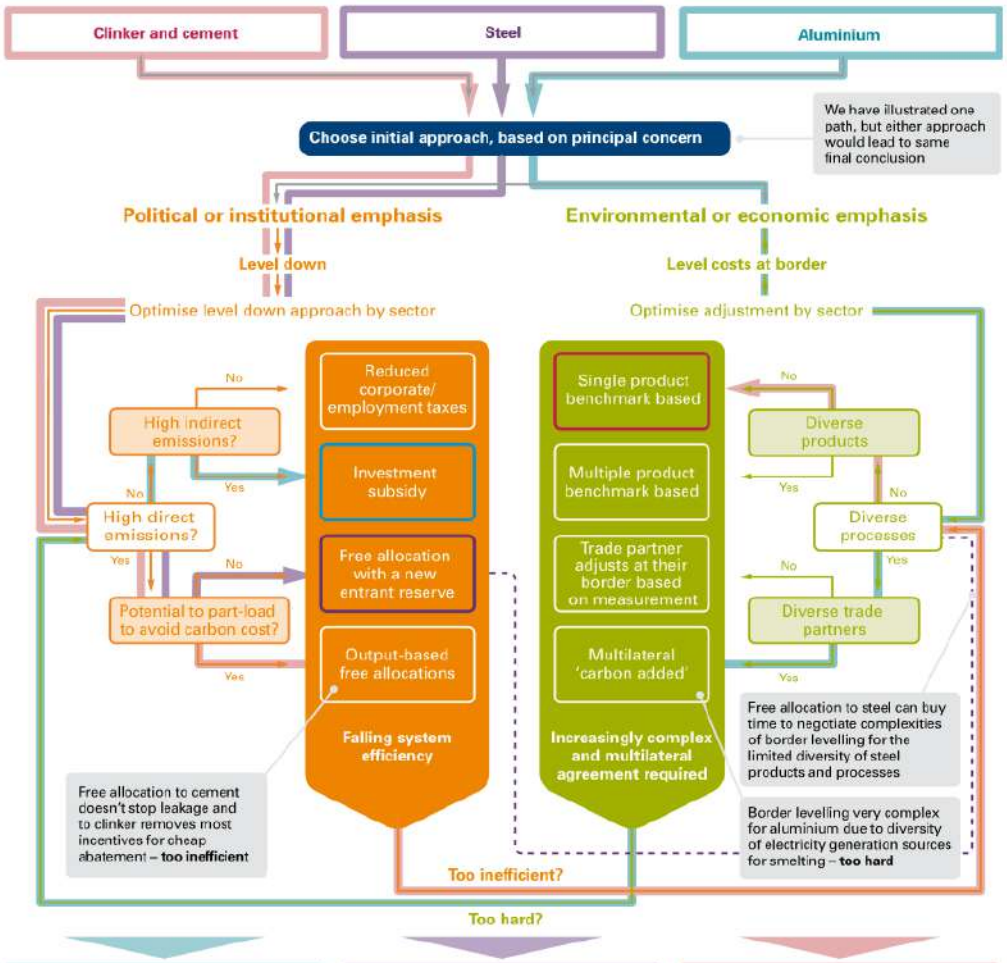
- 'Levelling down' the carbon cost a sector faces, for instance through free allocation, is a potential option. However, this approach may not prevent carbon leakage and could retard low carbon investment and innovative solutions for the exposed sectors, increasing the cost of meeting carbon targets 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).

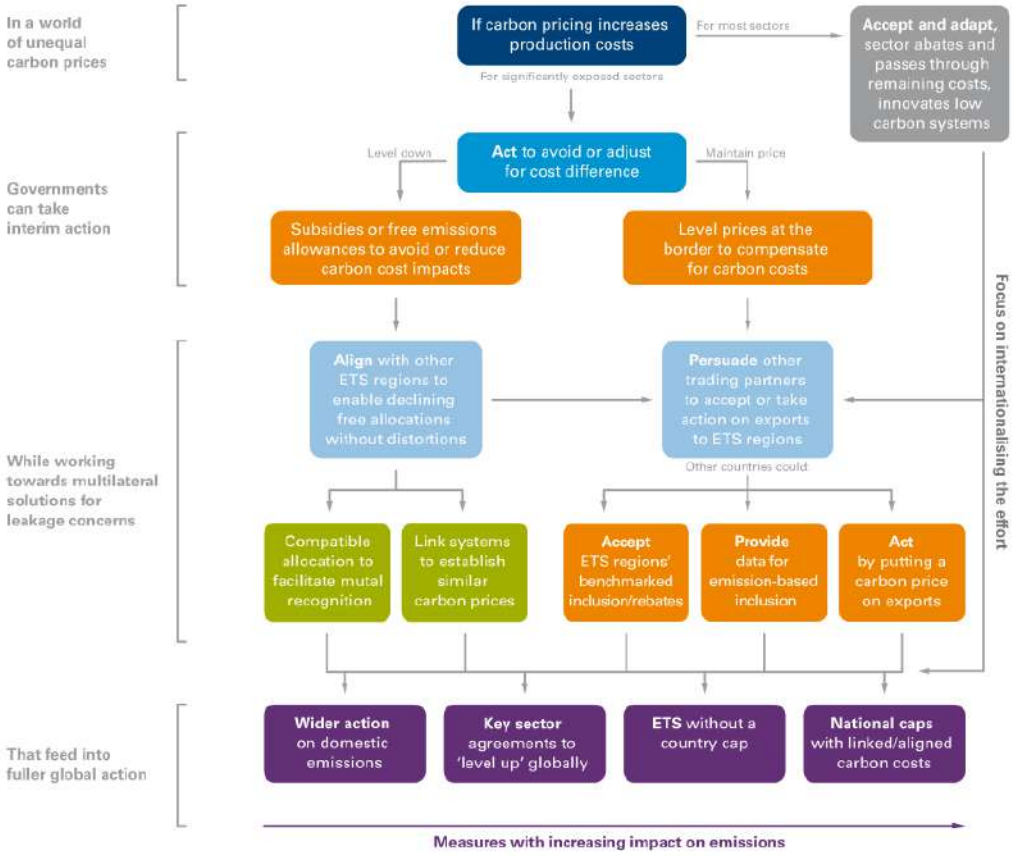
At a technical level, border levelling is in principle both more effective and more efficient than free allocation, but it is also more complex and controversial and consequently carries other risks and challenges. There are relevant precedents however. No one disputes excise taxes levied on petroleum 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.

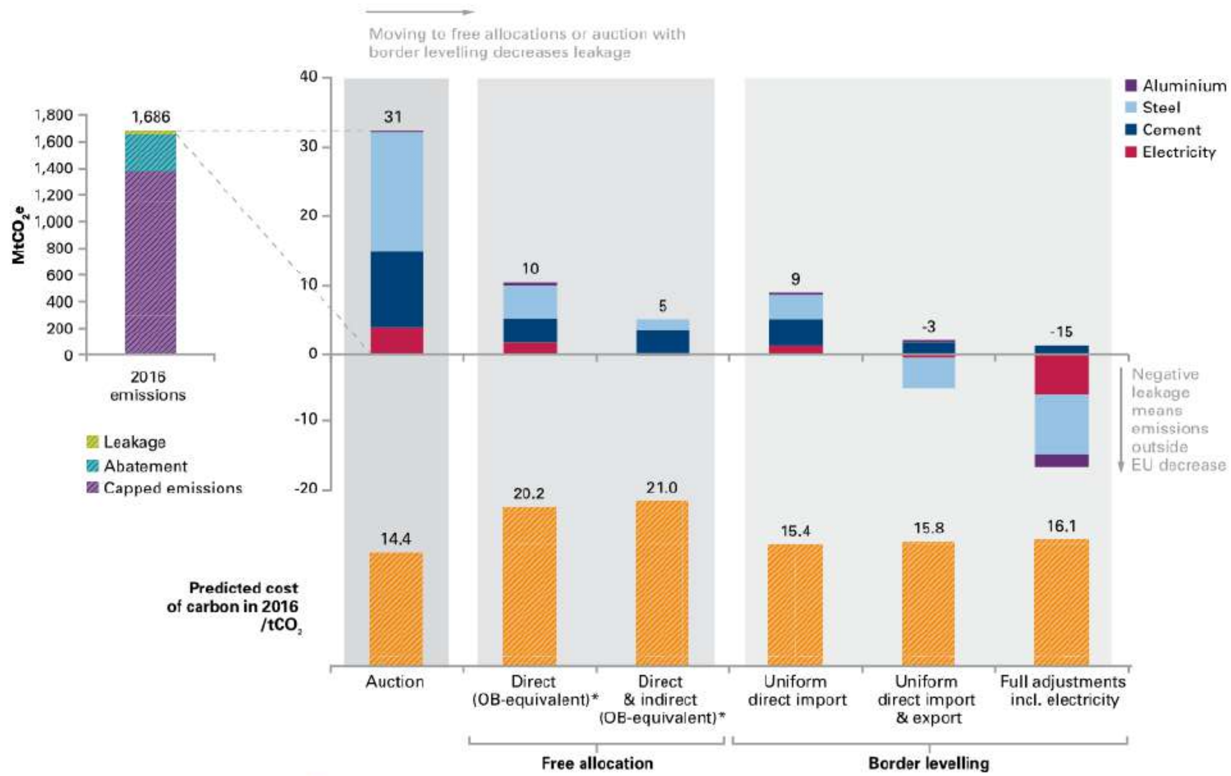
Reimbursing carbon costs for exports from ETS regions raises different sets of legal issues (see box at the end of the executive summary). However since the EU has largely exhausted cheap domestic supplies of energy and ore, it has little inherent advantage in carbon-intensive commodities particularly 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.

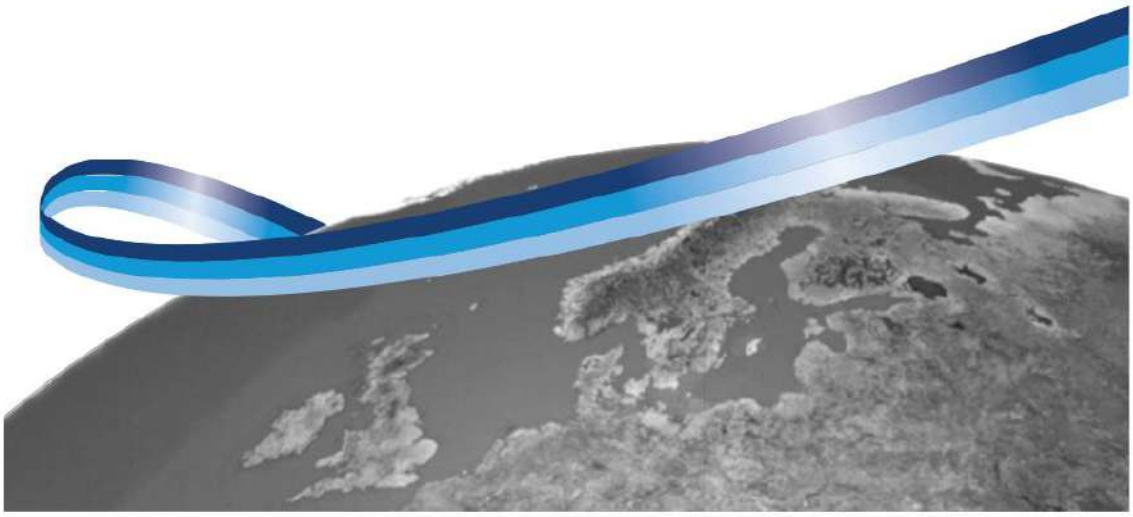
Sectors with high direct carbon costs (very carbon-intensive) that are also capital-intensive may be addressed transitionally through allocation decisions, but this carries drawbacks that accumulate over time:

- 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.

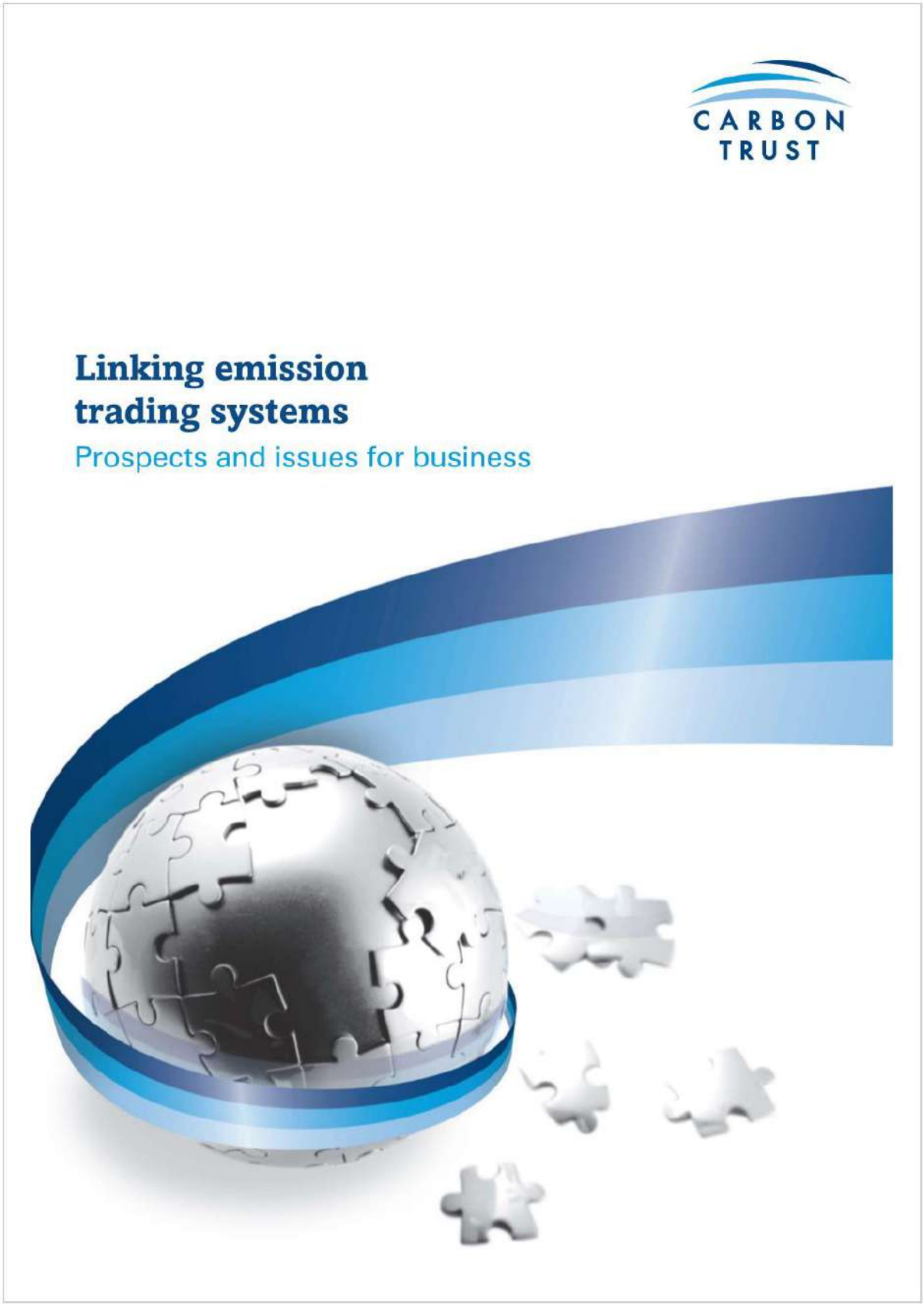
Export levelling. Reimbursing carbon costs for exports (rebates) can be compatible with the international agreement on Subsidies and Countervailing Measures providing carbon controls take the form of a charge or energy-related cost (for which ETS would probably qualify), not as a regulatory measure, 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.

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



Contents

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): Türk, A., Sterk, W., Haites, E., Mehling, M., Flachsland, C., Kimura, H., Betz, R., Jotzo, F: Linking emissions trading schemes. The individual studies of national emission trading schemes are carried in a Special Issue of the Climate Policy journal, Climate Policy volume 9 issue 4.

Preface

The idea of using emissions trading to cap and cut greenhouse gas emissions is becoming widespread. The Obama Administration is rapidly developing a domestic US programme, hard on the heels of concrete Australian and Canadian plans. There are pilot systems in Japan and Korea, and some developing countries are beginning to consider the idea.

A natural progression is to consider linking such systems, so that one system's trading units can be used, directly or indirectly, in another. Such inter-system trading would enlarge the carbon market by connecting otherwise isolated domestic systems, include more participants with more diverse sources and abatement options, and thereby improve market liquidity and efficiency.

Given these apparent benefits, linking is emerging as a major policy goal: the EU aims for an interlinked OECD market by 2015 leading on to a global carbon market. Indeed, linking appears to be such a simple and unambiguously sensible idea that one is tempted to ask, 'what's the problem?'

This study charts both the attractions and the problems. It emerges that there are quite formidable obstacles. These reflect numerous differences in national and regional circumstances, and in resulting designs and levels of ambition as detailed in this report. Government and business need to be prepared for a long transition, which will not provide 'quick fixes'.

The challenge is not so much to 'link' systems, as to ensure that emergent systems are designed in such a way that linking becomes *possible:* systems must be 'designed to dock'. The study thus emerges with a paradox: linking is likely to be slower than many hope, and yet it is more urgent to consider it now in the design of emergent systems, lest design differences start to pose insuperable obstacles further down the track.

The study is built in particular upon our earlier work on design of the EU Emission Trading System, and on the Global Carbon Mechanisms (see inside back cover for a list of publications). Like some of these earlier publications, it is based upon research carried out by the international research organisation Climate Strategies, whose project on linking convened experts in each of the major countries concerned. However, this report represents the independent conclusions and observations of the Carbon Trust.

James Wilde
Director of Insights, Carbon Trust

Michael Grubb
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Tom Brewer
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August 2009

Executive summary

Emission trading systems are under development in many parts of the industrialised world, and under consideration more widely still. If all these plans proceed as independent systems, investments in different industrialised countries will face different regulatory structures, coverage and carbon prices, with ongoing uncertainties about how each system will be developed and influenced by others.

Linking: a solution with many benefits...

Linking these systems would in theory have many benefits, potentially including greater stability and predictability, higher economic efficiency, and reduced potential for competitiveness distortions; it would also greatly reduce the complexity for multinational companies in managing differences between systems. The EU has expressed a desire to establish, though linking, an OECD-wide carbon trading market by 2015 and to extend this to other developing country emitters by 2020.

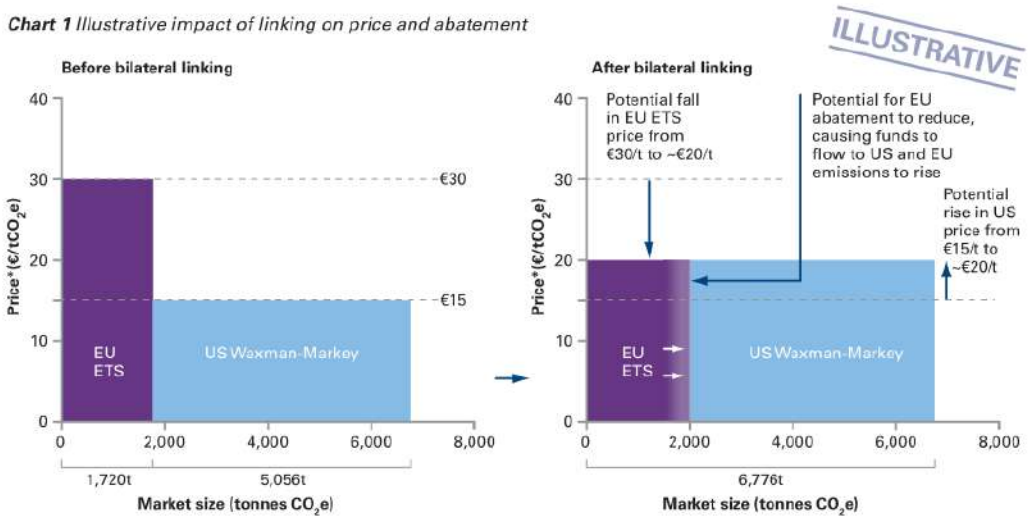
...but it will be difficult

However, there are many serious obstacles to linking in practice:

- Linking systems with differing overall *levels of ambition* could tend to violate the politically negotiated objectives underlying *each* of the linked systems, and place key influences on pricing outside the political control of any specific national authority: one example, indicating the potential price and abatement impact of linking the EU ETS to an emergent US system is illustrated in *Chart 1*. If not carefully managed, linking systems with significant price differences could cause major funding flows to other regions which may be politically unacceptable. In the case of emerging systems, this risk could be mitigated by waiting for systems to go through a learning phase and reach equivalent levels of ambition and stability to more established systems.
- Different *enforcement* provisions between systems may erode confidence in the markets emerging from linking or otherwise reduce the stringency of enforcement in one region to levels it considers unacceptable.
- Differences in the *kinds and scale of offset credits* that are considered acceptable may create large barriers, if systems that have been designed to focus mainly on domestic efforts, or to preclude offset investments that are considered politically or institutionally problematic (such as the exclusion of nuclear or forestry credits in the EU ETS), are linked to systems that are much more open to offsets.
- Linking systems with *absolute* to *intensity-based* allocation (allowances allocated in proportion to industrial production) introduces many technical complexities and means that different sectors would face different carbon cost structures even at the same carbon price.
- Linking to systems with *cost containment measures* (such as price ceilings) would tend to act on all the linked systems, in the case of a price ceiling with resources flowing to the region with the lowest price ceiling.
- An initial decision to link has profound long-term implications for *governance*, since through linking, each system would also be exposed to decisions taken by its partners about further changes, development, links or other expansion through multiple chains of connections. When systems commit to linking it should be recognised that future decisions on further development of the system should be taken jointly or with full discussion.

Systems currently being developed around the world do differ radically in several of these characteristics, and this will pose serious obstacles to linking. The underlying challenge is not just to link, but rather to facilitate sufficient common elements that it becomes both technically *possible* and politically *acceptable* to 'dock' systems together. At present there is little sign of this and system designs are proceeding largely independently.

Chart 1 *Illustrative impact of linking on price and abatement*



*This is an illustrative example of price impact only. Obviously, if starting prices were reversed (EU ETS prices lower than US) then the price impacts of linking would be similarly reversed.

Source: Climate Strategies.

These factors will make it hard to establish extensive links within the next five to 10 years. Consequently, businesses may face an extended period with multiple trading systems of increasing regulatory complexity and uncertainty:

- The diverse array of separate emissions trading systems will lead to higher compliance costs for business compared to full linking among all systems.
- Business leaders should be prepared for carbon price differences between systems and differing cost containment measures, as well as differences in the allocation rules, strictness of emissions caps and core design features of different systems.
- Multinational companies will also need to become more informed about the idiosyncrasies of individual systems in order to be able to plan and act strategically, for instance when considering the impacts of trading systems on plant location and operational issues.

Business lobbying in different regions is one of the factors driving differences in emerging design features; multinational companies should review the consistency of their positions in different parts of the world in order to assist the process of linking, given that it is ultimately in businesses' long-term interest to achieve a single, stable, lowest-cost carbon price.

Governments for their part need to consider urgently the implication of currently preferred designs for the ability to link systems in the future. With the design of the US Waxman-Markey bill, the Australian system and others still being developed, and the possibility of aspects of the EU ETS being reviewed post-Copenhagen, there is a need for more consultation between regions. Particular areas of focus could be in the level of ambition of systems, approach to offsets and cost containment design.

A new international climate change agreement, reached at Copenhagen or elsewhere in the next few years, could improve the prospects for linking domestic systems by embodying or fostering a more comparable degree of effort and clarifying some common rules and procedures (for example, around offsets). But such an agreement is not essential to linking domestic schemes, nor can it ensure that a global carbon market does emerge. It could take many years – potentially decades – for such an agreement to be translated into a truly global carbon market.

Global Carbon Mechanisms: Emerging lessons and implications - 2009

CARBON TRUST

Global Carbon Mechanisms

Emerging lessons and implications

Contents

This report is dedicated to the memory of Bernhard Schlamadinger, Research Director of Climate Strategies, who tragically passed away in August 2008. Bernhard made huge contributions to the world's understanding of the links between land-use, forestry and climate change policy, and was widely regarded as the world's leading expert on their potential incorporation in the Global Carbon Mechanisms.

This Carbon Trust report draws in part upon 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.

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Climate Strategies

* Three Climate Strategies studies examined the emerging lessons from the three main Kyoto mechanisms: P. Castro and A. Michaelowa, *Empirical analysis of the performance of CDM projects* (June 2008); A. Korppoo and O. Gassan-Zade, *Joint Implementation: looking back and forward* (October 2008); D. Urge-Vorsatz et al., *Green Investment Schemes: maximising their benefits for climate and society* (November 2008). The report also draws tangentially upon two other Climate Strategies studies: P. Baalman and B. Schlamadinger, *Scaling up AFOLU Mitigation activities in Non-Annex I countries* (June 2008); and Neuhoff et al., *International support for domestic climate policy* (December 2008).

Preface

To tackle climate change, a key challenge is creating incentives for companies – and indeed governments – to invest in activities that reduce greenhouse gas emissions internationally. This report provides an overview of the various different 'Global Carbon Mechanisms' that exist today, and surveys the evidence on how they have developed to date.

Over the next year or so, the shape of the next global deal on climate change will be negotiated. The successor to the current Kyoto Protocol commitments offers an opportunity to improve the Mechanisms that are used to motivate countries around the world and their companies to change what they do. The final sections of this report highlight the strengths and weaknesses of the existing Mechanisms, where changes are appropriate and where carbon markets are unlikely to work and therefore other policies are required.

This report focuses on global mechanisms; however, local carbon markets such as the European Union Emissions Trading Scheme (EU ETS) are increasing in number and importance – the Carbon Trust has analysed the EU ETS in a series of reports culminating in an analysis of the future of the scheme. More directed and interventional policies are also required, particularly to stimulate innovation, as identified for instance in a major Carbon Trust report on the offshore wind sector. We have also examined how the global transition to a low carbon economy could be accelerated by a network of 'innovation' centres, designed to stimulate low carbon technology innovation and diffusion, with an emphasis upon their possible contribution in developing countries.

Finally, the power of consumer and employee choice to influence corporate behaviour needs to be nurtured and supported, topics that the Carbon Trust has recently addressed through: standards for measuring and reporting carbon emitted by products, services and organisations; and work with companies to measure and communicate these carbon footprints in practice.

Through such different and complementary approaches, tackling climate change will result in opportunities for well-prepared companies to make significant profits and the unprepared to make significant losses – as described in our 'Climate Change: a business revolution' report last year.

The report in your hands represents our latest contribution to the international debate as we enter a crucial year for international policy – and its consequent implications for business.

Tom Delay
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March 2009.

Key findings

The Global Carbon Mechanisms are and will continue to be a central pillar in the global response to climate change to 2020, but are not on their own sufficient.

The global carbon offset and trading Mechanisms established under the Kyoto Protocol have grown rapidly to support compliance with national commitments and to channel billions of euros towards lower carbon investments in developing countries.

Their success has overcome initial scepticism and persuaded most countries to support market-based flexible mechanisms: the existing Mechanisms can, should and will continue post 2012 as a key part of tackling climate change globally.

To cope with the rapidly growing volumes in the Clean Development Mechanism (CDM), to learn from experience gained, and to increase public confidence, reforms are required in implementation structures and operating rules, supported by a more sophisticated debate about ensuring environmental integrity:

- Too many roles are concentrated in the Executive Board: strategy and governance should be separated from executive project decisions, with a separate appeals procedure.
- This would free the Board to focus on increasing stability, transparency and administrative efficiency of the rules for assessing the additionality of project emission savings, and adapting rules to facilitate a broader interpretation of environmental integrity and wider scope of individual project types and programmes.

Despite shortfalls in project performance, the strong response to the mechanisms overall, combined with the progress in cutting emissions (particularly in some of the big EU emitting countries) and the impact of high energy prices in 2008, means that supply will exceed demand to 2012:

- Several factors including the ability to bank European Emissions Trading Scheme (EU ETS) and Kyoto allowances forward will soften the impact of this surplus, but the market may heavily discount for political risk and a major 'shakeout' will occur as prices fall below €10/tCO_2.
- Industrialised countries could choose to support prices by making early commitments on post-2012 cutbacks; by purchasing and retiring credits; by announcing decisions to bank allowances forward; and/or by setting a reserve price on EU ETS auctions (predominantly in the UK and Germany).

Sustaining project inflow at present rates could make a large contribution by 2020 to the abatement required in the sectors currently engaged. This reinforces the need for a strong global agreement and for far more attention to the future balance of supply and demand:

- Cutbacks over 2013-2020 will have to absorb 15-20,000 MtCO_2 of credits and allowances – equivalent to over one third of one year's global emissions. This is divided roughly three ways between the existing surplus from transition economies, ongoing credits from projects already active by 2012, and projects that would be implemented post-2012 if they continue at the present rate – plus any EU ETS allowances banked forward.
- The lack of any internationally accepted process to analyse the interaction of supply from the Mechanisms with the demand implied by future emission targets is the greatest single weakness in the current negotiating process.

Tackling climate change to 2020 will require new mechanisms for engaging developing countries that should learn from the experience with the wider diversity of mechanisms available to industrialised countries:

- The CDM is an effective vehicle for decarbonising investments in no more than three of the seven main sectors that need to be addressed.
- At least four international mechanisms operate across the industrialised countries and each has found a niche; Green Investment Schemes are particularly interesting for their potential to finance programmes upfront that harness multiple and longer term benefits, notably in building and land use sectors, though much remains to be proven given their slow start.

The Mechanisms can only deliver part of the overall effort required:

- Harnessing the economy-wide potential for low-cost mitigation requires extensive policy reforms, for example around building and vehicle efficiency standards, land use policies, and regulatory structures to overcome diverse barriers.
- The Mechanisms will not drive innovation at the pace or scale required to prepare the world for longer term, deeper emission reductions.

Thus the Global Carbon Mechanisms are and will continue to be a central pillar in the global response to 2020, but are not on their own sufficient.

Key recommendations

1 The Global Carbon Mechanisms should continue post-2012, but reforms are required particularly to professionalise the operation of the Clean Development Mechanism and to provide greater public confidence about its environmental integrity.

2 Because the additional emission savings delivered by individual projects cannot generally be measured directly – it is a judgement not a science – environmental integrity can and should be defined at a higher level. The unifying theme should be to work from project-by-project emissions additionality towards the wider goal of channelling *additional investment* into low carbon economic development, with debate also extended to consider whether and how 'additionality' should be appropriately applied to Green Investment Schemes.

3 With a looming surplus of supply over demand, governments cannot rely on markets to maintain carbon prices based on uncertain expectations about the scope or strength of post-2012 cutbacks:

- Industry should prepare for a year (at least) of mostly low but very volatile prices driven by fluctuating expectations about the prospects for a meaningful post-2012 deal.
- If governments wish to support prices the options to consider are: coordinate retirement of credits/allowances; commit to 'bank' part of current Kyoto targets; specify post-2012 cutbacks prior to a global deal; and/or set a reserve price in the major countries auctioning EU ETS allowances (predominantly Germany and the UK).

4 The Kyoto post-2012 negotiations process should develop a capacity to analyse the consequences of its decisions on post-2012 mechanisms and targets for the balance of supply and demand in an integrated manner.

5 The range of mechanisms available to developing countries should be expanded beyond the current CDM and World Bank/Global Environment Facility (GEF) financing mechanisms, and learn from the wider diversity of mechanisms available to industrialised countries (mainly as a result of accepting emission caps).

6 The following should be examined as options to evolve the geographic, sectoral and temporal effectiveness of the Mechanisms and thereby support low carbon economic development:

- *Incremental reform of CDM project additionality methodologies and eligibility rules* to streamline (e.g. programmatic CDM) and to review current exclusions.
- *Radical reform of project crediting rules* towards 'top-down' assessments based on benchmarked performance and/or levels of market penetration.
- *Evolution to sector and possibly policy-based crediting and trading mechanisms* for more advanced developing countries.
- *Establishing norms for Green Investment Schemes*, mostly likely through a forum of participating countries which could also ensure collective international learning.

Credit discounting could be applied to any or all such developments, to help maintain aggregate additionality and/or contribute to the global supply-demand balance.

7 Beyond the Global Carbon Mechanisms, the international negotiations also need to consider incentives for policy reforms and low carbon infrastructure, and more direct means to enhance technology innovation and commercialisation.

Executive summary

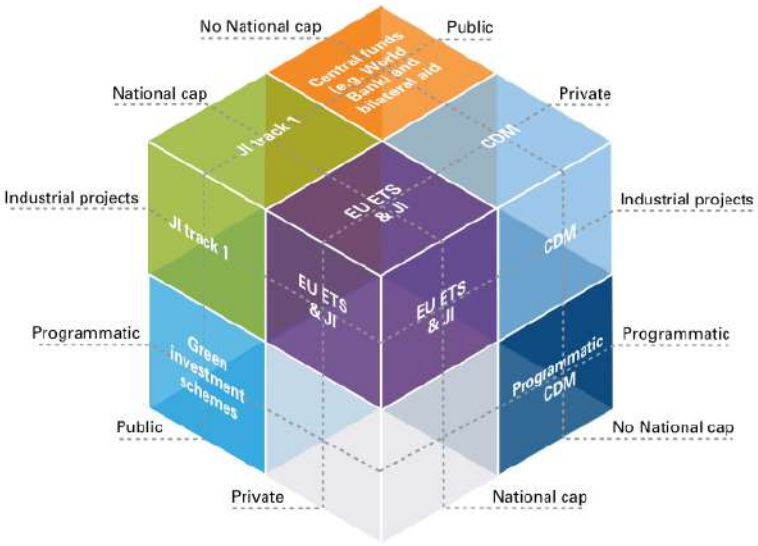
To stabilise the atmosphere, emissions must be reduced globally. In an unequal world, moving towards this requires richer countries (and companies) to fund emission reductions elsewhere. Mechanisms that create incentives for countries and companies to support emission reductions wherever they are cheapest also enable targets to be met as efficiently as possible.

The Kyoto Protocol established several global incentive mechanisms that rely on the international transfer of emission 'offset credits' or allowances:

- Projects in developing countries can generate 'certified emission reductions' for transfer through the Clean Development Mechanism (CDM).
- Projects in industrialised countries can generate 'emission reduction units' for transfer through Joint Implementation (JI). This takes two forms ('Track 1' or 'Track 2') depending on the host countries' depth of institutional compliance with the full set of Kyoto inventory and reporting provisions.
- Industrialised countries can also directly trade emission allowances, which has also generated two variants – direct industry trading such as the EU ETS, and intergovernmental Green Investment Schemes (GIS).

These complement funds operated by the World Bank, notably the Global Environment Facility (GEF) established in the early 1990s. Together these form a range of mechanisms that each have different focal areas regarding the intersection between: countries with and without emission caps; private and public sectors; and project versus programmatic-type activities (Chart 1). The desire for simplicity would suggest fewer mechanisms; practical experience suggests that even the present mix is insufficient for the real depth and complexities of the global challenge.

Chart 1 *The different Mechanisms*



Note: Joint Implementation (JI) has two variants: 'Track 2' refers to projects that are subject to direct international oversight (like the CDM); 'Track 1' involves bilateral procedures.

The response to date

The response to these Mechanisms has confounded expectations in both scale and nature:

- The most heavily regulated Mechanism – the CDM – has seen explosive growth, with around 3,000 $MtCO_2e$ of emission savings out to 2012 projected in the 'nameplate' estimates of design documents, assuming prompt implementation. A little over half of this is likely to be delivered by 2012 in practice, due to under-performance in approved projects, the potential for rejection or revision in those awaiting approval, and delays in project registration and start-up.
- Growth in Joint Implementation has focused mainly upon the component subject to direct multilateral supervision ('Track 2'). A phase of early growth in Central and Eastern Europe was eclipsed by the processes of EU Accession and EU ETS in the New Member States; about 300 $MtCO_2e$ (to 2012) is now proposed in 'nameplate' estimates from projects mostly in Russia and Ukraine. Procedures for the simplified 'Track 1' process, which formally relies on internal supervision within countries that have met the Protocol's full set of national inventory and reporting procedures, have been established more recently and in practice generally still involve third-party verification. Their greater flexibility in terms of scope and process has attracted about twenty 'Track 1' projects across Germany, Hungary and New Zealand; the volume remains small, but growing.
- The first direct intergovernmental emission trades under the Kyoto Protocol were only finalised in Autumn 2008, consisting of pilot sales of allowances to finance Green Investment Schemes that have been legislated in Hungary and Latvia to guarantee appropriate use of the revenues.

These experiences underline that for international exchanges of a publicly-created good – 'credited' emission reductions – political and environmental legitimacy of the product is crucial. No country has acted purely to 'minimise costs' through use of the international Mechanisms: governments have avoided least-cost purchases of surplus allowances, and mostly (except New Zealand) blocked private sector access to foreign surplus in domestic trading schemes. Regulated markets can grow only when relevant authorities on both sides of any transaction are convinced that it does indeed provide 'a good.'

A voluntary market for offset credits has also grown rapidly and traded 65 $MtCO_2e$ in 2007, but is undermined both by the lack of a regulatory driver and greater exposure to public doubts about the legitimacy of the product. To address these concerns and criticisms (and in some cases to help shape expected future regulation), the markets are seeking to establish credible voluntary standards, but voluntary buyers are also increasingly looking to the CDM for supplies of greater legitimacy and official oversight. However, the voluntary market remains the only route for activities – like most land-use projects – that remain either exempt or impractical under the regulated mechanisms, and this provides valuable experience.

There is no evidence that the existence of these Mechanisms has weakened the efforts of industrialised countries to control emissions. Domestic action, as constrained by domestic politics, has led; and some of the strongest efforts are emerging in countries that face the biggest gap and have made the biggest financial provisions for international purchases, like Spain. The Canadian government, the only other large Kyoto Party with a shortfall comparable to that of Spain, is eschewing both use of the Mechanisms and stronger domestic action, the consequences of which remain to be determined. In all other Kyoto Parties, the Mechanisms are facilitating compliance with commitments in appropriate ways, and channelling several €bn/yr toward emission reductions in developing countries in the process.

Strengths and weaknesses of the Mechanisms

The Mechanisms were introduced into the Kyoto Protocol by the US government in the face of considerable scepticism and fierce opposition from many developing countries. In the decade since, they have proved a remarkable political success.

The Mechanisms have attracted growing support globally. One of the few decisions so far taken in post-2012 negotiations is that the Mechanisms will continue. In such a divided world with almost two hundred sovereign governments, this is no small achievement.

Inevitably, growth and attention has led to many criticisms. Potentially the most fundamental was the risk that crediting emission savings from individual projects relative to a 'baseline' would create perverse policy incentives to worsen the baseline, or at least, reduce incentives to improve policy. This has been addressed through provisions that allow policy baselines to be 'backdated.'

A second criticism – particularly levelled at the early industrial projects – was that paying a uniform carbon price resulted in large profits for cheap projects. This is inevitable when any new, single-product market (like the CDM) succeeds in uncovering low cost options. Critics recommended instead a centralised funding approach, but this already exists in the form of the UN Global Environment Facility. The GEF's impact is constrained by its centralised public funding and the difficulty of applying this to private investments; these constraints, coupled with continuing political disputes and its failure to support some of the least-cost options subsequently identified under the CDM, suggest that a centralised fund approach is not credible as the primary means for driving the scale and nature of global decarbonisation efforts required.

Indeed, the most striking feature of criticisms of the Mechanisms has been the lack of credible alternative approaches proposed. The main debates now are not about replacing the Mechanisms, but improving them. Specifically, debates over the CDM have identified issues in rules, implementation, structures and scope.

Rules and implementation

A founding principle in the CDM is the need for environmental legitimacy. This has been widely equated with proving that each project generates additional emission savings as credited. However this is theoretically problematic, and experience confirms that assessing such 'additionality' unavoidably involves judgement that can be challenged. Moreover experience suggests that the task of 'proving additionality' is getting more difficult over time, not less.

In addition, the CDM has become a victim in part of its own success, with long procedural delays and growing criticism about the consistency of decision-making when the Executive Board has sought to learn from experience and thus deviate from precedents.

An honest political debate is required based on recognition that project-by-project additionality is an imperfect art with an unavoidable trade-off between administrative costs and the level of assurance. Several other options have been proposed, including credit discounting to account for the uncertainties in additionality associated with different types of projects and rules. Increasing economic returns to low carbon investment, particularly in emergent industries, itself has value and such wider benefits indicate that 'environmental legitimacy' could be recognised as a broader concept than just project-by-project additionality.

With an expanding scale of operation, the CDM cannot efficiently deliver its mission without greater professionalisation of staffing (rather than relying on government secondees) and its structures.

Structures and scope

The CDM's structures need reform to improve operations, clarify accountability and facilitate strategic development. The key need is to separate more clearly the governance and strategic tasks of the Executive Board from the implementation task of accredited agencies; a separate appeals procedure could further increase the legitimacy of decisions.

Such reforms, however, will not in themselves address other concerns that have focused on the realised scope of CDM activities:

- The main investments have focused upon certain regions and kinds of projects: the CDM has brought least benefit to the poorest regions (like Africa).
- The extent to which projects have brought 'sustainable development' benefits is varied and contested.
- In addition to officially excluded project categories (like nuclear), others like forestry and infrastructure projects are in practice also almost absent, and efforts to launch 'programmatic' activities in the CDM have yielded little to date.

These concerns all reflect fundamental features of a market mechanism that specifically credits greenhouse gas emission reductions: the market will seek out the most cost-effective options with the highest returns within the given set of rules. The biggest and most cost-effective opportunities will be in the biggest emitters with stable, attractive operating environments for investment; governments may seek to vet projects for their contribution to national development, but this will never be a driving force. The focus of investment will be upon projects that deliver maximum returns on the timescales for which credits can be generated, for minimum risk.

Some objectives cannot credibly be delivered by the CDM: rather than seeking to distort its fundamental principles, developing countries need rather to consider additional mechanisms.

The industrialised country Mechanisms

The experience in Central and Eastern Europe sheds important light on these issues. Initial Joint Implementation activities focused upon the most developed countries in this region and this provided a spur for other countries to improve procedures. However, the collapse of JI in the EU's New Member States illustrates the complexities of introducing mandatory standards and emissions trading on top of pre-existing crediting mechanisms; revisions in CDM rules should carefully consider the lessons.

Subsequent Joint Implementation projects, which could not start until 2008 and whose credits formally expire after 2012, have focused upon projects under direct international supervision ('Track 2') that generate very high returns, like plugging methane leaks from pipelines and mines, and on industrial gas and energy efficiency projects. The emerging interest in 'Track 1' projects suggests that full-scale national inventory and reporting procedures can build trust that facilitates greater flexibility around projects and procedures.

Early decisions are needed regarding future crediting to facilitate longer term investments under Joint Implementation. JI 'Track 1' should continue after 2012 and maintaining 'Track 2' could provide a valuable bridge for projects (including CDM projects) in countries that move to take on emission caps post-2012.

Green Investment Schemes are now also emerging as a means through which governments can attract finance to projects and programmes that generate multiple social and developmental benefits. Additionally, benefits may have much longer time horizons reflected through the ability to sell the present emission allowances that would otherwise be banked forward. Securing such benefits requires governments themselves to trade on the basis of criteria other than simple short-term minimisation of abatement costs. It remains too early to evaluate the practical experience – and there is a danger that the experience will be missed due to a collapse in demand.

Supply, demand and market outlook

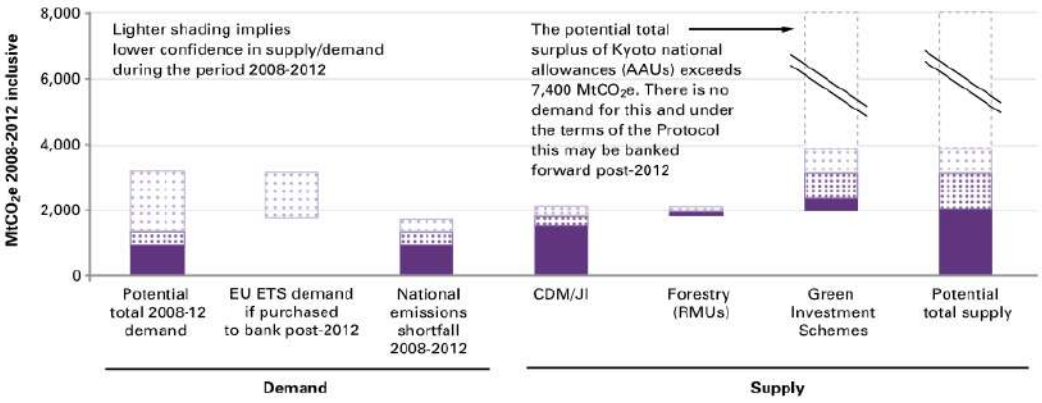
The prices of over €20/tCO_2e prevalent during 2008 are unsustainable. This mirrors the situation in Phase 1 of the EU ETS, but the outcome will be different.

During 2008, estimates of CDM supply declined as analysts looked more critically at project performance and delays in the system, and as the CDM Executive Board toughened its stance on approvals: likely delivery from the project mechanisms (CDM and JI) out to 2012 is about 1,800 $MtCO_2e$ ± 15%. Prices initially rose accordingly given expectations of reduced supply. However earlier projections that demand out to 2012 would exceed this are not credible (at least without Canada): after accounting for the impact of recent trends in emissions and fuel prices, demand from the remaining Kyoto Parties is unlikely to exceed about 1,500 $MtCO_2e$ (Chart 2), and could be much lower particularly if recession is prolonged. The prices of over €20/tCO_2e prevalent during 2008 are thus unsustainable, particularly after allowing for carbon sinks and GIS.

As with Phase 1 of the EU ETS, this reflects a combination of response exceeding expectations matched against insufficient overall cutbacks. The spectacular growth of the CDM has been joined by credible JI projects and GIS programmes. The Kyoto emission targets have proved less onerous than projected at least in some of the biggest European emitters; German success in renewables has greatly curtailed its emissions and UK progress on energy efficiency has contributed to an overall surplus; Spain is also now making rapid progress. The situation also of course reflects the impact of high fuel prices, and the absence of US and (at present) Canadian demand. Nevertheless, the resulting situation poses major dilemmas.

The price will not collapse to zero (as in the EU ETS Phase 1). Many factors will support prices despite the looming surplus, the single most important being that surplus EU ETS and governmental allowances can be banked forward post-2012. The ultimate value of this will depend entirely upon the strength of post-2012 commitments, and the extent to which these drive a demand that can absorb the likely supply.

Chart 2 *Supply and demand 2008-12*



Note: The data on demand do not include Canada, which is a Party to the Kyoto Protocol but not currently participating in the Mechanisms (see pp.46-47). Canadian participation would add c. 500-600 $MtCO_2e$/yr of demand and so do much to restore a balance between demand and the supply of project-based emission reductions.

During 2013-20, projects already established or expected from current inflow are likely to generate more than 5,000 $MtCO_2e$ credited savings. Continued expansion at present rates would add as much again. Assuming the banking provisions of the Kyoto Protocol, the likely surplus of Kyoto allowances from the EU's New Member States, other east European countries, and Russia may add another 7,500 $MtCO_2e$, to which would be added any surplus EU ETS allowances banked forward by industry. Over these eight years, the total supply is thus likely to be 15,000-20,000 $MtCO_2e$, divided roughly equally between credits from the CDM and the combination of credits and banked allowances from industrialised countries. This is more than 20% of total projected emissions from the EU and Japan over the period, which clearly could not on their own absorb such volumes. The Kyoto structure needs major cutbacks after 2012 across all the industrialised countries to ensure a carbon price sufficient to tackle climate change meaningfully.

During 2009, private markets are likely to apply a strong discount to the prospects for the deep and wide-ranging cutbacks that would be required to drive up carbon prices substantially post-2012. Also government demand is likely to broaden to include more significant purchases at lower cost from Green Investment Schemes, increasing downward price pressures.

If governments wish to shore up prices, different options would have different consequences. The present EU policy to protect its post-2012 package from excessive imports can help to sustain EU ETS prices and domestic action, but will further weaken demand and price in the global mechanisms. However, opening up the EU ETS unilaterally could not remotely absorb the future supply. Approaches that could support near-term term prices more broadly include:

- Retiring units (or buying units specifically for retirement) would support prices generally, but looks implausible particularly given the credit crunch.
- Government commitments to bank some of their Kyoto allowances post-2012 could increase demand in the present period, but would add further to the level of post-2012 supply.
- A reserve price set on forthcoming EU ETS auctions (dominated by the UK and Germany) could sustain both EU ETS and to some degree international credit prices.
- Commitments to steeper cutbacks post-2012, in advance of a global agreement, would send the strongest and most consistent signals but still only provide a partial solution.

In the absence of such measures, credit and allowance prices are likely to fall, and average below €10/tCO_2 during 2009, provoking a major shakeout in the global carbon markets. Prices may also be highly volatile as perceptions of the prospects for an effective post-2012 agreement fluctuate. The only positive side to this is that such a shock would focus attention on the need for post-2012 negotiations to embody an integrated balance of supply (from the Mechanisms) and demand (implied by negotiated cutbacks on a wider group of countries, and possibly sectors). The lack of any internationally acknowledged independent source for such analysis is the greatest single weakness facing the global negotiating process.

The future challenge

The Global Carbon Mechanisms are only effective in some sectors, and other instruments will be required to address the parts they cannot reach.

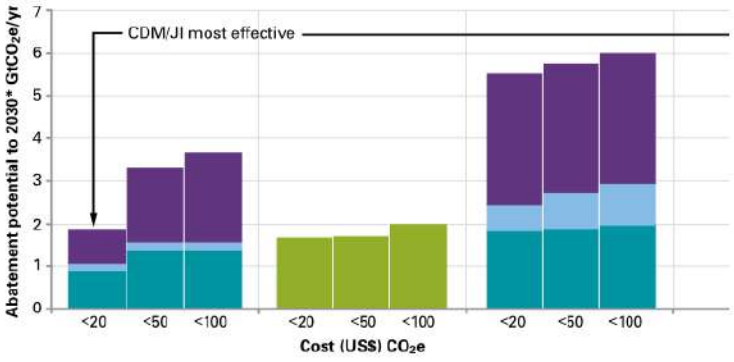
Pathways to stabilising the atmosphere at concentrations of 450-550ppmCO_2e imply cutbacks (relative to projections) by up to 10 GtCO_2e/yr by 2020 – at least half of this from within the OECD. The cutbacks will require, at a minimum, strong action across the industrialised countries; and approaching the tougher targets requires strong global action. If developing country action is financed predominantly through crediting mechanisms, much deeper targets will need to be adopted across industrialised countries. Lesser cutbacks to 2020 imply much higher costs and cutbacks later on to achieve a given stabilisation goal.

Financially, pathways to stabilisation at 450-550ppmCO_2e are estimated to require additional investments of 40-15% respectively in the energy sector alone, over and above the $26 trillion required out to 2030 to finance 'business as usual' growth. If spread evenly over the period, this implies incremental costs *globally* of around $200bn/yr for 550ppm$CO_2$e or over $500bn/yr for 450ppm.

If project inflow to the Mechanisms continues at the rate experienced since 2006, by 2020 they would be crediting about 2 GtCO_2e savings annually, and financial transfers from the project Mechanisms could approach levels for 550ppm pathways by about 2020 for the sectors they address. However, this would be insufficient to prevent huge lock-in to carbon-intensive investments in the interim, and will not prepare the world for lower levels and the more radical global transformations required in 2020-30.

Experience has demonstrated that the CDM is appropriate to incentivise investment in commercially-available low carbon technologies, mainly in energy supply (including power generation) and industry, and potentially waste sectors. These are sectors in which major investment decisions are driven by informed analysis of financial costs and benefits. CDM growth at current rates could reasonably capture most of the lower cost potential in these sectors by 2020. However, these technologies and sectors form only a minority of the total global saving potentials identified to 2030 (Chart 3).

Chart 3 *Long-term (2030) abatement potential by sector, with sector characteristics and focus of current CDM and JI*



	Energy supply	Transport	Buildings
Common project scale	Years construction, lasting decades; €m or €bn	Vehicle purchase: few years; €1,000s. Infrastructure: decades, €bns	Retrofit: household scale, few years, €100s. Construction: years lasting decades
Dominant investment driver/barriers	Costs, risks and returns at commercial or World Bank interest rates	Behavioural choice: fuel cost savings minor influence. Infrastructure: usually strategic state-funded decisions taking decades	Planning, tenant-landlord splits, high consumer discount rates. Dispersed, small scale companies for building insulation/services
Relevance of CDM/JI	Highly relevant for mature technologies close to cost-effective	Very limited	Almost irrelevant – a handful of projects – except through indirect effect of power sector decarbonisation

* Building & industry abatement includes their share of emissions reductions from using less electricity. See also Chart 22 for other estimates and comparisons.

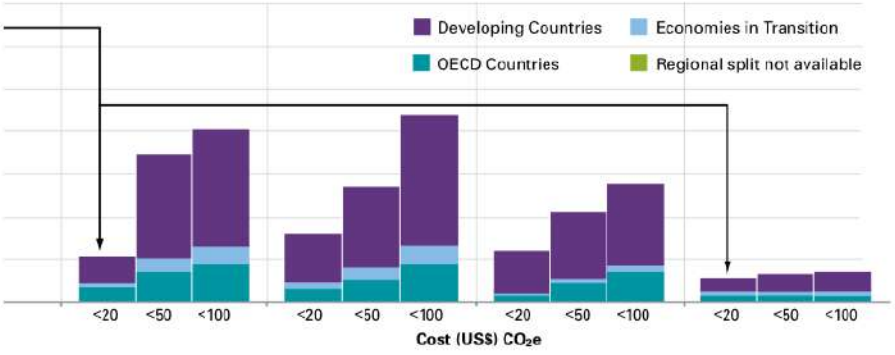
Adapted from: IPCC (2007) Working Group III Report *Mitigation of Climate Change*.

The CDM is intrinsically far less appropriate for capturing the potential in building efficiency, transport, agriculture and forestry and additional support is required to drive innovation.

- Project-based crediting mechanisms cannot overcome the main barriers that account for the large 'negative cost' potential, predominantly around buildings and transport energy efficiency.
- Perceived risks and high transaction costs in the face of measurement uncertainties and dispersed sources, combined with a conservative approach to crediting, deter projects in agriculture and land use.
- The limited time periods of crediting and uncertainties around future prices preclude options that deliver long-term or more uncertain benefits (like infrastructure and forestry projects).
- Innovation support is required to bring new technologies to market. Renewables and CCS are examples where support over and above the CDM is required short term – the CDM should, however, stimulate investment in these technologies once they have been adequately developed and could be crucial in their commercialisation and international diffusion.

Experience with the four Mechanisms in industrialised (Annex I) countries has shown the value of a diversity of instruments: though they share a common basic economic incentive, each has found a niche and started to deliver opportunities that others could not. Annex I countries do not have too many instruments; rather, there are not enough that engage developing countries across the full spectrum of potentials. The Annex I experience should inform the development of new instruments post-2012 to assist lower carbon developments in the developing world.

However, mechanisms that hinge on crediting or carbon pricing can only address the central part of the global 'supply curve' potential. Tapping the 'negative cost' potential mainly from energy efficiency hinges upon domestic regulatory policies. Other instruments will be required to foster large scale innovation and structural changes. These fall outside the scope of the Global Carbon Mechanisms and remain the biggest missing components in the global armoury. Ideas and support to fill these gaps could be one of the biggest contributions of the new United States Administration as it starts to engage with the international system after its long absence.



Industry	Agriculture	Forestry	Waste
Varied but often €m investments lasting decades	Distributed farm-level actions; plans as short as annual	Cumulation over years/ decades	Varied but often €m investments
Costs, risks and returns at commercial interest rates. Subject to focus on core business	Varies between agrobusiness and small farmers. Multiple considerations including nature of national agricultural support schemes	Long-term returns subject to multiple land risks in developing countries	Complex chains: emission/ cost savings modest influence
Highly relevant	Poor track record where attempted	Only one project registered	Relevant mainly to landfill gas capture.

Low Carbon Technology Innovation and Diffusion Centres:

Accelerating low carbon growth in a developing world – 2008.

CARBON TRUST

Low Carbon Technology Innovation and Diffusion Centres

Accelerating low carbon growth in a developing world

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Preface

The twin challenges of global climate change and energy insecurity can only be solved with rapid development and diffusion of low carbon technologies, both for energy supply and energy efficiency. Moreover, this rapid development and diffusion is needed globally. This need is recognised in statements by governments, business, and in international agreements and declarations such as those adopted by the G8 and in the Bali Action Plan. The challenge is how this can be achieved.

There are many dimensions to this challenge. Many proposed solutions address either the R&D end of the problem, or focus on issues of technology supply, funding, intellectual property and enabling environments, as with the work of the UN Expert Group on Technology Transfer. But less attention has been given to the overall process of low carbon technology innovation and diffusion, and how the emerging experience of some national efforts in this area might be extended internationally. That is the focus of this study.

The Carbon Trust, established in 2001 to help the UK move to a low carbon economy, has grown to become one of the world's largest such operations, and is unusual in combining programmes for innovation and for deployment of low carbon technologies. The Carbon Trust experience has emphasised the value of combining these activities and indeed the difficulty of drawing a line between them: for example, its technology acceleration programmes foster innovation 'in the field' to reduce the real and perceived risks around new technologies, building commercial capacity, reducing costs and increasing confidence for both users and the private sector.

Earlier this year, the Carbon Trust held discussions with the World Bank concerning different approaches to designing a network of low carbon technology centres, drawing on the Carbon Trust's technology development expertise, and lessons from the Consultative Group on International Agricultural Research (CGIAR) network in developing countries. Based upon the Carbon Trust's experience and drawing on interviews with thirty developing country and sector experts, we set out to explore whether and how the global transition to a low carbon economy could be accelerated by a network of centres designed to stimulate low carbon technology innovation and diffusion, with an emphasis upon their possible contribution in developing countries. This report summarises our recommendations and expands on these in a number of areas, including benefits of support for early-stage R&D and integrated approaches in commercial technology development and diffusion.

Michael Grubb
Chief Economist

Tom Delay
Chief Executive

Executive summary

This report sets out the case for establishing a network of Low Carbon Technology Innovation and Diffusion Centres internationally, and focuses upon some of the issues and options in the design and activities of the Centres.

There are a wide range of technologies at various stages of development that could contribute to energy and environmental goals. However, they are not being developed at the rate required due to a combination of technological, skills, financial, commercial and regulatory barriers. In addition, public and private sector funded low carbon R&D is low relative to the scale of the challenge and is concentrated in the G8. Faced with the scale and urgency of the energy-environment crises, one of the greatest challenges for the world is to accelerate the commercialisation and international transfer of better low carbon technologies. Developing countries in particular have the potential to leapfrog existing technologies and move directly onto a low carbon, sustainable economy pathway.

Current proposals for 'Climate Investment Funds' totalling several $/€bn remain modest compared to the scale of the challenge and ongoing mainstream energy sector investments. They are set against a backdrop of recognised inadequacy in low carbon energy R&D expenditure and a long-standing intergovernmental debate about international technology transfer. However, in neither of these areas have efforts to date adequately engaged the private sector, which has the potential to bring far greater resources to bear upon the challenges, combined with different and complementary expertise.

Thus a huge gap remains that requires a different approach from large-scale public funding of demonstration projects on particular 'big-ticket' technologies in the developing world. The need is for publicly funded organisations that can work on the ground in individual countries across a wide range of technologies appropriate to the needs of those countries, and engage national as well as multinational companies to overcome the local barriers to the development and deployment of these technologies.

A network of these Low Carbon Technology Innovation and Diffusion Centres located in selected developing countries could enhance local and regional engagement with global technological developments, and catalyse domestic capacity to develop, adapt and diffuse beneficial innovations. Experience indicates that effective innovation needs to encompass the 'software' of commercial, institutional and financial structures, as well as the 'hardware' of the technology itself, and both need to learn from experience in the field. The Centres would nurture these capabilities through targeted interventions including field trials, business incubation, capacity building and seed capital (see Table 1 for full list of potential activities). These Centres would reduce technology costs through innovation and help to leverage private resources and thus bridge the clean energy financing gap that currently exists.

To achieve this, the Centres would need to be set up as Public-Private Partnerships that could work collaboratively with local academic organisations, businesses and governments to ensure the most cost-effective projects are supported, catalysing the large commercial investment required to achieve a transition to a low carbon economy. These national Centres would be independent, but could be supported by an umbrella organisation which ensures lessons are shared between Centres and with other countries with similar characteristics.

Based on the Carbon Trust's experience over the past seven years, we estimate that each Centre would require an investment of $40m to $100m per year. At an overall level this would require a total investment of $1bn to $2.5bn over five years to establish five national Centres, as a first phase of activity. Given the long lead times involved in energy research, development and deployment projects, a five year funding budget is the minimum necessary to establish the network and achieve measurable progress. Future funding for additional Centres and subsequent time periods should be considered in light of the success of the first phase.

Such public sector support could leverage 5-10 times as much as private sector investment. It could enable up to 50 projects per year to be supported in each Centre, many of which could lead to self-sustaining low carbon technologies and businesses, given appropriate

policy environments, with considerable carbon and economic benefits. Locating the first set of such Centres in archetypical developing countries, to develop capacities appropriate to fundamentally different kinds of operating environments, could accelerate the wider international impact. Establishing such a programme thus holds the potential to make a major contribution to the combined goals of low carbon technology, energy security and development.

***Table 1**: Types of interventions required to address specific local barriers to technology innovation and diffusion*

Activity	Gap/need addressed	Benefits
Applied research and development Grant funding, open and/or directed at prioritised technologies	Inadequate support for relevant applied research for technologies where private funding is minimal due to classic innovation barriers[1]	New ideas from local scientific knowledge base applied and developed to point of potential commercial relevance
Technology accelerators Designing and funding projects to evaluate technology performance e.g., field trials	Uncertainty and scepticism about in-situ costs and performance, and lack of end user awareness	Reduction in technology risks and/or costs by independent collection and dissemination of performance data and lessons learnt
Business incubator services Strategic and business development advice to start-ups	Lack of seed funding and business skills within research / technology start-ups – the 'cultural gap' between research and private sectors	Investment and partnering opportunities created by building a robust business case, strengthening management capacity and engaging the market
Enterprise creation Creation of new low carbon businesses by bringing together key skills and resources	Market structures, inertia and lack of carbon value impede development of low carbon start-ups or new corporate products and services	Creation of new high growth businesses to both meet and stimulate market demand Development of local commercial and technical capabilities
Early stage funding for low carbon ventures Co-investments, loans or risk guarantees to help viable businesses attract private sector funding	Lack of financing (typically first or second round) for early stage, low carbon businesses due to classic innovation barriers combined with perceived low carbon market / policy risks[1]	Enhanced access to capital for emerging businesses that demonstrate commercial potential Increased private sector investment in the sector through demonstrating potential investor returns
Deployment of existing energy efficiency technologies Advice and resources (e.g. interest-free loans) to support organisations to reduce emissions	Lack of awareness, information and market structures limit uptake of cost-competitive energy efficiency or low carbon technologies	Improved use of energy resources through enabling organisations to implement energy efficient measures and save costs Catalyse further investment from organisations receiving support
Skills / capacity building Designing and running training programmes	Lack of capacity to install, maintain, finance and further develop emerging low carbon technologies	Growth in business capacity and employee capabilities to enable more rapid uptake of existing and new low carbon technologies
National policy and market insights Analysis and recommendations to inform national policy and businesses	Lack of independent, objective analysis that can draw directly on practical experience to inform the local government and the market	Enhancing the policy and market landscape to support the development of the low carbon economy

[1]Governments have long recognised the case for public support of research and development, because new ideas often create public benefits which are not possible (or desirable) for private companies to capture exclusively. In addition, analysts have identified numerous other barriers to adequate levels of innovation, including the long time horizons and the lack of fit between 'disruptive' technologies and existing institutions and infrastructure. For a recent survey of research on this topic see T. Foxon et al. (eds), 'Innovation for a low carbon economy', Edward Elgar, 2008

EU ETS impacts on profitability and trade: A sector by sector analysis – 2008.

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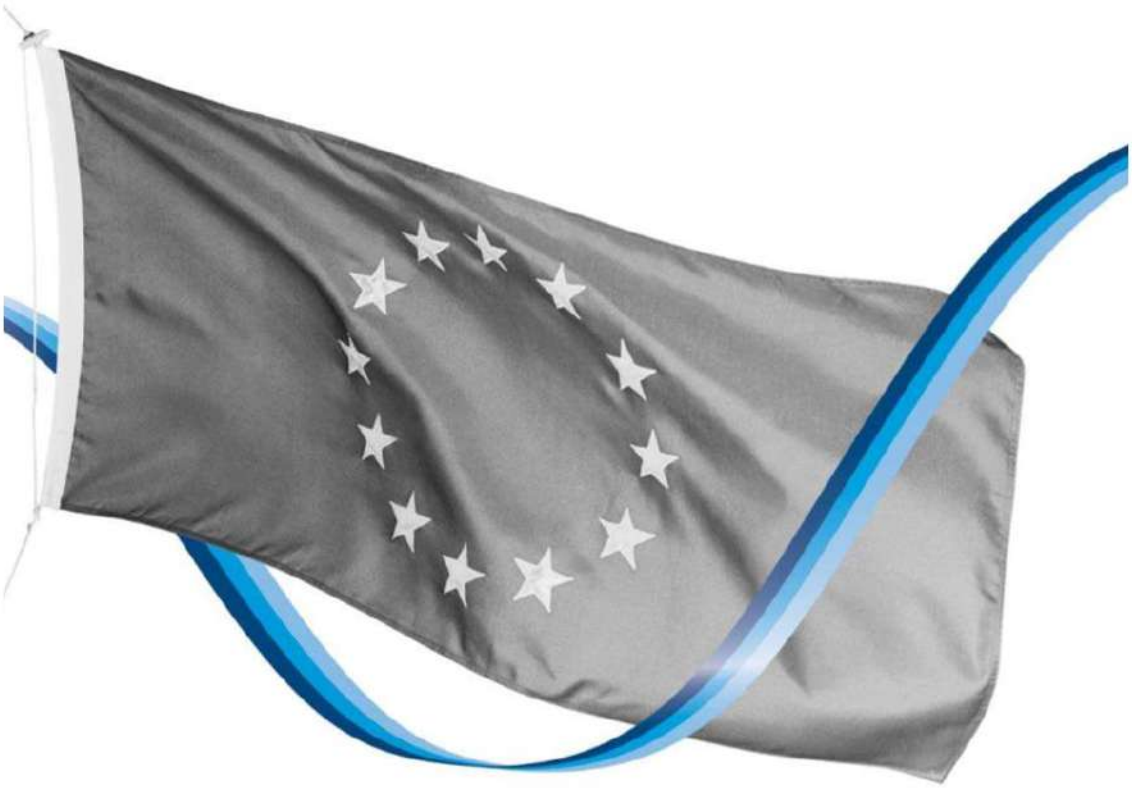
EU ETS impacts on profitability and trade

A sector by sector analysis



This Carbon Trust report is based 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. This report presents Carbon Trust insights based upon our synthesis of their underlying academic work.

* Climate Strategies (2007): J.C. Hourcade, K. Neuhoff, D. Demailly and M. Sato, Differentiation and dynamics of EU ETS industrial competitiveness impacts, www.climate-strategies.org.

Contents

Preface

The potential impact of carbon pricing – and in particular the EU ETS – on industrial competitiveness continues to worry business in the UK and the EU. The interventions by the European Commission to strengthen Phase II of the scheme, from 2008–2012, has underlined the seriousness of the endeavour and raised expectations for carbon prices.

Our previous studies have concluded that in these circumstances, and over the five-year period of Phase II, most participating sectors are likely to profit from the scheme, or at the very least are unlikely to suffer any significant negative impacts.

However no sooner has the dust begun to settle on Phase II allocations, than attention has turned to Phase III, running from 2013 potentially out to 2020. The EU's adoption of an ambitious commitment to a 20% CO_2 reduction by 2020 even in the absence of wider international participation – and a growing belief that Phase III will see significant cutbacks in allowances to manufacturing industry – continue to stoke concerns about potential competitiveness impacts. In addition, as governments seek deeper cuts in emissions, they are paying more attention to specific, high emitting activities rather than to sector averages.

To extend and deepen our earlier work on the topic, this report looks at cost, trade characteristics and competitiveness issues at a much more detailed activity level right across UK manufacturing. It also brings new research to bear upon the debate between business and academics about likely price and trade responses to higher carbon prices with particular attention to the high-profile sectors of cement and steel. It reaches the surprising conclusion that the 'trade and competitiveness' impacts on manufacturing may, ironically, turn out to be more of an environmental than a financial worry.

As with our previous report on the EU ETS, this report is based on research convened by the European research network Climate Strategies, of which the Carbon Trust is a founding supporter. The Climate Strategies programme included a CBI-hosted review of initial research, a release of a draft report for open consultation, and stakeholder consultation meetings hosted by the UK Emissions Trading Group (July 2007) and the French IDDRI (September 2007).

This report however presents the Carbon Trust's own conclusions based upon our view of the underlying research.

Tom Delay, Chief Executive
Michael Grubb, Chief Economist

Previous publications available from the Carbon Trust

2007 EU ETS Phase II allocation: implications and lessons.
2006 Allocation and competitiveness in the EU emissions trading system options for Phase II and beyond.
2004 The European emission trading scheme: implications for industrial competitiveness.

Key findings

The EU ETS and other carbon control measures out to 2020 will have negligible impact on the international competitiveness of more than 90% of UK manufacturing activities. Overall, the EU ETS can extend with deeper emission cutbacks in Phase III (post 2012), without damaging UK or European competitiveness, but issues around a few key activities do merit policy attention.

These key activities account for under 1% of total UK GDP yet constitute over 50% of manufacturing CO_2 emissions. Moreover companies that receive substantial free allocation but pass carbon costs on to their consumers will generally maintain or increase their profits. However the resulting loss of market share for the most exposed sectors, such as cement and steel, leaks emissions abroad and this makes competitiveness an environmental as much as an economic issue. Total leakage by 2020 is unlikely to exceed 1% of EU emissions, but it could be much higher from some sectors.

The chart below shows key data for the 23 activities whose costs would be most affected by paying for all the CO_2 they emit. Our report combines this data with analysis of the effect on prices and international trade in order to identify the small group of activities for which competitiveness is an issue for the environment, as well as for business, and to identify potential responses. The table on the right summarises the activities found to be most likely to be exposed to such competitive effects, and what action could be taken.

Out of 159 UK manufacturing activities studied, only a few are potentially exposed:

Significantly: Cement/clinker; steel from blast oxygen furnaces; aluminium	EU cement and steel producers could lose up to 8% market share to overseas production in central price cases with highest trade sensitivities. Sufficient free allocation to maintain their profits can buy time to negotiate a multilateral response to trade exposure.
Plausibly: Fertilisers & nitrogen compounds; 'other' inorganic basic chemicals; pulp, paper and paperboard	Should be in the EU ETS with a compensating rate of free allocation, combined with other measures to help them tackle their exposure to carbon and electricity costs.
Possibly, at higher CO_2 prices: Some refineries; manufacture of glass; household paper; tyres; copper; potentially one or two other basic chemical processes	At higher carbon prices, some products from some refineries and a few other big activities could face trade impacts. Should be in the EU ETS; modest free allocation in Phase III, particularly for new sectors, would protect profits and give time to invest in lower carbon solutions, but should not extend beyond that.
Significantly, but very small activities: Notably lime production	Loss of market share to overseas production would involve tiny absolute carbon leakage. A political decision as to whether to ignore, offer protection, or exempt.

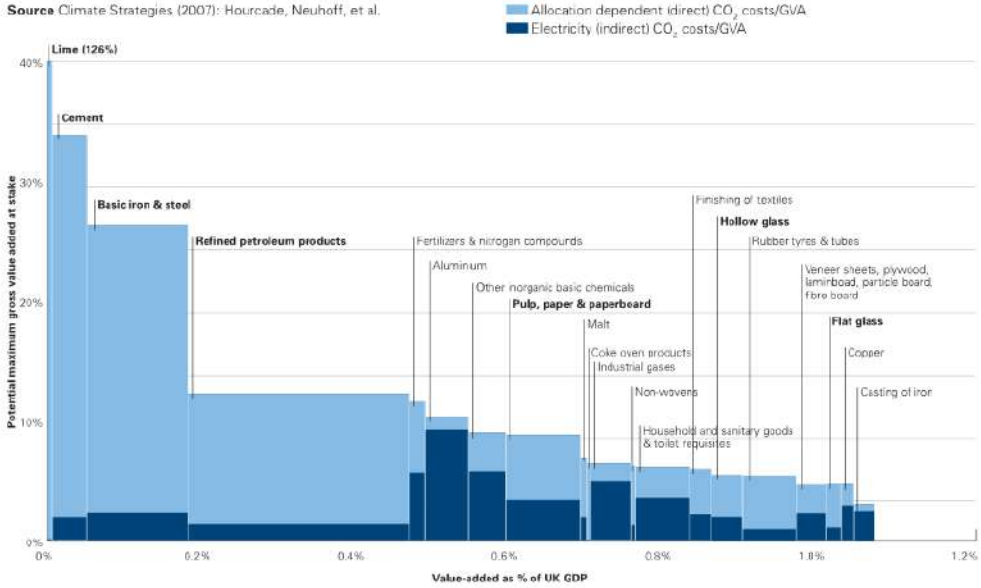
Chart 1

Manufacturing activities most cost-sensitive to CO_2 pricing

The vertical axis shows the cost increase brought about by paying the full cost of CO_2 at €20/t CO_2 as a percentage of the activity's current value added. The horizontal axis indicates the scale of the activity's contribution to the UK's GDP. The area of each column is proportional to total CO_2 emissions. The **dark blue** bars show the cost of carbon that will be paid through higher electricity prices (equivalent to €10/MWh at €20/t CO_2).

The **light blue** bars show the cost due to the carbon emitted through direct fossil fuel consumption and manufacturing processes. Activities labelled in **bold** are in sectors that already participate in Phase II of the EU ETS. Some combustion facilities in other sectors may also be participating, and more sectors will be added in Phase III. Definitions of value-added and numbers for each activity are in the Annex of this report.

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



Executive summary

Context

As the dust settles on the design of the second phase of the EU ETS (2008–2012), attention is turning to the implications of its likely development after 2012. The EU Council's adoption of a 20% CO_2 reduction target implies stronger cutbacks across a wider range of European business. This raises concerns about the possible impacts on the competitiveness of UK and European industry from more sustained and/or higher carbon prices, from likely cutbacks in the levels of free allocations, and from the expansion of and/or additions to instruments that impose a cost of carbon, like the UK's Carbon Reduction Commitment. Previous research has underlined the need to quantify potential impacts before jumping to conclusions, and to consider impacts on both costs and product prices, in the face of international trade. This study spans most of UK manufacturing industry and further deepens our previous work by ensuring coverage of all relevant CO_2 emissions (including process and on-site emissions), a wider range of carbon prices, and by conducting detailed exploration of cement and steel sector impacts and responses.

Identifying carbon-intensive sectors

The 2-digit Standard Industrial Classification (SIC) divides manufacturing into 15 sectors. Our screening analyses of potential carbon cost impacts covers 159 manufacturing activities in 11 of these 15 sectors, which comprise over 90% of manufacturing emissions and about two-thirds of manufacturing value-added. No activities in the remaining four sectors are likely to be exposed. For the twenty most carbon-intensive activities each €10/tCO_2 they pay would increase their input costs by more than 2% of their gross value-added (GVA). Carbon prices out to 2020 are likely to be in the range €20–€40/tCO_2, corresponding to a cost increase exceeding 4–8% of GVA if they paid for all their emissions. Sectors that receive free emission allowances or do not participate in the EU ETS would still be affected because the EU ETS will increase electricity prices. Under likely UK electricity sector conditions, half of the 'top twenty' – plus three other activities – face such indirect electricity cost increases exceeding 1% of GVA for each €10/tCO_2 increase in the carbon price.

These 23 most carbon exposed activities, as mapped out in Chart 1, account for more than half of manufacturing sector CO_2 emissions, and one-seventh of the UK's total CO_2. Economically they comprise around 1% of the value-added of the UK economy and about 0.5% of employment. This reflects the fact that most of the emissions in manufacturing are in primary production, while most value-added is in the downstream processing and applications.

Most other activities are well below these threshold levels of carbon exposure. Carbon costs for such activities would be very small compared to differences in labour, energy and other input costs, between EU and non-EU countries and over time. The €:$ exchange rate, for example, appreciated by more than 50% between 2001 and 2006, with a much bigger impact on costs for most sectors than would be created by a carbon price of €20/tCO_2.

Thus the cost impacts of the EU ETS or other carbon price instruments are highly concentrated. Cost impacts between different companies in the UK market may be significant for a much wider group, but the possibility of significant impacts on international trade outside the EU need only be seriously examined for a limited number of specific industrial activities that comprise around 1% of the UK economy together – not on the economy overall.

The most cost-impacted sectors

Production of lime and cement, and of basic iron and steel, stand out as far more carbon-cost-sensitive than other activities; paying €20/tCO_2 would increase their production costs by more than 25% of GVA.* These sectors comprise about 0.2% of the UK economy and 0.1% of employment. At present, free allocation of emission allowances offsets almost all of these costs, but this does not necessarily prevent trade effects as explained below.

The next most carbon cost-sensitive activity, refining, is bigger economically but the EU ETS is unlikely to have much impact on the trade of oil products. Amongst other factors, a cost of €20/tCO_2 on refinery emissions is well under €1 per barrel of oil equivalent, making it small compared to daily fluctuations in crude oil prices (and differences in tax). In addition there are several strategic benefits that link European refineries to their product markets. However, competition between EU refineries may make different emissions allowance allocations between EU countries, and even individual refineries, politically sensitive. Harmonising free allocations could be complex and create perverse incentives. Avoiding free allocation altogether by requiring refineries to buy allowances from the market or via auctions, would avoid these problems and the benefits of this requirement may outweigh any plausible international trade impacts.

Aluminium has been noted as exceptionally exposed to carbon prices in our previous studies. In addition, fertilisers (with other nitrogen compounds including ammonia), inorganic basic chemicals, and pulp and paper all face cost impacts close to 5% of GVA per €10/tCO_2 that they pay. To offset such carbon costs, these latter sectors would have to raise average product prices by about 1% for each €10/tCO_2 paid, which may become significant for highly tradable products – particularly at higher carbon prices or if other costs (such as extension to non-CO_2 gases) are added. Moreover, many of these activities are large users of electricity. At €20/tCO_2, UK electricity prices would rise by c. €10/MWh if generators pass through the 'opportunity' cost – comparable to the range of existing electricity price differences across the EU. Aluminium smelting stands out for its electricity-related exposure, as noted in our previous reports, but electricity price increases would also increase sector input costs by 3–6% of GVA for fertilisers, inorganic basic chemicals, and pulp and paper, though the extent to which manufacturers would in practice see such cost increases may vary for reasons laid out later in this report.

* Throughout this report, references to cement include production of clinker (which is the most energy-intensive component of cement) and references to blast furnace steel include on-site production of coke (which contributes about 5% of steel emissions). The steel data in Chart 1 comprise all UK steel output including a c. 20% contribution from lower carbon electric arc processes; blast furnace steel itself has maximum value at stake similar to cement.

What is at risk?

The activities at risk account for well under 1% of UK GVA in total and 0.5% of UK employment. For these activities the net effect of carbon cost exposure depends upon the extent to which a sector (i) has free allocation, (ii) can pass costs through to product prices, and (iii) can reduce its emissions. The impacts of the EU ETS are complex and not necessarily negative, even for sectors facing significant cutbacks and costs – as illustrated by electricity generation, which tends to profit in aggregate because the pass-through of carbon costs to electricity prices increases revenues far more than it increases costs. Our previous reports have set out the principles and presented aggregate sector data. The most fundamental and general insight is that sectors with substantial free allocation have incentives to profit in the short term by passing through carbon costs, but the more they add these costs to their product prices, the more they risk losing market share to foreign competition. Profit and competitiveness are not synonymous: in terms of EU ETS impacts, they are often opposites, as higher prices generate profits from free allocation but attract imports.

Increased imports and/or loss of exports may represent a leakage of emissions from within to outside the EU. This does not necessarily mean emissions will increase, e.g. importing electricity-intensive products may reduce global emissions if they come from largely carbon-free electricity systems such as in Norway or Iceland. However, focusing on leakage helps to align economic and environmental goals and keeps the focus on issues around the EU ETS, rather than on other trends and influences on trade and competitiveness.

The extent to which carbon cost differences across countries result in leakage depends upon the impediments to greater trade. For example, the cost of producing industrial gases is sensitive to carbon prices, but transport cost and safety considerations impede any leakage. A given company may produce specialised products not matched by foreign competition, or have local networks that favour local production. However, trade is generally growing, suggesting a weakening of barriers to trade, and most activities in our 'top 20 + 3' have trade intensities in the range 10–30%. This suggests a significant scope for changing trade patterns, though existing trade may not imply a high sensitivity to cost differences if it is driven by other factors, such as differences in the availability or composition of raw materials.

A number of the less cost-exposed activities in Chart 1 are unlikely to face significant trade impacts, due to such trade barriers. However, we could not rule out slight trade impacts particularly at higher carbon prices for manufacturing of glass, household paper products, tyres, and copper. These activities, and a couple of specific chemical products that fall just below our threshold, may merit further study and monitoring of trends to establish whether there is a plausible case for concern over time, and if so, whether free allocation would be an appropriate response. Also some other smaller (less than £50m GVA) activities, including lime, coke production and possibly some specialist food or chemical products, could be affected. Our conclusion that refining will not generally be affected also merits further testing and monitoring, given the complexities of different refineries and product streams. International trade in the rest of UK manufacturing out to 2020 is unlikely to be materially affected even if it participates in the EU ETS or equivalent carbon controls with no free allocation.

To explore the nature and scale of potential impacts for the most exposed activities, this report considers more fully at the European level the two major activities for which carbon costs are most unequivocally significant: cement and steel products.

Detailed analysis of cement

As a relatively homogenous product, cement produced in different regions could in principle be relatively easily substituted, but continuing big price differences between countries reflect transport cost and other barriers to trade. Imports have risen, but mainly to southern Europe, reflecting an imbalance between limited domestic production capacity and surging domestic demand. However the industrial structure is globalising, with import sourcing switching from north Africa to China; and there has also been a trend to growing imports of clinker, the intermediate energy-intensive component of cement.

Our earlier studies showed that if manufacturers priced to maximise short-run profits, coastal markets would suffer leakage whilst European producers overall could profit substantially. Chart 2a summarises the impact of the EU ETS on cement trade and profits in the EU overall, for various scenarios of allocation, pricing behaviour and carbon price levels. If producers do not raise prices at all, there is no impact on trade but profit margins decline as the proportion of free allocation falls and turn negative with no free allocation, across all carbon price scenarios. However if producers pass on the full marginal/opportunity costs, profit margins rise sharply if they have extensive free allocation – increasingly so at higher carbon prices – or remain roughly constant with zero free allocation.

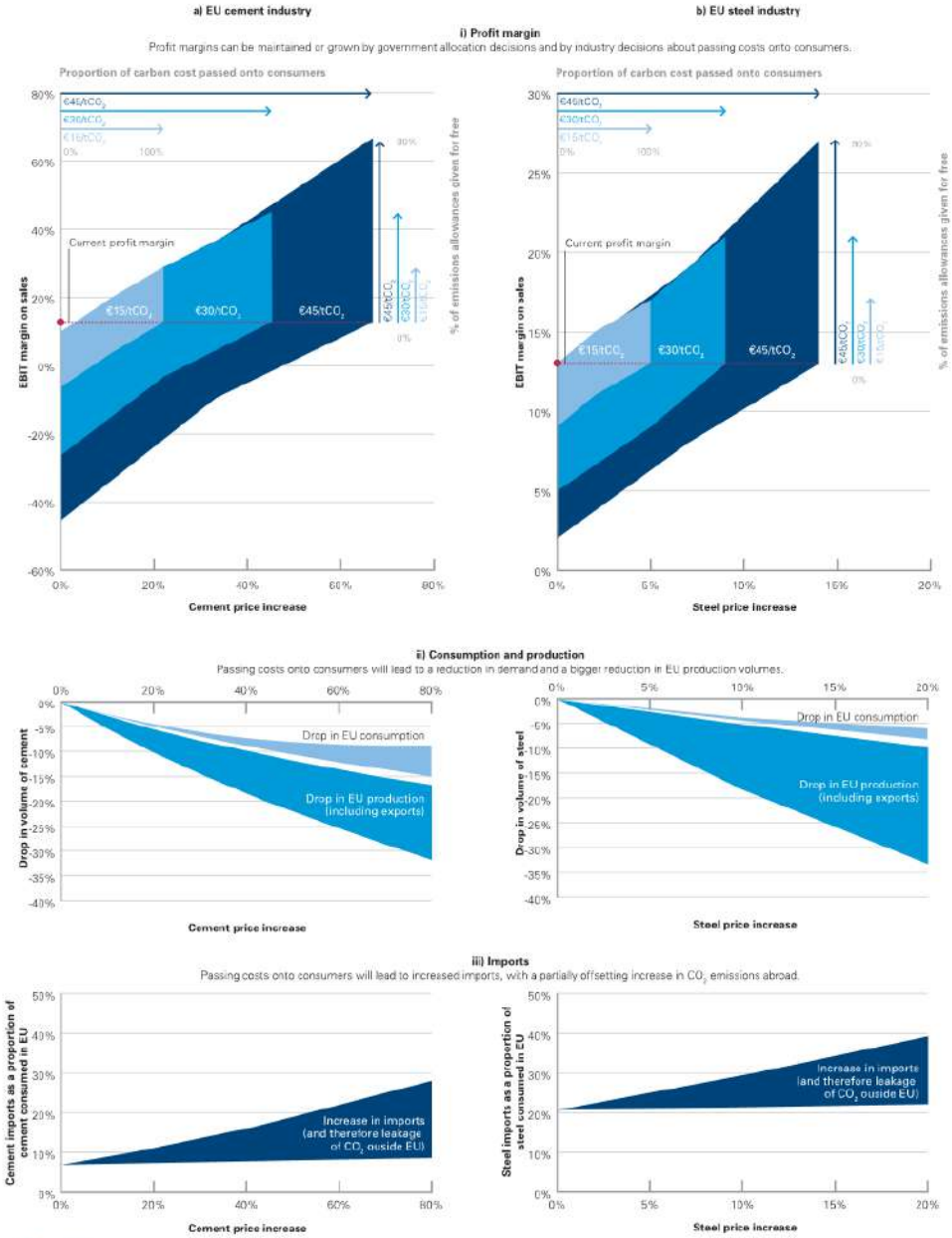


Chart 2

Impact on profits and demand for the EU cement and steel industries of different carbon prices, allocation and cost pass-through decisions

Source Carbon Trust analysis based on data from Climate Strategies (2007): Hourcade, Neuhoff, et al.

As indicated in the second panel of Chart 2, EU production declines as producers raise cement prices. This is partly because higher prices reduce demand, but the drop in production is bigger because of rising imports. These imports drive the emissions leakage and are shown separately in the third panel. Trade responses, as measured from historical patterns, are quite uncertain and this is reflected in the broad range shown. With full pass-through of marginal/opportunity costs, imports rise from the current 8% to 13–27% depending on the carbon price and trade sensitivities assumed.

The pattern with half pass-through is more varied, with up to a few percentage points increase in imports and impacts on profit margins ranging from loss to significant gain depending upon allocation methods. For a central case, with 50% pass-through of carbon costs at €30/tCO_2, domestic cement consumption declines by about 5% and imports displace another 0.5–5.5% across the range of trade sensitivities considered. The sector overall may profit if the proportion of business as usual emissions that are allocated for free significantly exceeds the pass-through rate.

The actual degree of emissions 'leakage' combines many uncertainties in demand, trade and abatement responses. However if the technical options for abatement are limited, it is quite possible that at higher carbon prices and increased rates of cost pass-through, cement imports could outweigh domestic reductions as a source of emission 'reductions' – hardly the desired aim of the EU ETS.

Detailed analysis of steel

For steel, production of 'flat' products (e.g. panels) from iron ore in blast oxygen furnaces dominate emissions and potential cost exposure, and forms the main process in UK steel production. The exposure of 'long' steel products (e.g. for construction), predominantly from electric arc furnaces using scrap, is much less.

The specialised nature of most flat steel products (e.g. 40% goes to automotive) provides some short-term protection and the EU has until recently produced as much steel as it consumed despite international price differences of 20–40%. The steel market has historically been largely regional rather than global, but non-EU trade intensity is growing and in 2006 the EU became a net importer, largely from China. Steel trade is much more sensitive to price differences than cement is, and consolidation is increasing this sensitivity further. In addition, steel is slightly more exposed to electricity prices than cement is.

However the relative impact of a given carbon cost on product prices is much less than for cement, as is the impact on profit margins (Chart 2b). Compared to the base case, profit margins decline but remain positive even if the industry passes on no costs.

The combination of low price impacts and higher trade sensitivities together make the estimated impacts of cost pass-through on steel trade comparable to those on cement trade for a given carbon price and pass-through.

Thus for a case with 50% pass-through of carbon costs at €30/tCO_2, domestic steel consumption declines by about 2% but EU production declines by 2.5–9% across the range of trade sensitivities considered; again however this would yield net profits if the sector receives significantly above 50% free allocation. The abatement cost curves in the model suggest higher scope for steel abatement than for cement, and this significantly exceeds leakage except for the combination of the most extreme assumptions around all three variables of price (€45/tCO_2), cost pass-through (100%), and trade sensitivity. Such combinations can generate several times the central estimates of trade impact – though even in this case, profit margins rise if such conditions are combined with a high degree of free allocation.

Like any numerical modelling, the assumptions underpinning these results are subject to challenge. Probably the most fundamental argument is about whether the estimates of trade sensitivity based on past data – which underpin the model results – reasonably represent the future. Our highest impact results use the highest estimates of trade sensitivities that have been made on the basis of past responses to price differences. Industry argues that globalisation, and associated industrial consolidation, may further increase trade sensitivity to price differences, to beyond even the higher levels suggested by the results in Chart 2. There is no robust analytic answer to this conjecture, but increased imports of both cement and steel in the past couple of years, though modest in cement outside southern Europe, could be taken as indicating such a change, with EU ETS costs playing some role.

However, we did not find compelling evidence of 'tipping points' in carbon prices beyond which there would be a dramatic decline in market share. Even if these may exist, free allocation could enable companies to avoid such consequences by reducing levels of cost pass-through required to maintain a given profit margin.

Nor is there compelling evidence of 'tipping points' in relation to new investment. In the energy-intensive, trade exposed sectors, new investment in the EU is confined mostly to upgrading existing sites. In many sectors, foregoing this in favour of overseas investments-for-import would carry several risks, including those around how long carbon price differences would remain. However, relocation of steel investment is already under consideration and carbon costs could exacerbate this. This provides an additional reason to consider response options.

Options for reducing leakage

Leakage through closure of existing facilities in favour of imports is deterred in many national allocation plans by provisions to withdraw allowances from facilities that close. Whether free allocation in general addresses leakage depends upon the business response. If companies prioritise protecting market share and thus do not pass through much carbon cost – behaviour corresponding to the left hand side of the panels in Chart 2 – impacts on product prices and therefore on leakage will be minimal.

However if businesses seek to maximise short-run profits, free allocation is much less effective in preventing leakage: an incentive remains for these sectors to reduce domestic production, sell the allowances and import substitutes or carbon-intensive intermediate products. The irony of our analysis is that whilst business has worried about competitiveness impacts of the EU ETS and environmental constituencies have argued these concerns to be hugely overstated, the relevant impacts suggest the opposite to be more rational. With a high degree of free allocation, many sectors including cement and steel may profit from the EU ETS, and yet lose market share that represents significant emissions leakage to other parts of the world, reducing the environmental gain.

The provision of free allowances for 'new entrants' may similarly protect the near-term profitability of new investments in Europe, but as set out in our previous report this may undermine the long-term environmental effectiveness of the EU ETS.

Thus, a case remains to consider other options for protecting against carbon leakage. As outlined in our previous report, these might include rebates of carbon-associated costs upon export, various forms of border adjustments for imports, or international sector-based agreements. However, a rush to general protective measures could be extremely risky to international trade, and such risks would need careful consideration.

The maximum impact of carbon prices on the cost of other major activities is less than a third of that for cement or blast furnace steel. With the possible exception of aluminium and other non-ferrous metals (that are presently outside the EU ETS), trade and profit impacts will be correspondingly less. For the next most exposed group of activities identified (fertilisers, inorganic basic chemicals, and pulp and some paper products) free allocations could address the cost impacts of their direct emissions, but not their relatively more significant electricity consumption. Border-related solutions may be even more difficult in relation to electricity-associated cost impacts. Recycling of revenues from EU ETS auctions to electricity-intensive activities is one option that could be considered. However the strategic need is for electricity-intensive industries to access directly low cost, low carbon electricity sources, which would genuinely reduce their exposure. Varied government decisions, both around the EU ETS and more widely in electricity market regulation, could facilitate this.

Recommendations

The EU ETS can and should continue with deeper emission cutbacks post 2012. This need not damage UK or European competitiveness overall. Our previous publications summarised the benefits of increasing levels of auctioning and these conclusions remain unchanged. However the extent and pace at which free allocations are reduced should differ between sectors according to their degree of cost and trade exposure.

For a very small number of carbon-intensive, internationally exposed activities headed by steel and cement production, governments should establish a transitional 'compensating rate of free allocation' on an activity-specific basis, based upon the likely degree of cost pass-through given international trade conditions. The scale of free allocation to electricity-intensive activities in the EU ETS (notably pulp and paper) should also take account of their electricity consumption, whilst manufacturing of fertilisers and basic chemicals might benefit from being brought into the EU ETS on a similar basis. Together with aluminium smelting these constitute four trade-exposed electricity-intensive activities for which additional measures, linked to redistribution of auction revenues or equivalent 'downstream' allocation of electricity-related allowances, could be considered (subject to state aid and associated legal considerations). However, focused measures to facilitate direct, long-term investment in low carbon electricity generation may offer the best long-term solution.

A watching brief is justified for about half a dozen other activities, possibly with some free allocation for those in the EU ETS. Concern about international competitiveness does not in itself justify free allocation for other sectors in the EU ETS – or for free allocation within other instruments that tackle less energy-intensive activities, such as the UK's Carbon Reduction Commitment.

Moving to a low carbon economy will require all sectors to face carbon costs. The existing approach of almost 100% free allocation to manufacturing industries shields them from this. Continued free allocation offers a medium-term palliative that can protect profits in relevant activities but is less effective at tackling leakage from either existing facilities or new investments.

The modest degree of leakage predicted means that the EU ETS can be extended in its current structure. However to provide a more robust longer term solution and to influence expectations for new investments, the EU should signal its intent in international negotiations to pursue multilateral solutions to problems of leakage.

Cutting Carbon in Europe: the 2020 plans and the future of the EU ETS - 2008

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Cutting Carbon in Europe

The 2020 plans and the future of the EU ETS

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.

* This underlying research comprised several working papers brought together in Climate Strategies (2007): K. Neuhoff, M. Grubb, J.C. Hourcade, F. Matthes, *Submission to the EU ETS Review*, **www.climate-strategies.org**

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Preface

The European Commission (EC) package of measures to implement Europe's climate change goals for 2020 comprises a far-reaching set of proposals that will be heavily debated throughout 2008, and probably 2009. The proposals include a wholesale revision of the EU Emissions Trading Scheme (EU ETS), intended to make it capable of driving deep emission reductions in Europe over the longer term.

Recognising the central role of the EU ETS and its importance to business in the UK and elsewhere – both for companies covered by, and those outside the scope of the scheme – the Carbon Trust has over the past few years produced several publications on its impact. These included analysis of its strengths and weaknesses in Phase II, from 2008-12. That analysis concluded that Phase II was likely to induce operational emission reductions, but not support investment in low carbon technologies unless and until Europe defined the scheme's longer term future. The proposals for doing just that are now firmly on the table.

This publication consequently sets out: to describe the EC package particularly in relation to the proposals for the future of the EU ETS; to analyse its implications for business; and to consider a range of complexities that have yet to be fully addressed. We intend it as a contribution to debate that can still help to shape the final outcome. Our overall conclusion is that the package proposals for reform of the EU ETS are a big and bold step in the right direction – but that some of the toughest roads still remain to be travelled.

Tom Delay
Chief Executive

Michael Grubb
Chief Economist

Previous publications on the EU ETS available from the Carbon Trust

The following publications are available to download from **www.carbontrust.co.uk** or by calling **0800 085 2005**:

2008 EU ETS impacts on profitability and trade: A sector by sector analysis.

2007 EU ETS Phase II allocation: implications and lessons.

2006 Allocation and competitiveness in the EU emissions trading system: options for Phase II and beyond.

2004 The European emissions trading scheme: implications for industrial competitiveness.

Executive summary

The European Commission package represents probably the most radical development in the energy and environmental policies of the EU and its Member States since the founding Treaties of the European Community that encompassed agreements on coal, steel and nuclear power 50 years ago.

The EU ETS Phase III Proposals

On 23rd January 2008, the European Commission released a package of proposals to implement the goals for 2020 laid out earlier by the European Council of Ministers – with specific legislative proposals on how Europe should cut emissions of greenhouse gases by 20% and increase the share of renewable energy to 20% of final energy consumption.

The centrepiece of the package is the proposed design of the EU Emissions Trading Scheme from 2013 onwards (known as Phase III). To increase its effectiveness and efficiency, the proposals lay out a series of major developments and reforms as summarised in Table 1.

This is an ambitious set of objectives. The Phase III design proposals take good account of lessons learned and of developments in economic debates about how to maximise the efficiency of sequentially negotiated cap-and-trade schemes, whilst reflecting practical constraints around implementation and the incompleteness of global participation.

The proposals increase the consistency, effectiveness and efficiency of the EU ETS, across sectors and countries, and also reduce transaction costs associated with smaller installations. The move to auctioning all emissions allowances for power generation, and as the default goal for other sectors, although constrained by sunk cost and international competitiveness concerns, is grounded firmly in economic 'polluter pays' principles and greatly reduces the risk of retrospective intervention in the future.

The radical changes in the EC package represent a huge step forward towards clarifying the future and simplifying the process of allocating free emissions allowances and setting it on a more principled basis. They thus offer a rational and stable structure, as a basis for European industry to invest sensibly for a carbon constrained future.

Impact of the package proposals on UK & European business

Like any major advance, these positive developments come at a cost that will be shared between consumers and government, between different companies particularly in power generation, and between countries. However the full consequences for who pays and how much remain quite uncertain.

The 20% greenhouse gas reduction, 20% renewable energy and 20% energy efficiency improvement targets set by the European Council of Ministers interact in complex ways. Scenarios are possible in which continuing trends together with stronger action towards the 20% energy efficiency target and towards the renewable energy target achieve almost all the emission reductions required in EU ETS sectors. Any residual could then largely be taken up by emission credit imports, which may then define a floor price.

But radically different scenarios are possible in which a substantial gap emerges between EU ETS sector emissions and the declining cap, that can only be closed by much stronger action on industrial emissions and large-scale switching from coal to gas power generation (given that carbon capture and storage (CCS) is not likely to be widespread before 2020). Carbon prices in EU ETS Phase III could correspondingly be anywhere in the range €15-50/tCO_2, and variations outside this range in either direction cannot be entirely ruled out.

This range partly reflects political choice about the division of effort between: public expenditure and regulation on energy efficiency; targeted support for renewable energy; and the EU ETS.

Table 1 *Major developments proposed for Phase III of the EU ETS*

Objective	The proposal
Provide longer term certainty for investment.	8-year trading period, 2013-2020, with overall cap extending beyond this.
Avoid distortions and inconsistencies between Member States and reduce the burden of negotiating allocations.	Replace National Allocation Plans by harmonised rules for allocation which apply equally across the EU, thereby also avoiding the need for national EU ETS caps.
Deliver the 2020 greenhouse gas targets.	Overall cap on EU ETS sector emissions declining linearly to 21% below 2005 levels by 2020. Other sectors to reduce 10% below 2005 levels with targets distributed between Member States. Provisions to revise both to secure 30% reductions in the event of global agreement.
Optimise coverage whilst reducing transaction costs and minimising distortions at the boundary with non-participants.	Extend EU ETS to include additional activities characterised by large industrial facilities, aviation and potentially shipping. Streamline monitoring, reporting and verification systems. Exempt very small contributors to site emissions and introduce flexibility to opt-out facilities below 25MW if they are covered by equivalent incentives.
Avoid potential windfall profits and distortions arising from repeated free allocations and new entrant provisions.	Move to zero free allocation from 2013 for power generation and as the ultimate goal for other sectors – about two thirds of allowances auctioned from 2013. Allocation of free allowances will be based on 'benchmarks' to the extent possible.
Minimise international competitiveness impacts and associated carbon leakage.	Continued free allocation up to 100% of proportionate share of declining overall cap for sectors identified as exposed to significant risk of carbon leakage.
Allow appropriate recovery of historic sunk costs in carbon intensive facilities without protecting new carbon-intensive investments from the cost of their emissions.	Phase out free allocations from 80% to 0% by 2020 for other manufacturing activities. New entrant allocations to mirror this.
Contain costs and protect value of current Kyoto project mechanisms without flooding the market.	In absence of new international agreement, allow post-2012 use of international credits generated during Kyoto 1st period, within agreed caps, and continued crediting for projects in Least Developed Countries.
Address distributional and other equity concerns, within societies, between EU Countries, and globally.	Redistribute 10% of auction rights toward the poorer EU Member States; require governments to earmark 20% of auction revenues for expenditure on helping poorer consumers cope with price impacts, and a wide range of climate-related expenditures at home and abroad.
Encourage other regions and countries to develop effective trading schemes.	Potentially link EU ETS to regional and sub-regional schemes irrespective of global agreement.
Incentivise developing countries to reach a meaningful global agreement and contain costs of moving to EU 30% emission reduction target.	Confirm tougher targets for both EU ETS and other sectors in event of global agreement matched by opening up to greater international crediting.

Combined with the move to auctioning, the EU ETS will substantially and appropriately affect the relative value of different power stations and companies according to their carbon intensity. Other participating industrial sectors will have to increasingly face up to carbon costs as the scale of their free allocations decline, and must learn to handle the price uncertainties involved. All sectors will face impacts on electricity prices, with carbon costs likely to add €10-20/MWh.

The provisions to allow opt-out of smaller installations subject to demonstrating 'comparability of effort' may have interesting ramifications. In the UK, Climate Change Levy (CCL) payments alone appear insufficient to qualify as comparable effort, but the combination of CCL, carbon cost pass-through in electricity and the new Carbon Reduction Commitment (CRC) may well. The much lower transaction costs of the CRC are likely to make it a more attractive option for many such facilities, whilst the need to demonstrate comparability of effort may well influence the future strength of the CRC caps.

The move to auctioning is likely to raise tens of billions of Euros annually across Europe, with revenues in the UK most likely in the range €4-8bn/yr averaged across Phase III. This is a substantial revenue stream and is likely to form a new focal point of debate, along with the potential impact of carbon prices and auctions on industrial competitiveness (as examined in our previous report). This points towards some of the most politically difficult issues outstanding.

Issues outstanding

Although the EU package clarifies a great deal, several types of implementation issue have yet to be resolved.

Applying categorisations. Treatment of self-production of electricity for manufacturing activities could prove thorny. However, the dominant classification dispute is likely to be deciding which sectors are at significant risk of carbon leakage. The key issue is whether the European Commission will adopt quantitative indices of this, how these might be applied and, in particular, whether classifications will be driven by aggregate impacts at EU level, or by the concerns of individual facilities and countries.

Applying allocation principles. Where free allocations are granted, the ideas underpinning 'benchmarking' of allocations based on the best available technologies are sound, but applying them in practice is likely to be very difficult. Precedents do not appear to provide a strong and compelling basis for how to do this, and the adoption of technology-based benchmarks in the EU could also have important global ramifications that have not yet been adequately considered.

Tackling carbon leakage. Free allocation can protect profitability but does not really solve the problem of carbon leakage, unless it is made conditional upon production and investment decisions in ways which could seriously undermine the fundamental purposes of the system. The ideal 'solution' of global sectoral agreements, however, is unlikely to be realised in ways that resolve concerns about carbon leakage, at least in the next round of global negotiations.

The 'second best' option of invoking border adjustments in one form or another is legally complex and politically very delicate. If no specific action is taken (beyond free allocation), the scale of carbon leakage would not severely undermine the emission savings from the EU ETS in Phase III, but it could weaken the case for including the most exposed sectors, and undermine political support for the system through the loss of some activity in a few sectors. Deferring a specific decision on how to tackle carbon leakage until 2011 is a sensible compromise, and could be separated from the identification of a first tier of 'sectors at risk' which might be attempted earlier.

Spending the money. The Commission proposal that 20% of auction revenues should be reserved for activities associated with tackling climate change appears reasonable, and would be facilitated by proposed revisions to State Aid legislation. Such expenditures could help to reinforce the impact and political stability of the EU ETS and strengthen action around climate change more broadly, in Europe and abroad. However, such linkage is strongly opposed by several governments (including the UK), is not critical to the overall design, and may not survive the political process.

Increasing price confidence. Wide uncertainty in the carbon price may reduce the efficiency and effectiveness of the EU ETS, complicate use of auction revenues, and exacerbate some of the political and technical complexities. Establishing a reserve price on allowance auctions would support a 'floor price' that would greatly increase confidence for low carbon technology investments, and also provide a more stable base of auction revenues.

Mechanisms to lessen the risk of price spikes or unexpectedly high prices could include increasing access to external emission credits at higher prices. However, this does raise other complexities. Also, any such 'cost containment' mechanisms would need to avoid undermining the possibility for carbon prices to reach levels that would support investment in key technologies (such as CCS).

Burden sharing. Finally, there are additional, crucial 'roads not yet travelled' that lie beyond the scope of this report. These mainly concern distributional and political questions between governments. A struggle between European governments about the 'burden-sharing' dimension is likely, and the constraints on importing emission credits are already being contested. The biggest of all is the effort to secure a global agreement on post 2012 commitments, at the Copenhagen conference scheduled for December 2009. An adequate outcome would trigger a shift of the EU target from 20% to 30% below 1990 levels, and open up the EU ETS to a much wider scope of international crediting and global engagement – which is a major, deliberate and highly desirable objective of the proposals.

Conclusions and timelines

The redesign of the EU ETS offers the structural certainty that business has been asking for, with a design that offers a rational and sound basis for efficient investment towards a low carbon economy. However, this comes at a price which remains more uncertain than is generally recognised, with significant distributional impacts and important hurdles yet to be overcome.

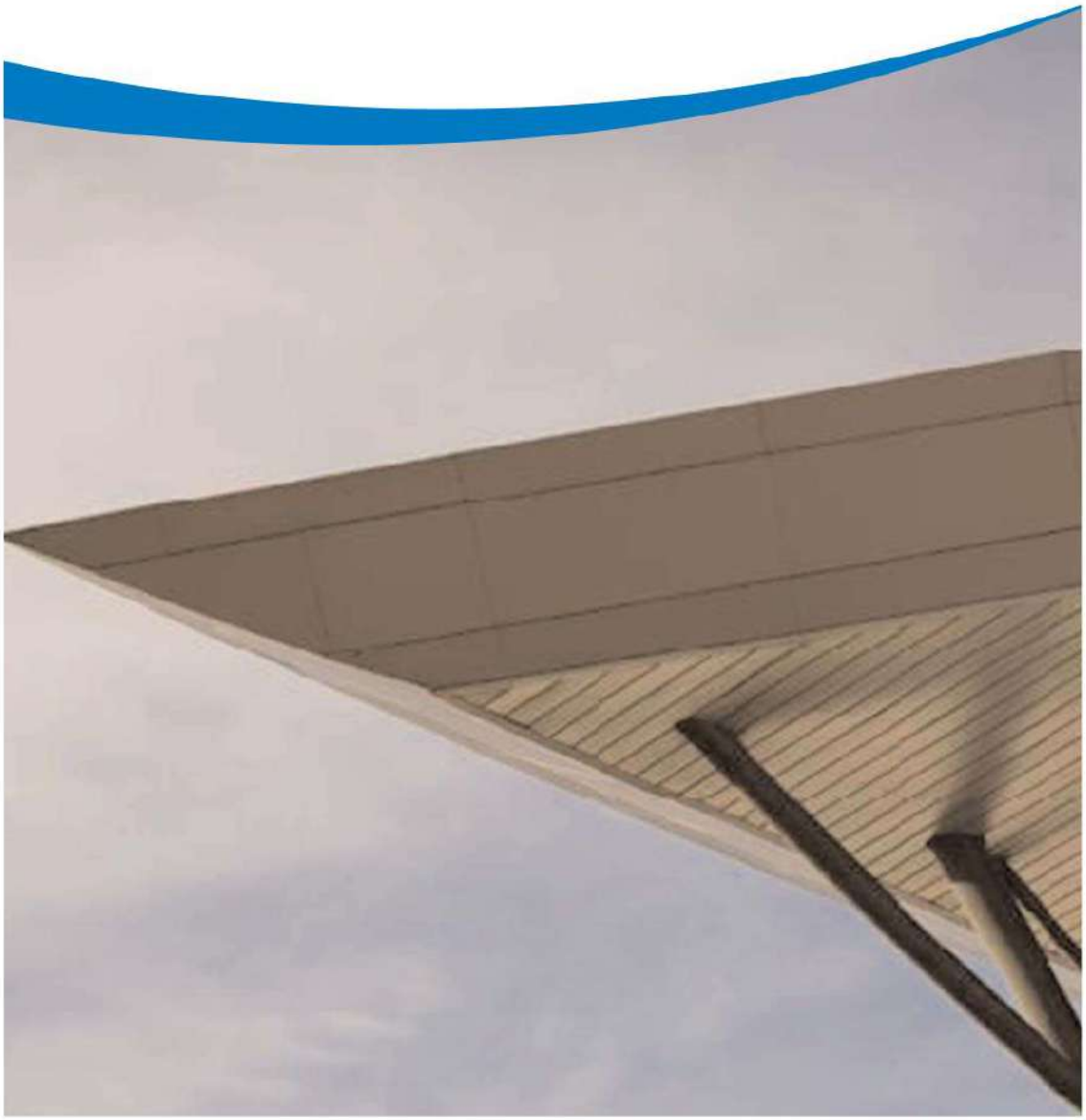
The EU ETS proposals, as explained in this report, are but a part of the overall package of proposals for cutting carbon in Europe. There would be tremendous value in adopting the EU ETS part of the package at least (and if at all possible, the renewable energy directive) by Spring 2009, before the EU Parliament and Commission rise. This would: provide investors with early confidence about the direction of policy as a platform for investment in the EU; send a powerful marker to the new US Administration about EU commitment and expectations on the strength of industrialised country action; and form a focal point around which global negotiations up to Copenhagen could coalesce. The stakes are high; but the prize is even bigger.

EU ETS Phase II allocation: implications and lessons - 2007

CARBON TRUST

Making business sense of climate change

EU ETS Phase II allocation: implications and lessons



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Preface

The European Emissions Trading Scheme (EU ETS) is the backbone of European efforts to tackle climate change, and a central instrument for countries to deliver their Kyoto emission targets. In setting a price for carbon, it has also become the focal point for industrial interest - and in some cases concern - about the impact of measures to tackle climate change.

The UK Government's Energy Review concluded that 'a carbon price is essential for making lower carbon emissions a business imperative...' and established the EU ETS as a centrepiece of UK energy and climate change policy, with 'the Government committed to there being a continuing carbon price signal which investors take into account when making decisions. The EU ETS is here to stay beyond 2012 and will remain the key mechanism for providing this signal.'

The extent to which the EU ETS can deliver on these lofty goals - and the carbon price that participating sectors will see over the next few years - hinges first and foremost upon the allocation of emission allowances. Over the past eighteen months, governments around Europe have developed their 'National Allocation Plans' for its second phase - the Kyoto first period of 2008-12. Negotiation with their own domestic business and other constituencies defined their initial proposals; for most, attention subsequently turned to the European Commission, after its first round of decisions cut back all but the UK's allocation plan.

As the process for allocating Phase II allowances approaches completion, the Carbon Trust is publishing this report to analyse both the implications for the Phase II carbon market (and the resulting industrial abatement incentives), and also the wider lessons to be learned from the allocation process. As with our previous EU ETS report[1], it draws upon research conducted by Climate Strategies, with detailed supporting material published as academic papers.[2]

1 *Allocation and competitiveness in the EU ETS: options for Phase II and beyond*, Carbon Trust, 2006. See also *The European Emissions Trading Scheme: Implications for industrial competitiveness*, Carbon Trust, 2004.

2 www.climate-strategies.org; results of Phase II NAP analysis published as three papers in *Climate Policy*, Vol.6 no.4., www.climatepolicy.com

Executive summary

The EU ETS has emerged as the primary instrument for reducing CO_2 emissions across power generation and heavy industry in Europe. By setting a price on carbon, it aims to generate incentives for companies both to reduce their operational emissions and to invest in lower carbon technology. The allocation plans now agreed for Phase II (2008-12) make it likely to succeed in the first aim, but not the second. The incentives for low carbon investment could still be improved if governments auction more of the Phase II allowances, and define carefully the longer term structure of the scheme.

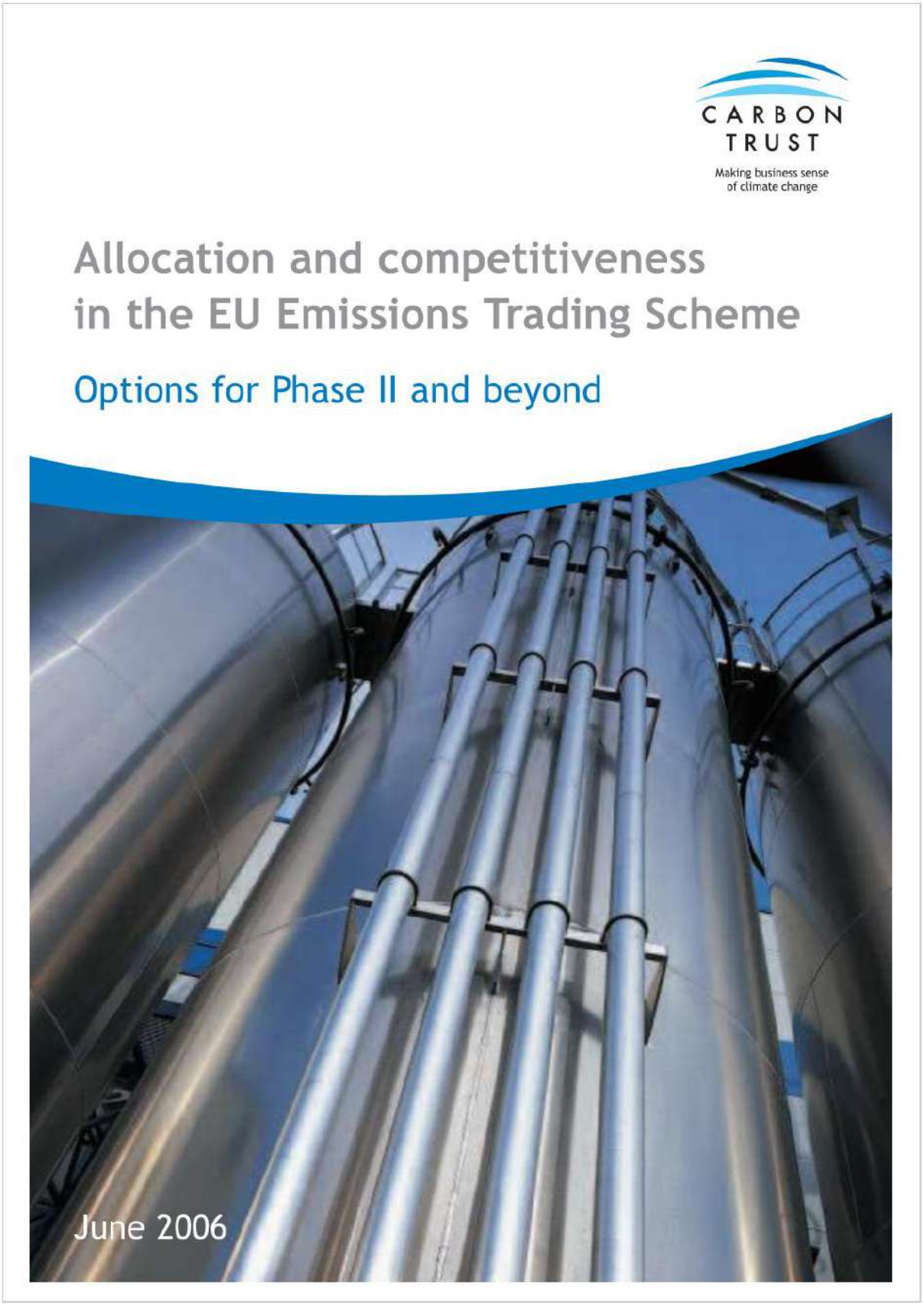
Phase II allocations and price impacts

During 2006, twenty-seven EU Member States proposed 'National Allocations Plans' for distributing allowances to emit CO_2 under the EU ETS during Phase II (the Kyoto first period of 2008-12). The plans proposed would have enshrined an increase in EU ETS sector emissions to 5% above verified 2005 levels. This exceeds the trend of historic emissions and, combined with inflow of emission credits from emission-reducing projects outside Europe (mainly certified emission reductions under the Kyoto Protocol's Clean Development Mechanism), would probably have led to a virtually 'dead market'.

The European Commission ruled that almost all the submitted plans violated its interpretation of the EU ETS Directive, and proposed an allocation formula that in aggregate turns the proposed 5% increase into a 5% decrease below 2005 levels. The key criteria were Kyoto constraints in most of the EU-15, and the imposition of a growth and intensity formula based on independent sources for most of the new Member States. The total is below emission trends and all 'business as usual' forecasts, and in winning the ensuing political struggle, the Commission decisions have thus established EU ETS Phase II as a viable carbon market for 2008-12.

The forward trading carbon price for Phase II has remained steady in the range €15-20/tCO_2, but the realised price will be highly uncertain. A low gas price or high availability of international emission credits would yield a "floor" price, which might be underpinned by a Chinese tax on its CDM credit sales, currently around €8/tCO_2. Opposite conditions could generate prices over €20/tCO_2; this appears less likely, though much higher price spikes are not impossible. The option to bank allowances forward into Phase III (post 2012) will also support prices, whilst making them more dependent on the progress of international negotiations.

Allocation and competitiveness in the EU Emissions Trading Scheme: Options for Phase II and beyond June – 2006.



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Preface

The EU Emissions Trading Scheme is a driving force for business interest in reducing CO_2 emissions. In capping emissions from power generation and much of heavy industry in Europe, it gives value to their efforts to reduce emissions and has created a market worth tens of billions of Euros annually. Putting a price on carbon has been an achievement of global significance and provides a focal point also for those seeking to invest through Kyoto's international project mechanisms.

Like any market, price is central and the key to prices is the balance between supply and demand. Recent events have underlined the need for robust allocation as the system moves into the Kyoto phase and investors are already starting to look beyond that to the post-2012 period. Yet governments also have a duty not to undermine the competitiveness of their industries and there are fears that the two could conflict.

Building upon our pioneering 2004 study of competitiveness implications, in 2005 the Carbon Trust initiated an international collaborative study with the European research network *Climate Strategies*, led by our Chief Economist, Michael Grubb. We are grateful to the wide group of researchers involved, and also to those that co-sponsored the work, the full results of which are presented in seven papers published in the academic journal *Climate Policy*.

Drawing upon that analysis, this report explains the main findings and sets out the Carbon Trust's own conclusions and recommendations for the future of the EU ETS as an instrument that can both help business deliver emission reductions efficiently and also protect and ultimately enhance its competitiveness in a CO_2-constrained world.

Tom Delay
Chief Executive
The Carbon Trust

Executive summary

The first phase of the EU Emissions Trading Scheme, 2005-7, has successfully created incentives that give economic value to CO_2 emission reductions across Europe for all the participating sectors. It has also established and demonstrated the importance of sound verification systems. These are big achievements that lay the foundations for efficient business responses to the challenge of climate change mitigation. Phase I also confirms that sectors can profit from the EU ETS, but that this is very unequally distributed between sectors. Moreover, present approaches to allocation create volatility in the market and distract industry from the core task of emission reductions, the incentives for which are further undermined by uncertainties around the extension of the scheme post-2012. Learning from Phase I will enable a more robust system for Phase II and beyond.

In 2006, governments will decide on allocations for Phase II (2008-12), and conduct a review of options for continuing the EU ETS post-2012. As a contribution to these processes, the Carbon Trust has supported extensive research, particularly into the allocation and competitiveness aspects of the scheme. That work, published separately as a set of academic papers, forms the evidence base for the Carbon Trust conclusions set out here.

The focus of this report is on the key issues and specific decisions required to ensure that the EU ETS provides an effective, efficient framework that protects the competitiveness of business in the UK and Europe, whilst providing clear and stable incentives to support low carbon investment. Given the reality of the need for climate change mitigation, we consider this balanced approach to be fundamentally in the strategic interests of industry in the UK and Europe. It leads us to three core recommendations for Phase II allocation and to identify three main options for post-2012 design.

Allocations for 2008-12

Total free allocations should be substantially below total projected 'business as usual' emissions and should involve some cutback for all sectors. This is to reduce the volatility arising from cutbacks that are small compared to uncertainties in projections; to hedge against an unavoidable element of inflation in those projections; to reduce potential perverse incentives from current and future expectations about free allocations; and to ensure that management in all sectors has to actively consider mitigation options, rather than focusing purely upon projections and compliance. The degree of cutback should be differentiated according to the cost and international exposure of different sectors; notably bigger cutbacks to power generators could help to address distributional and legal (State aid) concerns.

Benchmarking allocations, e.g. against the performance of best practice technologies, could offer important advantages compared to projection-based allocations, but can be complex; diverse approaches between countries in Phase II will give useful experience. Benchmarking allocations to incumbents can be differentiated by fuel/technology type to protect the value of existing assets. However a common standard for new entrant reserves (NERs) should be sought across the EU, based on effective capacity rather than technology or fuel. Differentiating NERs to cover the emissions of new carbon-intensive coal plants would act to subsidise these investments, which would conflict with climate change mitigation objectives, raise power prices in the long term, and would risk them becoming stranded assets as carbon controls tighten. Care needs to be taken to avoid similar possible distortions from technology-specific NERs in other sectors.

Maximum use of allowed auctioning (10%) would increase supply of allowances, reduce distributional disparities, and improve the efficiency of the EU ETS. Governments can use auction revenues creatively to address distributional concerns and to support low-carbon technology investment in the EU through revenue recycling. Coordinated minimum price auctions would reduce price volatility, help to stabilise the system and provide a more secure platform for low-carbon investments.

Profits, costs and competitiveness

The measures set out above will not preclude most participating sectors profiting from the EU ETS during Phase II: though most profits will accrue to power generation (notwithstanding greater allowance cutbacks), the same basic mechanisms apply for others.

In addition to continuing abatement possibilities and any availability of allowances through auctions, EU ETS prices will be constrained by the large volume of external emission credits from international projects already submitted for registration (principally under the Clean Development Mechanism).

At prices likely under these circumstances, cement and steel production are the only participating sectors for which net input cost impacts may exceed 2% of sector value-added; if these sectors maximise profits by passing on opportunity costs, they could lose a few percent of market share to imports over the Phase II period. Alternatively, companies can choose to scale back their potential profit increases to protect market share. The potential for both profiting and loss of market share increase at higher carbon prices.

Downstream sectors outside the EU ETS face slightly higher prices as the costs of carbon become factored into product prices, as detailed in our previous report.

Accelerating investment in energy efficiency and low-carbon energy sources is the surest way to contain the costs of carbon controls over the longer term. Companies can use revenues associated with ETS price impacts to support longer term emission reduction investments, in both energy efficiency and low-carbon supplies; auction revenues could be used to assist other sectors.

However, such investment will only occur at scale if there is a clearer and more credible prospect of returns from low-carbon investment across Europe post 2012. Without this, the operational costs of the EU ETS will not be matched by the benefits that can flow from more efficient investment and innovation. This raises the more serious, strategic, dimension of competitiveness, which concerns the nature and location of all new investments based on expectations for the post-2012 period.

Post-2012 design

Facilitating low-carbon investment and securing the potential benefits of the EU ETS thus requires a timely, concrete commitment to its continuation beyond 2012. But this must be in a more durable form that addresses concerns about distribution, incentives, and industrial competitiveness.

Declining free allocation combined with greater auctioning offers the simplest solution to distributional and incentive problems.

In the absence of an international agreement that puts in place a global price for carbon, three approaches are available that would enable the EU ETS to protect competitiveness of investments in Europe under higher carbon prices over longer periods:

- International sectoral agreements which ensure that major competing producers of specific internationally traded products embody a similar carbon cost
- Border tax adjustments that reimburse companies for direct carbon costs incurred on exported products, and establish a directly equivalent charge on imports on a non-discriminatory basis
- Output-indexed (intensity) allocation that increases allowances in line with the production of carbon-intensive intermediate goods, and thus takes most of the carbon cost out of product prices.

To secure the value of low-carbon investments, EU governments should commit now to continuing the EU ETS whilst developing all of these options as a potential basis for post-2012 implementation. In addition, carbon-intensive new entrants during Phase II should not be promised free allocations for subsequent periods, as this would exacerbate perverse incentives and could undermine the EU's options for future design.

These three options would require the ETS Directive to be renegotiated in relation to allocation procedures. Such changes are neither feasible nor necessary for Phase II operation. Rather, Phase II should be a period in which greater cutbacks combined with some auctioning create a more stable platform for business engagement and investment, and in which experience is gained with benchmarking and auction design. Meanwhile, the profits potentially accruing to participating sectors can be harnessed to jump-start UK and European investments for a globally carbon-constrained future.

The research underpinning this report was coordinated by the *Climate Strategies* network and appears as a set of seven papers forming a Special Issue of the *Climate Policy* journal, published in June 2006.

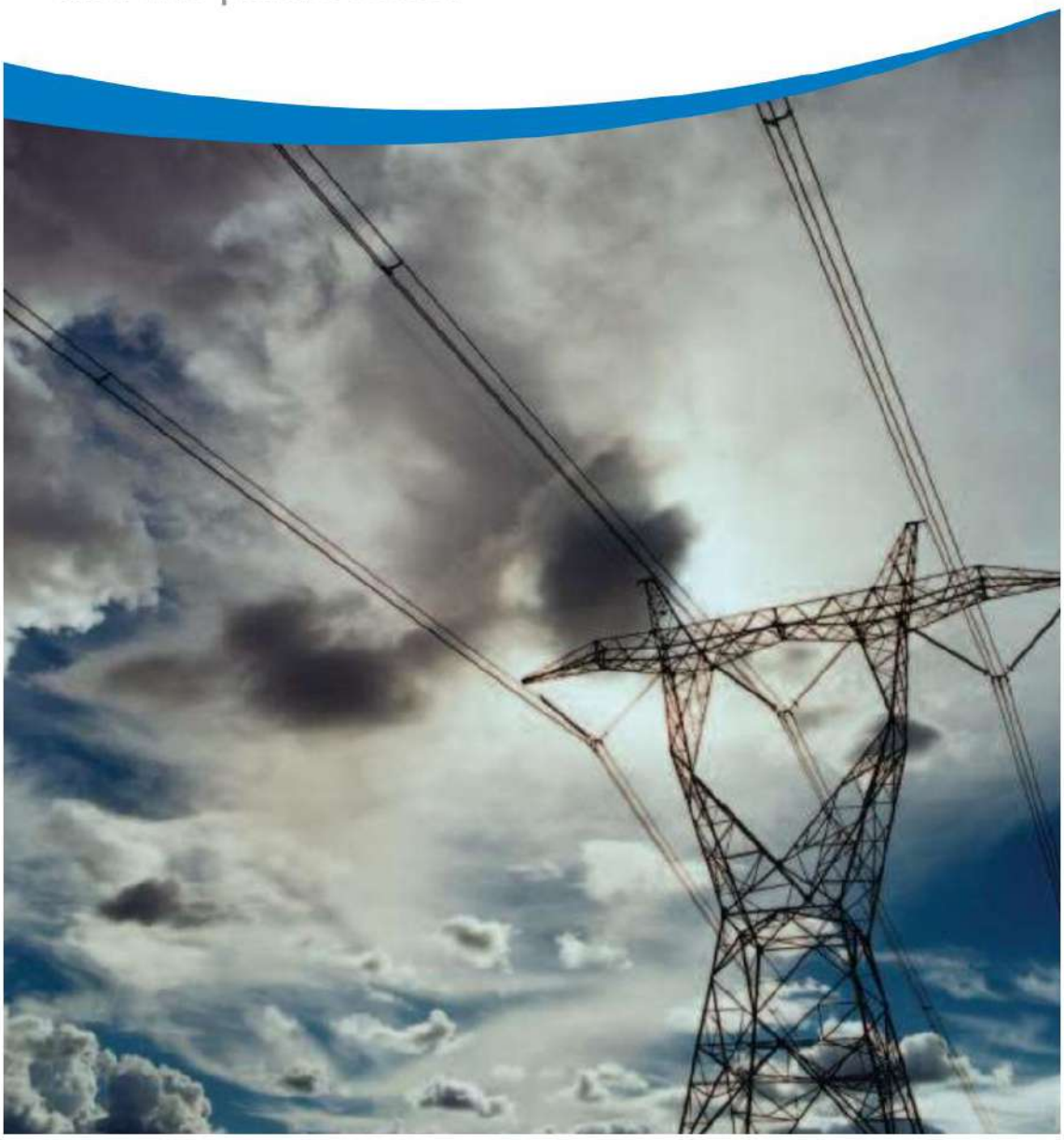
The UK Climate Change Programme: Potential evolution for business and the public sector – 2005

CARBON TRUST

Making business sense of climate change

The UK Climate Change Programme:

Potential evolution for business and the public sector



Implications for abatement and investment

A positive carbon price will drive some abatement, as it did during 2005-6, particularly in power generation and cement manufacturing. The incentive to abate may be weakened in countries and sectors that have allocated allowances in proportion to historic or projected emissions, if companies expect this approach to be carried forward to Phase III. Greater cutbacks combined with more 'benchmarking' particularly in the power sector in Phase II have lessened but not eliminated this risk. Nevertheless, prices below €20/tCO_2 are intrinsically insufficient to drive much investment in low carbon power sources, and may have modest impact on energy efficiency outside the energy intensive sectors.

Moreover, most allocation plans withdraw allowances from plants upon closure, and offer free allowances to new entrants. The former discourages closure of old inefficient plants and the latter partially protects new entrants from the impact of CO_2 prices. In many allocation plans, the new entrant rules give more free allowance to more carbon intensive fuels; the German plan gives even more to the most polluting (lignite power plants). This implicit subsidy creates perverse incentives to construct new, high emitting facilities that would last for decades.

In many countries the '*devil in the detail*' thus risks making Phase II of the EU ETS largely ineffective as an instrument to support low carbon investment (as opposed to operational emission savings).

Improvements and ways forward

To some degree, the various problems identified can still be fixed by (a) greater use of auctioning and (b) rapid progress to clarify a better basis for Phase III allocations.

Despite most plans cutting back allocations to power companies much more than other sectors, the power sector overall across Europe will make net profits from the EU ETS amounting to tens of billions of Euros during Phase II, through its impact on power prices. The current NAPs only propose a trivial volume of auctioning (around 1.5%) but governments retain flexibility and can still decide to auction more. The much higher degree of auctioning proposed in the emission trading schemes being developed in the US will also increase pressures in the EU. Where the power sector is profiting, greater auctioning would not increase power prices but it could help to improve incentives for low carbon investment in three ways: by reducing some of the perverse incentives noted; through judicious use of auction revenues to support such investments; and by enabling a reserve auction price that would help to stabilise price expectations. More auctioning would also intrinsically stabilise the system.

The biggest measure that could help the EU ETS as an incentive for low carbon investment would be to pay as much attention to the details and investment incentives in Phase III, as the Commission paid to volumes in Phase II, and to clarify some basic common principles through the Review being conducted this year. Some key principles have been elaborated in our previous publication.[3]

The first phase of the EU ETS successfully established the EU ETS as a functioning market across all the Member States, delivered significant abatement and generated awareness of the climate change issue at the highest levels in European industry; these were hugely important achievements. The outcome of the allocation process for Phase II has largely succeeded in dealing with the fundamental problem of over-allocation that was evident in Phase I, but at the expense of allowing through detailed provisions that undermine the incentives to invest in low carbon technology. Phase III will have to tackle these challenges, if the EU ETS is to deliver successfully on both its objectives.

3 Carbon Trust, *Allocation and competitiveness in the EU ETS: options for Phase II and beyond*, 2006.

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Preface

This report looks at how policy instruments acting on business and the public sector can be optimised to deliver significant carbon savings whilst maintaining/enhancing the competitiveness of UK companies. It explains why energy efficiency must play a central role in the national energy and climate change strategy, where the main potentials lie for energy efficiency improvement, and what are the main barriers and drivers to the take-up of current and upcoming energy efficiency/low carbon technologies in business and the public sector. It then examines in more detail the policy instruments and potential policy packages that could deliver a step change in energy efficiency while maintaining or improving UK competitiveness.

The Carbon Trust, which led the analysis presented here, was established to encourage and promote the development and deployment of low carbon technologies to support the transition to a low carbon economy in the UK. To help achieve these goals in the industrial, commercial and public sectors, the Carbon Trust also seeks to inform policy makers based on real world experience of low carbon technology development and deployment.

The report represents the high-level summary of detailed studies on the options for developing UK policy in the business and public sectors which were carried out by the Carbon Trust as input to the UK Climate Change Programme Review and the Energy Efficiency Innovation Review (EEIR). A balanced national strategy must also address on equal terms the growth of emissions from transport and the domestic sector, which fall outside the remit of the study.

Michael Grubb, Chief Economist
James Wilde, Associate Director of Strategy
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With significant contributions from Cath Bremner, Anthony Justice, Charles MacDonald, Claire Norris, Michael Rea and Catherine Willan at the Carbon Trust.

Modelling support provided by Ecofys, Oxera, Cambridge Econometrics and Oxford Economic Forecasting.

Executive summary

The 2003 Energy White Paper committed the UK to reducing carbon emissions by 60% by 2050 and to making significant progress towards that goal by 2020. The main aim of this work was to understand how policy measures impacting the business and public sectors might evolve to deliver significant carbon savings while at the same time maintaining or enhancing the competitiveness of UK companies.

This summary provides an overview of our findings in five key areas:

i **Context**

ii **Strengths and weaknesses of current Climate Change Programme**

iii **Addressing gaps in the Climate Change Programme**

iv **Quantified conclusions on cost and delivery**

v **Innovation and interactions**

i Context

The business and public sectors generate over one third of UK CO_2 emissions. Significant carbon abatement could be achieved in these sectors while at the same time delivering bottom line financial benefits using existing energy efficiency technology. However, existing policies do not sufficiently target the diverse barriers that inhibit uptake or utilise the corresponding drivers that could most cost-effectively deliver change.

Emissions mapping. Manufacturing processes and commercial and public sector buildings (i.e. excluding all transport and domestic related activity) produce ~54Mt of carbon emissions (based on 2002 data). Within these there are four main classes of users: energy intensive industries (c.45% of business and public sector emissions as defined in this study), large non-energy-intensive companies (c.25%), SMEs (c.20%) and the public sector (c.10%). Energy for manufacturing processes (of which two thirds is direct fuel combustion) dominates the first of these; electricity and other buildings-related emissions dominate emissions from the other sectors.

Carbon abatement opportunity. Significant carbon abatement could be achieved using available technological and behavioural energy efficiency measures that are cost effective, generating a rate of return above 15%. This 'cost effective' potential could reduce emissions by 2020 by at least 12% across manufacturing processes and 20% in non domestic buildings using existing carbon abatement technology. In addition, innovation over this time-frame would be expected to significantly increase the longer term potential.

Barriers and drivers. Policy can deliver this potential only to the extent that it helps to overcome barriers or harness the drivers of business decision-making. Financial cost/benefit considerations that define overall rates of return on a carbon abatement investment are the first overall type of barrier/driver and it can be primarily addressed from a policy perspective through economic instruments such as the EU Emissions Trading Scheme. Three other categories of barrier/driver account for the gap between the cost-effective potential and current implementation:

- 'Hidden' costs associated with adopting more efficient equipment e.g. perceived risks of poor performance, implementation issues, and the transaction costs of getting information and making sound, informed judgements on the value of available opportunities. Equipment standards, or technology labelling and listing schemes, can help address this barrier. Policies can also tap into 'hidden' benefits such as customer, investor, or employee preferences for companies that are minimising their impact on the environment and managing carbon risks (e.g. 'Corporate Social Responsibility' drivers)
- Market failures that result in split incentives, e.g. the 'tenant-landlord' split where business tenants pay the energy bills but landlords control the properties and associated energy services. Primary metering is another example of split incentives, where utilities do not have a strong incentive to help their customers monitor energy use effectively. Potential solutions include contractual and market standards solutions
- Organisational factors stemming from ignorance and inertia, or from internal structures that prevent the relevant persons from realising the financial/business benefits of decisions that improve energy efficiency, result in inconsistencies in capital deployment and neglect of opportunities that would be cost effective for the overall organisation. Tackling this requires measures that address senior-level commitment in an organisation.

The mix of drivers/barriers differs between different types of energy use and energy user, and therefore policy measures need to be tailored to the specific needs of the user type if the cost effective carbon abatement opportunity is to be harnessed.

ii Strengths and weaknesses of current Climate Change Programme

The current Climate Change Programme (CCP) for the business and public sectors has a number of powerful building blocks in place. The Climate Change Levy (CCL) sets a key backdrop against which the EU Emissions Trading Scheme (EU ETS) and Climate Change Agreements (CCAs) are driving change in the energy intensive industries. In addition Building Regulations and the Energy Performance of Buildings Directive (EPBD) are helping to address other sectors. However, across all of these instruments there are significant implementation issues that could limit their ultimate carbon delivery. Moreover, the current package is not providing sufficient incentive for change across the less energy intensive segments, where energy costs are less material, and where in particular the current CCL does little to drive change and structural failures persist.

- The **EU ETS** is the right basic approach for incentivising change in power generation and in energy intensive sectors while at the same time minimising competitiveness impacts. However its delivery depends upon collective allocation across the EU and it is potentially undermined in some areas by perverse incentives. The EU ETS design is specific to large industrial facilities and it does not provide a basis for addressing the rest of manufacturing or service sector emissions. *The UK needs to take a leadership role in the EU and beyond to ensure that a level playing field is created through robust pan-European allocation, and that the future of the scheme post 2012 is defined to give firms the long-term certainty they need to make investments*
- **The Climate Change Agreements (CCAs)** provide a wider set of energy-intensive sectors with an 80% rebate on the CCL if they meet agreed carbon reduction targets. CCAs create a good incentive to secure low-cost emissions reductions in the rest of energy-intensive industry outside EU ETS sectors. In addition CCAs offer insurance from a policy perspective against EU ETS price uncertainties and under-delivery. Overlap between the CCAs and the EU ETS is not problematic from an economic perspective at this stage but the overlap does create administrative burdens. However 'awareness' impacts of CCAs may be wearing off and tightening CCA targets may become increasingly difficult. If confidence grows in the EU ETS and its price stability, and a corresponding trading instrument is introduced for non-EU ETS sectors, then *CCAs need not be extended beyond their current term and the participating sectors could move into an appropriate emission cap-and-trade system whilst maintaining their CCL discount, i.e. the EU ETS or a new UK trading scheme as described in this report*
- **Building Regulations and the Energy Performance of Buildings Directive (EPBD)** can drive significant change in the UK's building stock. However, enforcement of and compliance with Building Regulations are patchy and definitions (e.g. of public buildings in the EPBD) may be restrictive. *'Part L/J inspectors' focussed on large buildings (>1000m²) with the ability to ensure compliance with Building Regulations would make a significant difference. In addition, extending the definition of 'public buildings' within the EPBD to include all large buildings visited by the public (not just public sector buildings), moving to phased display of operational ratings across all large buildings, together with obligations on building owners to implement 'easy and cost effective' measures as identified by asset rating certificates could greatly and cost effectively increase carbon delivery across the UK*
- Increasing the **Climate Change Levy (CCL)** rate could increase carbon savings, particularly in manufacturing, but *economically acceptable CCL increases would have little impact in services energy use. Restructuring the CCL to a consumption-based carbon tax increases carbon delivery but only very slightly. Therefore a new approach to incentivising change across the less energy intensive segments is required*
- **Metering inadequacies** reduce efficiencies and impede any strengthened CCP outcomes — it is hard to manage what you can't measure. *Stronger requirements should be placed on energy suppliers to provide accurate, verifiable metering data and the coverage of half-hourly metering should be extended.*

iii Addressing gaps in the Climate Change Programme

A new instrument is required to address the big growth in service sector energy use in particular. Having investigated various routes to incentivise change in less energy intensive organisations, we conclude that a new mandatory trading scheme for large, less energy intensive organisations that fall outside the EU ETS is required. The key to such a scheme is simplicity, and the inclusion of not just direct emissions, but also electricity related emissions which constitute up to 70% of the CO_2 produced by the target sectors.

- The CCL is not a material cost and it does not address the market misalignments (e.g. tenant-landlord split) or leverage other drivers (e.g. investor, customer or employee pressure) that could overcome organisational and behavioural barriers in less energy intensive sectors. *The UK should build upon the UK ETS and the success of CCAs in terms of driving change by considering a new separate but simple mandatory, company/organisation-based emissions trading scheme, including electricity-embodied emissions and perhaps fleet haulage for large companies, which we have termed UK CETS (Consumption-based Emissions Trading Scheme)*
- The scheme would increase the transparency of energy use and emissions in less energy intensive organisations. It would be based on energy use as measured by the electricity and gas meters already in place, with results presented in a consistent fashion in annual reports, making emissions a compliance issue and requiring larger UK organisations (both public and private sector) to articulate a clear carbon management strategy
- Full auctioning of allowances would avoid gaming and transaction costs associated with allocation negotiations, and accompanying CCL rebates would prevent creating an additional financial burden for business
- This instrument has significant potential coverage. Even if initially restricted to the existing coverage of half-hourly meters, it could span baseline emissions of ~20MtC split roughly equally between less energy intensive manufacturing and the service sector, and encompass around 14,000 companies and public sector organisations (occupying 91,000 sites).

Other instruments will also be required to overcome specific barriers in the public sector and for small and medium sized enterprises (SMEs). SMEs are difficult to target cost effectively, both because of their diversity and the lack of time, resource and expertise they have to apply to these 'non-core' issues.

- **Product energy efficiency** *labelling could be extended across business and public sector-related products, and increasing product standards could be used as a highly cost-effective way to remove the least energy efficient products from the market-place. This approach would be highly cost effective for SMEs in particular.* **The Government's Enhanced Capital Allowances Scheme** (ECAs) energy technology list strongly influences product selection and manufacturers; *ECAs should be maintained and criteria for qualifying technologies regularly tightened*
- **Interest-free loans for SMEs** will also help to drive change in the SME segment, overcoming the barrier that many small firms have of inadequate access to capital
- Far stronger **Public Sector leadership** can both set a behavioural and strategic example to the private sector and leverage its large purchasing power (the public sector was responsible for one third of non-domestic new build and refurbishment in 2004). *Meeting the established target to reduce public sector carbon emissions by 12.5% by 2010 will require greatly improved governance, tighter procurement guidelines, extension of ring-fenced interest-free loans, and extension of other support mechanisms.*

'White certificate/baseline and credit' project style trading offers supplementary but limited options. These schemes require costly, complex verification and monitoring of individual projects, have lower impact as they focus largely on asset-related investments rather than behavioural opportunities and, if Government pays for the credits generated, are less cost effective than alternative approaches. Placing obligations on energy suppliers to save energy amongst their business customers, particularly small and medium sized enterprises – *'Energy Efficiency Commitment for SMEs'* – may help but delivery through such market-based routes is likely to remain modest and high-cost in this intractable market segment.

iv Quantified conclusions on cost and delivery

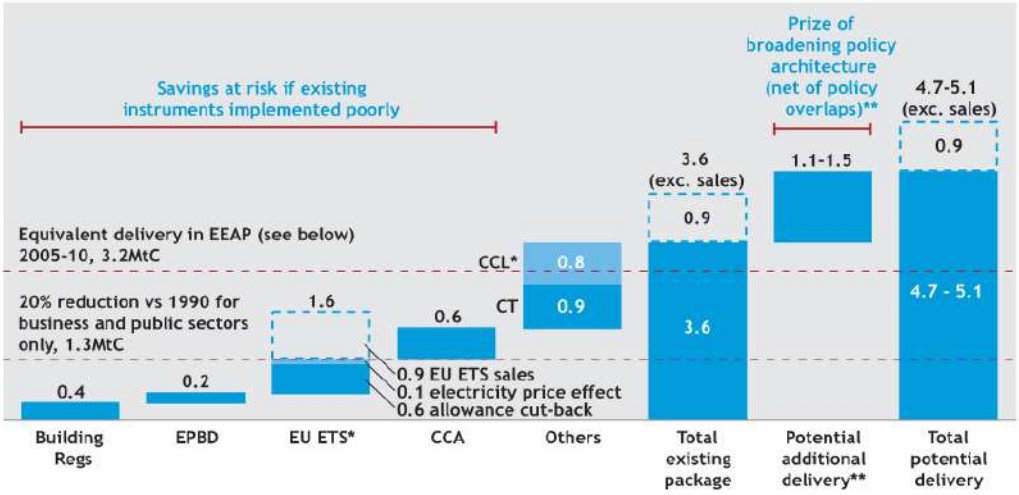
Resuming and accelerating the decline in UK CO_2 emissions is possible and need not damage UK business. We analysed various policy packages in detail using diverse methodologies to establish carbon savings, cost implications and the best mix of measures from a carbon reduction and competitiveness point of view going forward.

- Prompt implementation of our most cost-effective package of measures could reduce carbon emissions from business and public sector end use by up to -4.7-5.1MtC p.a. by 2010 and -11.2-12.6MtC p.a. by 2020 (about 10% and 20% respectively of projected emissions from these sectors). This would turn projected growth into an absolute decline averaging about 1%/yr. In 2020, -9MtC p.a. of this delivery would come from the existing instruments (assuming they are fully implemented to maximise carbon savings), whilst the net prize of broadening the package of measures is an additional carbon saving of 2.2-3.6 MtC p.a. (Charts A and B). This significant additional prize is primarily driven by the proposed new UK trading scheme
- Over 90% of these savings can be achieved by technologies that deliver net cost savings at a 15% cost of capital. On this basis, a strengthened Climate Change Programme would create a significant aggregate net benefit for UK firms, saving up to £70/tCO_2 on a lifetime basis.

The overall impact of strengthening the policy measures to address climate change in the business and public sectors will have little or no impact in terms of competitiveness of UK business except potentially in a few limited cases:

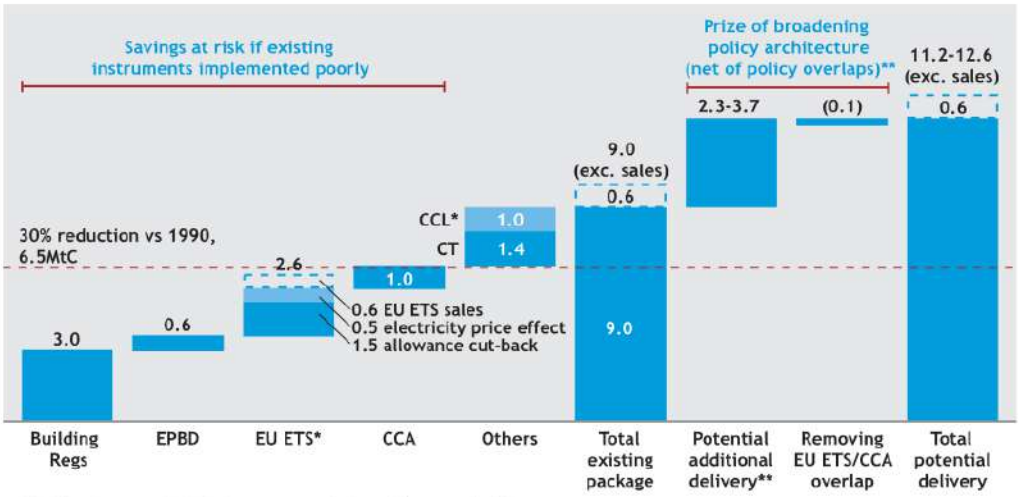
- As explained in previous studies, several of the sectors in the EU ETS have potential to profit from it due to pricing effects and the value of the free allocations they receive. The cumulative impact of the instruments modelled in this study, and separation of EU from non-EU trade, do not change this fundamental conclusion
- Despite derogations in the energy-intensive sectors, aluminium smelting could be severely impacted if purchasing electricity from the grid, and for strengthened measures beyond 2012 the steel and cement industries might justify protection against imports from regions without equivalent measures. The cost increases in other energy-intensive sectors overall would not materially affect their competitiveness, though we cannot rule out possible exposure of exceptional individual subsectors
- Outside the energy-intensive industries, the cumulative financial impact of the price-based measures in our strongest scenarios would add 1-1.5p/kWh to electricity prices by 2020. This, and any additional investment required, could be offset by efficiency gains and revenue recycling. Outside the energy-intensive sectors the net cost impacts of the policies under consideration are immaterial and many could gain
- The macroeconomic modelling studies we employed tend to confirm the carbon savings potential of pure price instruments but generate a range of conclusions about GDP impacts in particular. In our high carbon price scenarios, GDP impacts vary by +/- 0.3% by 2010 (compared to baseline projected emissions). Further work is underway to reconcile the conclusions from the two macroeconomic models used in this study.

*Chart A Carbon delivery 2005-2010 of existing package, and additional carbon prize of a strengthened package of measures MtC p.a. saving in 2010 vs. projected emissions (60MtC)****



- Base case delivery of existing package close to EEAP (Energy Efficiency Action Plan) estimate (~3MtC), however mix of instruments is different
- Building Regs. and EPBD delivery still low as insufficient churn of stock
- Broadened package including UK CETS capable of delivering additional 1.1-1.5MtC

*Chart B Carbon delivery 2005-2020 of existing package, and additional carbon prize of a strengthened package of measures MtC p.a. saving in 2020 vs. projected emissions (58MtC)****



- Building Regs. and EPBD key route to deliver change in buildings
- EU ETS and CCA effective for energy-intensive sectors, with little loss on removing overlap in regulation post 2010
- Broadened package including UK CETS has potential to deliver additional 2.2-3.6MtC

Note: *Savings in end-use only, excluding power sector switching, EU ETS based on market price of €15/tCO_2 in 2010, €30/tCO_2 in 2020 and 1% p.a. cutback, CCL at current strength; **Additional delivery of a strengthened package including UK Consumption-based Emissions Trading Scheme (UK CETS), net of overlap with CCL and the Carbon Trust (strengthened EPBD product standards are only additional to UK CETS in SMEs); ***Allowing for CCP delivery 2000-2005 (3MtC).

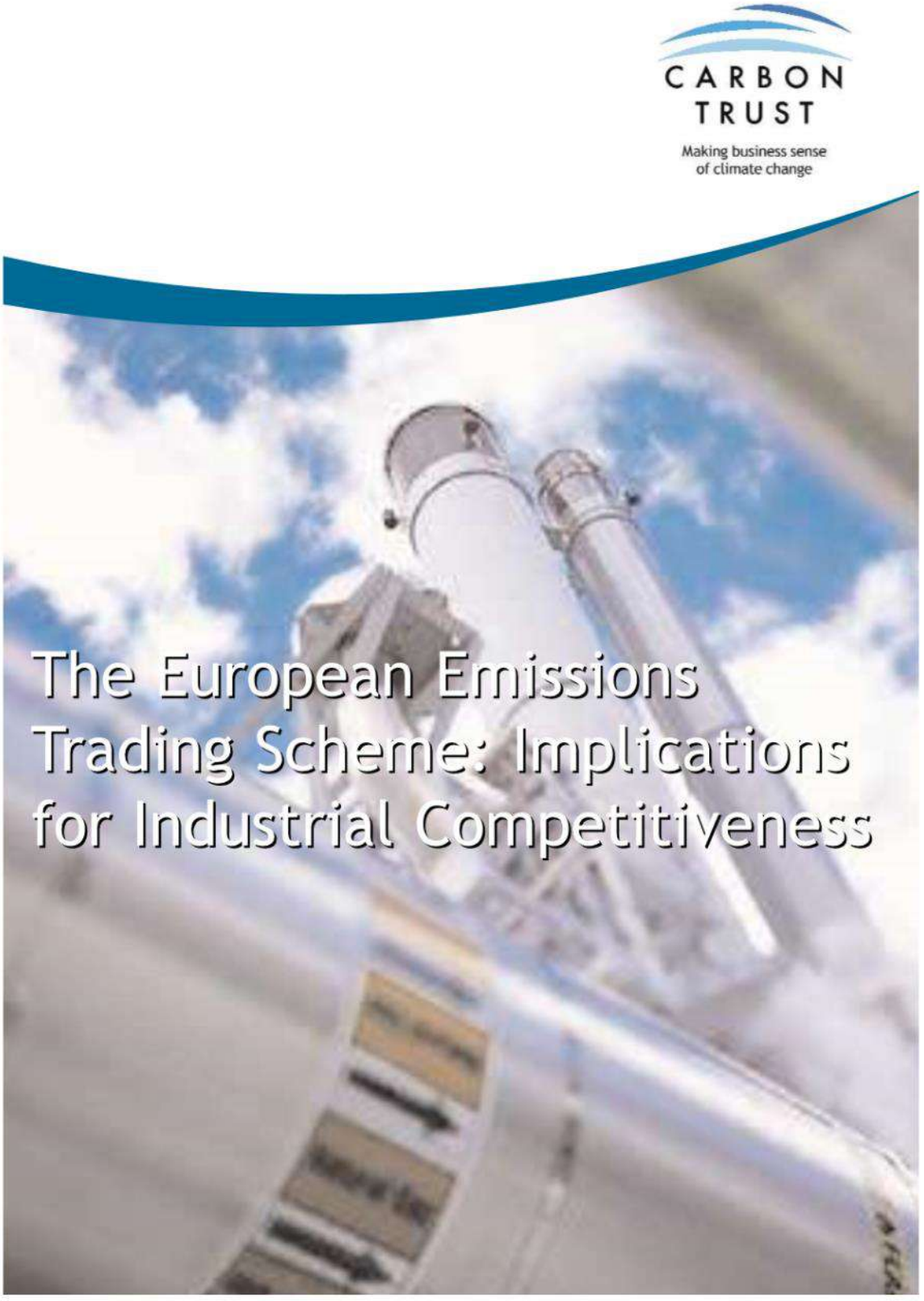
v Innovation and interactions

Innovation and interactions with other sectors offer the potential of additional savings, but costs could also be increased if instruments are inappropriately extended or the CCP is insufficiently broad-based.

- UK businesses, particularly energy-intensive industries, are already a prime focus of climate-change-related legislation. Strengthened action must be accompanied by equal policy attention to emissions growth in transport and the domestic sector
- A high EU ETS carbon price would drive coal to the margin of power supply and magnify the near-term carbon-value of end-use electricity efficiency. Decarbonisation of power generation over time, driven by the EU ETS and industry-building instruments like the Renewables Obligation, has the potential to reduce the knock-on price impacts of the EU ETS to electricity consumers
- Extending the EU ETS to aviation carries the risk of magnifying cost impacts on the rest of UK and European industry, if the price is to develop to a level that would significantly affect aviation emissions directly.

Implementing policies that accelerate the adoption of leading-edge efficiency technologies will also accelerate related innovation. However, additional and ongoing policy support will be required to accelerate the development of new energy efficient and low carbon technologies (which fall outside the scope of this study). The potential for end-use innovation is enormous and international data suggests that higher domestic energy prices do not in the long-run increase national energy expenditure.

The European Emissions Trading Scheme: Implications for Industrial Competitiveness – 2004



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Headline findings

- The European Emissions Trading Scheme (EU ETS), properly implemented, will not significantly threaten the competitiveness of most industrial sectors in Europe, including most energy-intensive sectors
- Several sectors have potential to profit from the EU ETS, although there are expected to be winners and losers at an individual company level
- However, weak and inconsistent implementation between different European countries could introduce distortions that may be significant for a few sectors (notably steel). By shielding companies from the need to start adjusting now, weak allocations also expose companies to greater risks in coming years.

Preface

The EU ETS will start operating from January 2005. It is a cornerstone of UK and EU strategy for tackling climate change, and will be by far the world's biggest programme of pollution control, worth potentially tens of billions of Euros. Many industries have raised concerns about the scheme's potential impacts on industrial competitiveness.

For these reasons, the Carbon Trust initiated this project to explore in depth the implications of the EU ETS for industrial competitiveness in the UK and the wider EU. The study incorporates both economic modelling, conducted by OXERA, and a series of interviews with key stakeholders primarily in industry. The full details, assumptions and results of the OXERA modelling are available on **www.thecarbontrust.co.uk**

This report presents our analysis of the combined insights from the economic modelling and the stakeholder interview programme.

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Associated Director of Policy,
The Carbon Trust

Dr James Wilde
Strategy Manager,
The Carbon Trust

Executive Summary

Background

The EU Emissions Trading Scheme is the world's most ambitious programme for environmental management: it is central to delivering Europe's Kyoto commitments, and it will create pollution control assets potentially worth tens of billions of Euros. It has already engaged the attention of industry across Europe far more than any other initiative to address climate change.

Emissions trading should enable European industry to seek out the lowest cost emission reductions anywhere in the enlarged Europe without restrictions - or indeed, through more specific project investments, anywhere in the world. At the same time, industry has voiced vigorous concerns about the scheme, particularly its potential impact on industrial competitiveness. If the scheme does damage competitiveness it could not only be economically detrimental: it would also undermine the environmental objective if disadvantaged industries moved abroad to regions where operations might be less environmentally efficient than current European practice.

Our approach

The impact of the EU ETS on the competitiveness of a given sector will depend upon policy decisions relating to the price and allocation of emission allowances, and upon the sector's potential exposure. A sector's potential exposure in turn depends upon the proportion of energy as a component in its overall production costs (its energy intensity), and the extent to which international or other competition may constrain its ability to pass any cost increase on to buyers of its products.

Our modelling work examined in depth five sectors that differ widely in their energy intensity and trade characteristics: electricity, cement, paper, steel and aluminium. Quantitative results were generated for three scenarios at various prices and allocations reflecting plausible stages in the development of the EU ETS, whilst interviews tested emerging conclusions against real-world conditions and added a variety of insights about actual conditions and concerns.

Sector findings

Because most sectors in the EU ETS will be given allowances to cover the great majority of their emissions, they need to pass only a small fraction of the marginal cost increase arising from the EU ETS through to prices in order to maintain profits at previous levels. Economic theory suggests that companies would pass the majority of the marginal cost increase through to prices, leading to increases in operating profits subject to the constraints of competition from any companies in the market that do not face similar EU ETS-related costs.

Our overall conclusion is that the EU ETS is unlikely to reduce the profitability of most industrial sectors, providing that it is implemented in roughly equivalent ways across different EU countries and that the price rises are not so large as to make non-EU imports profitable on a large scale.

In our central scenario with a carbon trading price of €10/tCO2 and a large allowance cutback focused upon electricity, the generating sector can maintain its profits by increasing wholesale UK industrial electricity prices by about 5%. Even if the power sector passes through three times as much (the level that would theoretically maximise its profits from the EU ETS), both steel and cement have to raise final prices by only about 1.5% in order to maintain their current profitability, whilst the corresponding rise in newsprint prices is negligible (0.1%).

Our specific sector studies indicate that electricity, cement and the paper (newsprint) sectors could increase operating profits across a range of scenarios by passing more of their marginal cost increases through to prices. However, there could be winners and losers at the individual company level. The steel sector can also maintain its profits in our first two scenarios but may suffer in our more severe, longer term scenario, and again there are likely to be winners and losers at an individual company level. Of the modelled sectors, only aluminium loses from the EU ETS - despite, or indeed partly because, of the fact that it is not within the EU ETS system.

Interviews with companies in the sectors point to a number of important complexities, but do not alter these basic conclusions assuming sectors across Europe face similar constraints in terms of their emissions caps.

High-level analysis of other sectors suggests that aluminium is unique: no other sector comes close in terms of either its net value at stake, or its degree of international trade exposure. We could not rule out the possibility that some specific subsectors, at a level below aggregated sectors, may be similarly exposed, but nor could we positively identify any such cases.

Competitiveness effects within the EU

Overall our findings do not support the view that the EU ETS threatens the competitiveness of industry in Europe for most sectors, providing that EU Member States take a broadly consistent approach.

Industry is very concerned about differential allocation, pricing effects and possibly differential enforcement between EU countries. Differential allocation would not in principle affect pricing directly, but would affect overall profitability.

Present allocations between different countries indicate wide differences, with several countries proposing allocations that appear likely to give a significant surplus to their sectors. This inevitably fuels the concern of UK industry about differential treatment. Moreover, such allocations will not get industries in these countries on course to meet their Kyoto targets and leaves them with the prospect of more rapid cutbacks in the Kyoto period of 2008-12.

The low prices arising from these weak allocations mean that such differential treatment is unlikely to be competitively significant for any sector with the possible exception of steel. Such intra-European effects would become more significant at higher prices, reinforcing the case for a consistent approach to allocation across the EU. If the EU ETS is to generate significant abatement activity and get EU countries on track towards meaningful reductions, without distorting competition within Europe, the EU will need to act both to strengthen allocations and to ensure more consistent approaches between Member State allocation plans.

The Climate Change Challenge - 2003

CARBON TRUST

Making business sense of climate change

The Climate Change Challenge

Scientific evidence and implications

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Foreword

Climate change is emerging as a major challenge for modern society. Government, business, and wider society will all be affected and all have a role to play in tackling it. This report is the first in a series of Carbon Trust reports that are designed to help businesses in particular to understand the nature of the challenge, why and how governments are acting to address it, and what the implications may be. The reports are subject to both internal and external international review.

This report summarises the nature of the problem. It explains the fundamental science and the accumulating evidence that climate change is real and needs to be addressed. It also explains the future potential impacts, including the outstanding uncertainties.

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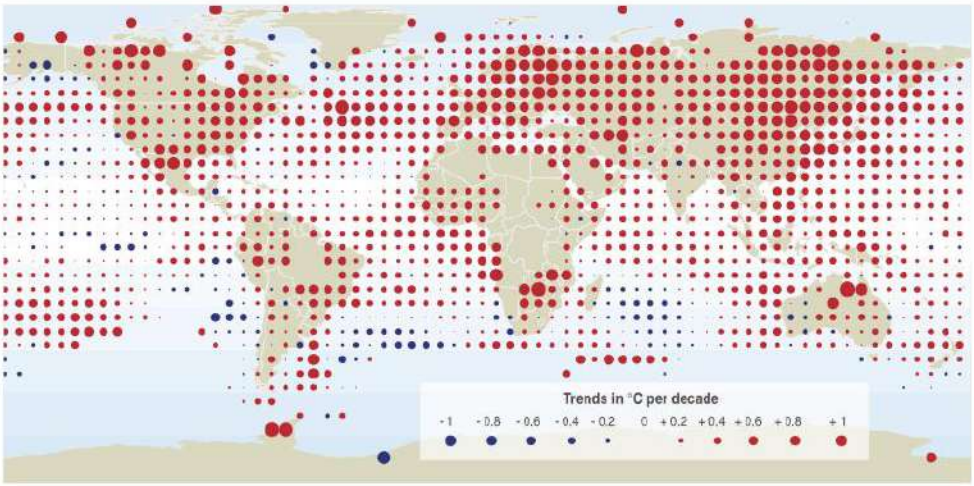
Chart 1. Temperature changes around the world in the last quarter of the 20th century



Large-scale warming of both the land and ocean surface occurred in the last quarter of the 20th century, with the largest increases over mid and high latitudes of North America, Europe and Asia. The pattern, including faster warming over land than oceans and faster near the poles than equator, is consistent with that expected from greenhouse-gas warming.

Source: Intergovernmental Panel on Climate Change, Third Assessment, Climate Change 2001: Synthesis Report (Figure 2-6b)