CARBON TRUST

Making business sense of climate change

The European Emissions Trading Scheme: Implications for Industrial Competitiveness

Contents

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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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.

Part 1: The EU ETS and our approach

Introduction and overview of the EU ETS

Tackling climate change requires approaches to reduce CO_2 emissions as cost-effectively as possible. Economists have long advocated emissions trading as a way to achieve this, and in 2003, the Member States of the EU unanimously agreed to adopt it as the primary instrument for controlling industrial sector CO_2 emissions in Europe. When the EU Emissions Trading Scheme (EU ETS) starts operating in 2005, it will be by far the world's biggest application of emissions trading. This report explores the key concern: its possible impact on industrial competitiveness.

Emissions trading is a simple idea. A cap is set on the emissions allowed from a given group of emitters, who are issued individual emission 'allowances' that can be traded. If an emitting entity can over-achieve its initial allowance by say investing in energy efficiency, it can sell its surplus. However, if it is faced by high costs to reduce its emissions, it can instead buy allowances from those that find it cheaper to cut back. Consequently, a market is created which enables companies to seek out the lowest cost emission reductions, wherever and however they can be achieved. The resulting 'carbon market' should develop a price that reflects the cheapest ways of implementing emission cutbacks.

The Kyoto Protocol embodies emissions trading, in that the national emission targets defined under Kyoto can themselves be traded between countries. In the EU, if Member States cannot deliver their targets domestically, they have the option to comply by trading internationally – a flexibility that underpins the EU Emissions Trading System. In the EU ETS, Kyoto emission allowances are transferred to companies by their governments, and the companies themselves can then trade them freely within the EU.

After long delays, President Putin has now publicly indicated that Russia is likely to ratify the Kyoto Protocol and thereby bring it in to force internationally, when it will also become binding upon the 122 countries that have already ratified the Treaty. However, to remove the planning uncertainties and maintain momentum in tackling climate change, EU countries have already politically and legally committed themselves to delivering their Kyoto commitments, irrespective of the delays in Russia. This is embodied in the EU ETS Directive that was adopted by the European Council and the European Parliament in June 2003.

The scheme covers all the biggest 'point source' CO_2 emissions across the EU25: power stations; cement manufacture; iron and steel; pulp and paper; oil refining; glass and ceramics; and all other industrial facilities greater than 20MW-

thermal capacity. In total, this accounts for about 46% percent of European CO_2 emissions (Member States have to address emissions from other sectors – primarily households and transport emissions – through other means).

The Directive defines two phases:

Phase 1: 2005-7 (precursor period). Member States retain the option to 'opt out' particular sectors or facilities if they face transitional difficulties, providing they can demonstrate 'equivalent effort' is being made to tackle emissions in the facilities exempted.

Phase 2: 2008-12 (Kyoto period). The named sectors and facilities greater than 20MW thermal capacity are all mandatory in the scheme, and governments have the option to 'opt-in' additional sectors, facilities and gases.

In other respects too, the scheme becomes much more potent in Phase 2, which corresponds to Kyoto's first commitment period. The Directive specifies the penalty that shall be levied if companies do not comply, which rises from €40/tCO_2 shortfall in phase 1 to €100/tCO_2 in Phase 2. This is on top of a requirement to make good the allowance shortfall by purchasing allowances in the market, thus giving a powerful incentive to comply. Also, governments can auction allowances to their companies - up to 5% of total allowances issued in the first phase, and 10% in Phase 2.

The individual Member States retain responsibility for deciding how to distribute the initial emission allowances among their sectors and companies, through a National Allocation Plan (NAP), but this is subject to criteria laid out in an Annex to the Directive. This specifies that allocations should help to get countries on a trajectory to achieve their Kyoto targets, and that governments should not deliberately allocate allowances surplus to a companies' needs – which would in effect constitute a subsidy, since it would be a resource given freely that companies could then sell.

Companies participating in the EU ETS can also fulfil their obligations through investments outside of the EU. The Kyoto Protocol itself defines 'project mechanisms', under which specific emission-reducing projects can generate 'emission credits' that can be used by the investing party towards their national emission targets. The EU's Linking Directive, adopted in May 2004, allows companies to use emission credits generated under Kyoto's project mechanisms towards compliance under the EU ETS. Through this, the EU ETS becomes not just an internal EU system; it also allows companies the freedom to seek the most cost-effective reductions anywhere in the world, and can also support the international diffusion of cleaner technologies in developing countries. The Linking Directive caps the volume of credits to be imported into the EU at 6% of total emissions, though this will be reviewed if the cap is reached.

The EU ETS, therefore, whilst simple in conception, is in practice a complex and ambitious undertaking of worldwide importance. In addition to its goal of enabling European industry to implement our climate change commitments in the most efficient manner, it also has the potential both to maintain the international momentum on climate change, and to give Europe a leading edge in the global response as others too have to respond to the challenge of climate change.

Yet nothing comes for free, and the EU ETS is a major endeavour. Since the Directive was adopted and member states started to develop their National Allocation Plans, many voices in Europe have raised concerns about the potential costs and possible implications of the EU ETS for the international competitiveness of European industry. Competitiveness is a key issue not only from an economic standpoint. If energy-intensive sectors in Europe face a significant reduction in profits as a result of the EU ETS, they may be tempted to move operations abroad, to places where CO_2 emissions are not controlled; or consumers may preferentially buy more goods from regions where emissions are not controlled. This would not achieve anything in terms of global emissions – and if the facilities concerned were less efficient than current European operations, this would even result in increased global emissions. The competitiveness implications of the EU ETS are thus a central concern, for environmental as well as economic reasons.

For these reasons, the Carbon Trust has conducted a major study of the potential implications of the EU ETS for the competitiveness of industry in the UK and the EU.[1] This report sets out the results of that work, in three main parts. Part 1 explains the EU ETS scheme in outline, discusses the major factors that would determine competitiveness implications for given sectors, and outlines the scenarios and the analytic approach used in the study. Part II presents results of detailed analysis for a range of sectors. Finally, in Part III, we consider the wider implications of the EU ETS and ways forward in the light of our findings.

[1] Our study does not address a range of other technical issues surrounding the design of the scheme, for example, the rules relating to 'new entrants' and exit of facilities, which are subject to detailed discussion and negotiation in many countries.

Competitive drivers around the EU ETS

Three factors determine a sector's inherent potential exposure to the EU ETS: its energy intensity; its ability to pass cost increases through to prices; and its opportunity to abate carbon.

1. Energy intensity. Sectors that consume a lot of energy (energy intensive), both those covered by the EU ETS scheme and those not covered, will see their input costs rise if they do nothing to reduce their energy consumption.

This is partly due to the cap that will be set under the EU ETS on industrial direct emissions – i.e. those incurred directly in the plant e.g. gas-fired boilers, process emissions etc. This will affect only companies in sectors within the scheme that emit CO_2 directly either due to the fuel they burn (e.g. gas, coal or oil) or as a consequence of the chemistry of their industrial process (e.g. cement manufacture generates CO_2 as part of the conversion process). If their emissions exceed their initial free allowance, they will need to purchase allowances or invest in abatement activity to make up any shortfall.

In addition, almost all industrial sectors consume electricity and the inclusion of the electricity sector in the EU ETS is (as we discuss later) expected to raise electricity prices. Thus all sectors will be indirectly exposed to the impact of the EU ETS. Industrial electricity price rises of 10-40% attributable to the EU ETS out to 2012 have been widely predicted. Our own estimate is at the lower end of this range. However, even at this lower level the impact of the scheme on electricity prices represents a greater cost risk to many sectors than the direct impact of the scheme.

2. Ability to pass cost increases through to prices. This depends on three main factors:

- **Price-responsiveness of demand.** Sectors in which demand is not very sensitive to price will not suffer a significant loss in volume of sales when prices are increased, particularly if possible substitute products are exposed to similar cost uplifts as a consequence of the EU ETS.
- **Nature of competition.** Market structure will influence pricing dynamics, driven both by the number of players in the market and extent of state involvement either through regulation or direct ownership. In general, markets with more players are more competitive and costs affect sector pricing more directly.
- **Geography of the sector's market.** Companies outside the EU will not see any cost increase as a result of the EU ETS, though some (such as in Japan) may be affected by other domestic policies associated with implementing the Kyoto Protocol.

Even within the EU, widely divergent situations or different approaches to the EU ETS in different Member States could provide players in some countries with a competitive advantage. This could be brought about by a less stringent National Allocation Plan for the sector in question or differences in the electricity price uplift brought about by the scheme (caused by differences in generation portfolio, state ownership or allocation to the electricity sector). This possibility is examined separately in the final section of this report.

Whilst all three factors will affect the extent to which sectors can pass cost increases to prices, international competition, in particular from outside the EU, is of utmost importance. Players in globally traded commodity markets will have far less scope to offset their exposure to the scheme through price rises.

3. Opportunity to abate carbon. With CO_2 emissions gaining a market price, investment in abatement e.g. energy efficiency, represents a means to both limit exposure to the EU ETS,

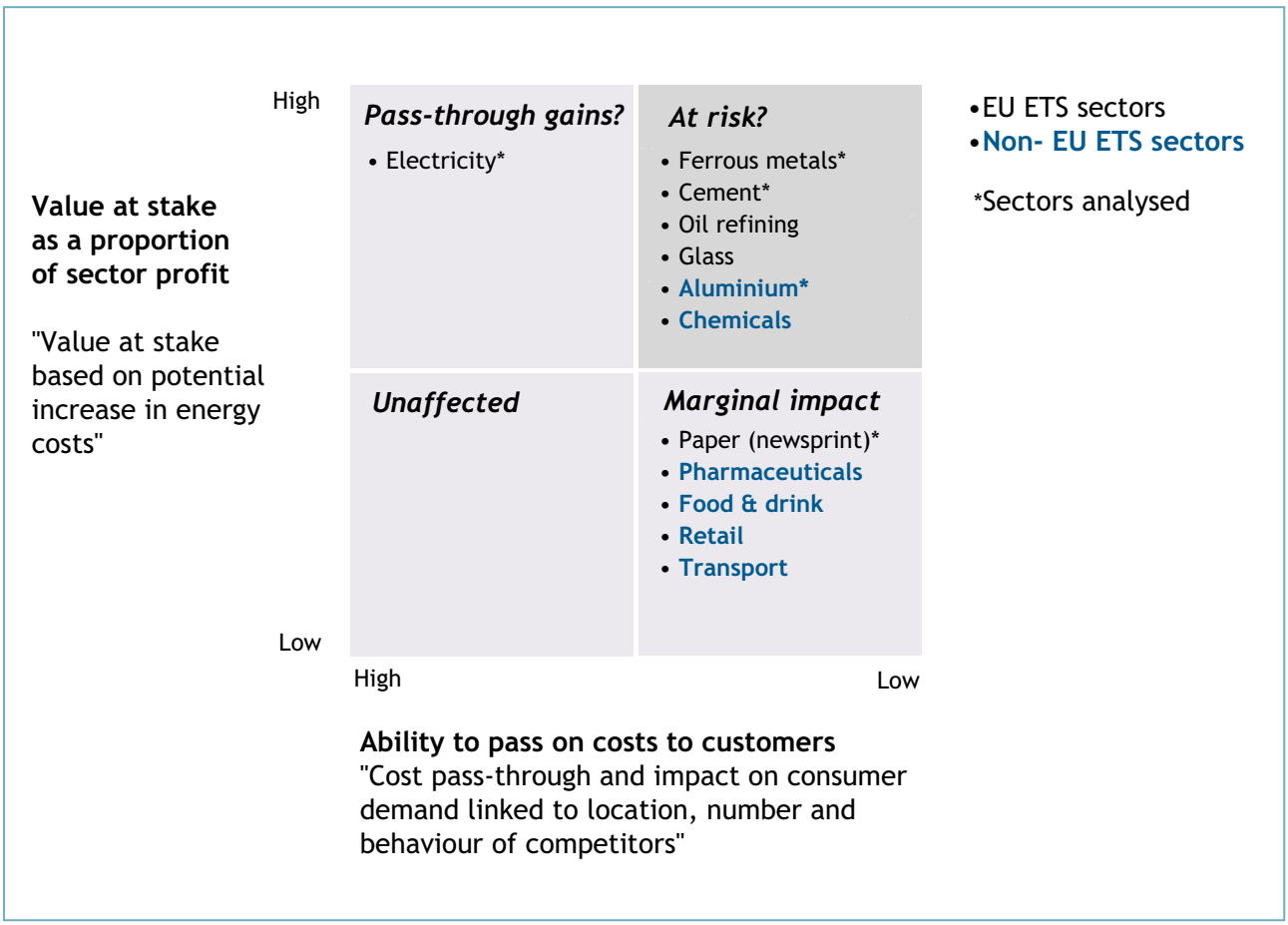
and potentially to benefit from the cost savings associated with abatement activity.

The Energy Review 2002 by the Performance and Innovation Unit estimated that £12b of energy goes to waste in the UK each year. This level of saving is in line with the experience of the Carbon Trust in working with companies to reduce their carbon emissions primarily through energy efficiency – which realises energy savings between 10% and 30% on an NPV positive basis. Recognising the value of carbon in future investment decisions will become critical for those sectors covered by the EU ETS. The EU ETS has also raised the importance and focus on carbon abatement up the management agenda.

Chart 1 classifies various sectors according to what are considered the two primary dimensions of competitive exposure: potential value at stake as indicated by energy intensity, and ability to pass cost changes through into prices. In the design of our study, we focused detailed analysis upon five sectors that span a cross section of levels of international exposure:

1. Electricity, representing a large proportion of EU emissions and widely considered to be the key sector with unique characteristics, generally not exposed to international competition and seen by many as a possible winner from the EU ETS;
2. Cement manufacture, a highly energy-intensive sector with some degree of international/country-to-country competition;
3. Paper (newsprint) – part of the pulp and paper industry, a highly international subsector with material energy costs.
4. Steel manufacture, a highly energy-intensive sector with strong but differentiated international competition;
5. Aluminium (smelting) – a sector not part of the EU ETS but unusually dependent upon electricity, and a fully global commodity market.

Chart 1. Classification of industrial sectors according to exposure.



EU ETS allocation and scenarios

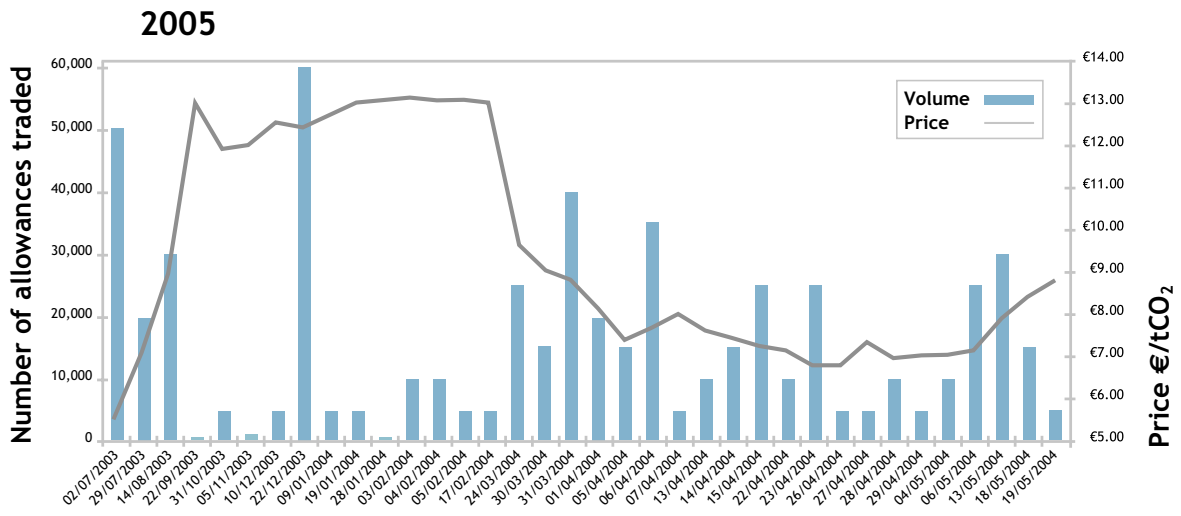
The process of allocating emission allowances between companies is not easy, since in effect governments are allocating potentially valuable resources for free. Industries, not surprisingly, have lobbied to increase their allowances and to address a number of technical concerns. Viewed across Europe, weak allocations have led to low price expectations.

The UK National Allocation Plan (NAP) embodies certain principles that are common to many, and our study focuses primarily upon the competitiveness implications of the EU ETS for UK industry, based on the allocation approach proposed in the UK NAP. Many of the findings, however, are likely to be relevant across Europe; and for the more internationally mobile sectors we have carried out modelling corresponding to the pan-European nature of these industries.

The main principle underlying the UK NAP, in addition to achieving consistency with the UK's national target and international commitments, is an 'electricity leads cutback' approach. The allocations aim for the EU ETS to deliver, by 2010, reductions of 5.5MtCO_2 below the projections of emissions without it; and all of this cutback is allocated to the power sector (which accounted for over 60% of the relevant UK emissions in 2000). Other sectors are granted allocations equal to their projected emissions after implementing the other elements of the UK Climate Change Programme. In particular, the energy intensive industries receive allocations equal to their emission targets negotiated under the Climate Change Agreements, which set the terms by which these sectors gain an 80% discount from the UK Climate Change Levy.

For a given sector, the implications of the EU ETS will depend upon the trading price that emerges, as well as issues surrounding allocation and certain other implementation details. Because the EU ETS allows free trading across Europe, the price will depend upon the collective impact of allocation decisions across Europe; the deeper the reductions required, the higher the price will rise. The terms under which companies can use credits from international activities – how easily

Chart 2. Forward trading price of EU ETS allowances (for Quarter 4 2005).



Source: Tradition Financial Services

and cheaply they can acquire credits under the Linking Directive – will also affect the price.

As the EU ETS was being developed, a nascent 'forward' market in emission allowances began to develop. Initially, price settled around €12-13/tCO_2 on the basis of small volumes of trial trades. As countries began to publish their allocation proposals, the forward trading price fell and at the time of publication stood at €7-9/tCO_2 (Chart 2).

The ability of firms to respond will also influence the price. A particularly important aspect is the scope for power generators to switch from coal to high efficiency natural gas generation; such switching is expected to be economically attractive on a large scale across Europe for a carbon price in the order of €10-20/tCO_2. Different combinations of circumstances could lead to various prices in the future (see Table 1), and the circumstances will vary over time as the system develops.

In addition to the price, the choice of allocation, and in particular the way in which cutbacks are allocated between the power sector and other sectors, will influence the competitiveness impacts between different industries.

In this study, we explore the implications of the EU ETS under the three price and allocation scenarios set out in Table 1, which correspond roughly to plausible ways in which the system might evolve over time. The price in our central scenario (2), €10/tCO_2, is also chosen as one from which many results can be easily scaled for different price assumptions in a plausible range for Phase 2 of the EU ETS, e.g. up to c.€20/tCO_2.

Table 1. Price and allocation scenarios for study of EU ETS

	Price and allocation characteristics	**Example conditions that might lead to these characteristics**
Scenario 1/ Phase 1	Price €5/tCO_2 Allocation as UK draft NAP: • Electricity on trend to projection minus 5.5MtCO_2 by 2010 • Other sector allocations equal to projection/ updated Climate Change Agreement (CCA+) targets	First phase of EU ETS, with: • Generous Allocation • Uncertainty about Kyoto • Loose rules on external linkages
Scenario 2/ Phase 2	Price €10/tCO_2 Allocation based upon principles of NAP strengthened and extended to 2008-12: • Electricity leads cutback, sufficient to achieve national 20% reduction (=> electricity allocation 28.3% below projection) • Other sector allocations equal projection / CCA+ targets	Second (Kyoto) phase of EU ETS 2008 -12, with: • Allocation to companies similar to national or Kyoto targets • Commission acts against allocations that are inconsistent with Kyoto targets • Russia ratifies Kyoto, some use of Russian surplus allowances in EU system • Linking Directive protected against emission credits from 'business-as-usual' foreign investments
Scenario 3 long term	Price €25/tCO_2 Allocation 30% below projected emissions / CCA+ targets for all participating sectors	Long term post-2012 phase, with: • Conditions in which deeper reductions are required e.g. to allow for transport growth; OR • More rapid emissions growth / abatement more difficult than expected; OR • No use of Russian surplus or US rejoins Kyoto and absorbs Russian surplus allowances

Analytic approach

The Carbon Trust analysis of the EU ETS adopts two complementary approaches, one based upon economic modelling, the other based upon interviews primarily with the affected sectors.

Economic modelling is needed to quantify analysis of the price and competitive effects – for example, how carbon allowance prices may affect industry costs in relation to other factors. The difficulty is that there is no universally agreed way of predicting how a cost increase would affect the price that companies pass on to their customers, which as noted earlier is a key issue.

To address this, the Carbon Trust employed economic consultants OXERA to develop a model to evaluate the financial impact of the EU ETS given the market structures of the sectors involved. The model is based on standard economic theory (Cournot theory) of company behaviour in markets which are characterised by relatively high fixed costs relative to marginal operating costs. In these conditions, companies have to maintain prices well above their short-run operating costs, in order to recoup their capital investments. If new companies enter the market trying to sell more goods, the price eventually drops to a level at which companies can no longer cover their fixed costs, and a company drops out again. Thus, a rough equilibrium price is attained based on controlling the quantity of goods produced, or more fundamentally, the production capacity of firms in the market – a state known as 'Cournot equilibrium' (see separate OXERA Report for full details of modelling approach and results).

Because the theory predicts pricing behaviour based upon cost and industry structures, it can also predict the extent to which any increase in operating costs – such as with emissions trading – would be passed through to customers. And the conditions of high capital costs with limited numbers of firms are characteristic of the energy-intensive sectors that are most concerned about the impact of the EU ETS. This determined the choice of modelling approach.

At the same time, like any modelling approach, it is simplified compared to the real-world complexities of the various industries involved. In particular, in calculating cost pass-through effects, the model assumes that all firms share the average characteristics of the sector. Also, the model represents the effect of foreign competition (from outside the EU) – which does not face the increase in costs – indirectly, starting from the current share of foreign entrants as the basis for determining how much more market share they might take when relative costs change.

As in many economic modelling studies, the results are bound to be an approximation, and are probably more accurate for relatively modest changes in prices – the data and other structural assumptions might become less valid for bigger changes, which could lead to more fundamental realignment of some market structures.

Since real markets are more complex – and particularly in the longer term, some of the changes associated with carbon pricing might be far from marginal for some sectors - the Carbon Trust also conducted an extensive set of interviews alongside the modelling work. These interviews probed how different companies, and other market participants, view the likely impact of the EU ETS, and help to bring out real-world complexities that might not be captured by the modelling studies.

The combination of these interviews with the insights of the modelling provides rich – and at times, contrasting - insights into the potential competitiveness implications of the EU ETS.

Part 2: Sector findings

This section presents results for the five sectors that we analysed in detail: electricity, cement, paper, steel and aluminium.

Electricity

Electricity generation accounts for over 60% of UK emissions under the EU ETS, and it has been by far the most heavily analysed sector by the investment community in particular – not least because any cost pass-through could affect all other sectors. The sector is widely expected to benefit financially, though by how much is highly uncertain.

The impact of the EU ETS on competitiveness will be closely related to its impact on operating profit, and as a measure of this, OXERA's Cournot model calculates the impact on the sector's total earnings before interest, tax, depreciation and amortisation (EBITDA). The model calculates results separately as an equilibrium change for each of the three EU ETS scenarios outlined earlier. The resulting analysis can be decomposed into 5 analytic steps to build up the full picture (Chart 3), as follows.

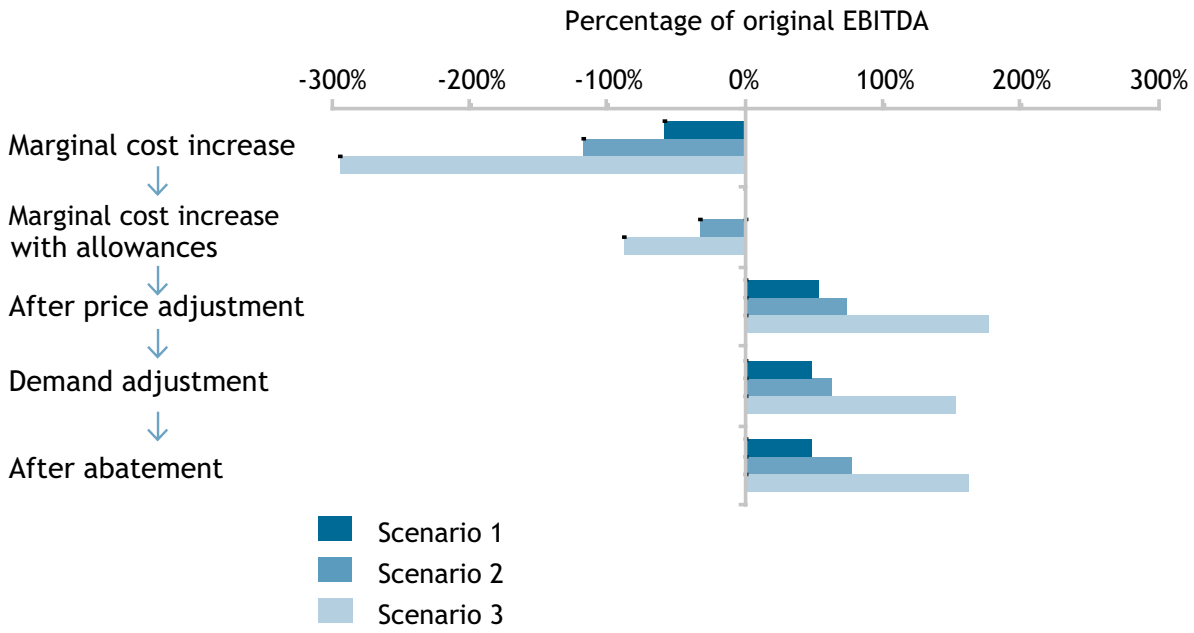
- **Root 'cost of carbon' impact.** When the EU ETS is introduced, carbon will acquire an implicit price. The first step reflects the gross impact of this theoretical carbon price increase on the sector's production costs before taking any account of allowance allocation or price responses: it shows the scale of potential gross 'carbon costs' that would arise from a pure carbon tax at the same price, in relation to current operating profit. This would increase sector marginal costs by 12%; 23%; and 49% taken across the 3 scenarios. Taken in isolation, without any allowance allocation or response, this would be sufficient in scenario 2 to offset the sector's operating profit – and move the sector to a loss making position in scenario 3.
- **Net cost increase after allowance allocation.** Netting off the value of the allowance allocation greatly reduces the impact, as shown in the second set of bars (Chart 3). Under the UK National Allocation Plan for phase 1 (modelling as our scenario 1), the sector has a 5.5mtCO_2 shortfall total over the three years, versus its projected 'business as usual' (BAU) emissions. This decrease is equivalent to about 1.5% of the sector's total emissions, so the allocation covers virtually all of the cost increase. However in our scenarios 2 and 3, which model far deeper cut-backs for the sector (about 30% vs BAU) and rising allowance prices, this 'net value at stake' remains significant for the electricity sector.
- **After price adjustment.** Because the UK electricity sector is not significantly exposed to foreign competition, the industry may be able to pass most of the marginal cost increases on to customers – and in theory, it would seek to raise prices by almost as much as the increase in its marginal cost. The Cournot model predicts that the sector will maximise its profits by passing 90% of the marginal cost increase on to prices. But this increase in prices applies to all electricity sales – not just the net 'value at stake' (see Annex). As a result, the sector would increase its profits, illustrated in the third set of bars.
- **Demand adjustment.** The price rise comes at the expense of lower sales. But electricity demand is relatively 'inelastic' – people don't use much less when the price rises – so the net impact, illustrated in the fourth set of bars, is modest and the sector is still set

to gain. Electricity demand is predicted to fall by up to 12% in scenario 3, assuming the 90% cost pass through predicted by the Cournot model.

- **After abatement** – Finally, firms may abate emissions, reducing CO_2 intensity and electricity use and boosting profits. For the electricity sector, the main abatement option is switching from coal to gas fuelling, which in most cases means closing coal-fired plant and opening gas-fired plant. The estimated impact of this, based upon abatement cost data, yields the overall net position shown in the last set of bars (Chart 3).

The sector needs to pass only a relatively low proportion of its cost increase through to prices to maintain its profits at the pre EU ETS level (Chart 4). In scenario 1 – a modelling approximation of the UK NAP - free allocation is assumed to cover all but a very small fraction (about 1.5%) of the sector's projected emissions, and a minimal price increase is required to cover the costs of this shortfall. Electricity companies question whether the UK allocation is really only a 5.5MtCO_2 shortfall on its 'business-as-usual' projections, pointing to recent growth and also the fact that the reserve for new entrants is drawn from the electricity sector allocation (see footnote 1). However even in scenarios 2 and 3, with allocation almost 30% below projected needs, the sector would only need to pass on ~30% of the marginal cost increase to prices to maintain current profits.

Chart 3. Five components of impact of EU ETS on UK electricity sector operating profit.



Source: OXERA

This translates to wholesale price increases of 6% and 13% in scenarios 2 and 3 respectively. The 90% cost pass-through predicted by the Cournot model to maximise the sector's overall profits (as in Chart 3) would translate to correspondingly larger wholesale electricity price rises – about 8% in scenario 1, and 15% and 31% respectively in scenarios 2 and 3, equivalent to the wholesale price rising from ~£23/MWh to £27/MWh and £30/MWh respectively.

The profit impact of abatement appears small relative to the swings created by the allowance allocation and price adjustment stages, but may be important in determining relative gains to different companies as they seek to respond to the price incentives of the EU ETS. The underlying data indicates that the electricity sector's emissions would fall 12% in scenario 2 (5% due to reduced electricity demand assuming "every thing else is held constant" and 7% due to fuel-switching, with a 3GW switch from coal to gas driven by a cumulative investment by 2012 of about £1.1bn).

Electricity companies agree that some costs will be passed on to prices, but feel talk of large increases in profits is unrealistic. The

Chart 4. Electricity sector cost pass-through required to maintain operating profit (EBITDA) at pre-EU ETS level

	Cost pass-through required to maintain sector profits (EBITDA)		
	Increase in marginal production cost, %	Proportion of increase in marginal cost passed through to prices, %	Increase in wholesale electricity price, %
Scenario 1 €5/tCO_2	12%	4.4%	0.4%
Scenario 2 €10/tCO_2	23%	32.2%	5.6%
Scenario 3 €25/tCO_2	49%	29.5%	12.8%

Minimal value at stake in scenario 1 as allocation is close to total cost uplift; required cost pass through in scenarios 2 & 3 increase as c. 30% allocation cut back

Profit-maximising pass through predicted by Cournot modelling: c.90%

Source: OXERA

extent and timing of any price increases is complex and unclear, companies are diverse, and the need for new investment may limit impact on profits.

Sector companies and commentators do expect price rises, but the extent and timing of increases is complicated by the backdrop of historically low prices that are already increasing, and the potential strategies of the different utilities based on differences in their portfolios:

- *"We don't dispute that some costs could be passed through, but how much and how fast is complex and constrained particularly if prices are rising anyway"*
  Utility
- *"Although prices have increased lately this is off a very low base and there is little confidence looking forward of sustained increases"*
  Utility

The sector is also facing considerable uncertainty and has had a decade of little investment and recent low prices:

- *"Talk of windfall profits feels unreal given state of the industry and all uncertainties about the future"*
  Utility
- *"The big question is the need for new investment… much is uncertain and we are looking at small but important growth and need for investment, for example to meet sulphur regulations coming into force in 2008 and new capital requirements to ensure security of supply"*
  Utility

Yet, details of the EU ETS may ironically act to inhibit plant closure and associated earlier investment:

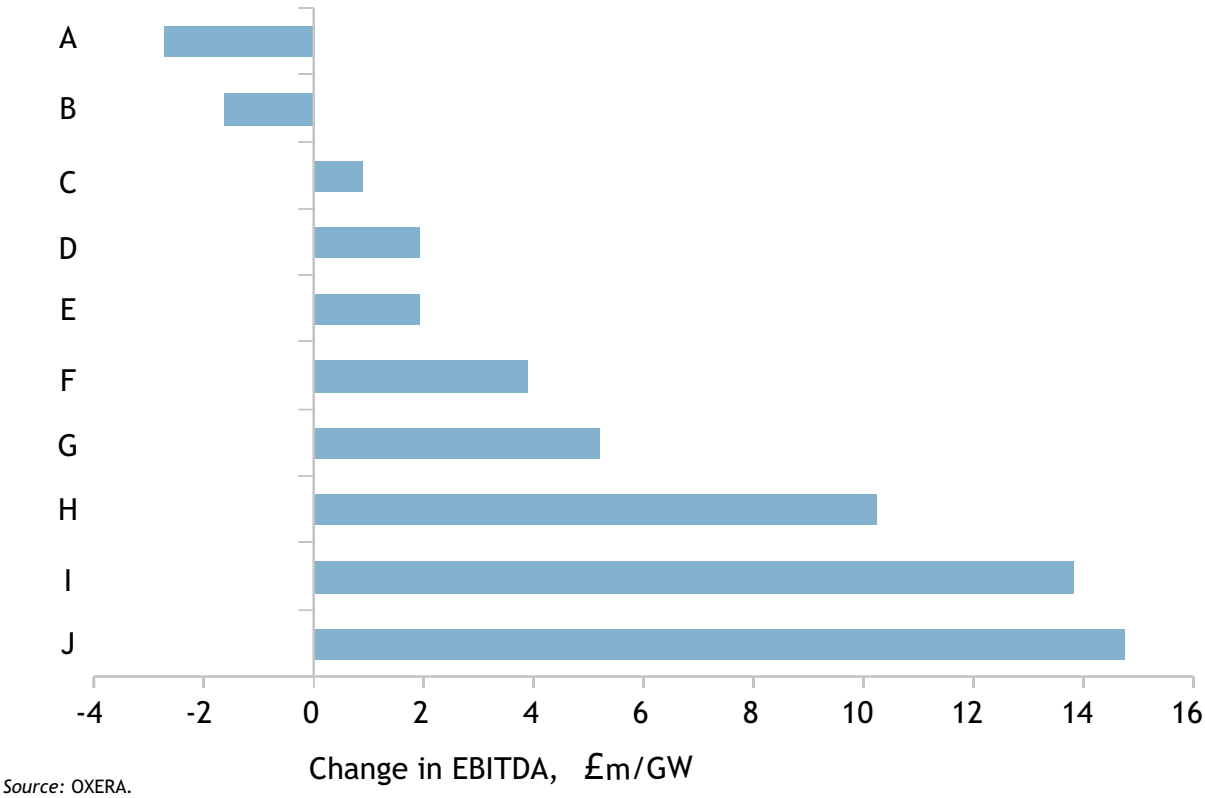
- *"Companies will be reluctant to close down plant as it may mean a loss of an allocation or future allocation; the non-closure of plant may act as a discouragement for investment in new, emissions-efficient capacity… emitting from marginal plant may be a cost in the short term, but an asset as far as the medium term is concerned as it may positively influence the allocation in future years when CO_2 prices may be higher"*
  Utility

The diversity of companies in the sector is also an important feature in the context of the EU ETS. Different firms have different mixes of plant (coal, gas, nuclear and renewables), each with different cost structures and CO_2 intensities.

This will affect both firm profits and pricing strategies.

To explore the effect on firm profits, OXERA also applied a generation dispatch model which is based on a full breakdown of available plant in the UK. The results in Chart 5 show a large diversity of earnings impacts attributable to the EU ETS. Even if the sector as a whole passes through costs to the level predicted to maximise

Chart 5. Impact of EU ETS on net earnings of different electricity companies in the UK



Source: OXERA.

its profits, different companies are affected very differently – indeed two companies are predicted to see their operating profit decrease under the EU ETS even with the high degree of sector pass through predicted. These are players with mid-merit/marginal coal plant at risk of losing market share. The results are not related only to carbon intensity, due to the complexity of the electricity market operation. By the same token, other companies would increase their operating profits by more than the average.

Would lower-carbon generating companies really price at the optimum theoretically sustainable by the sector, or would they use their lower cost-base to undercut more carbon-intensive companies in a bid for greater market share? How would the real market behave when faced with the potential for operating profits from marginal-cost-pricing under the EU ETS?

- *" Heavy industrial electricity consumers may be able to negotiate prices below the inflated market price when striking long-term contracts with low carbon intensity generators whose costs plainly have not risen in line with the price – particularly when purchasing from a local source"*
  Industry Commentator

Taking account of the various observations made by sector participants, reality is likely to lie between the high profits predicted by the Cournot model, and the more cautious assessment of many utilities. The sector would probably pass some proportion of the cost rise through to prices, at least the 30% required to maintain profits under the substantial cutbacks modelled for Phase II, but not the 90% pass-through predicted by the Cournot model. At a carbon price of €10/tCO_2, wholesale electricity price rises in the order of 10% (assuming 60% cost pass-through) may well be realistically attributed to the EU ETS.

Nevertheless, to bring out the potential impacts on other sectors, the rest of this study analyses the impact on other sectors assuming that the power sector does pass through 90%.

Whilst the exact timing and extent of changes in electricity prices is uncertain, the electricity sector will almost certainly not lose as a result of the EU ETS. Only small price rises are required to maintain the sector's current levels of profitability. However, structural differences between players in the electricity sector will drive the extent to which individual generators gain.

Cement

Despite being an exceptionally carbon-intensive sector, modelling suggests that cement manufacturing will benefit from the introduction of the EU ETS, although to a lesser extent than the electricity sector. In our scenarios out to 2012, the sector's net cost increase after allocation is small and, due to the local nature of many cement markets, can generally be recovered through small price rises.

Defining the geographical market for the cement industry is complicated as although cement cannot travel economically far on land, it can be transported over long distances at sea at reasonable cost. In the UK, however, import penetration from outside the EU is very low, around 5% of all UK consumption. This means that although prices close to ports with cement handling facilities may be constrained by import costs, in general local producers have some flexibility to increase prices to reflect any cost increases associated with the EU ETS.

The cement sector is highly energy intensive and its marginal cost of production increases significantly as a result of the EU ETS – up ~30%, ~50% and ~140% across the 3 scenarios. Chart 6 shows that the sector in fact need pass only a relatively low proportion of this cost increase through to prices to maintain its profits in the first two scenarios modelled – thanks to the offsetting effect of its allowance endowment. The price of cement would need to increase by 1-2% to maintain current levels of profitability in scenario 2 which is our proxy for the Kyoto period, 2008-12.

In scenario 3 where the sectors direct allocation is cut back by 30%, imports start to represent a more significant risk. In this long term scenario the cement price needs to rise by ~17% to keep the sectors profits at current levels. Even in this scenario, this cost pass-through remains significantly short of the level predicted by the Cournot model to be optimal for the sector in UK conditions. Whilst the Cournot model captures the current conditions of low import exposure, it does not reflect details of how things might change under more extreme scenarios.
A sensitivity study reflecting the higher import conditions typical in Spain, for example, showed the sector struggled to maintain current levels of profitability in the Cournot modelling in our long term scenario.

Interviews with cement groups in the UK highlighted that the EU ETS is a high priority issue for the cement industry and as high energy users, they are actively looking at carbon abatement opportunities. However, the extent to which the sector will be able to pass cost rises onto prices is somewhat unclear; many argue that imports from outside the EU will limit any possible price increases.

The sector is highly energy intensive and has high value at stake:

- *"Around 1tonne of CO_2 is produced per tonne of cement… ~50% of emissions result from fuel burn and ~50% from process emissions… process emissions are 'uncontrollable' as they are dictated by the chemistry of the process and cannot be reduced"*
  Cement manufacturer
- *"Energy costs make up ~30-40% of overall production costs… although electricity makes up to 10% of energy consumption, it constitutes over 25% of energy cost"*
  Cement manufacturer

Cement manufacturers have carbon abatement opportunities, based on adoption of new technology, alternative fuels and energy efficiency. The recent uptake of new technologies across the sector created difficulties with the industry's draft allocation:

- *"All Cement manufacturers are either planning or have just invested in new more energy efficient plant… new technologies have been developed over the years with lower energy content with a shift from wet to dry processes… the treatment of these new investments has raised issues across the industry in the draft allocation plan"*
  Cement manufacturer
- *"The sector has been actively increasing use of alternative fuels, based on waste solvents,*

Chart 6. Cement sector cost pass-through required to maintain operating profit (EBITDA) at pre-EU ETS level

	Cost pass-through required to maintain sector profits (EBITDA)		
	Increase in marginal production cost, %	Proportion of increase in marginal cost passed through to prices, %	Increase in wholesale cement price, %
Scenario 1 €5/tCO_2	27.3%	8.4%	0.7%
Scenario 2 €10/tCO_2	54.5%	8.8%	1.5%
Scenario 3 €25/tCO_2	136.3%	40.6%	17.4%

Scenario 1 & 2, direct allocation helps offsets electricity price rise (c.90% cost pass-through in electricity)

Profit-maximising pass-through predicted by Cournot modelling: c.80%

Source: OXERA.

tyres and paper and plastic waste (recognised under CCA, but not EU ETS)… EU ETS is driving investment emphasis towards biomass fuels… all investment decisions now need to take account CO_2 trading"
Cement manufacturer

- *"Energy efficiency is a significant lever for reducing electricity costs"*
  Cement manufacturer

While modelling and some industry participants predict cost pass-through, others believe that this will not be possible:

- *"Cement is a local commodity market, with 95% of cement used in UK manufactured in UK – haulage costs are significant… therefore expect significant cost pass-through"*
  Cement manufacturer
- *"As import prices often cap selling prices, margins will be squeezed as costs rise … we expect no change in current cement prices"*
  Analyst
- *"Cement travels on water, not well on land… imports set the price anywhere close to water with a decent port facility… UK is an island, nowhere is over 100 miles or so from the coast"*
  Cement manufacturer
- *"Price rises could lead to increase in penetration from less efficient plant from outside EU without reducing overall emissions levels"*
  Cement manufacturer
- *"Transport is a sufficient cost that high imports is a sign of market imbalance – it is not like Aluminium – not a world price… logistics in the port are important"*
  Cement manufacturer

Regardless of the complexity surrounding price setting in the cement market, as with the electricity sector, it appears very unlikely that the UK cement industry is at risk from the introduction of EU ETS in the medium term. Only very small price rises are required to maintain the sector's current levels of profitability. Given the high intensity of both energy and electricity use, however, the situation could change under higher carbon prices in the longer term.

Paper (newsprint)

Paper (newsprint) is highly traded across Europe, but is less exposed to electricity price increases thanks to its own Combined Heat and Power (CHP) generation plant. Economic modelling indicates that the sector makes small gains under the EU ETS given a 'level European playing field', because the price increases required to maintain or increase profits – and to fund abatement measures - are too small to fundamentally change the economics of non-EU imports.

The introduction of the EU ETS, even in the tough long-term scenario modelled, only increases the marginal cost of newsprint production by about 3%. This is a consequence of the fact that all UK newsprint producers have CHP plants that limit their exposure to the uplift in electricity prices (the modelling assumes no exposure to grid price rises). Even in the most stretching scenario 3, OXERA's modelling suggests that the sector need only increase prices by 1% to keep their profits flat under the EU ETS (Chart 7).

Newsprint trading across the EU is very active, but imports from outside the EU are more limited at ~15%. Whilst some market share is predicted to be lost to players from outside Europe, if all countries use a similar basis for allocation the sector is expected to be able to increase prices enough to make very marginal gains as a result of the EU ETS.

Discussions with representatives across the paper sector indicate that the UK industry as a whole is concerned that it may be a net buyer of allowances. Structural differences and/or lack of harmonisation across Europe could put UK players at a competitive disadvantage. EU ETS is one more factor that could affect future investment in the UK.

The paper sector as a whole is quite varied in terms of its energy intensity:

- *"Energy costs constitute around 10% of turnover, with some variation between sub-sectors… as low as ~5% in higher value lightweight products, but up to ~20% in lower margin bulk grades"*
  Paper Federation

The sector is concerned that its targets under the UK Climate Change Agreement assume future

Chart 7. Paper (newsprint) sector cost pass-through required to maintain operating profit (EBITDA) at pre-EU ETS level

	Cost pass-through required to maintain sector profits (EBITDA)		
	Increase in marginal production cost, %	Proportion of increase in marginal cost passed through to prices, %	Increase in wholesale newsprint price, %
Scenario 1 €5/tCO_2	0.6%	9.3%	0.1%
Scenario 2 €10/tCO_2	1.1%	9.1%	0.1%
Scenario 3 €25/tCO_2	2.8%	41.6%	1.3%

Scenario 3, required paper cost pass-through increases as its direct allocation is cut back 30%

Profit-maximising pass-through predicted by Cournot modelling: c.80%

Source: OXERA.

investment in CHP – which under current market conditions is uneconomic. The newsprint sector has already invested in CHP, but other paper sectors have not and seem unlikely to do so at present. Without such investment in CHP, this would increase their value at stake under the EU ETS relative to newsprint due to their increased exposure to electricity prices and need to buy allowances. Lack of recognition of early action is also once again a concern:

- *"CHP investment is central to paper sector carbon abatement… energy utilisation /efficiency will be important but progress to date has been made in large part through installation of 530MW of CHP and future CCA targets anticipate future investment in CHP… as CHP investment currently appears to be uneconomic, basis of CCA targets is not valid"* Paper Federation
- *"Allocation doesn't recognise early action – all our low hanging fruit has gone, putting us at a competitive disadvantage… we have focused on energy efficiency and emissions reduction and achieved a 10% improvement over the period 1993-2000… consequently we expect to be a net buyer of allowances"* Paper manufacturer

Harmonising the approach to the EU ETS across Europe will be important to ensure a level playing field in a market where companies compete across the continent. Structural differences may also give some players a competitive advantage when the EU ETS is introduced – in particular the integrated producers that already use biomass as their primary fuel source:

- *"~60% of paper consumed in UK is imported, the majority (75-80%) of these imports come from within EU… arguably if equivalent cost rise across EU may not expect competitive effect between EU players, but this represents a risk"* Paper Federation
- *"All UK mills bar 2 are non-integrated, either buying in pulp or using recovered fibre……integrated pulp mills, e.g. in Scandinavia, are self-sufficient as they use biomass as an energy source and may be at a competitive advantage under EU ETS"* Paper Federation

In addition to other drivers, industry participants are concerned that EU ETS may be one more factor that could drive future investment and manufacture out of the UK:

- *"EU ETS could have significant impact on future investment decisions and could jeopardise the UK operations rationalisation strategy that has been pursued… this is driven by internal competition as much as external competition… plant could be moved to Czech Republic tomorrow, moving is not easy but on top of other factors (e.g. labour costs) EU ETS could shift our long term vision for our manufacturing strategy"* Paper manufacturer

The EU ETS is a marginal consideration for the current UK newsprint sector, which seems likely to gain slightly, but other parts of the paper industry may need to act, principally through CHP investment, to reduce their exposure. Associated costs could probably be passed through given a 'level playing field' in the EU, but biomass-based integrated mills will have an inherent long-term advantage under higher carbon prices.

Steel

The steel sector is a highly energy-intensive industrial sector, but despite this and rising import trends, our modelling analysis of cold rolled steel suggests that the EU ETS impact on profitability across Europe is highly scenario-dependent; gains in early stages followed by potential risk of falling profits in our tough long term scenario.

Cold rolled flat steel is a largely European based market, dominated by 4 large producers: Arcelor, Corus, ThyssenKrupp and Riva. The industry has restructured over recent years driven by a number of factors: absence of growth, significant overcapacity and the fragmented nature of the industry. Imports from outside the EU have a market share of up to 20%.

In the first 2 scenarios, the Cournot modelling suggests that in order to maintain current levels of profitability the sector would need to pass ~30% of their marginal cost increase through to prices to keep profits flat (increasing prices by 1-2%). The profit maximising cost pass-through predicted is somewhat higher at 66%; though the price rise leads to a 3% and 5% loss of market respectively in scenarios 1 and 2, the net effect is a slight rise in operating profit. However, by scenario 3, the cut-back in allocation combined with increased loss of market share to imports as allowance prices rise means that the sector struggles to maintain current levels of profitability.

Industry stakeholders fear that in reality price increases will not be possible because of the international competitive dynamics of the steel sector. In addition, intra-EU competition is also a concern due to possible differences in allocation and electricity price rises. Current abatement options are limited although next generation technologies are being actively investigated. However, the EU ETS is thought to be unlikely to shift the mix between the two key current steel production routes: the blast furnace and electric arc furnace.

Industry players believe that thanks in part to the significant global trade in steel, it may be very difficult for the sector to pass cost increases through to prices:

- *"Steel is increasingly becoming an internationally traded commodity*

Chart 8. Steel sector cost pass-through required to maintain operating profit (EBITDA) at pre-EU ETS level

	Cost pass-through required to maintain sector profits (EBITDA)		
	Increase in marginal production cost, %	Proportion of increase in marginal cost passed through to prices, %	Increase in price of cold-rolled steel, %
Scenario 1 €5/tCO_2	3.2%	33.0%	0.8%
Scenario 2 €10/tCO_2	6.3%	31.6%	1.5%
Scenario 3 €25/tCO_2	15.9%	63.3%	7.3%

Profit-maximising pass-through predicted by Cournot modelling: c.66%

Source: OXERA.

– we expect to have limited ability to pass cost increases through to prices"
Steel manufacturer

- *"Pricing has been irrational in the steel market… large overcapacity combined with reluctance to close plant due to high closure costs has created demand-led pricing, where supply is fixed and demand sets price – resulting in wild price swings"*
  Industry consultant
- *"China currently accounts for over 100% of the global growth in demand for steel… to sustain this growth China is sucking up imports, tightening supply conditions and bolstered prices in the EU… we would expect significant impact on EU steel prices if Chinese growth should fall off"*
  Industry consultant

Although there is substantial global trade in steel, it remains a regional market with prices varying from one large economic region to another (e.g. North America, Europe, Asia etc). Consequently, EU manufacturers are particularly concerned about differences in the implementation of the EU ETS across Europe:

- *"A lack of harmonisation in approach to allocation across the EU and differences in the uplift in electricity prices between countries will affect the relative competitiveness of steel manufacturers within Europe"*
  Steel manufacturer

Current abatement opportunities are limited but the industry is investing in research into new more efficient production routes. Although all cold-rolled steel is manufactured by the blast furnace route, around 40% of all EU crude steel is produced by electric arc furnaces or "mini-mills". Despite the different carbon intensities of these two processes, the EU ETS is not expected to accelerate the underlying shift in global production to the cheaper "mini-mill" route:

- *"The manufacture of 1 tonne of cold-rolled steel consumes ~320kWh of electricity and generates ~1.75 tonnes of CO_2… 80% of emissions are uncontrollable process emissions… beyond limited fuel substitution (e.g. gas injection in blast furnaces) the industry has limited abatement opportunity using current technologies"*
  Steel manufacturer
- *"7 of the EU steel groups have funded a €40m industry wide collaborative research study with the express goal of developing both breakthrough lower carbon production routes and improvements to existing technologies"*
  Steel manufacturer
- *"It is not obvious that the introduction of the EU ETS will affect the shift in crude steel production from blast furnace to electric arc… This is likely to be far more correlated with the world scrap market… Mini mills rely on scrap, which will be unlikely to be able to meet the projected long-term growth in global steel demand driven by developing countries, particularly with steel going into infrastructure projects with long recycling periods."*
  Steel manufacturer

Although the modelling suggests the steel industry should not lose out as a result of the EU ETS out to 2012, the extent to which EU companies can pass even small cost increases on to consumers is disputed. In the tougher long term scenario, EU producers would suffer if other major producers did not face carbon constraints.

Aluminium (smelting)

Aluminium smelting is the one sector we studied in which the EU industry loses from the EU ETS in all scenarios. Not only does the sector see profits fall in the first two scenarios, firms are predicted to exit the EU market. This is all driven by the sector's extremely high electricity intensity and the fact that aluminium is a truly global commodity.

Aluminium is sometimes called "solid electricity". The process of smelting consumes over 15,000 kWh of electricity per tonne of aluminium; steel production by comparison consumes around 300 kWh/tonne. Power constitutes over 35% of production costs. Some plants, including 2 out of the 3 UK smelters, generate their own electricity but many across the EU will be exposed to electricity prices when their current long term contracts run out. If smelters then purchase electricity from the grid, the Cournot modelling suggests the increases in electricity prices (at 90% pass-through) could equate to ~25%, ~50% and ~125% of current sector operating profits (EBITDA).

As the sector is outside the EU ETS scheme its direct emissions are not capped but it receives no allowances. However, inclusion in later phases of the EU ETS will not help as its exposure is driven by electricity prices – and direct emissions are hard to reduce as a significant proportion result from the chemistry of the electrolysis process.

When modelled as a European market subject to imports, the Cournot model suggests that the "loss-minimising" pass-through would see the sector's firms' profits (EBITDA) fall by ~15%, ~30% and ~20% across the 3 scenarios – the lower impact in scenario 3 driven by the exit of one firm, which then enables others to recoup some market share and price (Chart 9).

Furthermore, under an alternate approach which models aluminium as a pure global market made up of 11 identical firms, even the modest cost increase associated with our scenario 1 EU ETS

Chart 9. Aluminium loss-minimising Cournot model results

	Increase in marginal production cost, %	Increase in price of aluminium, %	Change in EBITDA, %
Scenario 1 €5/tCO_2	2.6%	1.4%	-16.0%
Scenario 2 €10/tCO_2	5.2%	2.7%	-31.4%
Scenario 3 €25/tCO_2	13.1%	10.5%	-20.2% One firm predicted to exit

Sector not predicted to be able to maintain current level of profitability in any of the scenarios modelled. Assumes plant are buying electricity from grid with 90% electricity sector cost pass-through.

In long term scenario, one firm predicted to exit; remaining firms have increased output. Loss minimising pass-through predicted by Cournot modelling: c.66%

Source: OXERA.

assumptions would be sufficient to make firms leave the market.

The sector is well aware of the risks posed by EU ETS. It has limited abatement opportunities - the scheme is one more reason that future investment is likely to focus outside the EU.

The sector may well be shielded to some extent in the first phase of the scheme, principally by long term power contracts or owning its own power plant - but is very concerned about the future implications of the EU ETS given its inability to increase prices:

- *"Currently we are shielded from electricity price impacts through a long term contract, this will expire in 2009. Not part of EU ETS in phase 1 but expect to join in next phase … big concerns about potential impacts when fully exposed to both effects"*
  Aluminium smelter
- *"~20% of EU Aluminium smelters are self generated, the rest tend to have long-term contracts with specific suppliers and will be exposed to electricity market price uplift"*
  European Aluminium Association
- *"Aluminium is a commodity with set international market price… margins are tight, low profit per tonne of CO_2e… EU ETS therefore represents a significant threat"*
  Industry consultant
- *"We are concerned about EU competition… UK tends to gold-plate implementation of EU legislation"*
  UK Aluminium smelter

Many aluminium smelters in the EU already benefit from long-term power price arrangements that may need to be extended if existing plant are not to close, perhaps irrespective of the EU ETS.

The EU smelting industry may well require protection if plant closure is to be prevented.

In addition to the economic case for protection, there is an environmental case as it will prevent "carbon leakage" through the shifting of capacity to developing countries where there are less stringent controls on emissions.

- *"New investment will focus outside EU (South Africa, Australia, China) driven by energy prices, energy availability and labour costs… only new smelter in EU is likely to be in Iceland which has large hydro and geothermal capacity"*
  European Aluminium Association

Irrespective of climate change policies or abatement opportunities, the fact is that investing in aluminium smelting is attractive chiefly where electricity can be readily produced at very low cost – which can in fact mean hydro or other concentrated low carbon sources:

Apart from opening smelters near low cost, low carbon electricity supplies, the sector has limited abatement options.

- *"Primary sector has very limited opportunity to reduce direct CO_2 emissions further… industry has achieved in recent years 60% reduction in PFC gases released when electrolysis is reversed (up to 9,000 more potent than CO_2)… CO_2 released as the carbon anode is consumed during electrolysis cannot be controlled as it is dictated by stoichiometry of the reaction"*
  Aluminium Federation

Grid electricity price rises associated with the EU ETS could not be tolerated by aluminium smelters in Europe, which already operate at the high cost end of a global commodity. The EU ETS will not impact on new smelter investment in the EU, since none are planned anyway, but could threaten the viability of existing smelters if these do become exposed to grid-based electricity prices.

Part 3: A wider view on competitiveness implications of the EU ETS

This final part of the report builds upon the detailed sector market studies of Part II to consider the wider competitiveness aspects of the EU ETS, general price effects and the implications for policy going forward.

Overall implications for UK energy-consuming sectors

This section extends the insights gained from the detailed sector market studies of Part II, to derive sector-level conclusions across UK industry. None appear to be as exposed as aluminium smelting.

Two key dimensions that determine industrial exposure, as indicated in Part I of this report, are the value at stake, and the ability to pass costs on to customers as determined by demand sensitivity, market structure and international exposure. The case studies of Part II now enable us to better define these indicators and apply them to other sectors.

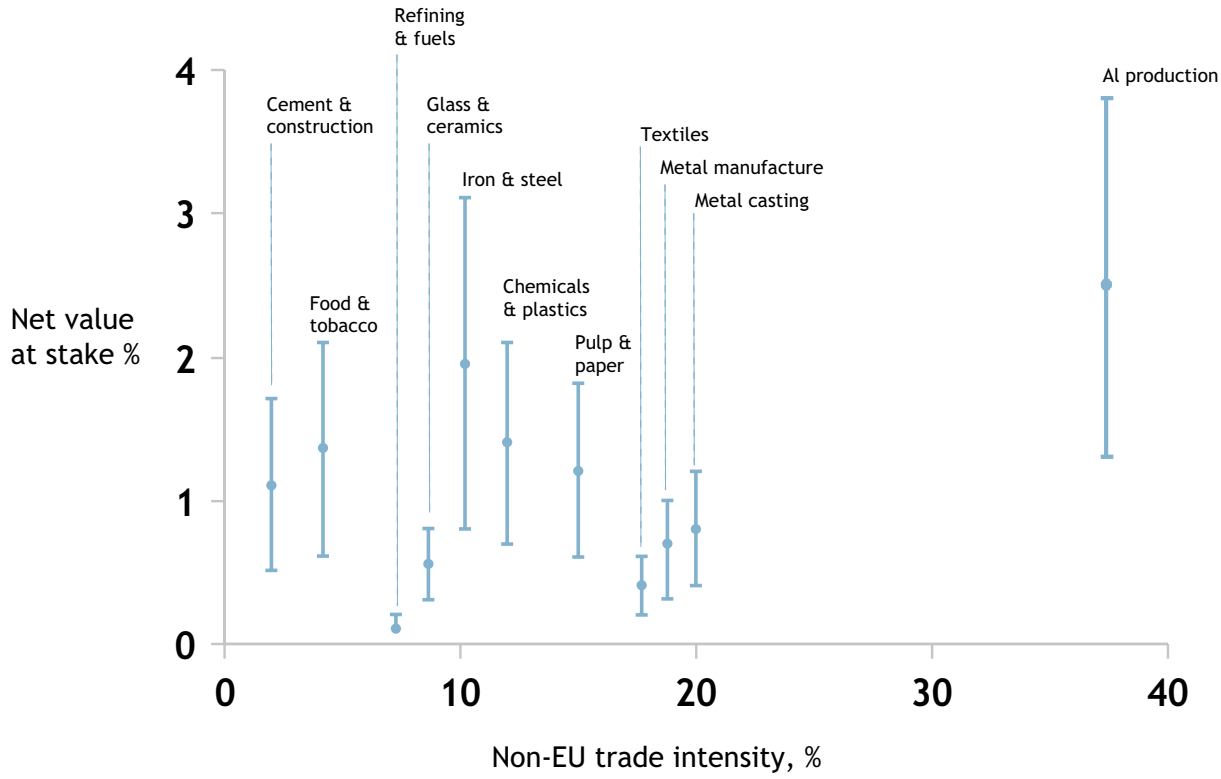
The analysis of Part II suggests that for most sectors, the main constraint on ability to pass costs through is international exposure. Providing a level playing field is established across the EU (considered in the next section), the simplest indicator of this is the current degree of imports from outside the EU.

The relevant indicator of value at stake is the cost uplift after allowance allocations. This defines the net value at stake (NVAS) that the industry needs to recover through price increases if it is to maintain profitability. As explained, the UK allocation plans adopt a principle of 'electricity leads cutback' in which all sectors other than power generation are granted allowances corresponding to their emission projections or negotiated targets under the Climate Change Agreements. Most EU countries appear to have followed a similar pattern in granting non-electric industries allowances close to (or in some cases apparently exceeding) their likely needs. The fact that electricity appears likely to gain even with much greater cutbacks than are currently being considered suggests that this pattern is likely to maintain at least through the first Kyoto period.

A sector's NVAS is thus closely tied to its electricity consumption (for which it receives no permits) times the degree of cost pass-through in electricity prices, plus any shortfall in the allowances received for its direct emissions. A plausible range for each of these is:

- Electricity component: Generation cost pass-through 30% (low), 60% (medium), 90% (high).
- Direct emissions component: Emissions allowance shortfall 0% (low), 5% (medium), 10% (high).

Chart 10. Net Value at Stake and Non-EU Import Intensity for different UK industrial sectors



Source: derived from DTI data

Using data from the UK Department of Trade and Industry on sector fuel consumption and energy use per unit value added, we apply these ranges to derive a span of potential Net Value at Stake[2] for the various sectors of UK industry corresponding to a carbon price of €10/tCO_2 (the value in our central scenario); the values would scale linearly for different carbon prices. Chart 10 shows the resulting range of NVAS for the various UK industry sectors, plotted against the sectors' non-EU imports.

Unlike the analysis of Part II, which modelled very specific industrial subsector markets, this analysis applies to whole sectors: net value at stake is defined relative to the whole sector value added (rather than a specific market EBITDA), and trade reflects the average imports in the sector. For example, aluminium shows a much lower value-at-stake than for smelting itself, mainly because much of the value added in the UK is in the non-smelting parts of the aluminium business; whilst pulp and paper in aggregate shows a higher energy intensity than the newsprint market modelled in Part II.

Even with the non-smelting parts of the business included, the aluminium sector overall remains unique in its exposure, driven by the electricity consumption and trade exposure of the smelting business. The whole sector's aggregate NVAS is typically 20% higher even than iron and steel, which has the next highest NVAS because of the combination of high fuel and electricity use in the UK steel industry, and has far lower imports. Pulp and paper is likely to be less exposed than suggested by the Chart for the reasons set out in the sector study.[3] The intrinsically domestic nature of the construction industry reinforces the conclusion that the cement and construction sector overall has little to fear from the EU ETS; the same would be true in taking a sector-wide view of electricity to include the supply business, which is not energy intensive and which is even less internationally exposed than generation.

Of the sectors not modelled in Part II, the chemicals sector, with aggregate net value at stake in the range 1-2% of value added, has exposure characteristics not far removed from those of iron and steel; some individual subsectors in the chemicals industry could indeed be more exposed. Food and tobacco has similar

[2] In these calculations Net Value at Stake is defined in relation to sector value added, not EBITDA. The results are comparable in most cases, but whole sector value added is significantly higher for the most energy-intensive sectors (notably steel and especially aluminium - see text).

[3] These data do not pick up the extent to which current or potential CHP investments may protect the sector against power price rises, and also the import intensity probably reflects constraints on domestic pulp availability, not cost differentials.

Table 2. EU ETS impacts on energy prices		
	% increase in final price at carbon price of €10/tCO_2	
	Large industry	Domestic consumer
Electricity	10%	4%
Fuel oil	0.9%	0.6%
Petrol and diesel		0.1%
Natural gas	0.2%	0.1%

Source: authors, derived from DTI data

net value at stake, but has much lower imports from outside the EU on aggregate. Again, some individual subsectors might be more exposed, though the question arises as to whether these might similarly be able to insulate themselves through greater use of CHP, like the newsprint subsector.

The other group of sectors of interest are those with higher non-EU import intensity (around 20%), but with lower energy intensity leading to relatively lower NVAS - under 1% of their value added across the various assumptions for an allowance price of €10/tCO_2. These include metals manufacture and casting, and textiles. Within these groups, again, there may be subsectors that retain high trade intensity but have much higher than average energy intensity and associated NVAS, but again, it seems unlikely that any could match the overall exposure of aluminium.

From the standpoint of the EU ETS, the oil refining sector is of particular interest as the second largest emitter after electricity. Chart 10 shows that it has both a low NVAS, and low non-EU imports. The low NVAS is driven by the fact that the sector consumes very little electricity from the grid. If it receives allocation anywhere close to its emissions, and if there is a level playing field across the EU, the sector thus may have potential to profit in the way that electricity does, though more marginally because of the lower relative costs and latent potential of rising non-EU imports of refined products.[4] The gas transmission sector, receiving allowances to cover its main source of emissions (from natural gas
use to power compressors) and facing no foreign competition, would also profit.

The low NVAS for refining is important because this suggests a low impact of the EU ETS on fuel prices. Refining consumes about 8% of the oil throughput in the UK, and pumping natural gas takes about 2.5% of the throughput. Even if the refining sector did pass-through a high proportion of the marginal cost increase (akin to electricity), the resulting impact remains small given that tax accounts for a significant proportion of pump petrol prices. Table 2 shows our estimate of the impact of the EU ETS on energy costs in the UK, for our central scenario, assuming a 60% pass-through of marginal costs for all the energy industries. The cost of industrial fuel oil might increase by about 0.9% and industrial gas by 0.2%, confirming that it is really only the electricity price effect that matters to most industries.

The impact on consumer fuel prices is even smaller, being only 0.1% on current prices of both petrol and domestic natural gas. These tiny effects would still be enough for both industries to more than recoup any directly EU ETS-related increase in input costs. It is possible that the increased demand for natural gas for power generation under the EU ETS (estimated at 6% in the Kyoto period) might itself have some knock-on effects on gas prices. However in general, other energy effects are dwarfed by the impact on electricity, where the EU ETS might add around 4% on typical UK domestic prices.

Overall, it seems likely that aluminium smelting is the only major UK sector market that might suffer significant loss of competitiveness, due to non-EU competition, under the EU ETS out through the Kyoto period to 2012. No other sectors are exposed to the same degree and most can maintain or even increase their profitability, given a sufficiently 'level playing field' across Europe; a contentious issue, which we now examine more closely.

[4] North Sea oil and gas production also falls under the scope of the EU ETS but involves special provisions outside the scope of this study. The economics of oil production are dominated by international oil prices, which are politically determined and bear little or no relationship to production costs. In the current geopolitical climate, oil production is a hugely profitable activity in which any costs arising from the EU ETS will be completely insignificant.

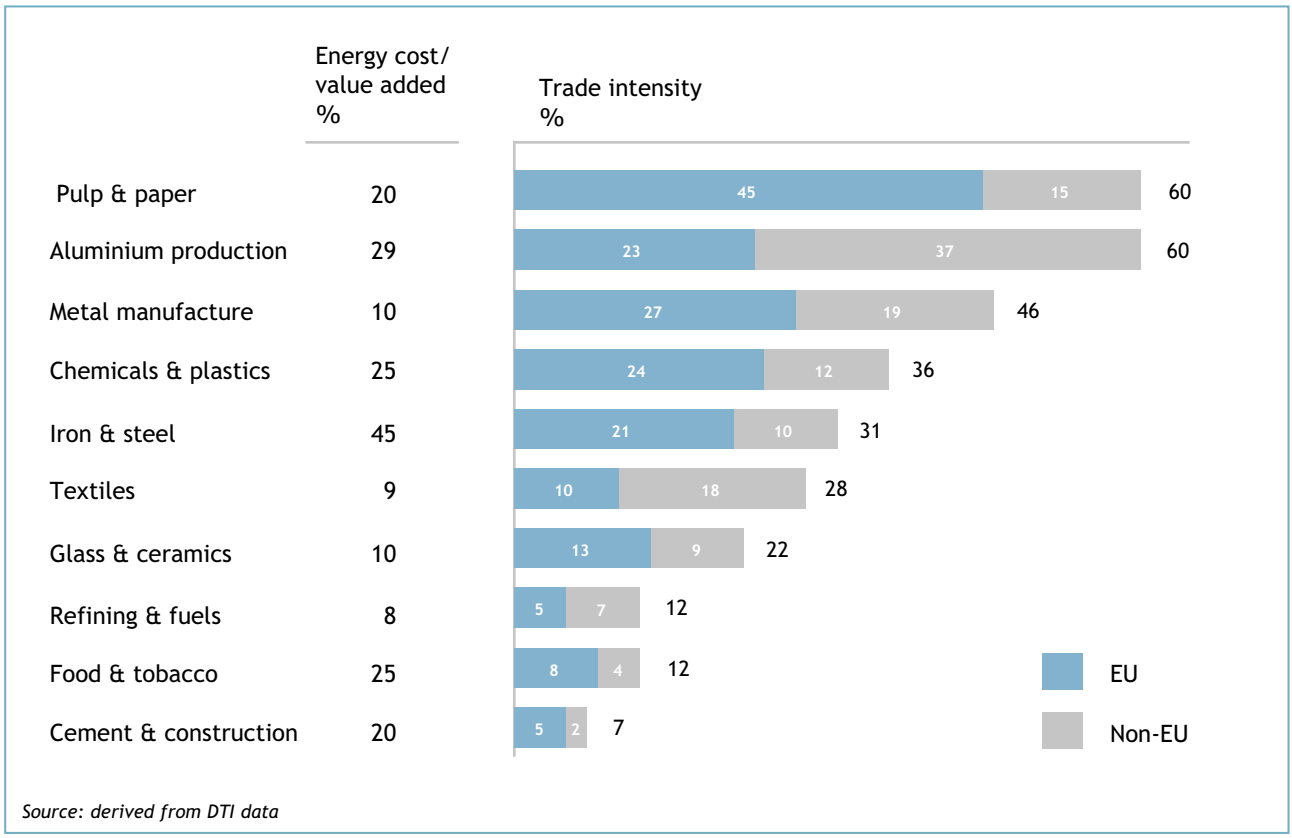
Competitiveness effects within the EU

A defining purpose of the European Union is to ensure a free market in goods and services. Ironically, because of the free flow of trade within the EU, the biggest concern expressed by UK industry about the EU ETS is that it will not be fairly and equally implemented in different Member States, leading to competitive distortions within the EU.

Two factors drive industrial concerns that the biggest competitiveness problem from the EU ETS may arise from competition with other firms in Europe: the low barriers to trade within Europe; and the perception that countries may implement the EU ETS in different ways and/or that price effects may differ substantially between countries.

The barriers to trade, arising from both transport costs and differential treatment, are generally far lower within the EU than outside it, which from an economic perspective is one of the great economic achievements of the EU. This is reflected in trade statistics – even in the UK, an island trading nation on the geographical edge of Europe, all sectors other than aluminium, textiles, and (marginally) refining, have higher imports from other EU countries than from outside the EU (Chart 11) - in many cases about twice as much. As a consequence, any significant

Chart 11. EU and non-EU Import intensity of different sectors in the UK



Source: derived from DTI data

cost differences arising from the EU ETS have the potential to affect competitive positions.

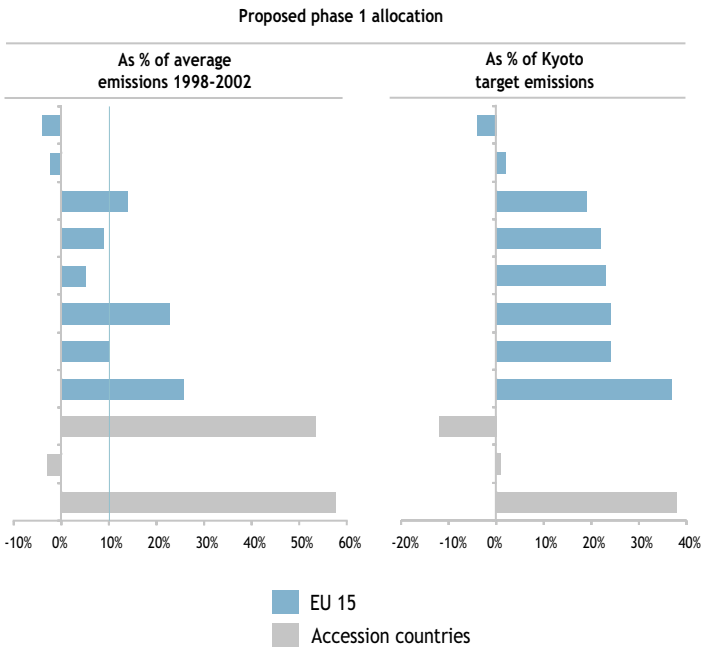
Even within companies that operate on a European-wide basis, different operating units fear the distortions that could arise from intra-European cost differences. As indicated by the stakeholder interviews, there is a belief that different EU countries will implement the EU ETS in different ways and with different stringency of allocation and enforcement. This fear is fuelled in part by the differences in Kyoto targets and, more specifically, by the allocation plans so far put forward.

Under Kyoto, the European Union agreed to a collective target to reduce greenhouse gas emissions, averaged over the period 2008-12, to 8% below 1990 levels. This target that was distributed among member states, to reflect different emission and growth patterns, giving the national targets set out in the first column of Chart 12. Most of the countries that joined the EU in 2004, the Accession countries, agreed to allocations 8% below their 1990 emissions (with the exception of Hungary and Poland at 6%) – but their emissions declined sharply during the economic transition and most have considerable headroom for emissions growth from current levels.

The proposed total allocations in different European Member States relative to average emissions 1998-2002 and each country's Kyoto target emissions are also shown in Chart 12. Only the UK, Germany and Slovenia have not allocated more than their recent emissions in the EU ETS sectors. Most of the allocations appear to be inconsistent with their Kyoto goals and most indeed appear to give allocations higher than recent emissions even where the trend has been declining emissions.

Chart 12. Emission targets and EU ETS allocations for EU Member States that had submitted allocation plans by June 2004

	Kyoto commitment (% change from 1990 levels averaged over 2008-12)	Emissions in ETS sectors ($mtCO_2$ p.a. average 1998-2002)
UK	-12.5	253
Germany	-21.0	506
Netherlands	-6.0	87
Ireland	+13.0	21
Denmark	-21.0	32
Sweden	+4.0	19
Austria	-13.0	30
Finland	0	36
Lithuania	-8.0	9
Slovenia	-8.0	9
Slovakia	-8.0	23



Source: authors, derived from published National Allocation Plans

Table 3. Impact of difference in allocation and electricity price impact on Net Value at Stake relative to sector value added (central scenario, carbon price = €10/tCO_2)

Sector	Relative impact on sector value added (for fixed product pricing)	
	Impact of 10% change in direct emissions allocation	Impact of a 30% difference in electricity cost pass-through
Food and tobacco	(0.18%)*	0.65%
Textiles	(0.07%)*	0.21%
Pulp, paper etc	0.12%	0.59%
Refining & fuels	0.10%	0.07%
Chemicals & plastics	(0.16%)*	0.71%
Glass & ceramics	0.07%	0.27%
Cement & construction	0.38%	0.46%
Iron & steel	0.73%	0.80%
Aluminium	(0.06%)*	1.27%
Metal casting	(0.06%)*	0.41%

Source: derived from DTI data **Not currently covered by EU ETS*

This underlines fears that countries are not treating allocation equally, and some appear to be rewarding sectors with allowances substantially exceeding likely needs. Compared to the relatively hard bargaining that led to a reduction in overall allowed emissions under the UK NAP, the concerns of UK industry about unfair treatment are understandable. There is also a feeling that even where some justification has been given, UK industry has not been given parallel benefits:

- *"We chose to buy ultra-low emissions gas turbines at increased cost in recent years - the NAP base of emissions for 98-02 means that we were not rewarded for paying extra for procuring lower emissions turbines than we needed to… Germany took a different approach in announcing its NAP, rewarding companies that had been proactive with increased allocation"*
  Utility

As explained earlier, different allocations do not directly lead to different prices, because companies in different countries would still face the same marginal 'cost of carbon'. Different allocations would thus not affect the incentives for a company in one European country to enter another's market.

Rather, differential allocations would affect the overall revenue of companies, and hence their longer term profit and loss positions.

The other possible source of competitive distortion, namely differences in the way that the EU ETS may feed through to electricity price increases in different countries, would more directly affect production costs. This could arise because of different fuel mixes, or different market structures leading to different cost pass-through strategies.

However, neither allocation differences, nor electricity price effects, appear large for the carbon prices assumed in our central scenario. Table 3 shows for our central scenario (€10/tCO_2) the impact of a 10% difference in allocation for direct emissions, and a 30% difference in impact on electricity prices (e.g. arising from difference between 60% pass-through in one country, and 30% or 90% in another):[5]

- The steel sector is by far the most sensitive to allocation decisions; a 10% difference in allocation can change the UK sector value added by 0.73% on these estimates. Cement is the next most sensitive at 0.4%, and for all others the effect is less than 0.2% of sector value added. The sensitivity for specific energy-intensive subsector activities could be greater; nevertheless, the differential value at stake does not seem to be significant.
- Differences in electricity price effects are more important than direct fuel allocations for all sectors except steel where the two effects are roughly equivalent. Again, the sensitivity of the aluminium sector, driven by

[5] These are not necessarily the maximum differences that could arise. Some of the allocations in Table 2 would seem to suggest a difference in allocation potentially greater than 10%. On the other hand, these are Phase I allocations, in which our corresponding scenario is a price of €5/tCO_2 - not least because of the weak allocations proposed in the NAPs. Inconsistencies between NAPs would presumably lesson in Phase 2, when indeed some of those that had been weak in Phase I would have to make up lost ground with much tighter allocations.

Table 4. Electricity prices in major EU countries ($ to € = 0.8)			
		€ cents/kWh Industry	**€ cents/kWh Domestic**
UK		4.34	8.80
Germany		5.67	13.36
Netherlands		4.60	13.39
France		2.94	8.36
UK price with 60% EU ETS cost pass-through		4.78	9.24
Impact of 30% point difference in cost pass-through @ €10/tCO_2 (relative to UK prices)	0.21 € cents/kWh	5.1%	2.4%

Source: International Energy Agency

smelting, is apparent; it is the only sector for which differences in electricity price effects between EU countries could change value added by more than 1%. But in addition to these two, UK food, pulp and paper, and chemical sectors could all find value added affected by more than 0.6% relative to EU competitors depending upon electricity price impacts.

Nevertheless, the electricity price impacts are not big compared to existing EU price differentials. Table 4 shows that a 30% difference in cost pass-through between different EU countries, at a carbon price of €10/tCO_2, would amount to a change of 0.21€ cents/kWh – about 5% - which is much smaller than the existing price advantage of UK power compared to Germany, for example.

Though most of these effects are relatively small, the steel production sector in particular, given the tight operating margins which drive the relatively high value-at-stake, has understandable reasons for concern about both allocation and electricity difference. So do some other sectors that face tight margins and strong pan-European competition. The lax allocations in the initial NAPs also fuel scepticism that countries will take their Kyoto targets seriously.

This points to the other consequence of weak allocation. The Kyoto targets are not discretionary; all the EU countries are required to deliver on their national commitments both politically and legally under European law. Once Kyoto enters into force, the targets will also become commitments under international law, bolstered further by the continually mounting evidence of the reality of climate change. Countries that have set weak NAPs at this stage will need to make sharp cutbacks in 2008. To comply they may also need to cut back more in other sectors like transport – where emissions in fact are growing rapidly - and buy allowances internationally. This creates considerable risk and uncertainty for all the sectors. Weak allocations will not help industries tackle emissions efficiently and will expose them to considerable risks going forward – something the UK plan seeks to avoid.

Although the relative impact on sector value added of divergent allocations between Member States appears small in most cases, it inevitably fuels concerns about competitiveness within Europe. Weak allocations also undermine the incentives for industry to prepare in an efficient and timely manner for the Kyoto constraints. They inject additional uncertainties into the market, and may leave governments having to meet commitments in more costly ways. Action by the European Union to try to harmonise and to strengthen National Allocation Plans would be to the long-run benefit of industry across Europe.

Conclusions

In all, this study gives grounds for cautious optimism about the competitiveness implications of the EU ETS. The five detailed sector studies suggest that three of the sectors may profit from the EU ETS, one (aluminium smelting) is clearly disadvantaged if it is exposed to electricity price rises, whilst the impact on steel could be positive or negative depending upon the strength of the scheme and steel market behaviour. No other sectors appear exposed to the extent of aluminium, or indeed steel. The newsprint study, where the sector's use of CHP (Combined Heat and Power) shields it from electricity price rise effects, also points to the importance of abatement in reducing potential exposure.

Of course, real markets are always more complex than models and we cannot rule out the possibility of very specific subsectors being more exposed. But the data on the price rises required to offset EU ETS cost increases does indicate why it should not be hard for most sectors at minimum to maintain current levels of profitability, all other conditions being equal. The lower barriers to trade within the EU mean that intra-EU competitiveness issues may be most important, though at the prices in our scenarios 1 and 2 any possible effects still appear marginal.

Our conclusions could become more questionable if carbon prices were to rise substantially above the level illustrated in our central scenario. At present, that seems a less relevant concern than the opposite case, namely that weak allocations in many European countries may lead to prices too low to have much effect at all. Ironically, this is likely to make extreme prices more likely later on. Efficient change takes time and many of the investments that could help EU countries deliver on their Kyoto targets need to start now. The EU ETS provides an opportunity to set up efficient incentives for industry to do just that, in ways that need not harm industrial competitiveness. The opportunity should not be squandered.

Annex. Understanding cost pass-through and potential profits from the EU ETS

Few things about the EU Emissions Trading Scheme cause as much surprise as the idea that some sectors might gain from it. But this is a result found consistently in numerous studies of the power sector, and understanding it is key to understanding much else about potential competitiveness impacts of the EU ETS.

The key is to understand that profit-maximising companies will generally tend to set prices in relation to marginal production costs – the cost of producing an extra unit is balanced against the value of the additional sales. The EU ETS increases this marginal cost, since companies would have to buy allowances (or forego selling allowances) to cover the associated extra emissions. As a result, companies will tend to raise prices to reflect this if they can. Such a price rise will generate additional revenues across all their sales. But the companies are not facing a corresponding increase in their overall costs.

The main reason for this is the fact that, under the EU ETS, governments will give all but a small proportion of allowances to companies for free: this is both a requirement under the Directive (which stipulates that governments may auction no more than 5% of their allowances in Phase 1, and 10% in Phase 2), and the observed practice in their National Allocation Plans. Consequently, although companies will face an added 'cost of carbon' at the margin of their operations (in considering whether to increase or reduce output), this will not apply across the main part of their cost base.

It is as though the price of energy inputs in the economy rises, but governments then compensate companies by paying them an amount close to their total cost increase. If companies still pass on most of the marginal increase in energy costs to their customers, they will then end up better off under the EU ETS, because they receive revenues to match the 'opportunity cost' associated with all their emissions whilst in fact these theoretical costs are almost all offset by the emission allowances they receive free from government.

In economic terms, the carbon cap creates 'scarcity rents'. The impact on competitiveness will depend on who gets these rents, and the principle of giving the vast majority of the allowances to companies for free means that industry may capture a high share of these rents.

In the power sector, there is an additional factor at play. Generating companies have a mix of power plants with different carbon intensity, and those with lower carbon intensity (such as renewables, nuclear or new and highly efficient gas plant) tend to be cheaper to run. Consequently, carbon prices would not raise average operating costs by as much as they raise the cost of the marginal plants – the ones that are switched on and off to match the variationsin electricity demand. It also follows that companies with a preponderance of such low carbon plant will see a lower cost increase than the industry average, and so can profit from the general price rise.

There are a number of details surrounding implementation of the EU ETS, including the rules around plant closure, auctioning and new entrants, as well as issues surrounding external linkage to non-EU investments through the 'Linking Directive.' Some of these could have a bearing upon cost pass-through. For example, the UK National Allocation Plan creates a special reserve of allowances that may be given free to new facilities or companies. If new entrants do receive free allowances, in effect their entry into the market is being subsidised, giving an incentive for 'new entrant' carbon intensive facilities relative to increasing the output from existing ones. Although the rationale is that the EU ETS should not become a barrier to new entrants, granting free allowances to them could deter established companies from including the full marginal carbon cost in their pricing. Of course there are usually other significant barriers to new entrants, and the significance of the effect may vary by sector. Such sector-by-sector analysis of the effect of detailed implementation rules was beyond the scope of this study, but it does illustrate the fact that there are many details about the EU ETS that deserve scrutiny, concerning which more will be learnt as the scheme progresses.

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