Ten insights from the EU Emissions Trading Scheme

With Reference to Carbon Pricing in Australia

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Preface

Most policy researchers and policy makers agree that directly putting a price on carbon will be an essential element of any comprehensive and coherent climate policy framework. An appropriately set carbon price creates an incentive to use lower carbon technologies; induces substitution towards lower carbon inputs, products and services; and stimulates innovation and development of lower carbon technologies, products and services.

However, behind the simplicity of this prescription, the actual implementation of a carbon pricing scheme – whether through an emissions trading scheme or carbon tax – has proven far more problematic than many may have expected. Emissions trading is still a relatively novel policy option – certainly by comparison with regulatory, taxation and direct incentive based approaches. Policy makers face an array of policy instrument design questions which interact in complex and sometimes surprising ways yet will shape the success or failure of the effort. Beyond that, the current climate science highlights that the ultimate objective of climate policy must be transformative in nature. As a potentially economy-wide market-based approach, carbon pricing gives the key decision making role – which economic activities respond in what ways – to many and diverse stakeholders. Even cautious early efforts to price carbon might have potentially significant and uncertain cost and distributional consequences. Unsurprisingly, the distributional consequences are front and centre for many stakeholders.

The Australian experience with carbon pricing to date highlights many of these challenges. The Federal Government commissioned a series of thoughtful and internationally influential reports on emissions trading in the late 1990s following the Kyoto Protocol. However, there has been limited progress in what is more than a decade since then. We've seen a highly innovative yet problematic State-based Scheme established in 2003, a State Government led ETS design process in the absence of Federal action, Federal political consensus on the introduction of an ETS followed by a detailed design process for the so-called Carbon Pollution Reduction Scheme (CPRS), its deferment following the Global Financial Crisis (GFC), a loss of political consensus, further proposed delays, and now another process and proposal for the introduction of an emission trading scheme (with a fixed price starting period) commencing in 2012. Many of the key design and implementation decisions are still under consideration and a fierce debate is underway on both the merits of this approach versus other policy approaches, and particular aspects of scheme design and implementation.

This lack of progress with carbon pricing is not unique to Australia. And it makes the European Union experience with emissions trading even more remarkable. The EU was able to agree upon, design and then implement an emissions trading scheme in little more than five years. Their ETS has now been running for six years, with work underway to finalise its third phase running from 2013 to 2020.

The EU experience has made a valuable contribution to the policy discussions of many countries over the last decade, including Australia. However, there is great value in revisiting its lessons at this time. We are improving our understanding of the key issues, and the EU ETS has now had three years of operation in its Second Phase, and in the context of the GFC.

This report by Climate Strategies therefore offers a very welcome and timely contribution to the Australian policy debate. It provides a sober and clearheaded analysis of the lessons on the design and implementation of a cap and trade scheme provided by the experiences of the EU. While the economic and political structure of Europe differs from Australia in many respects, there are still a number of valuable insights from the EU ETS experience that can help inform the Australian debate.

The lead author, Professor Grubb, has been a leading researcher in Europe on the economic and policy dimensions of climate and energy policy for over two decades. He has been a lead author for several reports of the Intergovernmental Panel on Climate Change (IPCC), holds positions at the University of Cambridge and Imperial College London, was the chief economist of the UK Carbon Trust, and is currently a member of the UK Committee on Climate Change. Climate Strategies, the international network organization which he Chairs, and helped to found along with other
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researchers, has played a crucial role in bridging the gap between academic analysis and informed climate change policy making. Reports by Climate Strategies on issues such as carbon leakage and allowance allocation have provided crucial input to the development of EU policy.

Some lessons from the EU experience now appear reasonably clear and it is these which the report focuses on. Others remain debated and some of the key issues, particularly the longer-term transformational role that carbon pricing can play, are still open. Looking at the lessons highlighted in this report, perhaps the most obvious, but still a valuable reminder for Australia, is that a major scheme covering over 10,000 facilities in 30 countries exists and is reducing emissions. Furthermore, the scheme continues to have significant bipartisan political and public support, and carbon pricing has been mainstreamed into EU businesses.

Other lessons address some of the key issues currently bedevilling policy makers here in Australia – the direct adverse economic impacts of the EU scheme have been modest to date, inappropriate permit allocation can adversely impact efficiency as well as equity (free permits don't come free) and international competitiveness does matter for some sectors but can be addressed and is not an argument for inaction.

As the report highlights, there are some areas where the EU ETS experience to date provides far less guidance. Although a number of EU countries have transitioned from limited carbon taxation arrangements into the EU ETS, this has generally been in a very different context to that envisaged with the transition from a fixed to market-based carbon price in Australia. Questions of household compensation options rely on scheme revenue from the sale of emissions permits which will only become significant in the EU ETS in its third phase. The EU ETS has, to date, only included Carbon Dioxide (with a few minor exceptions), large point source emitters and non-transport energy related emissions.

Therefore, while we can and should try to learn as much as we can from the successes and mistakes of the EU ETS to date, Australia must still find its own path towards an effective and coherent climate policy framework. In this process, perhaps one of the most useful lessons we can learn from the EU ETS experience is the importance of incorporating the inevitable learning process into the ongoing evolution of policy formation.

As Australia contemplates if, and if yes what route, it wishes to begin the transition to a low carbon economy, it particularly needs to be conscious of the risks of inaction. As the discussion in this report on border adjustments should remind us, there is a possibility that growing national efforts in both developed and developing countries might see coalitions of like-minded countries looking for ways to mutually support their transition to low carbon economies. Beyond taking leadership of the new technologies and business opportunities of transition, it is certainly possible that trading partners who haven't acted to price their emissions might begin to encounter border carbon adjustment arrangements to level the playing field for their industries who are required to pay for their pollution. As such, delays in implementing effectively climate policy might sometimes appear to come free, but actually involve potentially considerable risks and future costs. The most expensive policy lessons for Australia may yet prove to be the real costs of more than a decade of delay.

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Executive Summary

Many countries and regions including Australia, California, Canada, Japan and South Korea, are now in the process of developing emissions trading systems. Such systems are also being considered by increasing numbers of developing countries. Europe has accumulated a rich experience with designing and implementing a cap and trade program, and policy makers elsewhere have an opportunity to look at this experience on key issues that continue to challenge consensus. Foremost amongst these are issues surrounding allocation, costs and competitiveness and the risk of carbon leakage.

This report examines the experience of the European Union’s Emission Trading System (EU ETS) to date and suggests key lessons relevant to current debates in those countries considering implementing similar schemes, as follows:

1. Emissions trading works.
The EU ETS is estimated by MIT researchers to have cut European CO₂ emissions by 120-300MtCO₂ during its first, highly imperfect phase – up to 5% of emissions from the covered power and manufacturing sectors, despite excessive allocations of emissions allowances. It captured private sector attention like no other climate initiative, and its rapid introduction and impact contrasted with a decade of dispute over (failed) attempts to introduce a European carbon tax.

Emission fell sharply in 2008 and 2009 due to the financial crisis, but as EU industry has recovered, emissions remain well below 2005 levels. There will be a coordinated centralized cap in Phase III, set at 21% below 2005 levels should the EU economy-wide target stay at 20% below 1990 levels. More ambitious caps to 2020 are still under consideration.

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

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

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

3. Prices can be volatile and impacted by numerous unforeseen factors - which to date have reduced prices below expectations.
EU ETS prices have been quite volatile and after initial peaks have been lower than expected. This was partly due to incomplete data and intrinsic problems in emission projections; other direct policies, on energy efficiency and renewable energies, also reduced the CO₂ price. Given the fixed cap, prices fell with the economic recession, and have since (for almost two years) been fairly stable around €12-15/tCO₂. Whilst this means it costs less than projected, beyond a certain point the lower-than-expected price reduces incentives for low carbon innovation and investments.

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

4. GDP impacts are small.
Thus far, the EU ETS has been able to achieve its environmental objectives at costs significantly below those projected; a small fraction of 1% of EU GDP. The cost of the tougher action to 2020 is estimated at about 0.5% of GDP, or a few months of foregone economic growth. If auction revenue
is used effectively to reduce distortionary taxes and to fund low-carbon investments, the cost impact can be lowered, and could be positive in the longer term.

*Recommendation: Don’t let concerns about macroeconomic impacts dictate the environmental targets – economic impacts have been consistently less than projected.*

5. **Industry can profit.**

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

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

6. **Robust regulation of the market is required.**

The EU ETS was established with strong systems on emissions monitoring and high penalties for non-compliance. This has underpinned the credibility of the system. However, as the value of the system attracted attention, there have been problems with fraud and theft, which at one point required suspension of registries in some of the Member States.

*Recommendation: Since emissions trading creates valuable assets, the systems for security must match those of finance.*

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

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

*Recommendation: Concerns about competitiveness impacts should focus on a few, potentially exposed industries. For these, tailored solutions should be pursued such as benchmarked free allocation, auctioning with border leveling, or effective sectoral agreements.*

8. **Free allocation degrades efficiency and introduces risks either of windfall profits or other inefficiencies.**

Distributional or competitiveness concerns imply some free allocation, but it comes at a cost. Protecting carbon-intensive sectors inevitably increases the burden on other sectors to achieve a given economy-wide emissions target. Some economic inefficiencies can be avoided by basing free allocation on historical data or benchmarks, but there is the risk in some sectors that this approach will generate windfall profits and may not prevent international carbon leakage. Tying compensation to production levels (‘output-based allocation’) can tackle windfall profits and leakage but at the cost of further reduced efficiency. EU policymakers consistently rejected industry pressures for output-based allocation or rebates on a mix of practical, environmental, and efficiency grounds.

*Recommendation: Allocation method should be designed to minimize net impacts on the aggregate profitability of incumbent sectors, whilst boosting the profitability of cleaner technologies and innovators. A balance of free allocation should strive to minimize economic distortions as well as windfall profits. Relative risks are determined by sector specific characteristics namely: the ability of each major sector to pass through prices, its exposure to international leakage, and its potential for emissions abatement through radical innovation or demand reduction.*
9. There is a compelling economic rationale to increase auctioning over time.
Auctioning ensures that price signals remain intact to drive efficient corporate and private decisions on consumption, innovation and low-carbon investment. It also provides revenues that could be used for public goals – such as low carbon technology development, to help compensate consumers as carbon costs feed through to product prices, and/or for international programs for technology transfers or economic assistance for adaptation.

Recommendation: Increase auctioning over time.

10. ‘Border leveling’ of carbon costs – rebating on export, or charging on imported goods – is an option for longer term consideration and negotiation in relation to particular sectors at risk of carbon leakage.
The possibility of adopting border adjustments was discussed in Europe, but so far resisted: although they appeal to particular industries and associated interests, they risk being abused as disguised trade protectionism. Border adjustments provoke correspondingly strong suspicions that could disrupt multilateral negotiations. However in principle, border leveling of carbon costs focused upon tackling carbon leakage would be environmentally and economically more effective than free allocation, and some forms can be entirely compatible with WTO principles. The option may be revisited should the EU chose to move to a 30% emissions reductions target. International agreements including mitigation commitments and multilateral trade rules have the potential to be more effective and equitable while limiting international fallout.

Recommendation: Negotiate multilateral arrangements to contain or structure the use of border adjustments, focused upon minimising emissions leakage, by rebating (or charging) carbon costs on exports (or imports) as and when specific problems can be demonstrated.

These are ten key lessons for the design of domestic trading systems from the evolution of the EU ETS. In addition, the EU experience points to one lesson about the wider international structure. The EU ETS would not have been launched without the international framework of the Kyoto Protocol; pressures for excessive allocations in Phase II were only contained by the legal basis of the EU’s Kyoto targets; and the EU’s proposed tightening beyond 20% reduction by 2020 was conditional upon an adequate and binding successor set of commitments. The EU is unlikely to be alone in finding that binding international commitments help to bolster more effective domestic action.

At the same time, there are important areas in which the EU ETS experience may not be able to offer guidance to policy makers in other regions considering an EU ETS. For example:

- The EU ETS focus upon regulating at point of emissions from well monitored sources means that it cannot offer direct insight in the consequences of broadening the system “upstream”, e.g. to cap the carbon in oil and gas flowing into the economy
- Similarly, constraints on electricity involvement with attribution “downstream” to consuming industries; the EU ETS can offer little guidance for this, though some national initiatives (such as the UK’s Carbon Reduction Commitment for large commercial and public sector organizations) may do so.
- The EU is not a major exporter of carbon-intensive primary commodities; a country like Australia not be able to draw easy parallels concerning impacts and options for these industries.

Similarly, the EU’s rejection of output-based compensation means EU experience cannot directly illuminate the consequences if other countries experiment with that approach. Perhaps in its fourth phase (post 2020), the EU ETS will in turn be able to learn from experience elsewhere.
1. Introduction

The worldwide development of climate change legislation is stimulating intense interest in the options for detailed design of greenhouse gas emissions cap-and-trade programs. As these plans develop, even more attention is likely to focus on the economic implications for particular industries and regions, as well as their consequences for the effectiveness of the system in reducing greenhouse gas emissions.

A cap and trade program will create a price for carbon. Carbon pricing is important for incentivizing the transition to a low carbon economy. In order to make cost savings, producers in theory will shift towards low carbon and energy efficient technologies and less carbon-intensive inputs in general. A carbon price can also be introduced through taxation. Both cap-and-trade and carbon taxation will encourage producers to incorporate the impact of their emissions on the environment into their production cost schedules.

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

These are not new questions. Competitiveness impacts of CO₂ controls were debated in the 1990s, when both the US and the EU considered carbon taxation and some countries implemented such taxes. In general however, little progress was made with carbon taxation, largely because as well as setting a price it involves a huge transfer of revenue from industry to government. By introducing a second element (the degree of free allocation), emissions trading enabled this obstacle to be overcome, but industry remained concerned; the debate sharpened again in Europe as the EU ETS was developed, and began operation in 2005.

Many analysts and politicians know about the EU ETS, but not the analysis that shaped it, the stages of its evolution, or what has been learned. Yet the history of the EU ETS is rich in lessons. This report presents some of these insights, with a particular focus upon the issues around allocation of emissions allowances, competitiveness and leakage impacts of emissions cap-and-trade systems. It draws upon a large number of studies that have been conducted by the authors and others in recent years on the economic and environmental implications of the EU ETS.

The iterative, sequential design process for the ETS has enabled the EU to learn from its early experiences and avoid some of the mistakes from Phase I; it also enabled the EU to focus on just CO₂ from well monitored key sectors at the outset, and gradually add other sources to the ETS over time. Some emerging lessons from Phase II were incorporated into the design phase of Phase III of the EU ETS, most notably the way in which allowances are allocated to the power sector.

The purpose of this report is to reflect on Europe’s experience with the ETS and offer some recommendations to policymakers elsewhere as they contemplate the design of cap and trade programs.

- Section 2 outlines broad lessons concerning costs and cap-setting in the design of a cap and trade system.
- Section 3 analyzes in greater detail the implications of allocation methods for industry, particularly incentive effects.
- Section 4 focuses on which industries are most vulnerable to the international competitiveness impacts of cap and trade systems, in theory and in practice.
- Section 5 discusses the policy tools that are available to address the competitiveness and leakage issues.
- Section 6 offers insights into Phase III of the EU ETS from 2013 and beyond.
- The Conclusion synthesizes the lessons and presents recommendations based on them.
2. Caps and costs

**Key issues for ETS design**

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

As policymakers have become more familiar with the costs and benefits of climate policy, the technologies available to provide abatement, and the projected impact of climate change, they have become bolder in setting their targets. Emissions targets in the Copenhagen Accord represent a significant advance on the Kyoto targets, and many Non-Annex I countries have also proposed quantitative targets expressed in various ways. The strength of national caps can be hard to compare, in part because of different starting points and trajectories. Relative to 1990, EU GHG emissions had declined by 2005 by approximately 6% whilst those in the US rose sharply (16% increase) and even more so in Australia (38%)\(^1\).

The EU ETS is not a direct transition of an overall European cap: rather, its aim is to regulate strictly at point of emissions, the *direct emissions from large facilities*, notably power generation and heavy industry. In this it differs from some other proposals, for example the original US ‘Waxman-Markey’ proposal to regulate fossil fuels used in the transportation, commercial and residential sectors upstream. This would have eventually covered approximately 87% of US emissions, but perhaps also such ambition represented a bridge too far.

**Chart 1 EU Greenhouse gas emissions, 1990 – 2020 and the EU ETS component**

![Chart 1](source.png)


Chart 1 shows the EU ETS caps industrial emissions (including electricity production) representing about half of the EU’s CO\(_2\) emissions and over 40% of total greenhouse gas emissions. Other sectors are addressed through different policies.\(^2\) Emissions from the EU ETS sectors have been declining,

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\(^1\) Data taken from World Resources Institute, Climate Analysis Indicators Tool

\(^2\) For example, transport sector emissions are already subject to gasoline taxes at levels far higher than any expected equivalent carbon prices, and emissions from domestic and service sectors are addressed through a patchwork of largely national policies. The European Climate and Energy Package establishes targets for each Member State governing these other sources.
and are generally projected to be cheaper to control, whilst those covered by other policies have been rising. Chart 1 shows this division and the proposed total caps to 2020, which are set within EU goals to achieve 20% reductions (relative to 1990 levels) by 2020 unilaterally, or up to 30% in the context of broader international efforts. Macroeconomic implications of this are outlined in section 4.

In terms of design, features that distinguish the EU ETS from Australian proposals and some others in development include:

- The EU ETS is an international trading system, spanning the 27 Member States of the European Union. Its development as a harmonised system was provoked in part by the recognition that without coordinated action, Europe would end up with a patchwork of incompatible designs. In its early stages, the EU ETS still fell far short of a centralised system, and each Member State was responsible for allocations to its own industry, in “National Allocation Plans”, subject to oversight by the European Commission. There is the possibility that the Australian scheme could link to the existing New Zealand scheme but this is unlikely to occur in the next few years.

- The EU ETS was from the outset designed to operate in Phases. Phase I, from 2005-7, was in many respects a start-up period and insulated from subsequent Phases so that any major problems would not carry over into subsequent periods. Phase II, from 2008-12, coincides with the commitments of EU countries under the Kyoto Protocol and represents a cornerstone of their implementation plans. Phase III has now been defined to operate from 2013-20 and the main architectural features – including abandonment of the National Allocation Plans in favor of centralised allocation – were defined in an EU Directive agreed in December 2008. Similarly, the Australian Multi Party Climate Change Committee’s proposal on a carbon price starts with a carbon tax in July 2012 with the view to eventually move to a cap-and-trade system.

- Within each Phase of the EU ETS, allowances are fixed except for special provisions around plant closure and new entrants: neither allocations, nor any possible rebates, are adjusted in proportion to production levels, for example.

Despite potential differences between systems, it is possible to draw a variety of lessons from the EU experience.

**The EU ETS builds upon, and sits within, a range of complementary policies**

The EU ETS is not and was never intended to be the EU’s only climate policy instrument. In many European countries, climate change has been addressed through a wide mix of policies, not just one or two. Many countries use multiple policies and measures to target reduced emissions, including from the industrial sector. The EU ETS is complemented by domestic measures such as energy taxes, subsidies for renewable energy sources, voluntary agreements to reduce greenhouse gas emissions or measures promoting energy efficiency.

For example, Member States have a range of policies on energy efficiency in buildings, and transport emissions are addressed through gasoline taxes, which differ somewhat between Member States, but with vehicle standards adopted at European level. EU countries also have varied mechanisms to support the growth of renewable energy.

A number of EU countries also adopted carbon taxes through the 1990s, though they tend to vary significantly and most ended up giving various derogations to heavy industry. As the efforts to tackle power and industry emissions grew ever more complex and disjointed, and Denmark and the UK started to develop domestic trading schemes, the benefits of an EU-wide system that established a consistent carbon price across Europe for power generation and the principal carbon-intensive industries became more and more apparent. Most other policies continue, and many of these (like improving electricity efficiency and renewable generation) will indirectly also help to make it easier to meet the ETS cap, thus reducing the EU ETS price.
Caps have been easier to achieve than originally projected

By definition, the EU ETS delivers an emissions cap. The best indicator of how easy or difficult it proves to deliver this is found in the carbon price. Chart 2 traces the prices and volumes in the market for European Allowance Units (EUAs) over the first five and a half years.\(^3\)

Chart 2 EUA prices and volumes 2005-2010

![Chart 2 EUA prices and volumes 2005-2010](Image)

Source: Point Carbon

In Phase I (2005-7), carbon prices first rose on the back of rising natural gas prices, but then declined sharply after the first verification reports revealed a substantial surplus of emissions allowances. Phase I had been insulated from subsequent phases (with no banking of allowance allowed) in case of difficulties in this start-up phase, and as it became clear that Phase I was in overall surplus, the price declined towards zero.

However, there was already an active market in forward trades for Phase II (2008-12) allowances and this took over. Phase II sustained a substantial price during 2008, its first operational year, before a sharp fall early in 2009, during which prices have oscillated around half the levels originally projected (or prevalent during 2008). During the course of 2009, 2010 and the first months of 2011, EU carbon prices remained approximately at around €15/t. Both OTC and exchange volumes have risen significantly since the beginning of 2009.

These patterns echo those of some other trading experiences. In 2002, the UK launched a pilot emissions trading scheme, in which incentives were paid to the companies offering the most significant cutbacks; trading prices collapsed after about a year’s operation as it became clear that the targets were being easily met and, indeed surpassed. The US RGGI scheme, only a couple of months into its operation, was also trading at very low price levels reflecting growing perception of surplus. This trend in trade volumes has persisted as most regulators purchase their required permits at auction and financial speculators have been deterred from active market participation because of uncertainty with how RGGI would link to a potential federal level scheme.

There has been both over-allocation and significant emissions abatement.

The collapse of the UK ETS and EU ETS Phase I prices can be reasonably apportioned to excessive allocations combined with a greater than expected abatement in response to the price. Separating these factors requires careful study. The most detailed estimates are those in an MIT-led study by Ellerman and Buchner (2008), who use two approaches. They construct a “counterfactual” estimate of trend emissions in the absence of the EU ETS (Chart 3), which suggests that during its first two years the EU ETS turned an expected increase of 1-2%/yr into a small absolute decline.

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\(^3\) In many of the charts, the data have been expressed in Euros to maintain a constant numeraire. Otherwise, in the text, monetary amounts are expressed in US dollars, converted at $1.4084 per euro (market rate as of 26 June 2009) and rounded to the nearest dollar.
As additional evidence, they also compare the aggregate surplus of allowances at country or sector levels against the distribution of surplus and shortfall among facilities. Both approaches suggest that the EU ETS has achieved real emission reductions which have been pivotal in helping the EU realise its emissions targets.

This is not surprising: it is not plausible that companies would have faced carbon prices above $20-30/tCO₂ and not acted. Another study (Delaure, Voorsppols and D’haeseleer, 2007) estimates that the EU ETS cut power sector emissions by 88 Mt and 59 Mt in the power sector during 2005 and 2006 respectively, within the range estimated by Ellerman and Buchner. There is also clear evidence of abatement from changes in cement sector operations. A reasonable overall estimate is that the EU ETS in its first two years cut emissions by 50-100 Mt CO₂/yr, or by around 2.5-5%, and the most recent analysis by Ellerman and Buchner concludes that the EU ETS cut EU emissions by 120-300 Mt CO₂ over the three years of its first Phase, despite the price collapse.

EU ETS prices in Phase II have halved due again to some mix of inflated projections and abatement, plus other factors. The extraordinarily high energy prices up to mid 2008 drove a surge of investment in energy efficiency. Economic recession has led to further emissions cuts; overall, the trajectory of global greenhouse gas emissions is likely to have been lowered – perhaps by between 1 and 5% in the longer term. The reduction in the short run is likely to be much more than this, first, because the impact of lower energy prices is likely to take a long time to come through and, second, because an unexpected downturn initially hits harder the more carbon-intensive sectors of the economy (Climate Strategies, 2010). Also the supply of emissions offsets from the Clean Development Mechanism (CDM) has been much greater than originally anticipated. The US RGGI market has similarly experienced very low prices due to net oversupply of allowances and offsets.

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

5 Despite downward revisions due to performance problems and recent sharp declines in project investment, estimated project credit delivery over the Kyoto period (2008-12) is 1800 +/- 200MtCO₂ – the great majority of this from projects already registered and operating. See Carbon Trust (2009), The Global Carbon Mechanisms: Evidence and Implications.
Robust institutions with a legal basis have been required to achieve significant cutback

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

Under the terms of the EU ETS Directive, the European Commission was empowered to reject NAPs if they:
(a) Over-allocated allowances in ways that would create an implicit subsidy; or
(b) Were inconsistent with Kyoto emission targets.

In November 2006 the Commission rejected most of the NAPs as inadequate; most of the East European allocations were judged to include implausible emission growth projections (violating (a)); most of the proposed west European allocations were judged inconsistent with Kyoto targets (violating (b)). By rejecting allocation plans en masse and proposing a specific allocation formula for all member states in their place, the European Commission raised the stakes in the allocation debate enormously.

This decision turned a proposed aggregate emissions increase of 5 percent from 2005 levels into a 5 percent cut. In the end, West European Member States backed down from threats to challenge the Commission’s decision, since the Kyoto targets were written into international law (the Kyoto Protocol) and the Commission had a legal mandate to ensure the plans complied with the EU’s international legal obligations.

In aggregate, the Commission’s decision cut total allocations in Europe by 10 % as compared to the initial NAPs. The final allocations of emissions allowances totalled ten billion tonnes of CO₂ during Phase II or two billion tonnes annually. Some East European countries, which have a surplus under Kyoto, continue to challenge the Commission’s right to reject their national plans on the alternate basis (a).

The most recent assessments suggest that Phase II allowances will, like Phase I, be in overall surplus, and the allowance price is now sustained mainly by the prospect of banking allowances forward into Phase III of the scheme, which is assumed to be much tougher. Had the original allocations stood, the EU ETS would have by now disappeared in a second embarrassing surplus.

The trading market needs tight security

Over its six-year life, there have been a number of scandals as traders recognized the value and unique nature of ETS allowance trading. ‘Carousel fraud’, associated with shell companies manipulating different treatment of VAT between countries and then disappearing, has been closed off. Early in 2010 there was a widespread phishing attack on traders across Europe, some of whom revealed passwords to their registries, from which allowances were then stolen. There were also complications around a Hungarian government indirect swap of EU allowances for its national Kyoto surplus, in a manner that was technically legal but against the intent of the scheme. The EU has subsequently passed legislation banning such recycling of credits.

The EU is now introducing stronger controls on registry users, more frequent reviews of registry security and more integrated surveillance amongst Member States. In the longer term possible options include introducing mainstream financial market rules to spot inappropriate trading in the carbon market, bolstering the integrity of the market. Ultimately, a cap-and-trade system creates economic value and the regulatory systems need to be as robust as would be used for financial regulation.
All participating industrial sectors have profited from the EU ETS

In stark contrast to the strong industrial opposition to the EU ETS before it was launched – and despite the cutbacks imposed to comply with Kyoto targets - the evidence is that companies in all sectors have actually profited to date. This is for two reasons. One is the fact of most sectors other than power generators still having surplus allowances; they have thus been able to sell, with the value of allowance sales exceeding the cost of any abatement efforts.

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

Box 1 Windfall profits and opportunity cost

Emissions trading can either increase or reduce firm profits, depending on the extent to which a sector (i) has free allocation, (ii) passes through costs to product prices, and (iii) undertakes abatement. The power sector in the EU ETS Phase 1, for example, profited considerably by passing through CO₂ prices to consumers whilst receiving allowances for free. This increased revenues far more than any allowance shortfall raised costs. The EU ETS experience has thus confirmed a general economic principle illustrated in Chart 4 below: companies may profit from emissions trading, to a degree that depends on the extent of free allocation (vertical axis) and how much carbon costs are passed through (horizontal axis).

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

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

A foundational report on this topic (Carbon Trust 2004), which included modelling of five industrial sectors, first predicted that most sectors would profit from the EU ETS; this has been borne out by experience. Capping carbon means that emitting it is no longer free: emitters and consumers can and should pay for it. The impact on firm profits and competitiveness will depend upon who gets the resulting ‘economic rents’, and free allocation enables business to benefit from this (Grubb and Neuhoff, 2006, explain the mechanisms further). It is estimated that power generators in Europe have profited by many billions of Euros from the EU ETS, and this reality has underpinned a wholesale move to auctioning allowances to generators in Phase III of the scheme. The underlying principles however apply to any competitive market, subject to constraints of competition from countries without carbon pricing.
In its third phase, the EU ETS will avoid such windfall profits by moving to full auctioning in the power sector. Other regions may avoid the problem in different ways. For example, the now defunct Waxman-Markey bill in the USA would have aimed to avoid such windfall profits by giving power sector allowances to distribution companies, which then sell these to generators, and have an obligation to use the revenues in part to support energy efficiency programs. This should prevent windfall profits, but the full implications of shielding consumers from the full cost of carbon in this way remains to be determined. The Garnaut report in Australia argues that carbon pricing will cut power sector emissions significantly – as in the EU – but the exact nature of the impact will depend on the scheme’s eventual design.

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

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

Experience from both phases indicate that the EU ETS framework, in addition to attracting covered companies’ attention and providing clarity for decision-making, must ultimately contribute to the business environment that allows for the realization of low-carbon investment. Neuhoff (2011) argues that while the carbon price can contribute to the financial viability of a low-carbon project, uncertainty about the future carbon price may complicate decision-making particularly for financing of projects.

With a five-year Phase II, the EU has had time to take stock of a wide range of lessons learned. The redesign for Phase III, taking effect from 2013, includes the following:

- **Steeper emission cutbacks** – particularly in the event of a global deal, whereby the European Union has pledged to reduce its overall emissions by 30 percent below 1990 levels. Moreover, the cap is set to continue declining at a default rate after 2020, with a review clause in 2025. European industry knows the future is decarbonising; and will soon know whether the level of ambition is further toughened and by how much.

- **Centralised allocation rules** to avoid inconsistencies and remove the need for separate and inter-dependent negotiations in EU Member States. Given the enormous political importance originally attached to preserving national authority in this area, the unlamented demise of national allocation plans is striking. The lesson is that in a fully integrated economic zone, allocation by diverse jurisdictions is a needless and costly complication which introduces gaming and distortions. Most Member States and most industries have been happy to see the back of them and to focus instead upon more consistent, EU-wide rules.

- **A move to auctioning as the default, with no more free allowances for the power sector.** With the temporary derogation for central and eastern European Member States, power generators will have to buy all of their emissions allowances from 2013. The scale and terms of allowance allocation to other sectors covered by the EU ETS is dependent on whether or not the sectors have been classified as “at risk of leakage”. Manufacturing sectors “at risk” will receive benchmarked free allocation from a declining cap. Sectors not at risk will only receive a declining proportion of their total allowances and will be required to purchase any shortfall either at auction or in the market.

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

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

Allocation methods need to be adapted to sector-specific characteristics

Estimates from the European Commission suggest that around 50% of all allowances in Phase III of the EU ETS will be purchased at auction. As policymakers strive to craft an effective program, they will want to minimize distributional impacts (such as windfall profits) and yet maintain incentives for improved efficiency. The EU ETS provides important lessons not only for who receives allowances, but also how they receive them. While a specific allocation method may be appropriate for one sector, it may have more adverse consequences for distribution, efficiency or incentives for innovation in another.

Allocation of emissions allowances under the EU ETS has evolved through its different phases. In Phase I, few Member States differentiated between sectors at all. Power companies profited enormously as they received a large volume of allowances for free, and also by increasing the electricity prices to reflect the opportunity cost of CO₂. In Phase II, reflecting public outcry over the windfall profits of the generators (see previous section), free allowances to power generators were cut more than other sectors. Phase III takes this to the logical conclusion of full auctioning in the power sector, and introduces a differentiation between Member States. New Member States of Eastern Europe negotiated some derogations allowing them to continue free allocation to power generators, but it is unclear how much they will use this in practice.

Other regions are developing different rules for the allocation and use of free allowances that would avoid some of the outcomes experienced in the EU. Notably, in the most recently proposed US legislation:

- For the power sector, allowances would be given to distribution companies rather than generators and strict regulatory oversight would ensure that the value of the free allowances is passed through to consumers, preventing price increases, rather than pocketed by businesses. Ideally, this will avoid the windfall profits experienced in Europe’s competitive power markets.

- Output-based formulae for allocation to merchant coal plants and energy intensive industries would vary the number of allowances or revenues the entity receives in proportion to production. This reduces the risk of windfall profits, whether through price effects or through over-allocation.

However, while U.S. policymakers have tried to develop policies to avoid the windfall profits experienced in the EU, these efforts have drawbacks. The output-based approach to allocating allowances creates other problems. It is pro-cyclical (more allowances during boom years, less when times are hard) in contrast to the counter-cyclical feature of fixed allocations. In addition it exacerbates efficiency problems discussed below. Output based compensation is also probably more vulnerable to challenges under the WTO code of Subsidies and Countervailing Measures, since it represents a more overt subsidy to production than a fixed degree of free allocation. The EU consciously and consistently avoided both output-based allocation, and regulating the pass-through of the allowance value to consumers in power generation, for fear that these would undermine both the environmental objective and the economic efficiency of the system.
However, these electricity price increases help to drive consumers to conserve energy and other lower-emitting investments. The legislation asks that the allowance value be used to reduce the fixed-cost portion of utility bills, rather than the cost per kWh, but many consumers may not recognize this distinction in their energy bills. Similarly, allocations to energy-intensive manufacturers are intended to keep their prices from rising, which discourages substitution toward imports but also deters alternative products that may be less carbon intensive. Losing such opportunities for low cost abatement and incentives for innovation will increase the overall cost of the program. Policymakers must be aware of the nature and scale of these distortions as they balance this risk with other political concerns.

**Free allocation based on outputs poses different issues**

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

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

**The unavoidable tradeoff points to a bigger role for auctioning**

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

The underlying lesson from the EU is not that allocations must be based on output to avoid windfall profits (this can also be addressed by removing free allocation). Rather it is that free allocation in general can carry a real cost, either in terms of reduced efficiency or distributional fairness (or both).

Consequently, there is an underlying economic rationale to maximize the role of auctioning as a default to create a robust, fair and transparent market framework. Auctioning ensures price signals remain intact to encourage efficient corporate and private decisions on consumption, innovation and low-carbon investment. It also provides revenues that could be used for public goals. These could include measures directly related to climate policy - such as low-carbon technology development, to help compensate consumers as carbon costs start to be reflected in product prices, or for international expenditures to help poor countries adapt and alleviate the damage inflicted as a result of climate change. Other uses could target more at offsetting macroeconomic effects as indicated briefly in the next section.

Although regional disparities, transitional and competitiveness concerns make it unlikely that 100 percent auction will be politically feasible in the early years of the program, policy-makers should be aware of the risks that free allocations pose, and ensure a good understanding of the conditions under which they may be appropriate.
**Economic reasoning behind free allocation**

Once carbon is recognized as a cost that should be internalized, there are only two sound economic reasons for considering free allocation or equivalent direct rebates to producers. One is to compensate incumbents that invested in plants before climate change was an issue, in cases where stranded assets arising from changing circumstances might be a legitimate concern. Some analysts suggest evaluating a ‘compensating rate of free allocation’ that could preserve firm profits, taking account of likely cost pass-through rates, though calculating this by sector would be fraught with difficulty.

The other constraint is if foreign competition might undermine the ability of companies to pass through carbon costs, which this report considers in section 4.

**Investment and innovation**

As indicated, the EU ETS achieved emission reductions in its early years primarily due to its impact on operation of existing plant. Its impact on investment and innovation is more complex to establish. A recent study (Climate Strategies 2011) brings together some surveys of corporate responses, and finds:

- The extent to which power generators consider climate issues in their innovation and investment activities is highly correlated with the relevance of the EU ETS;
- Companies that expect more stringent allowance allocation are more likely to pursue low carbon innovation;
- Technology-specific support schemes are most directly relevant to producers of renewable energy, but these are also perceived to be linked to both longer-term targets and the EU ETS;
- The move from Phase II and Phase III in the EU ETS has an important impact: the percentage of companies expecting to continue ‘business as usual’ due to the level of free allocation declines from 40% to 10%, and the share of companies that expect fundamental change in their operations and investment increases from 4% to 10%.

Overall, the investment response hinges upon three factors: the framework must capture the attention of relevant decision-makers; it must allow companies to assess the new opportunities and challenges in their operation, investment and strategic decisions; and it must provide an enabling environment that allows business to generate tangible benefits from lower carbon investment projects. The evidence is that the EU ETS is becoming more effective in all three domains, as the system matures and strengthens.

Another important emerging link is with revenues. The power sector and energy-intensive industries invest far less of their turnover in R&D than eg. pharmaceuticals and IT, for deep structural reasons. With the EU ETS moving to full auctioning in the power sector, some revenues from emission allowances are being targeted to support innovation such as the development of a series of CCS demonstration plants, programmes around energy efficiency and end-use technologies, and the development of ‘smart grids’. The aim is to help put Europe at the forefront of the technologies and industries required in a decarbonizing world.

That of course is the plus side. As the ETS becomes more stringent, the other question is what it may imply for energy intensive industries and the European economy more broadly, which is the subject of the next section.
4. Competitiveness: Who’s at risk?

*Macro-level issues for the national economy are modest*

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

The estimated costs of proposed climate action are modest relative to GDP. At current carbon prices they are hard to discern, so Table 1 shows estimated impacts of more aggressive action planned out to 2020 in the EU and Australia. The European Commission estimates that the overall EU package for 20% emission reductions would cost around 0.5% of GDP, a few months of foregone economic growth. Criticisms that this is too optimistic (Tol, 2011 as promoted by Bjorn Lomborg) depend heavily on one model, and are driven mainly by costs outside the EU ETS, associated with other measures targeted at driving innovation and reducing oil dependence. The European effort thus combines carbon pricing for mid-term economic efficiency with direct investment to enhance energy security and to build up future capabilities; the criticisms count the costs of these other, more expensive elements but not their benefits.

Moreover, if auction revenue is used effectively to reduce other (and more distorting) taxes, fund low-carbon investments and innovation, and compensate disadvantaged consumers for example, the long-run cost impact on the economy can be moderated further, or potentially create positive economic impact. Auction revenue could also be used to assist developed countries meet their international financial pledges on mitigation (including REDD activities), adaptation, technology development and transfer and capacity-building for developing countries under the Copenhagen Accord.

Table 1 Macroeconomic cost estimate of climate policies and targets from economic studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Policy</th>
<th>Region</th>
<th>Timeframe</th>
<th>GDP impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU Commission</td>
<td>EU ETS caps to 2020</td>
<td>Europe</td>
<td>Out to 2020</td>
<td>-0.3% to -0.7%</td>
</tr>
<tr>
<td>(2008)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garnaut Review</td>
<td>Reduction of emissions by 10-25% relative</td>
<td>Australia</td>
<td>Out to 2020</td>
<td>-1.1% to -1.6%</td>
</tr>
<tr>
<td></td>
<td>to a 2000 Baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPRS</td>
<td>Reduction in emissions by 5-15% relative</td>
<td>Australia</td>
<td>Out to 2020</td>
<td>-1.1% to -1.5%</td>
</tr>
<tr>
<td></td>
<td>to a 2000 Baseline via the introduction of</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>an emissions trading scheme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frontier Economics</td>
<td>Meeting the emission reductions in the CPRS</td>
<td>Australia</td>
<td>Out to 2020</td>
<td>-1.25% to -1.07%</td>
</tr>
<tr>
<td>Stern Review (2007)</td>
<td>Reducing GHG emissions to avoid the worst</td>
<td>Global</td>
<td>Out to 2050</td>
<td>-1%</td>
</tr>
<tr>
<td></td>
<td>impact of climate change</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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6 Tol (2011) analyses the EU target results from five models. His claim that ‘the EU as a whole would lose 1.3% of welfare’ – much higher than the Commission estimate – neglects to clarify that this is driven by one model (DART) that predicts a 4.5% impact, whilst the other four generate estimates in the range 0.4 - 1.3%. Moreover, the major costs arise outside the EU ETS, from policies designed to build up new industries (eg. renewables targets) or to accelerate the EU’s move away from oil dependence in transport.

7 This possibility involves a complex economic debate, stemming from the observation that economies frequently are far from optimal in use of resource, and in particular systematically under-invest in innovation, and may suffer from structural inefficiencies (eg. from acknowledged barriers in energy efficiency). Climate policy has potential to improve economic performance to the extent that it may help motivate improvements in these areas.
The Australian government’s report "Australia’s low pollution future" modelled the impacts of four carbon pollution mitigation scenarios on energy intensive industries, relative to a reference ‘business as usual’ scenario. As with other similar regional studies, the report found the macro-economic impacts to appear small. However, competitiveness issues may arise at the level of specific sectors of the economy (micro-level).

**There are wide variations in competitiveness impacts across specific sectors**

The international competitiveness of a sector is dependent on a multitude of factors including the market structure they operate in, their cost structures and the regulation they face relative to their international competitors. For most sectors, production cost differentials (e.g. on labour, raw materials and other physical inputs) far outweigh any international differences in the cost of carbon. The cost uncertainty induced by emissions trading is also less than that, for example, compared to energy cost and exchange rate fluctuations. Numerical analysis is key to bringing to bear a sense of proportion in the debate – and therefore also to an assessment of solutions.

Which industry sectors are potentially exposed to competitiveness impacts? Studies have demonstrated how competitiveness concerns arise because industrial greenhouse gas emissions are heavily concentrated in a few primary resource-based sectors with low-value added. For these sectors, per every unit of value-added, the carbon cost impact is high. This is in contrast to secondary sectors where carbon cost impact is lower, relative to unit of value-added.

Studies on energy use and carbon emissions by sectors in US, Japan, Germany, the UK and most recently for Australia show that only a very few industries stand out for their potential cost exposure. Chart 5 and Chart 6 illustrates this by ranking EU and Australian manufacturing activities in terms of the potential impact of carbon costs – in the absence of any free allocation – relative to the economic value added of each activity – roughly, its contribution to GDP. (Appendix II compares this to equivalent analysis conducted for UK, Japan and Germany).

**Chart 5 Relative cost-sensitivity and value-added of manufacturing activities in the EU**

Notes: The vertical axis shows the implied cost increase if sectors pay the full cost of CO₂ at $20/t CO₂ as a percentage of the sector value added. The horizontal axis indicates the scale of the activity's contribution to the EU GDP. The area of each column is thus proportional to total CO₂ emissions.

Chart 6 Emissions intensity of Australian manufacturing sectors and their contribution to GDP

Source: Adapted from Grattan Institute (2010), Restructuring the Australian Economy to Emit Less Carbon®, John Daley and Tristan Edis

There are differences between countries in terms of ranking, but in general the most potentially high-impact activities are consistent across the various country studies. The Carbon Trust (2008a) identified six main sectors as being either “significantly” or “plausibly” of concern in a number of studies for regions looking to introduce carbon pricing:

- Iron and steel
- Aluminium, alumina and some non-ferrous metal production
- Nitrogen fertilisers
- Cement and lime
- Basic inorganic chemicals (principally chlorine and alkalines)
- Pulp and paper

In both the US and UK studies, these sectors account for less than 0.5% of GDP together and in Japan and Germany it is estimated to below 1% of GDP. In addition, refineries are a complex sector

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1 The analysis doesn't distinguish between direct and indirect costs. The numbers in the brackets refers to the sector contribution to total Australian emissions

9 This shortlist doesn't preclude the inclusion of additional sectors being identified as being at risk of leakage but these 6 sectors are emissions and energy intensive and repeatedly identified as being at risk of leakage across studies and therefore should be the first sectors explored in more depth to better understand the risk of leakage they may face.
which may also have a case to be considered as significantly trade-exposed, and is of course economically significant in both the EU and the US; also mining was not considered in the Carbon Trust studies of UK exposure. All these sectors obviously are more important in Australia, where the overall share of economic production from carbon-intensive, trade-exposed sectors appears at around 6% of national production (this may be influenced also by a the slightly different analytical approach employed and differences in sector classification). A difference is to be expected, of course, because resource-intensive primary industries do form a much greater share of the Australian economy.

Of course, a sector may be linked to other activities – for example, special steels for local auto producers. This raises fears that more of GDP may in reality be at stake. By the same token however, if carbon-intensive production is linked to local, more valuable activities, it is also less likely to migrate – its "effective" emissions per unit of associated GDP are reduced.

**Most sectors can pass through some carbon costs**

In economic theory, passing on the full cost of carbon to consumers is desirable as this will send price signals to reduce consumption of carbon-intensive goods. In practice, if a sector has high potential carbon cost-impact, the potential to increase product price varies according to the cost structure of the industry and the degree of free allocation and competition.

For most of these sectors, the corresponding price increase necessary to maintain profit levels is small. Only in exceptional cases does it exceed 1% for each $10/tCO₂. (See Appendix 2 for data on key sectors from the UK studies.)

The degree to which companies can indeed pass through carbon costs is an empirical question. It can be restrained in some instances, for example, by price regulation and also the degree of exposure to foreign production that can be readily traded.

How much sectors can pass through carbon costs is difficult to estimate. Yet evidence from the EU ETS increasingly reveals that the correlation between carbon costs and product prices can be observed in many industries (IEA, 2009; CE Delft, 2009; Walker and Convery, 2008). These observations have been made in electricity, cement, refineries, chemicals, and steel sectors.

**International trade effects are immaterial for most sectors...**

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

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

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

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

However, the scale of costs for the six key sectors suggest that there could be some impact on trade, with consequent carbon leakage, as the systems toughen up. Modeling impacts on EU production in the two biggest sectors, cement and steel, suggests that the overall leakage of EU emissions is unlikely to be bigger than 1%, but could be significantly higher in these sectors (Carbon Trust 2008a). An equivalent analysis of the US that has been published (Aldy and Pizer, 2009) reaches similar conclusions:

“... pricing CO$_2$ at $15$/tCO$_2$ would lead to an average production decline of 1.3% across US manufacturing, but also a 0.6% decline in consumption. This suggests only a 0.7% shift in production overseas. There is no statistically discernible effect on employment for the manufacturing sector as a whole ... industries with energy costs exceeding 10% of shipment value would expect output declines of about 4% and consumption declines of 3%, suggesting a 1% shift overseas.”

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

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

Chart 7 Three options for policymakers, adapted from Neuhoff (2008)

**Levelling up is the best option in principle**

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

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

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

The default approach in the EU to date has been defined by free allocation. In Phases I for most sectors, and Phase II for manufacturing, this was the default mode. Most manufacturing sectors received free allocations close to projected needs (which in practice, frequently turned out to be excessive in addition to reduced emissions and output from the economic downturn) and this was
assumed to be sufficient to deal with leakage concerns. However, industry pointed out that the risk of future carbon costs could still deter investment, and economists increasingly pinpointed the limitations and drawbacks of free allocation, as outlined in Section 3. This research (notably Grubb et al 2007, and Neuhoff 2008) helped to increase the level of auctioning in Phase II, and influenced major reforms for Phase III.

*Chart 8 Allocation and emission in the EU ETS*

A fundamental change in Phase III is a move towards auctioning as illustrated in Chart 7. Within this, there are significant variations in treatment across industry sectors:

- **Power generation** moves to full auctioning as the default, though the new Member States of Eastern Europe have a degree of declining opt-out derogations (they are unlikely to use this to the extent illustrated as the implications for continuing windfall profits become clearer). There are no direct measures to protect consumers (domestic or industrial) from the impact on power prices, which are considered to be part of an appropriate strategy for carbon prices to flow through the economy. However, where electricity-intensive consuming industries can demonstrate a risk of adverse impacts, they may be considered for direct support to offset carbon costs, subject to scrutiny under the EU’s procedures for limiting State Aid.

- **Manufacturing** industry, in contrast, receives some free allocation, defined as a share of the declining cap based on 2005-7 emission levels. The default for manufacturing industry starts with them in 2013 receiving 80% of that historical share for free, declining to 30% by 2020. This allows for some ongoing transitional relief in manufacturing sectors.

- Sectors classified as being “at significant risk of carbon leakage” will receive allowances for free. The exact amount each installation receives will be based on a benchmark set as the average of the top 10% most greenhouse gas efficient installations in the EU. I.e. an installation that is as efficient as the average top 10% will receive 100% of their required allowances for free and this percentage will decline depending on the emissions efficiency of the installation. There are 52 product benchmarks expressed in terms of emissions per tonne of output.
The net effect is a big reduction in the overall volume of free allowances, marking the reversal of the allocation philosophy; the EU ETS will auction 60% its allowances from 2013, rising to 70-85% auctioning by 2020.

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

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

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

Cement provides an extreme and problematic illustration of this, because the most carbon-intensive step (production of clinker) could migrate even if cement itself were ‘protected’ with free allocation – whilst shifting free allocation to the production of clinker itself would greatly reduce the abatement options, many of which stem from using less clinker in cement production. Border adjustments would be relatively easy for cement, due to the homogenous production process and product, but the same is not generally true of other sectors (eg. see box 2).¹⁰

**Box 2: Steel – A chunky problem**

The Iron and Steel sector is responsible for around 7% of global CO₂ emissions. It is one of the sectors where climate policies could most increase production costs. It is widely traded (approximately 40% is traded internationally) and so differences in carbon prices between international competitors may lead to changes in competitiveness with possible leakage of emissions to countries with less stringent emissions policies.

Agreements on steel and coal were the starting point for the European Union (EU), yet within the EU, steel’s importance in the economy has steadily declined. Applying a carbon price, either directly through a tax or indirectly using an absolute target under cap and trade, would be the most economically efficient process for reducing emissions in the steel sector since it allows all options to be considered on an equal basis, but raises fears about competitiveness.

Sectoral Approaches represent an attempt to perform, at least partially, what carbon prices would do, but in a politically acceptable manner. Six specific options are identified in a recent study as indicated here.

Sectoral crediting or targeting, against an agreed sectoral baseline of CO₂ emissions per unit of steel produced, has been widely proposed and discussed (for example using a “no lose” basis where failure to meet a target would not lead to any penalty). Setting baselines to avoid surplus allowances would clearly be difficult. Sectoral crediting or targeting also does little to incentivise CCS (carbon capture and storage) or breakthrough technologies. Sectoral crediting or targeting along with other bottom-up measures, could however, help to build up countries’ capacities to identify and invest in abatement technologies.

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¹⁰ See G. Cook, ‘Climate change and the cement sector’, www.climatestategies.org. A fuller discussion of how different approaches may be appropriate to different sectors is given in Carbon Trust (2010), ‘Tackling carbon leakage’.
<table>
<thead>
<tr>
<th>Abatement Category</th>
<th>Possible Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The closure of inefficient, highly polluting plant</td>
<td>Agreement to partially fund or provide credit against an agreed profile of verified closures</td>
</tr>
<tr>
<td>2. Improving energy efficiency and carbon efficiency at existing, non-obsolelute plant</td>
<td>Carbon market and low-interest loans (with grace period) or other mechanisms to make investment more attractive. Similarities with project-based CDM</td>
</tr>
<tr>
<td>3. Ensuring that new plant is built using best available technology</td>
<td>Verification scheme, possibly releasing payments or some other form of credit</td>
</tr>
<tr>
<td>4. Increasing the use of recycled scrap</td>
<td>National collection targets, the meeting of which could trigger payments or credits</td>
</tr>
<tr>
<td>5. Adopting Carbon Capture &amp; Storage (CCS)</td>
<td>International co-operation required</td>
</tr>
<tr>
<td>6. Developing and implementing breakthrough technologies</td>
<td>International co-operation required</td>
</tr>
</tbody>
</table>

Sectoral approaches are limited to only reducing supply-side emissions; they don't create incentives for more efficient use. In addition, in reality they don't address concerns about competitive impacts in regions adopting carbon pricing schemes.

At the same time, using border adjustments to compensate for carbon price differentials would be complicated by the range of processes and diversity of specific products, and the sheer value of international trade. Free allocation may therefore provide a “stopgap”, whilst better solutions – included appropriate use of border measures or carbon-cost-based Sector agreements - are negotiated over the next few years.

Source: Climate Strategies reports on international sectoral approaches and agreements, available for download from: http://climatestrategies.org/research/our-reports/category/54.html

**Political proposals for border adjustments have been regarded with great caution**

Discussion of climate-related border adjustments in Europe has been accompanied by extreme nervousness about their potential impact, both on the world trade system and on the international climate negotiations. The issue was downplayed in negotiating the EU ETS Phase III in favor of free allocation to exposed sectors, but a clause in the EU Directive for Phase III does provide for the possible ‘inclusion of importers’. Recognising the imperfections of free allocation as a solution, the French government in particular has raised the issue again, partly as a way of protecting the integrity of an international environmental treaty.

The EU downplayed the issue in part because of the hopes it had for a binding agreement at Copenhagen in which major competing producers would take on binding commitments, including carbon pricing. There is rising debate in the EU about strategies for strengthening climate action in the absence of sufficient equivalent action elsewhere.

The common perception is that border adjustments might conflict with the fundamental principle of non-discrimination, which is at the core of the World Trade Organization and many other international trade and investment agreements, seeking to minimise impediments to free global trade. Moreover, decades of experience have led developing countries to be suspicious of many trade-related measures by developed countries - measures which have frequently been either motivated by, or distorted into, protectionism as a result of domestic lobbying pressures.

In practice the reality is more complex.\(^\text{12}\)

\(^{11}\) See for example the European Commission’s “ALCOS” project, which has been operational for over 5 years and is now moving onto demonstration projects costing over $100m each.

\(^{12}\) The concern is frequently presented as a legal one - namely that border adjustments for climate change purposes would conflict with GATT provisions overseen by the WTO. In practice, this is not clear-cut, and the WTO’s own study emphasizes that GATT rules serve to clarify the circumstances in which border adjustments are allowed, not simply to ban them. Also trade law is complex and the principles and commitments of some sections are set against other clauses that can be used to justify exceptions and exemptions. Like domestic law, interpretation ultimately comes back to processes – in this case, WTO Appellate Panels – to make rulings in case of disputes. The balance of judgment would depend in large part on a combination of how measures were
Border adjustments may take different forms

Different types of border adjustment by carbon-capped regions
There are several different types of cost adjustment measures that can be used. These different approaches have different characteristics in terms of their likely effectiveness and WTO-compatibility. The broad overall conclusion is that there are ways to design border adjustments that appear WTO-compatible. Crucial features would be that they be non-discriminatory, be targeted to protect the environmental objective, and consequently focus on allowances not tariffs (Climate Strategies: Dröge et al, 2009). To be compatible with the principle of non-discrimination, the focus would have to be on leveling carbon costs between domestic and foreign producers.

Border adjustments would be sector-specific
Like trade policy itself, measures would apply in terms of specific sectors. For example, our own research suggests that the cement sector poses the greatest problems for free allocation (since inland producers are protected from trade and hence may reap windfall profits as with electricity), and yet is the easiest sector in which to implement simple forms of border leveling, namely a requirement on importers to purchase EU ETS allowances at a fixed ‘benchmark’ rate. A similar approach could be considered for steel, but is more complex (see box), and less urgent (the much higher value of steel means that steel plants would never find it profitable to run down production in order to sell allowances).

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

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

Efforts should focus first on multilateral negotiations
There is a crucial difference between pursuing border adjustments unilaterally, by regions seeking to protect their industries, or though multilateral engagement. A key recommendation of a Climate Strategies report on ‘Tackling Carbon Leakage’ (Droege et al) is that border adjustments should first be pursued in the context of multilateral negotiations that would define the boundaries on acceptable border adjustments. This has greater potential benefits, and far less risk of challenge under the WTO. The recent French proposal places the full emphasis upon a multilateral approach.

Obviously, this is more complex and could take a number of years, and agreement is far from assured. However, a key principle of the WTO is also that countries should demonstrably try to negotiate agreements, before resorting to unilateral measures; the attempt would thus itself be valuable.

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

designed (to maximise compatibility with WTO), the practical consequences, and related judgments about the motivations.
6. Looking forward

This is one of a number of issues that are yet to be addressed in the evolution of the EU ETS. For the present, the design is established for Phase III, out to 2020, based on the EU’s existing commitment to a 20% reduction by 2020, with continued reductions thereafter but at a rate which is clearly inadequate in relation to the scale of the scientific challenge.

Debate continues about whether and in what circumstances the EU goal might be strengthened. If there is broader international momentum, the EU might move to strengthen its goal, this year (2011) or next, in which case additional design elements might be reconsidered. These could include reviewing some of the policies on carbon leakage, greater direction around the use of revenues for climate-related industrial transformation, and international linkages with systems that may be developed elsewhere.

The EU ETS is here to stay, and European industry has largely got used to it. Few would wish it to be discontinued, as it at least gives some clarity to industry about the direction of policy and provides a framework for business to consider carbon-related risks in investment decisions. Phase III is a considerable improvement upon the earlier phases. Even after three rounds, however, it is clear that there will still be room for improvement, particularly in some aspects of how manufacturing industry is treated. Pricing carbon is a long, and complex journey – but which, as a market-based policy, most actors in Europe recognise as preferable to the alternative of continuous political uncertainty and government micro-management of corporate investment towards a low carbon economy.
7. Lessons and Recommendations

The EU experience – and the economic debates behind it – leads us to identify the following lessons and recommendations. As set out in the Executive Summary:

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

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

3. Prices can be volatile and impacted by numerous unforeseen factors - which to date have reduced prices below expectations.
Recommendation: Consider carefully the lessons from the EU experience on price volatility, around unavoidable uncertainties in emission projections, the contribution of other policies, and systematic tendencies to underestimate the abatement and innovation responses. Additional supporting technology policy will be required to accelerate innovation.

4. GDP impacts are small
Recommendation: Don’t let concerns about macroeconomic impacts dictate the environmental targets – economic impacts have been consistently less than projected.

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

6. Robust regulation of the market is required.
Recommendation: Since emissions trading creates valuable assets, the systems for security must match those of finance.

7. International competitiveness impacts are limited to a small number of industry sectors.
Recommendation: Concerns about competitiveness impacts should focus on a few, potentially exposed industries. For these, tailored solutions should be pursued such as benchmarked free allocation, auctioning with border leveling, or effective sectoral agreements.

8. Free allocation degrades efficiency and introduces risks either of windfall profits or other inefficiencies.
Recommendation: Allocation method should be designed to minimize net impacts on the aggregate profitability of incumbent sectors, whilst boosting the profitability of cleaner technologies and innovators. A balance of free allocation should strive to minimize economic distortions as well as windfall profits. Relative risks are determined by sector specific characteristics namely: the ability of each major sector to pass through prices, its exposure to international leakage, and its potential for emissions abatement through radical innovation or demand reduction.

9. There is a compelling economic rationale to maximize auctioning.
Recommendation: Increase auctioning over time.

10. 'Border leveling’ of carbon costs – rebating on export, or charging on imported goods – is an option for longer term consideration and negotiation in relation to particular sectors at risk of carbon leakage.
Recommendation: Negotiate multilateral arrangements to contain or structure the use of border adjustments, focused upon minimising emissions leakage, by rebating (or charging) carbon costs on exports (or imports) as and when specific problems can be demonstrated.
Appendix 1: Efficiency Matters and Perverse Incentives are Possible

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

In simple economic theory, allocation methodology – whether the allowances are auctioned, or distributed free through grandfathering (based on some historic measure) or otherwise - should not affect the economic efficiency of an emissions trading scheme (Montgomery, 1972). Even if firms receive free allowances, they still have an incentive to cut emissions because any unused allowances can be sold on the market for a profit, so the price of carbon is still internalized in operational and investment decisions. With evidence from the U.S. SO2 and NOx trading schemes providing support for this theory, free allocation seemed to offer an attractive solution for addressing industry concerns about the potential costs of regulating greenhouse gas emissions.

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

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

Thus, inherent in free allocation is a risk of perverse incentives, summarised in terms of a “pyramid of inefficiencies” in Chart 9. Auctioning, in which all actors face the full cost of carbon, offers the purest incentives. Grandfathering free allowances based on historic capacity (including closure and new entrant rules) may distort closure and investment choices, but not operational decisions. However, if allowances are “updated” to reflect production or emissions, this starts to take the carbon price incentive out of operational decisions. (See Appendix II, “Updating and the Early Action Problem.”)
Benchmarking can retain incentives for firms to invest in energy efficiency measures, but is complex.

If the level of grandfathered allocation is linked to the capacity of a plant, multiplied by a benchmark factor (such as a standard emissions per unit of power generated or best available technology), plants have an incentive to improving carbon efficiency. This is in contrast to grandfathering that is linked to the plant’s technology, emissions or production. In the power sector, the fact that all power stations produce the same product (electricity) makes it easy in theory to make such allocations efficiently, if all generators receive the same benchmarked allocation. Several EU Member States used benchmarking for power sector allocation in Phase II of the EU ETS.

However, benchmarks in manufacturing can become much more complex, given the wide range of products and production processes. Complexity and distortions increase when recent data is taken into account to give a moving baseline, and rules are narrowly differentiated by fuel or technology type for older plants to protect the value of existing assets. This starts to remove the flexibility offered by a market-based instrument and undermine dynamic incentives for technological innovation. A few Member States succeeding in introducing benchmarks during Phase II. In Phase III, after a lengthy complex debate, around 250 manufacturing sectors will receive different levels of free allocation depending on their classification of risk of leakage based on 52 product benchmarks set on the basis of the average of the top 10% most greenhouse gas efficient installations in the EU. Sectors classified as being at risk of leakage will receive 100% of the benchmark whilst those not identified as being at risk will receive 80% of their total emissions in 2013 based on the benchmark which declines to 30% in 2020. Total amount of allowances allocated will decline for all sectors in Phase III because they come from a declining overall centrally determined cap. This cap will decline more quickly should the EU choose to move beyond a 20% emissions reductions target.

The different allocation decisions that emerged in across EU Member States in the first two phases of the EU ETS suggest that definition and scope of benchmarks are driven by the political power of incumbent firms as much as by economic rationale.
Appendix 2: Comparative Data on Industries’ Exposure

This technical appendix presents a series of charts and associated text concerning data on the exposure of European, US and Japanese industry to international competitiveness as a result of carbon pricing. These concern, respectively, the UK, Germany, the EU collectively then US and Japan.

Table 2 Impact of a €20/tCO₂ carbon price on major UK energy-intensive products

<table>
<thead>
<tr>
<th>Manufacturing Activity</th>
<th>Maximum value at stake at €20/tCO₂</th>
<th>Minimum value at stake at €20/tCO₂</th>
<th>Trade intensity (non-EU)</th>
<th>Employment</th>
<th>Implied average product price rise to offset €20/tCO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>33.9%</td>
<td>2.0%</td>
<td>1.8%</td>
<td>0.02%</td>
<td>14.54%</td>
</tr>
<tr>
<td>Basic iron &amp; steel and ferro-alloys</td>
<td>26.4%</td>
<td>2.4%</td>
<td>17.4%</td>
<td>0.08%</td>
<td>4.28%</td>
</tr>
<tr>
<td>Refined petroleum products</td>
<td>12.3%</td>
<td>1.4%</td>
<td>19.3%</td>
<td>0.04%</td>
<td>1.07%</td>
</tr>
<tr>
<td>Fertilisers &amp; nitrogen compounds inc. ammonia</td>
<td>11.6%</td>
<td>5.7%</td>
<td>13.2%</td>
<td>0.01%</td>
<td>1.96%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>10.4%</td>
<td>9.3%</td>
<td>23.2%</td>
<td>0.04%</td>
<td>2.07%</td>
</tr>
<tr>
<td>Other inorganic basic chemicals</td>
<td>9.0%</td>
<td>5.8%</td>
<td>20.6%</td>
<td>0.02%</td>
<td>2.36%</td>
</tr>
<tr>
<td>Pulp, paper &amp; paperboard</td>
<td>8.8%</td>
<td>3.4%</td>
<td>15.1%</td>
<td>0.06%</td>
<td>1.98%</td>
</tr>
</tbody>
</table>

Source: Carbon Trust (2008), EU ETS Impacts on Profitability and Trade, Table 2.2008

Five of the key six sectors are exposed mainly through their direct carbon emissions; thus free allocation directly reduces their cost exposure. Aluminium smelting stands out for its electricity-related exposure, which is generally 5-10% of GVA for each $10/tCO₂, if carbon costs feed through to electricity prices. The corresponding electricity-related increase would be less than half this for fertilizers, inorganic basic chemicals, electric arc steel, and pulp and paper; and negligible for primary (blast furnace) steel and cement.
Chart 10 UK Manufacturing activities most cost-sensitive to CO₂ pricing

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

Notes: The vertical axis shows the implied cost increase if sectors pay the full cost of CO₂ at €20/t CO₂ as a percentage of the sector value added. The horizontal axis indicates the scale of the activity’s contribution to the UK’s GDP. The area of each column is proportional to total CO₂ emissions. The blue bars show the cost of carbon that will be paid through higher electricity prices (equivalent to €10/MWh at €20/t CO₂). The grey bars show the cost due to the carbon emitted through direct fossil fuel consumption and manufacturing processes.

In this study, cost impacts were calculated for altogether 159 sub-sectors (defined using Standard Industrial Classification at 4-digit level). Both direct CO₂ emissions (combustion and process) and indirect emissions from the consumption of electricity were considered. Out of these, the top 25 collectively account for 1% of UK GDP, 0.5% of employment and 50% of UK manufacturing emissions.

A similar analysis of cost impacts on the German manufacturing sector show comparable results in terms of sector total production cost effects, although the ranking order may differ slightly.14 Ranking high in both countries is refining. However, for this sector, whilst economically big and, a carbon cost of approximately 28$/t CO₂ is unlikely to have much impact on the trade of oil products - among other factors, a cost of about $28/t CO₂ on refinery emissions is well under €1 per barrel of oil equivalent, making it small compared to daily fluctuations in crude oil prices (and differences in tax).

In addition in both countries, Aluminium smelting stands out for its electricity-related exposure, but electricity price increases would also increase sector input costs by 3–6% of GVA for fertilizers, inorganic basic chemicals, and pulp and paper. To offset such carbon costs, these latter sectors would have to raise average product prices by about 1% for each $14/t CO₂ paid, which may become significant for highly tradable products – particularly at higher carbon prices or if other costs (such as extension to non- CO₂ gases) are added.

14 Note that due to data availability, there are some differences in the level of sector disaggregation. For example, Coke, Refined petroleum products and Nuclear fuel (SIC 23) is included at 2-digit level for Germany. Similarly, Pulp, Paper & Board (SIC 21.1) is represented at 3-digit level for the UK.
Chart 11 Germany industry vulnerability

![Diagram of Germany industry vulnerability]

Source: Graichen et al (2009)

Chart 12 Trade intensity and value at stake (relative to GVA) for UK’s top 25 sectors in 2004

![Diagram of trade intensity and value at stake]

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

Source: based on Climate Strategies (2007)
Combining assumptions on carbon price, demand sensitivity, trade sensitivity allows the estimation of leakage rates.\textsuperscript{15} For UK steel, assuming 50% pass-through of carbon costs at the equivalent of approximately $42/t CO\textsubscript{2}, domestic steel consumption declines by about 2% but EU production declines by 2.5–9% across the range of trade sensitivities considered; this would yield net profits if the sector receives significantly above 50% free allocation. The abatement cost curves in the model suggest higher scope for steel abatement than for cement, and the efficiency gains significantly outweighs leakage from import penetration, except under the combination of the most extreme assumptions around all three variables of price (equivalent of $63/t CO\textsubscript{2}), cost pass-through (100%), and trade sensitivity.

\textit{Chart 13 Relative cost-sensitivity of Japanese manufacturing activities to CO\textsubscript{2} pricing (Detailed Input-output sectors)}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart13.png}
\caption{Relative cost-sensitivity of Japanese manufacturing activities to CO\textsubscript{2} pricing (Detailed Input-output sectors)}
\end{figure}


A striking feature of the Japanese data is the composition of iron and steel – a huge sector in which the ‘carbon cost per tonne of value added’, for pig iron in particular, appears much higher than other countries, implying higher sensitivity to carbon costs but also much lower economic value added per unit of energy (or carbon emissions). The reasons for this – assuming the data to be correct - would require further study but may reflect in part the export-orientation of the industry and the difficulty of maintaining high value-added when facing export competition. The consequent implications for climate policy seem similarly complex.

\textsuperscript{15} In terms of the environmental impact of changes to trade patterns, increased imports and/or loss of exports may represent of emissions leakage from within the EU to outside the EU. Yet this does not necessarily mean global emissions will increase, e.g. importing electricity-intensive products may reduce global emissions if they come from largely carbon-free electricity systems such as in Norway or Iceland. Focusing on leakage helps to align economic and environmental goals and keeps the focus on issues around the emissions trading scheme, rather than on other trends and influences on trade and competitiveness.
References


Climate Strategies is an international organisation that convenes networks of leading academic experts around specific climate change policy challenges. From this it offers rigorous, independent research to governments and the full range of stakeholders, in Europe and beyond.

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