The EU Emissions Trading System and Climate Policy towards 2050

Real incentives to reduce emissions and drive innovation?

CEPS Special Report

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Cover photo: A modern coal-fired power plant in Pątnów, Poland.

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Preface

The EU emissions trading system (ETS), the world's largest multi-sector greenhouse gas trading scheme, enters its seventh year of operation in 2011. This passage of time is now sufficient to allow for a first comprehensive evaluation of the different phases of the EU ETS as well as an assessment of the current and future challenges facing what is arguably the EU's most important policy instrument to combat climate change. Based on a literature review of recently published *ex-post* analyses and *ex-ante* studies and drawing upon our own calculations, this report reviews the experiences of the scheme's pilot phase from 2005-07, assesses the adjustments introduced in the second phase (2008-12) and looks ahead to the radical changes that will come into effect in the forthcoming third trading period starting in 2013. In the process, it also asks what lessons the first two phases can genuinely offer, in light of the fact that the third phase will work under radically different rules. The analysis covers the principal controversies that the ETS has provoked both in the EU/EEA and in international negotiations, such as its environmental effectiveness, economic rents, windfall profits and fairness, the role of CDM and JI and its impact on industrial competitiveness. It also evaluates the scheme's ability to promote innovation and low-carbon technology deployment. Ultimately, the study addresses the question of whether the EU ETS has lived up to its promise to "promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner", and if not, what are its prospects of doing so in the future and what additional changes will be required.

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Executive Summary

The objective of the EU emissions trading system (ETS) is to "promote greenhouse gas (GHG) reductions in a cost-effective and economically efficient manner".[1] This has both a short- and long- term perspective. In a short-term perspective (i.e. until 2020), this would mean aiming at the lowest possible EU allowance price to reach a given objective. While this may be sufficient in the short-term, for example to reach the 2020 targets, it masks the fact that over the long term – 2050 and beyond – an efficient climate change policy will need to accelerate the development and diffusion of new breakthrough technologies. If it does not, the EU risks being locked-in into high-carbon technologies, which, once carbon carries a higher price – explicitly through taxation or emissions trading or implicitly through regulation – EU industry would become uncompetitive. The current political debate on whether to increase the EU's unilateral target of reducing GHG emissions from 20% to 30% reflects this tension. Will the ETS be able to achieve its short- and long-term targets better by not touching its target, i.e. will a tighter cap be needed to increase the allowance price to stimulate innovation? This is the central question of this report, which, although ultimately not answered, will be discussed based on the initial experiences of existing *ex-post* studies from the first and, to some extent, the second phases of the ETS.

As the flagship instrument for domestic and international climate change policy of the EU and the European Economic Area (EEA), the EU ETS had a bumpy start, especially in its first (pilot) phase (2005-07), suffering from a number of 'teething problems'. These were partly the result of the rapid speed with which the ETS was adopted, motivated by the EU's desire to show a strong determination to tackle climate change. This should, however, not hide the fact that the ETS suffered from some serious design flaws, which were largely the result of two politically unavoidable choices: a high level of decentralisation and free allocation based on grandfathering, i.e. historical emissions. Initial allocation of allowances by member states on the basis of National Allocation Plans led to a 'race to the bottom', i.e. member states were under pressure by industries not to hand out fewer allowances than their EU competitors received. This led to a general over-allocation, and ultimately to a price collapse. During the period when the EU allowance price was high, free allocation also generated 'windfall profits', mainly but not only in the power sector. Some of these issues were addressed in phase 2 (2008-12) as a result of member state cooperation and the European Commission being able to reduce member states' allocation proposals. (The Commission's stance in the end survived a number of court cases.) Still, throughout both phases, by and large, the ETS has managed to deliver a carbon price. One result has been that carbon price has now officially entered board room discussions.

Experiences from phase 1 and 2 have greatly helped the European Commission to propose and adopt radical changes to the EU ETS, which were not even thinkable before its initial adoption in 2003. The 'new' ETS starting in 2013 has a single EU-wide cap, which will decrease annually in a linear way by 1.74%, starting in 2013, without a sunset clause. Such a target, however, is not believed to be in line with EU/EEA long-term climate change targets.

[1] See Art. 1 of the EU Emissions Trading System Directive (European Commission, 2003b).

The revised ETS Directive also foresees EU-wide harmonised allocation rules. Starting from 2013, power companies will have to buy all[2] their emissions allowances at an auction. For the industrial sectors under the ETS, the EU agreed that the auctioning rate will be set at 20% in 2013, increasing to 70% in 2020, with a view to reaching 100% in 2027. The remaining free allowances will be distributed on the basis of EU-wide harmonised benchmarks, set on the basis of the average performance of the 10% most GHG-efficient installations. Industries exposed to significant non-EU competition and thereby potentially subject to carbon leakage, however, will receive 100% of allowances free of charge up to 2020, based on Community-wide product benchmarks set on the basis of the average performance of the 10% most GHG-efficient installations. This will place the larger part of industry, with estimates ranging from some 70% to more than 80%, under the ETS.[3]

Since the ETS will operate under different rules in its third phase, the first two phases offer a limited number of lessons for the future. Nevertheless, some findings are pertinent.

Has the EU ETS led to reductions?

A number of studies provide evidence that the ETS has led to abatement of significant magnitudes in each of the first three years. This finding is based on an observed emissions-intensity improvement above historical trends. CEPS' own calculations, which extend these estimates to the period 2008 and 2009, show even greater intensity improvements in that new ETS phase, than the ones realised in the trial period. This causality has been criticised on grounds that changes are difficult to attribute. Indeed, it is difficult to disentangle factors that have influenced CO_2 reductions other than the ETS. A number of studies present evidence of abatement based on case study analysis and interviews, but they do not allow for quantification. According to these studies, investment has happened in energy efficiency and in large-scale coal power generation, i.e. where pay-back is fast or carbon-intensity is high. Surveys also show that the ETS affects the behaviour of firm managers and encourages investments in energy efficiency but also that behaviour is not consistent across industries. The same survey shows that companies try to exploit design to gain economic rents. Preliminary results of a statistical regression of the link between abatement ETS allowance prices and other input factors finally indicates that the ETS has effects on large but not on small investments. This may point to the importance of longer-term price expectations. To get a better understanding of the relationship between abatement and CO_2 price, it will be important to assess whether the ETS is indeed able to identify cheap reduction options – i.e. to fulfil its assumed market search function to identify low-cost potentials. Such a situation may partly explain the relatively high carbon price to date (in addition to the fact that allowances can be banked).

Economic rents and windfall profits

The *ex-post* analyses on economic rents and windfall profits are relatively clear, while also more or less consistent with *ex-ante* studies that assessed the potential windfall profits for the ETS sectors at the time. Ellermann, Convery and de Perthuis (2010), the most authoritative *ex-post*

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[2] The auctioning rate for *existing* power generators in some Eastern European countries can be lower, but it will be at least 30% and will be progressively raised to 100% to accommodate the high level of coal in power.

[3] Other changes include a partial redistribution of auction rights between member states, restrictions of the total volume of CDM/JI credits, the use of 300 million EU allowances to finance the demonstration of carbon capture and storage (CCS) and innovative renewable technologies and a general – non-legally binding – commitment from EU member states to spend at least half of the revenues from auctioning to tackle climate change both in the EU and in developing countries.

study conducted so far, conclude that in total the rents were substantial, even at a relatively modest carbon price of €12, and amount to more than €19 billion in windfall profits, plus more than €10 billion of 'informational'[4] rents, although with the caveat of surrounding uncertainties in the calculations. Other *ex-post* studies do not significantly disagree with this finding. During phase 1, all technologies and all participants included in the ETS – power and industry alike – benefited from ETS-related rents. Those rents for the power sector that accrued as a result of free allocation will disappear with the auctioning in the ETS phase 3. This is not the case, however, for those rents in the power sector of low carbon power-generation technologies, such as hydro or nuclear, which will enjoy additional revenues as a result of higher power prices due to the ETS but do not face additional costs. But they are a logical consequence of a policy that puts a price on carbon in a market where the marginal producer sets the price. Still some member states consider taxing these rents. Whether windfall profits for industrial sectors will continue and especially the size of them remains subject to debate. The benchmark-based allocation – in place as of 2013 – will reduce potential rents, sometimes significantly. Still, different studies come to diverse conclusions. This is partly so because windfall profits depend on the ability to pass through product price increases due to the ETS allowance price, an issue that is particularly controversial.

Flexible mechanisms such as CDM

From the outset, the EU ETS has experienced a difficult relationship with CDM and JI credits. While there are many issues around CDM/JI, the most important one in our view is the trade-off between 'cost-effectiveness' and 'incentives for EU/EEA industry' to reduce emissions, thereby avoiding EU/EEA lock-in in high-carbon growth patterns. Thus, from the beginning of the EU ETS specialists have debated how much of the abatement should be done domestically – i.e. is there a need for quantitative restrictions? – and on project type and quality – i.e. is there a need for qualitative restrictions? Early on, however, the EU and EEA tied themselves to the UN-based crediting mechanisms, not only to show support for the UN system but also to work towards one integrated system of offset mechanisms. However, 'failure' to act on 'controversial' emissions on the part of the UN eventually undermines the credibility of offsetting mechanisms and therefore the ETS. This is why qualitative restrictions, on for example industrial gases projects, have been adopted. On the other hand, they can pose a risk of retroactive market regulation. A one-off re-regulation seems defendable, but if this develops in a pattern of *ex-post* regulation (or adjustment) of eligibility, the efficiency of the market will eventually suffer. As a consequence of choosing a market-based instrument like the ETS, the market will identify the cheapest abatement options that offer the highest return.

Industrial competitiveness

In the EU/EEA under the ETS, the incentive for efficient abatement arises from the 'opportunity cost' of using allowances. If firms in a European industry cannot pass through the allowance price partly or fully, they eventually end up 'paying' for the costs of the allowance price. Failure to pass through would erode benefits from CO_2 abatement as well as producers' competitiveness, transfer allowance value abroad and ultimately lead to carbon leakage. Free allocation addresses these problems. It constitutes compensation or subsidy, potentially creating an incentive to continue producing in Europe. Yet, free allocation *per se* does not fully prevent industries in global competition from shifting their production. The reason is that production

[4] 'Informational' rents describe the fact that during the first period of general over-allocation, which should have produced a zero price, the EU allowance price remained at around €12. Companies that have received allowances for free – both industry and the power sector – could make large trading profits by selling their allowances. This appears to be a one-off rent.

decisions are not based on average industry margins, but on marginal costs for the last unit. Industry choices will depend also on structural effects including the need for investing in new emerging markets, commodity prices, but also assumptions on how fast a global agreement is forged and how it will look.

Historical grandfathering in the first two phases has led to significant windfall profits. This is why phase 3 allocation is based on benchmarking where firms receive free allowances only up to a benchmark that is calculated on the basis of the '10% most efficient' installations. This is a way to reduce windfall profits as a result of free allocation, with the amount of the compensation or subsidy being set by the level of the benchmark.

Can the ETS drive innovation?

While the EU ETS objective is 'cost-effectiveness', ultimately, any climate strategy will have to be measured against its capacity to foster first the development and then investment in new low-carbon technologies. Cost-effectiveness in the long-term will require a radically altered capital stock if the EU/EEA do not want to be locked into an obsolete capital stock. Does the ETS induce technological change of the magnitude that is required? In the absence of a comprehensive legally binding and enforceable global agreement, it is probably too optimistic to expect the ETS to drive innovation in green technologies *on its own*. For this to happen, actual and projected CO_2 prices would need to be much higher, with a higher visibility, i.e. providing more predictability over more than a decade or so. This is so despite the fact that the ETS has set a long-term cap by establishing a linear reduction factor of 1.74 per annum. It is mainly the CO_2 price as well as price expectations – to an extent along with the allocation during the allocation period – that informs a company's decision whether or not to invest. In this context – at least until a global climate change agreement is found – additional tools are needed to accelerate the natural rate of investment and technological change as well as additional dedicated innovation measures and possibly new instruments such as for example the European Strategic Energy Technology Plan (SET-Plan). This report identifies a number of such tools and measures and presents their principal pros and cons.

Key Messages

- The EU/EEA is determined to make the ETS a success. The ETS has become the EU/EEA flagship instrument to reduce GHG emissions in the power, industrial and selected other sectors, based on broad consensus. This makes it politically difficult if not impossible to replace it by another tool.
- There were numerous weaknesses in the initial pilot phase (2005-07) as well as the second phase (2008-12). Most of these have been addressed to be ready for the third phase starting in 2013. However, the perception of inefficiency and ineffectiveness continues to exist because most of the analysis in the literature is based on phases 1 and 2.
- A number of *ex-post* analyses as well as our own calculations conclude that the ETS has led to abatement, measured by intensity improvements. However, causality in terms of disentangling other factors than the ETS that could have influenced CO_2 reductions remains a problem. There are indications based on case studies and interviews that the CO_2 price generated by the ETS has influenced business and investment decisions. But this effect is not in evidence across all industries.

- The ETS in the first two phases has generated windfall profits for both the power generators and the industrial sectors, although the former benefited more than the latter. Different allocation rules, such as auctioning and benchmarking, will in some cases erode windfall profits and in others, reduce them. Nevertheless, some windfall profits will continue. The debate on the potential size of these reductions continues.
- CDM, JI and other potential post-2012 mechanisms represent a trade-off between 'cost-effectiveness' on the one hand, and 'incentives for EU/EEA industry' to reduce emissions, thereby avoiding EU/EEA lock-in in high-carbon growth patterns, on the other. This debate on where to find the correct balance and what mechanisms to allow is likely to continue.
- The EU ETS has chosen free allocation as a tool to address industrial competitiveness. Free allocation constitutes compensation for industries can create an incentive to continue producing in Europe. But it is an imperfect tool to prevent industries in global competition from shifting their production as industries are free to use the compensation in whatever way they want. Phases 1 and 2 have also demonstrated that free allocation risks generating windfall profits.
- In the end, the ETS and EU/EEA climate change policy will also need to be measured in terms of its ability to accelerate the development of and investment in new low-carbon technologies, beyond the current rate of capital stock turnover. In the absence of a comprehensive and legally global climate change agreement, EU allowance prices most likely remain too low to drive innovation to the extent required. Additional measures will be needed.

The EU Emissions Trading System and Climate Policy towards 2050

Real incentives to reduce emissions and drive innovation?

1. Introduction

The EU emissions trading system (ETS) is arguably one of the most important pieces of EU economic regulation in both scope and scale and by now is the world's largest multi-sector greenhouse gas (GHG) trading scheme. It sets a cap on the total level of emissions that can be emitted in the power sector and energy-intensive industries in EU and European Economic Area (EEA) countries. Over time, this cap is lowered to ensure that reduction objectives are met. At the same time, the cap generates a price, which should drive green investment. It principal objective is to "promote GHG reductions in a cost-effective and economically efficient manner".

More recently, there has been growing concern whether the ETS will be able to drive low-carbon investment, which is a precondition for Europe to reach its long-term climate change objectives. In order to keep its promise of cost-effectiveness in the long-term, the ETS – as part of a broader climate change package – must enable the development and deployment of low-carbon technologies to achieve GHG reductions in line with EU objectives, i.e. by 80-95% by 2050. Concerns have been fuelled by a number of initial teething problems – by now largely addressed by design flaws that have now been corrected in the ETS review and finally, by the economic crisis, which has sent ETS allowances prices tumbling. Some argue that the cap should be lowered by increasing the EU unilateral GHG emissions target from -20% to -30% to counterbalance uncertainty on a future global climate change agreement. Others argue for additional far-reaching changes, such as an EU carbon bank to ensure a 'balance of supply and demand'. A third group maintains that the most critical point is to create predictability both in the present and in the long-term.

This report takes stock of the ETS as it prepares to enter its seventh year of operation. Based on a literature review, including both *ex-post* analysis and *ex-ante* studies, it attempts to distinguish between what we know, where evidence is scarce or non-existent and where more research is needed. It focuses on what lessons the past can realistically tell us for the future. Thereby the study will address the question of whether the scheme has lived up to its promise in Article 1 of the ETS Directive to "promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner",[5] and if not, whether it can potentially do so in the future or whether additional changes will be required.

After a brief review of the history of the ETS in section 2, the report deals with the most controversial issues: Is there evidence for abatement (section 3)? What economic rents (or windfall profits) did it create and is it likely to generate more in the future (section 4)? What is the role of offset mechanisms (section 5)? How will the EU ETS affect industrial competitiveness (section 6)? The report concludes with considerations on whether the ETS promotes innovation and low-carbon technology deployment.

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[5] Recital 5 of the consolidated version of the Directive reads: "This Directive aims to contribute to fulfilling the commitments of the European Community and its Member States more effectively, through an efficient European market in greenhouse gas emission allowances, with the least possible diminution of economic development and employment."

2. Early EU ETS experiences

The EU ETS is implemented as a cap-and-trade system. This means establishing an aggregate limit, i.e. a cap on the total level of emissions that can be emitted. The cap is represented by transferable, i.e. tradable emissions allowances in the form of EU Allowances (EUAs) that covered installations are required to hold equivalent to their emissions. The cap is lowered over time, aiming towards the national emissions reduction target.

Implemented in 2005, the EU ETS covers GHG emissions of both the power sector and most energy-intensive industries in the EU, Norway, Iceland and Liechtenstein. The ETS has a global reach as it allows for the offsetting of EU emissions by crediting emissions reductions outside the EU/EEA, e.g. credits from the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) and as of 2012, aviation including all international flights from and to an EU destination. To accommodate for fluctuations in annual GHG emissions, emissions allowances allocations are calculated for a sequence of several years at a time, i.e. trading phases. Phase 1 ran from 2005-07, phase 2 will run from 2008-12 and phase 3 from 2013-20.

The ETS is also the central element of the EU's international climate change strategy, which is built around the concept of a gradually emerging global carbon market, whereby different regional or national carbon markets integrate over time through linking of systems and mutual recognition of allowances and credits. At the end of this process, i.e. once all world regions have joined, there would be a global – over time decreasing – cap. The scarcity derived from this global cap would generate a global carbon price, forming a critical factor in investment decisions by companies and consumers.

2.1 Why emissions trading in the EU?

Cap-and-trade systems such as the ETS are designed to provide incentives for companies to reduce emissions in the most cost-effective way, reward carbon-efficiency and create incentives for new and innovative approaches to reduce emissions. It ensures that the market price of carbon is equal to the lowest marginal abatement cost amongst all controlled sources, because it provides for a mechanism by which emitters – factory operators, oil refineries, etc. – can identify the most cost-effective way to reduce their emissions, and thus factor carbon-reduction strategies into day-to-day business decisions. The resulting carbon price should create long-term predictability for business, a crucial factor in efficient investment decisions. The incentive for efficient abatement will arise from the 'opportunity costs' of using allowances. Passing through the costs of GHG emissions allowances to consumers will create incentives to reduce the demand for GHG-intensive goods. At the same time, this will increase producers' cash flow to invest in abatement technologies. In a situation whereby all competitors are subject to similar carbon constraints in well functioning markets, the EU ETS would – at least theoretically – be the most suitable tool to achieve EU and UN-based targets at the lowest possible costs. Thereby, emissions trading would go beyond existing environmental policy – mainly seen as an inescapable overhead – by establishing a long-term and predictable price signal upon which firms would base investment decisions while maintaining significant flexibility to achieve the environmental objective.

Another advantage is that a cap-and-trade system such as the ETS provides environmental certainty by capping the overall emissions level from the covered sources.

From an internal market perspective, emissions trading can be expected to minimise the distortions to competition in the EU market as it imposes an EU-wide carbon price for all industries alike, doing away with national policies that risk creating different national carbon 'shadow' prices.

There are other specific reasons why the EU opted for an emissions trading system. There was perhaps even something inevitable about the ETS, as all other policy instruments to address greenhouse gas emissions in the context of the Kyoto Protocol at the EU level of governance had failed. Most spectacularly, the 1992 carbon/energy tax proposal by the European Commission failed to be adopted and was later withdrawn as the unanimity rule for taxation decisions[6] was too high a hurdle to overcome. Similarly, voluntary agreements or "negotiated environmental agreements", for some time proposed by EU industry have made very little impact at the EU level of governance, as the use of this instrument was far from any consensus in the EU institutions. In these circumstances, a cap-and-trade programme was seen as the most suitable EU instrument, particularly aligned with the emissions cap under the Kyoto Protocol and the concept of cost-effectiveness.

As a result, since the adoption of the original EU ETS Directive in 2003, a broad consensus has emerged in the EU and EEA to use carbon pricing in the form of emissions trading, i.e. a cap-and-trade scheme, as the foundation of its climate policy. The EU ETS was adopted unanimously by the Council of Ministers and by a very large majority in the European Parliament. Equally, the revision as part of the EU climate and energy package has been adopted within roughly one year in a single reading, another sign that the consensus within the EU institutions still prevails.

The EU ETS has been the result of intensive consultation on the part of the European Commission with stakeholders both before, during and after the European Climate Change Programme (European Commission, 2001[7]), followed by intensive discussions within and between the Council of Ministers and the European Parliament. In general, business was favourably disposed to the scheme, as were environmental NGOs.[8]

2.2 Teething problems

It is often forgotten that the ETS market is not a market that develops naturally because of supply and demand. Permit or allowance markets such as the ETS do not evolve on an *ad hoc* basis but instead emerge as a result of a specific government objective. In the case of the ETS the government aims to restrict the right to emit GHGs. This artificially creates a new set of assets (emissions permits are "quasi property rights") and is necessarily accompanied by rules on how these assets are established, treated and traded. Once the policy goal is defined and the assets are established, an allowance market should in principle work like any other market. However, there is always a significant level of government intervention first to set the cap and allocate allowances (permits) and then to set the rules to ensure signals to direct investment and finance the development and diffusion of new technologies (e.g. by forward selling), risk management and the minimisation of transaction costs. In the case of the ETS, initial rules were changed rapidly as some elements proved inefficient.

The ETS was adopted very quickly, partly as a result of the EU's determination to tackle climate change. As it turned out, this posed great challenges to governments and industry in preparing for it. There were a number of significant delays, following the start in 2005. Most importantly, member states registries and National Allocation Plans (NAPs) were delayed in some cases by more than a year. Delays were also caused by the need to adapt many national

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[6] Under the EC and now EU Treaty taxation measures need to be adopted unanimously, meaning de facto that each member state has a veto on taxation.

[7] European Commission (2001), *European Climate Change Programme: Report*, Brussels, June.

[8] A detailed overview on provisions and procedures and the history of the ETS are provided in Delbeke (2006). The political economy is explained in Skjærseth & Wettestad (2008). The most authoritative *ex-post* analysis is provided by Ellerman, Convery and de Perthuis (2010).

laws. Further "teething problems" included inconsistency of installation definitions, issues related to monitoring, reporting and verification, and insufficiently operating CDM and JI programmes. Finally, the absence of the International Transaction Log, to be set up by the UN system to verify the validity of emissions transactions governed by the Kyoto Protocol, meant that credits from CDM could only be traded as forward transactions.

The initial phase 1 also saw volatility, a phenomenon often observed in new trading schemes. In the initial phase, only the power sector engaged in active trading with other participating companies. Rising gas prices and falling coal prices had compelled power plants to burn more coal, which in return meant more emissions. The power sector therefore had been generally short of allowances. This gave market participants the false impression that there was an overall shortage in the market, pushing EU allowances prices to a record of almost €30 per tonne despite the market being in oversupply. Market participants from those countries with less stringent allocation, including but not limited to potential sellers from the new EU member states, had not yet engaged in trading, both as a lack of registries and in some cases, the absence of installation level allocation.

There were also questions on data. Data collection issues were most apparent when member states started to allocate allowances for free as the Directive foresaw. Only three member states could rely on verified data. In other member states, data collection was a "voluntary" effort by all stakeholders, leading to an intensive government-industry dialogue. While member states were cross-checking data they received from industry, this took time with no guarantee that the data was accurate. This was compounded by the inclusion of small installations, which has led to overall high administrative burdens on both governments and small installations.[9]

Still, although there have been plenty of "rough edges", the EU ETS managed to deliver "a transparent and widely accepted price for tradable CO_2 emissions allowances" as well as the necessary "infrastructure of market institutions, registries, monitoring, reporting and verification" (see Ellerman & Joskow, 2008).

Most importantly, the EU ETS has introduced carbon management systems within companies. The fact that the EU ETS created a price for carbon makes carbon management both a legal necessity, requiring monitoring, reporting and verification of emissions and the registration of allowances in the registry, and a management priority. It was said that "carbon has arrived in company board rooms". Investors will want and need to know about performance, liability and risks (Egenhofer, 2007), as managers try to exploit opportunities through better management and participation in the trading market. In some cases, better carbon management has revealed hitherto unnoticed reduction potentials (Browne, 2004).

2.3 Initial design problems

These successes cannot hide the fact that the original EU ETS Directive and its implementation in the first phase had a number of deficiencies, including notably over-allocation, distortion of allocation between member states, windfall profits and deferred investment (see Matthes et al., 2005; Swedish Energy Agency, 2007; Ellerman, Buchner and Carraro, 2007; Egenhofer, 2007 and Ellermann, Convery and de Perthuis, 2010).

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[9] Small installations emitting less than 10,000 tonnes of CO_2/year make up 32% (or about 3,400 participants) of all EU ETS installations and account for about 1% of all emissions. Installations emitting under 25,000 tonnes CO_2/year make up 55% of all installations while emitting only 2.4% of all EU ETS emissions (see Worrel & Woosen, 2005). Hence, by excluding 55% of the smallest installations, the total number installations of covered installations could have been reduced to around 4,700 while covered emissions would remain as high as 97.6% of the current coverage.

- For phase 1 and 2, initial allocation was provided for by National Allocation Plans (NAPs), to be submitted by member states and approved by the European Commission. During this phase, allowances were allocated for free based on historical emissions ("grandfathering"). In their NAPs, member states pitched their caps somewhere between "less than the business as usual" and moving towards a "path consistent with the Kyoto Protocol". Most NAPs foresaw modest caps and high dependence on projections. It turned out that most if not all projections were largely inflated (LETS Update 2006). This combination of modest cuts and inflated projections has led to over-allocation of as much as 97 Mt of CO_2 out of a total of about 2.2 billion annual EU allowance, i.e. almost 5% of total annual allowances (Kettner et al., 2007). Ellerman, Buchner and Carraro (2007: 354) found that allocation for the first period were close to expected business-as-usual (BAU) emissions, even for those member states that were far off their Kyoto paths, not accounting for uncertainty of future emissions and growth paths.
- The experience of allocation in the first phase has been that each member state has developed its own rules, notably for allocation to new entrants and closures and that these rules varied considerably between member states. This high degree of discretion for member states has increased complexity, administrative burdens and transaction costs while it decreased transparency. Moreover, industry has been able to put pressure on governments not to hand out fewer allowances than other governments did (e.g. Zetterberg et al., 2004; Matthes et al., 2005).[10]
- There was also criticism that the EU ETS discourages rather than encourages investment as a result of uncertainty. Although a fair degree of uncertainty is due to international indecision on a post-2012 agreement, some of the causes for deferral of investment were related to the ETS. Initial allocation periods provided certainty for only three – and then five years – periods that are far shorter than those associated with investment cycles. Other uncertainty stemmed from possibly perverse effects from new allocation methodologies, notably new entrants and closure rules.
- Free allocation in the first two phases has generated 'windfall profits' mainly but not only to the power sector. Power generators could pass on the full CO_2 costs while having received allowances for free. Windfall profits have been estimated to amount to as much as €13 billion annually (e.g. Keats & Neuhoff, 2005). This in return has heightened interest in the auctioning of allowances (as opposed to free allocation) and finally in the (almost) full auctioning of the allowances to the power sector as of the third phase 2013-20.

2.4 Phase two improvements

The second round of National Allocation Plans in the period from 2008-12 has seen some improvements in the implementation by EU member states and the EU. Member states had less leeway on allocation as a result of the need for consistency towards the Kyoto path. Most importantly, over-allocation has been avoided since the European Commission could impose a formula to assess member states' allocation plans and thereby *de facto* impose an EU-wide cap.

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[10] For example, under phase 1 rules, a new natural gas combined heat and power plant – producing both electricity and heat – would, in Germany, receive allowances corresponding to 130% of its expected emissions. The corresponding figures are 120% for Finland, 90% for Denmark and 60% for Sweden. For a new natural gas combined cycle electricity production unit (no heat), the differences are even larger. In Germany the installation would receive 105% of the required allowances. In Finland 100%, in Denmark 82%, and in Sweden 0% – Sweden does not give allowances for non-combined heat and power (Zetterberg et al., 2004).

For all NAPs in phase 2, the European Commission has used explicit "objective" projections based on 2005 verified emissions across the board for all member states.[11] As a result, the European Commission could shave off 10% of member states' proposed allocations, which was believed to leave the ETS sector short of around 5% for the second period. Some member states have challenged the use of the formula and the European Court of Justice ruled in their favour and in consequence, new National Allocation Plans were adopted. As a result of the NAPs for phase 2, the expected price for allowances had amounted to around €20-25 per tonne of CO_2. However, the economic crisis caused the prices to tumble and seems to have left the EU ETS in a situation where prices might not 'recover' for a prolonged period.

The second phase (2008-12) has also seen the inclusion of nitrous oxide emissions from certain processes. There is the potential for member states to exempt small emitters and hospitals so as to reduce the regulatory burden. The installations currently in the scheme account for almost one-half of the EU's CO_2 emissions and 40% of its total greenhouse gas emissions. Airlines will join the scheme in 2012.

This was also the time period when Norway, Iceland and Liechtenstein joined the ETS.

2.5 Radical overhaul

Experiences from phases 1 and 2 and identified design flaws have greatly helped the European Commission to propose and adopt radical – one could even argue revolutionary – changes to the EU ETS (see Skjærseth & Wettestad, 2010 for a detailed analysis). The principal element of the new ETS is a single EU-wide cap which will decrease annually in a linear way by 1.74% starting in 2013. This linear reduction continues beyond 2020 as there is no sunset clause.

In addition, there are EU-wide harmonised allocation rules, full auctioning to sectors that can pass through their costs (e.g. the power sector), and partially free allocation to industry based on EU-wide harmonised benchmarks. Starting from 2013, power companies will have to buy (almost) all their emissions allowances at an auction, there are however some derogations for some Central and Eastern European member states. In these countries, the auctioning rate in 2013 for existing power generators will be at least 30% and will be progressively raised to 100%. This means, for example, that existing coal-fired power plants in Poland will still receive their allowances for free, but that new power plants will need to buy them. For the industrial sectors under the ETS, the EU agreed that the auctioning rate will be set at 20% in 2013, increasing to 70% in 2020, with a view to reaching 100% in 2027. Implementation procedures are currently been put into place (e.g. Deutsche Bank Research 2010). Industries exposed to significant non-EU competition and thereby potentially subject to carbon leakage, however, will receive 100% of allowances free of charge up to 2020, based on Community-wide product benchmarks, set on the basis of the average 10% most greenhouse gas efficient installations. This will include by far the greatest part of the covered sector, i.e. around 70% to 80% or even more.

- Furthermore, 12% of the overall auctioning rights will be re-distributed to member states with a lower GDP per capita (10%) and those that have undertaken early action (2%). The system will be extended to the chemicals and aluminium sectors and to other GHGs, e.g. nitrous oxide from fertilisers and perfluorocarbons from aluminium.

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[11] The projections are based on verified 2005 ETS emissions x GDP growth rates for 2005-10 x carbon intensity improvements rate for 2005-10 + adjustment for new entrants and other changes, for example in ETS coverage.

- There is a non-legally binding commitment from EU member states to spend at least half of the revenues from auctioning to tackle climate change both in the EU and in developing countries.
- Up to 300 million allowances from the new entrants' reserve of the EU ETS will be used to support the demonstration of carbon capture and storage (CCS) and innovative renewable technologies.
- Member states can financially compensate electro-intensive industries for higher power prices. The European Commission is drawing up EU guidelines as to this end.

As already in the previous periods, access to project credits under the Kyoto Protocol from outside the EU will be limited. The revised ETS will restrict access to no more than 50% of the reductions required in the EU ETS to ensure that emissions reductions will happen in the EU. Left-over CDM/JI credits from 2008-12 can be used until 2020. Exact figures are subject to discussion.

2.6 Possible future changes

Changes for phase 3 are not the end point of ETS reform.

First, several implementation provisions, e.g. on allocation or monitoring and reporting of emissions, have not been finally adopted. New gases and sectors will require amendment of the Monitoring and Reporting Guidelines (MRGs).

Second, the ETS Directive has also developed a framework for possible changes without amending the Directive. This includes for example the possibility for member states to opt-in new gases and activities under certain conditions, a clause that has already been applied in the past. A second possibility constitutes a kind of domestic offset schemes, the so-called Community-level projects under article 24a, where member states can issue credits for reductions projects outside ETS coverage. Another clause (Art. 27) allows for the exclusion of small installations from the ETS. Finally, the ETS features an enabling clause for linking the ETS with other regional, national or sub-nation emissions trading programmes through mutual recognition of allowances (Art. 25). Another potentially contentious issue will be the compensation of electro-intensive industries by member states. Although the European Commission will draw up guidelines, there is a risk of a new round of distortions to competition between member states.

Third, the revised ETS Directive explicitly foresees the possibility for a revision in the case of an international climate change agreement. Depending on the nature of the agreement, this could mean the lowering of the cap, for example if the EU decided to move to a unilateral EU reduction commitment of 30%. The current ETS linear reduction factor of 1.74% annually is almost certainly not in line with EU/EEA and international climate change objectives and climate science. Depending on the content of such an agreement, this could affect a whole number of implementation rules including notably allocation rules, the role of flexible mechanisms, the inclusion of forestry credits and land use changes.

Irrespective of the review provisions in the Directive, the EU might implement additional changes by amending the Directive. If so, the most likely area for change is the inclusion of shipping, including all international services that arrive or start in the EU.

3. Allocation and abatement: What do we know?

The effectiveness of the EU ETS in inducing abatement in the power and industry sectors remains a matter of controversy. Economic theory suggests that from the moment carbon is priced, industry will react and develop strategies to reduce emissions in order to either buy less allowances, or sell excess allowances resulting from its reduction activities. Installations which emit less than their individual cap allows are able to sell their surplus emission allowances – and vice versa. Thus, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions. In reality, this incentive might be undermined by transaction costs, a lack of interest because the economic gains may be low, or strategic behaviour. Especially, during phase 1 and 2, where the majority of allowances have been distributed for free, some argued that industry did not always pass through the full allowance price and instead used the free allowances to subsidise production to gain market share.

Economic theory would also suggest that abatement is a linear to the actual and future level of the carbon price. With the price being determined by the scarcity of allowances, one needs to ask what leads to this scarcity. The major determinant of absolute emission levels in the absence of policy is the level of economic activity. Allocation, i.e. the overall cap and the distribution among sectors and individual emitters, determines the upper emission limits. Thus, if the allocated amounts are higher than actual emissions, e.g. in periods of recession such as during the current economic crisis, scarcity will diminish. Emissions and abatement by individual companies and sectors, however, would be influenced by numerous other factors. These include weather, fuel prices (i.e. the difference between coal and gas prices), and the level of economic activity within different sectors or disposable income. An additional determinant is also the volume and price of credits such as CDM or JI that can be imported into the system to reduce the overall allowance price level. Another factor is that abatement decisions are also taken on the basis of market and price expectations, and would therefore be more important than short-term permits allocation.

A number of studies (notably, Ellerman, Convery and de Perthuis 2010) have dealt with the issue of whether abatement induced by the ETS and the allowance price can be identified in phase 1 and 2. Conclusions however remain subject to uncertainty because the only true comparator would be the counterfactual, i.e. what would have happened in the absence of policy. McIlveen & Helm (2010) therefore criticise the causality that Ellerman, Convery and de Perthuis (2010) appear to assume regarding the fall in emissions compared to the business as usual scenario and argue that changes in emissions are difficult to attribute to the EU ETS, because other policies and determinants may have affected firms' decisions. What seems clear is that current data does not allow for the identification of standard patterns or averages of abatement because the relationship between abatement and CO_2 prices is too complex (see Delarue et al., 2008a and b). Nevertheless, there is evidence for abatement beyond business as usual based on a number studies and on our own calculations.

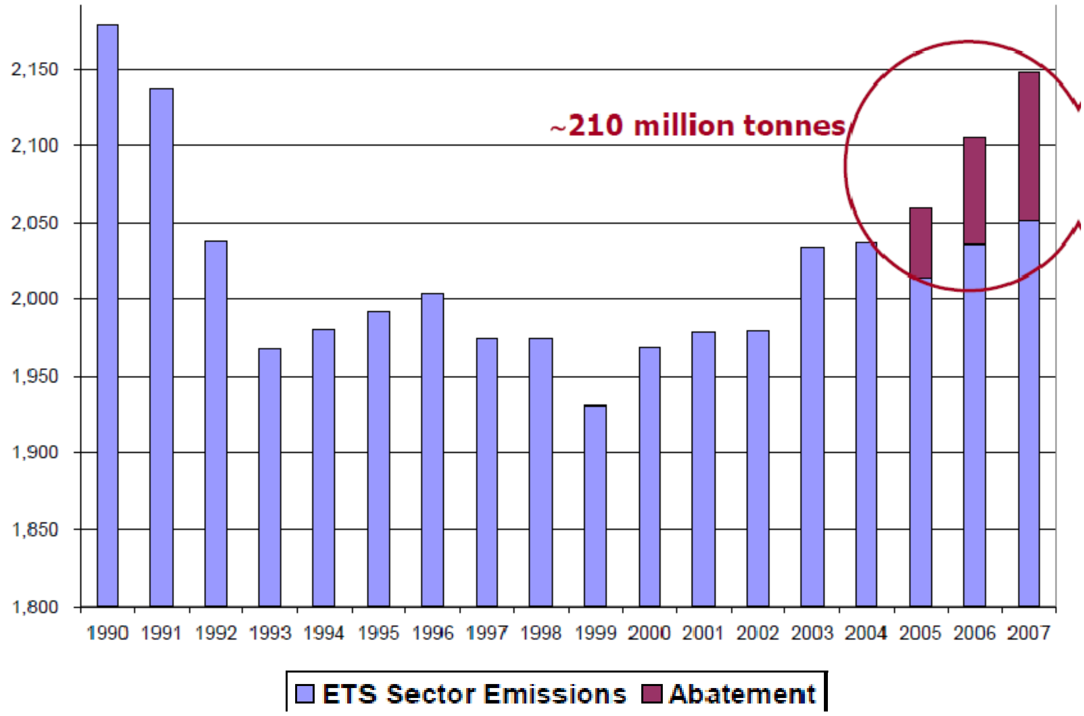
3.1 *Ex-post* evaluations

Given that the EU ETS only started in 2005 and is still relatively new, *ex-post* analyses are rare. The best known and most authoritative study is the one by Ellerman, Convery and de Perthuis (2010). The book is the culmination of a detailed analysis of the emissions produced by the industry and energy sectors covered by the EU ETS and is preceded by a number of studies, such as McGuiness & Ellerman (2008), Ellerman & Buchner (2008), Delarue et al. (2008). The book and the studies conclude that there has been abatement in both the industrial and energy sectors since the introduction of the EU ETS, despite an over-allocation of allowances and the consequent very low CO_2 prices.

For 2005 and 2006, Ellerman & Buchner (2008) concluded that there has been abatement of "probably between 50 and 100 million tons in each of these years". This would amount to between 2 to 5% of total covered emissions. Ellerman, Convery and de Perthuis (2010) confirm the same figure for the overall phase 1 of the EU ETS, i.e. emissions' reductions of between 2% and 5%, translating into 120 to 300 million tonnes of CO_2) (see Figure 3.1).

This figure is obtained against an estimated business as usual baseline projection, i.e. an assumed counterfactual BAU calculation developed on the observation that the rate of change in emissions intensity by unit of production in the sectors covered by the ETS has been fairly constant over the period preceding the ETS, with a relatively stable improvement (i.e. intensity decrease) due to efficiency gains. Thus the authors assume a continued trend in the absence of the ETS. They multiply from 2005 the previous year's ETS sector CO_2 emissions by the observed rate of GDP change and the annual rate of CO_2 intensity improvements over 2000-2004. Deviations would then be due to new developments (i.e. ETS) (pp.162, Box 6.1).

Figure 3.1. Emissions in EU ETS sectors, EU 25, 1990-2007



Source: Figure 6.2. p. 165, Ellerman Convery and de Perthuis (2010), as presented by Buchner (2009).

According to this analysis, emission reductions did not take place evenly across the EU: 80% of the reductions took place in the EU 15, i.e. the EU constituting of member states prior to the 2004 enlargement. The 'new' member states also saw a reduction compared to the business as usual scenario, but it is mainly attributed to the ongoing restructuring of the economy, as the new member states had been allocated an excess of permits due to their development needs.

The bulk of abatement has taken place in the energy sector, driven by fuel switching (i.e. the conversion of oil or coal fired powers stations to gas fired power stations). Ellerman, Convery and de Perthuis (2010) present evidence that the EU ETS influenced the fuel switching from coal to gas power stations, mostly due to the carbon price signals, either in terms of actual prices or price expectations. Without the EU ETS, there would have been no incentive to switch. Delarue et al. (2008) also reach the conclusion that the power sector reduced emissions in 2005 and 2006 by 88 MT and 59 MT, respectively. This is explained by the fact that fuel switching occurred due to exogenous factors unrelated to fuel prices, using a complex model of energy use and price interactions between fuels (e.g. coal and gas), but considering that the magnitude of the fuel switching is likely to be attributed to a regulatory effect, this implies a potential influence from ETS rules and expectations. Nevertheless the combination of high gas prices and a low carbon price in 2007[12] reduced the speed of the switching. Ellerman, Convery and de Perthuis (2010) still suggest that abatement also occurred in the industry sector despite the over-allocation of permits, due to the trade of allowances with the energy sector, i.e. the market value of the permits induced cost-effective energy efficiency investments because of the possibility to bank allowances in a limited way (in the form of CDM credits).

The authors conclude that the carbon price (and in particular the expected future carbon price) is driving companies to invest in energy efficiency. While incentives to reduce emissions were highest in the power sector due to their more stringent allocation of allowances, the existence of a carbon market and effectively a price, has induced abatement in the industrial sector.

Rogge & Hoffmann (2009) also attribute positive effects to the EU ETS. The study's focus is not only on emissions but also on technological innovation fostered by the EU ETS. Although the EU ETS is not specifically aiming at innovation, the study presents evidence of innovation in the power sector in Germany, based on 37 exploratory interviews conducted between December 2006 and November 2008, with German and European experts in the field of the EU ETS, the power sector and technological innovation. One of the main findings is that the innovation process has accelerated the large-scale coal power generation technological regime with a focus on energy efficiency and CCS. Consequently, the power generators and technology providers reacted to the ETS. It can also be observed that the ETS has led to the mainstreaming of CO_2 across organisational units, reflecting and/or triggering a change of thinking on carbon constraints. The lack of predictability and stringency has inhibited a larger impact on demand changes. The study attributes a positive impact of the EU ETS on innovation in the energy sector, but as an integral part of the wider policy mix, such as feed-in tariffs for renewables. The study considers that the EU ETS, and in particular the expected future stringency of the policy, have induced innovation and thus emissions cuts. Earlier work by Hoffmann (2007) – based on case study analysis – shows that electricity companies in Germany under the ETS incorporate CO_2 costs into their investment decisions. He finds, however, that this is only a driver for small-scale investments with short amortisation times. Newer work by Rogge & Hoffmann (forthcoming) goes one step further and interprets their findings from 42 exploratory interviews that the ETS affects the rate and direction of technological change of power generation technologies within the large-scale coal-based segment, to which "carbon capture technologies are added as new technological trajectory".

Preliminary findings on correlation of ETS prices and other input factors, such as energy prices by Löfgren & Wråke (forthcoming), indicate that the ETS is indeed driving large investments but has no apparent effect on small investments. It appears that these effects are largely based on signalling and expectations. Companies may invest based on the expectation of tighter policies and higher prices in the future rather than on current price levels. The caveat is that this effect is hard to distinguish from the impact of price variations in statistical analysis that the research applies.

CEPS' own calculations, which focus on the initial years (2008-09) of phase 2 of the ETS, seem to confirm abatement. Building on the approach employed by Ellerman, Convery and de Perthuis (2010) at the macro and sector level, the following calculations extend the analysis of abatement levels to the whole period of duration of the EU ETS (from 2005 to 2009). The

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[12] Carbon prices fell to nearly 'zero' following the realisation in EU ETS sectors of the amount of over-allocated permits.

calculations compare in a simplified form the CO_2 intensity improvement in ETS sectors with that of a counterfactual BAU scenario. This allows estimating the proportion of abatement associated with the impact of the EU ETS and the allowance price, provided other factors such as energy prices and the weather remain the same. This abatement is different than the emission fluctuations due to changes in production levels, i.e. GDP, because the calculation takes these changes into account.

The calculations in Table 3.1 are divided into 2 periods, period 1 from 2005 to 2007 – coinciding with ETS phase 1 – and period 2 from 2008 to 2009 of the EU ETS phase 2. An important methodological step is that the *average rate of change* in emission intensity in period 1, taking the annual rate in 2006 and 2007, is used as the BAU level for the period 2 projection. This rate of improvement is calculated based on the relative changes in each year's actual emissions in the ETS sectors and the EU25 GDP growth (for details, see the methodological notes in Box 3.1). For period 1, the projected rate of improvement is the one estimated by Ellerman, Convery and de Perthuis (2010, p. 164) based on a 2000-2004 trend.

In 2006 and 2007 the annual intensity improvement for the ETS as a whole was greater in absolute value by 1.1% and 0.9% respectively than the projected 1%. These differences are the portions of intensity reduction that can be attributed to abatement induced by the ETS, so let us call this "abatement portion". This is an indication of abatement, because the emissions during period 1 were lower than they would have been in the absence of the EU ETS, as detailed in Ellerman, Convery and de Perthuis (2010). The abatement indicated here is above and beyond the one realised during period 1. In a sense, the projection already reflects the impact of the EU ETS (Phase 1) from period 1, making the abatement in period 2 attributable to the impacts in this new period only, such as the more advanced Phase 2 of the ETS.

Period 2 emissions were even lower than the mere continuation of the trend from period 1. This is reflected in the annual intensity improvement in 2008 and 2009, which was greater by 1.3% and 5.4% respectively than the projected 2% average.

Table 3.1. EU ETS sectors annual CO_2 emissions and changes in intensity, EU25

	Period 1			**Period 2**	
	2005	**2006**	**2007**	**2008**	**2009**
1. ETS CO_2 emissions - all sectors ($MtCO_2e$)	2014	2036	2056	1998	1773
2. EU25 real GDP growth	+1.9%	+3.2%	+2.9%	+0.4%	-4.2%
3. Projected rate of change in emission intensity*	-1.0%	-1.0%	-1.0%	-2.0%	-2.0%
4. Actual rate of change in emission intensity		-2.0%	-1.9%	-3.3%	-7.4%
5. Abatement portion (i.e. 4. minus 3.)		-1.1%	-0.9%	-1.3%	-5.4%

* 2005-07 projections are estimated by Ellerman, Convery and de Perthuis 2010 (p. 164); 2008-09 projections take the average of the actual rate of change in emissions intensity from the preceding period (2006-07).

Note: EU25 data were chosen because Phase 1 included only 25 member states, because verified emissions data for the total period are available for this member state grouping and in order to ensure consistency with Ellerman, Convery and de Perthuis' (2010) projections and results.

Sources: Eurostat, EEA, Ellerman, Convery and de Perthuis (2010).

One of the problems with taking this simplified macro approach is that the precise underlying trends in separate sectors are not revealed, because the estimates are based on aggregate measures of production levels, such as GDP, for data availability reasons. This macro analysis uses economy-wide GDP, while the GDP components in the ETS sectors may be growing at different rates than those of the economy as a whole (see e.g. Ellerman, Convery and de

Perthuis 2010, p.166). Using a more refined production level proxy would allow a more precise estimate of the abatement level in ETS sectors, but is not likely to affect the conclusion whether abatement took place or not.

As an example of the different trends in intensity changes in specific ETS sectors, Table 3.2 follows the same approach as Table 3.1, but based on sector-level data for the non-combustion industrial emissions. Instead of EU-wide GDP, the calculations of emissions intensities are based on a proxy that is closer to the production levels of the respective industrial sectors. In this case, the gross value added[13] of the manufacturing sectors in the economy is used.

Table 3.2. Industrial sectors annual emissions and changes in intensity, EU25*

	Period 1			Period 2	
	2005	**2006**	**2007**	**2008**	**2009**
1. ETS CO_2 emissions - Industrial secto (2-9) ($MtCO_2$)	555	565	572	557	457
2. Gross value added growth - manufacturing	+1.8%	+4.4%	+3.5%	-2.3%	-13.5%
3. Projected rate of change in emission intensity				-2.3%	-2.3%
4. Actual rate of change in emission intensity		-2.5%	-2.2%	-0.4%	-5.1%
5. Abatement portion (i.e. 4. minus 3.)				+1.9%	-2.8%

* ETS sectors 2-9: 2. Mineral oil refineries; 3. Coke ovens; 4. Metal ore roasting or sintering; 5. Pig iron or steel; 6. Cement clinker or lime; 7. Glass including glass fibre; 8. Ceramic products by firing; 9. Pulp, paper and board.

Sources: Eurostat, EEA.

The numbers show that the emission intensity improvement in the industrial sectors of the ETS was worse than the projected BAU in 2008 (+1.9%) and better than the projected BAU in 2009 (-2.8%). These figures are naturally different than the macro ETS results because each sector is likely have more or less abatement as part of the whole. This example does not contradict the results from Table 3.1, but points out the nuances that call for in-depth and precise examination.

It must be kept in mind that, as in Table 3.1, the projection in Table 3.2 incorporates the abatement achieved in period 1, including the effects of the EU ETS Phase 1 and the presence of a carbon price in that period. Thus, on the basis of these simplified calculations alone, it could be said that the beginning of the second phase of the ETS has induced only moderate additional abatement, compared to the trend from the first phase, in the (non-combustion) industrial sectors. It emerges that the level of abatement under this simplified approach depends to a large extent on the projections, i.e. the BAU assumptions. On the one hand, period 1, which we take as the BAU for period 2, is too short and the economic developments underlying GDP changes in the years of the crisis (period 2) may be radically different. On the other, both projected and actual values in a sector depend on the choice of production level proxy (see the methodological notes in Box 3.1) to which the emissions are indexed when calculating the rates of improvement in emission intensities. The proxies chosen in this paper do not coincide fully with the ETS sectors from which the emissions originate and are thus prone to inaccuracies.

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[13] Gross value added is the difference between output and intermediate consumption, or in other words the value of goods and services produced less the value of any goods or services used in their creation. As an aggregate measure of production, gross domestic product (GDP) of a country is by and large the sum of gross value added of all resident producers. For details, see European Commission (2009).

Box 3.1. Methodological notes for Tables 3.1 and 3.2

Table 3.1

The total CO_2 emissions of all sectors covered by the ETS are indexed to the EU25 GDP of the economy as a whole. For Phase 1 (2005-2007) the BAU level is the one used by Ellerman, Convery and de Perthuis (2010, p.164) as projected from the 2000-2004 period. For Phase 2 (2008 and 2009), the averaged intensity improvement of the Phase 1 period is used for the counterfactual projection of the BAU. This approach shows the abatement brought about by Phase 2 alone on top of the trend that Phase 1 brought about. The Phase 1 trend was chosen as the BAU for 2008 and 2009 also because it allows calculations based on verified emissions data available for ETS sectors and is more recent than the 2000-04 projection.

- A minus sign in rows 3 and 4 indicates an improvement in emission intensity.
- Row 1 constitutes verified CO_2 emissions data from the EEA in million tonnes of CO_2 equivalent: EEA, European Union Emissions Trading Scheme (EU ETS) data viewer, http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=473.
- The GDP in EU25 and its annual growth rate (Row 2) are taken from the Eurostat online database: *nama_gdp_k-GDP and main components - volumes*, Last updated 15-11-2010, Extracted on 18-11-2010 at 10:52:48.
- Projected rate of change in emission intensity, Row 3: Projected values for 2005-07 are taken from Ellerman, Convery and de Perthuis 2010 (p. 164) based on their estimates for the period 2000-04. Projected values for 2008-09 are calculated by taking the average (geometric mean) of the actual rate of change in emission intensity from the years 2006 and 2007. A minus sign in Row 3 indicates an improvement (decrease) in emission intensity, i.e. less emissions per unit of GDP compared to the previous year.
- The emission intensity is calculated by dividing each year's ETS emissions (from the EEA) by the constant-price (year 2000) EU25 GDP (from Eurostat), tCO_2e/millions of euro. Row 4 shows the actual annual rate of change in that intensity. A minus sign in Row 4 indicates an improvement (decrease) in emission intensity, i.e. less emissions per unit of GDP compared to the previous year.
- The abatement portion of intensity improvement (row 5) is calculated by subtracting the projected percentage rate of change in emission intensity (row 3) from the actual rate (row 4). The percentage here does not represent by how much emissions decreased, but simply the difference in percentage points between the projected and actual intensity improvement. A minus sign indicates a rate of emission intensity improvement in that year that was better than projected, while a positive sign indicates the opposite.

Table 3.2

The methodology is the same as for Table 1 above with the following differences:

- CO_2 emissions data (row 1) in Table 3.2 are for the ETS sectors 2-9: 2. Mineral oil refineries; 3. Coke ovens; 4. Metal ore roasting or sintering; 5. Pig iron or steel; 6. Cement clinker or lime; 7. Glass including glass fibre; 8. Ceramic products by firing; 9. Pulp, paper and board.
- Row 2 shows the gross value added * growth rate in the economic sectors "Manufacturing" as taken from the Eurostat online database: *nama_nace31_k-National Accounts by 31 branches - volumes*, Last updated on 04-11-2010, Extracted on 18-11-2010 at 11:07:21.
- The gross value added in the economic sectors is used in calculating the emission intensities in the ETS sector subdivision (Table 3.2). In this paper "manufacturing", which also includes economic sectors not taking part in the ETS, is taken for convenience, while it would be possible to go closer to the ones covered by the ETS by adding together the gross value added of separate sectors, such as "Manufacture of basic metals" etc., from the Eurostat database. The resulting rates of change in intensity (row 4) is taken as a proxy of the rate of change that would be obtained by using the exact production volume in the specific ETS sector, if it were available; For the industrial sectors of the ETS, the calculations are based on the constant-price (year 2000) gross value added of the "manufacturing" industry sectors.
- Projected rate of change in emission intensity, Row 3: There are no projected values for 2005-07 due to unavailability of verified ETS sector data from the period before 2005.

The main lessons to be drawn from this short analysis and the associated caveats are that macro results show abatement in ETS sectors compared with BAU projections (absence of the EU ETS) both in periods 1 and 2, while more detailed (sector-level) and precise (ETS-specific production levels) analysis is needed to confirm the trends. Second, the intensity improvement trends are different among sectors and fluctuate heavily. This could be interpreted that they depend more strongly on non-ETS factors and non-ETS related efficiency measures in each sector than on the presence of the EU ETS and the carbon price. These factors may vary from sector to sector. Such factors, among which are the fuel prices and the weather, are essential and their impact on abatement trends needs to be further analysed and distinguished from the impact of the ETS. Third, the economic crisis and the preceding oil price shock may have had such profound effects on the behaviour of companies in the ETS sectors that the trend under normal business conditions in period 1 is not any more a reliable BAU projection for period 2. Finally, the average of two consecutive years (2006 and 2007) is too short to form a robust BAU projection trend and must be treated with caution.

A somewhat more mixed picture is emerging from surveys of firm managers undertaken by Anderson et al. (forthcoming) between January and March 2009. A key finding concerns the apparent overestimation of the vulnerability of the industry sector to non-EU competition and the risk of carbon leakage by the European Commission, compared to managers' views. If so, this would lead to windfall profits benefitting sectors that receive allowances for free. In addition, the surveys confirm that the ETS affects the behaviour of firm managers and encourages investments in energy efficiency. However, the changes in behaviour are not consistent across industries, as managers do not necessarily react according to economic theory, and do not always take the value of allowances as an opportunity cost. The choices of firms in using the allowances diverge across companies, with large emitters in the cement, chemicals, plastics and fuels industries being more efficient participants in the markets. Trading is in fact generally undertaken only by firms with large amounts of excess allowances. Other firms tend to hold on to allowances for use in the future, i.e. bank..

4. Economic rents and windfall profits

One of the most controversial issues has been the rise of power prices and associated 'windfall profits' that were a consequence of (basically) free allocation.[14] The intention of the EU ETS was to change relative prices to reflect the carbon value. In that sense, the ETS is a price instrument just as taxation, with one difference: In the case of taxation, receipts go into government budgets, while with free allocation, they remain with industry. This does not, however, mean that all industries receive the same 'scarcity rents'. Therefore, the ETS has led to different distributional effects among the covered sectors. Generally speaking, those industries that could and can pass on the additional carbon costs have in fact a net gain, since potential losses of revenues, through for example lower sales, may be compensated or even over-compensated by receiving allowances free of charge and earning 'windfall profits'. Those industries that are not able to pass on the additional (carbon) cost because prices are set by international commodity markets do not benefit from this compensation mechanism to the same degree.

This has led to many *ex-ante* studies (e.g. Carbon Trust, 2004; Sijm et al., 2005; Sijm et al., 2006 being the most important ones) on the level of 'windfall profits' in the power sector, which some have estimated to amount to as much as €13 billion annually (e.g. Keats & Neuhoff,

[14] Free allocation (95% in phase 1 and 90% in phase 2) was mandated by the Directive but many member states allocated all allowances for free. In total, less than 0.2% of all allowances were auctioned in phase 1 and some 3% in phase 2 (c.f. Ellerman, Convery and de Perthuis, 2010, p. 62).

2005). Ellermann, Convery and de Perthuis (2010, pp. 320-328) have studied windfall profits *ex-post*. They distinguish between different types of windfall profits or – as they prefer to call them – 'rents'.

First, they identify rents earned by power producers due to higher power prices as a result of including the carbon price. In the EU/EEA liberalised (regional) wholesale power market, prices are set by the marginal production costs, including the value of emissions in the allowance market. If the marginal producer is a (high-carbon) coal power generator, the power price can increase significantly as a result of the EU ETS. All electricity generators receive substantial gains from generally higher power prices without incurring extra costs. This effect was intended. However power companies could also receive 'windfall profits' additionally, as a result of free allocation. Power generators could pass on[15] the full CO_2 costs while having received allowances for free.

The second type of rent, according to Ellerman, Convery and de Perthuis (2010), is what they call 'informational' rent, describing the fact that during the first period of general over-allocation, which should have produced a zero price, the EU allowance price remained at approximately €12. Companies that have received allowances for free – both industry and the power sector – could make large trading profits by selling their allowances.

A third type of rent arises from the fact that carbon-intensive emitters receive large amounts of allowances that constitute financial assets at no costs. This kind of rents in the end turned out to be less controversial and significant in scale.

Overall, Ellermann, Convery and de Perthuis (2010, p. 327) conclude that in total the rents were substantial, even at a relatively modest carbon price of € 12 and amount to more than € 19 billion in windfall profits and an additional more than € 10 billion of 'informational' rents, although with the caveat of surrounding uncertainties in the calculations. De Bruyn et al. (2010a) and CE Delft (2010) conclude that energy-intensive energies have been able to pass through the market price of free allowances into product prices, thereby obtaining windfall profits to the tune of €14 billion for the period 2005-08. For phase 2, Sandbag (2010a), an environmental campaign organisation, comes to a similar conclusion. It estimates that the over-allocation to the industry sector amounts to approximately one billion allowances, worth €14 billion (based on September 2010 prices). During ETS phase 1 all technologies and all participants included in the ETS – power and industry alike – gained.

For the third ETS phase the situation will be different. The fact that allowances – in principle - will be auctioned to the power sector means that windfall profits stemming from free allocation will disappear. However this is not the case for those rents in the power sector of low carbon power generation technologies such as hydro or nuclear, which will enjoy additional revenues as a result of a higher power prices due to the ETS. Some member states consider taxing these rents.

More complicated is the situation for the industrial sector in phase 3, where allocation will be undertaken on the basis of benchmarks. The revised ETS Directive prescribes EU-wide *ex-ante* benchmarks for transitional free allocation for phase 3 from 2013-20. The starting point is the average of the 10% most efficient installations in sectors or sub-sectors, calculated on products. The amount of free allowances per installation will be established by multiplying the benchmark with historical average production for the period, for example the years 2005-08 while the

[15] In competitive markets, even a 100% pass-through rate for the marginal asset, which sets the price, does not mean that other assets can cover 100% of their CO_2 costs. For example, if all generators take 100% account of CO_2 costs, when gas sets the price the increase in the electricity price will be high enough to cover only about 40% of the CO_2 opportunity costs for a coal asset.

maximum total free allocation for industry is set at the industry's share of total cap based on emissions in 2005-07, declining annually in line with the decline of the emissions ceiling (the 'linear factor') by 21% between 2005 and 2020. A 'uniform and cross-sectoral correction factor' is applied if the allowances based on the benchmarks multiplied by the production factor plus the other free allowances for industry, based on fall back approaches, will exceed the cap.

De Bruyn et al. (2010b) argue that energy-intensive industries in ETS phase 3 will continue receiving windfall profits. This is based on the argument (p. 6) that the total amount of allowances that will be auctioned will most likely remain relatively small, initially starting at around 10% of ETS emissions while the benchmarks will bear on the energy-intensive marginal, not very profitable firm. As the real average costs for this company will increase due to the allowances above the benchmarks that will need to be bought through the auction, this marginal company *would have to* pass through the costs of the emission allowances into the product prices or it will go bankrupt. This would introduce higher prices in product markets, which most likely will cause windfall profits for non-marginal companies. The potential size of the windfall profits will then depend on how many allowances the individual installations will receive. To date there is no analysis on this subject. We should expect that on average the majority of installations will be short of allowances, in many cases significantly. Only around 10% of the installations – the most efficient ones – will get the allowances up to the benchmark. All others will be short of allowances. This depends on the spread factor of a sector, i.e. how much the performance of the most and least efficient installation differ and in which segment of the benchmark curve the installations are actually located. Only if a sector – on average – is efficient (i.e. many installations are close to the benchmark) will installations receive the majority of allowances for free. There will be many sectors where installations on average will need to buy around 30% of their allowances and the marginal installation up to 60%.[16] The assumption by De Bruyn et al. (2010b) that the marginal firm will remain in the market (after imposition of the carbon price) and is therefore able to pass through its costs, remains controversial and depends very much on the trade-intensity of the sector. The European Commission claims that it will only grant free allowances up to the benchmark for sectors that are trade exposed and carbon-intensive. On the other hand, any cost increase – also the one because of the ETS tends to lead to higher product prices, creating a potential for windfall profits. Whether this happens and the degree of it will depend also on the choice of the period upon which to base historical average production with which the benchmark is multiplied to arrive at final amount of allowances to be allocated. If this period is largely based on production figures prior to the crisis, allocation will generally be more 'generous' than if the fall in production is counted in. A study by the Grantham Institute (Martin et al., 2010) concludes that the European Commission criteria to identify industries that will receive free emission allowances in the third phase of the ETS was not restrictive enough and therefore has covered installations by free allocation that can pass-through the allowance price. As a result, Martin et al. (2010) claim that energy-intensive industries will receive at least € 7 billion in windfall revenues annually. The analysis is based on evidence from interviews with almost 800 managers in Europe.

[16] The study has been criticised by NERA (2010) on methodological grounds. A main criticism has been that the study ignored the influence of prices for material input into final product prices, a biased analysis on the factor that explain product prices, and finally a somewhat static analysis on the relationship between CO_2 prices and input or product prices and how they change over time. CE Delft (2010) rebutted this criticism by arguing that variations in crude oil prices only explained 3% of the variation in spot prices of CO_2 for the study period.

5. The role of offset mechanisms

The EU ETS has experienced a difficult relationship with CDM and JI credits. From the outset there was a debate on how much of the abatement should be done domestically and on project type and quality.

Linking JI and CDM to the EU ETS has been meant to increase cost–effectiveness.[17] At the same time, support for the JI/CDM mechanisms gives investors an incentive to engage in JI and CDM projects, and promotes technology transfer and investments in JI and CDM host countries in order to support their sustainable development. On the other hand, questions about whether emissions achieved in the CDM or JI are real have cast doubts on these instruments. Since CDM and JI are offsetting mechanisms – i.e. offset EU/EEA emissions by reductions in non-EU/EEA counties – a failure of "real" reductions does increase global emissions. In addition, there were fears that a too high level of offsets depresses the EU ETS price, therefore reducing the incentives of the sector covered by the ETS to deploy new low-carbon technologies. This would risk locking EU industry into increasingly obsolete technologies. Moreover, there have been complaints that the CDM finances reductions that would have happened anyways, causing developing country industries to receive excessive economic rents. Finally, there are question marks on whether the CDM has indeed contributed to sustainable development in host countries as it had been meant to do.

How much should be in non-EU countries (i.e. the question of 'supplementarity' or quantitative restrictions) concerns the relationship between economic efficiency (i.e. 'delivering an efficient market') and environmental effectiveness (i.e. 'achieving environmental objectives'). There have always been concerns about opening up the EU ETS to non-EU credits and thereby farming reductions out. On the other hand, due to the fact that marginal avoidance costs in countries that are expected to host CDM and JI projects are most likely to be lower than in the EU, exclusion of the project mechanism could lead to somewhat higher allowances prices. To give an example, the extended impact assessment on the 2004 Linking Directive calculated that unlimited use of JI and CDM credits would halve the expected allowance price to €13 per tonne of CO_2 (which is in the range of the current allowance price), thereby saving the EU €700 million.

The concerns regarding project types (i.e. the question of the need of qualitative restrictions) reflect both potential problems with environmentally and socially damaging projects, as well as the desire to promote technologies seen as more beneficial in terms of sustainable development and technology transfer. In particular, the EU has argued repeatedly in international negotiations that sinks provide neither technology transfer nor reliable climate benefits, and that large hydroelectric projects often entail unacceptable social and environmental impacts.

5.1 Quantitative and qualitative restrictions

The EU ETS places a limit to the number of emission credits that companies can obtain through this mechanism, in order to ensure a minimum amount of domestic reductions. In Phase 1 of the ETS, offsets were limited to 50% of the emission reductions. In Phase 2 the use of the CDM and JI for offsetting is limited to different levels depending on the national plans of each country, ranging from 0% to 20% of the reductions required by the EU ETS. In Phase 3, an EU-wide cap will be applied, and the limit of offsets is planned to be 1.4 billion tonnes for 2012-20, or 50% of the total emission reductions required. The CDM allowance, however, remains negotiable depending on the level of international commitments.

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[17] Recital 19 sees the mechanisms as "important to achieve the goals of both reducing global greenhouse gas emissions and increasing the cost-effective functioning of the ... scheme".

Sandbag (2010b) reports that in 2009, 4.2% (78 million CERs) of EU emissions have been offset through CDM's CERs and slightly under 0.2% through JI's ERUs. The report is critical of the actual impact of the offsetting mechanism, not because of the controversial effect, or lack thereof, on global emissions reductions, but because emission reduction investments concentrate on the cheapest form of emission reductions, namely investments in the reduction of HFC emissions (59%). This, however, is an automatic consequence of using a market-based approach. The market identifies the cheapest, i.e. most profitable solution. Sandbag (2010b) argues that CDM-funded reductions of HFC emissions could be achieved without the CDM and recalls that offsetting of HFC greenhouse gases is allowed because of China's and India's intervention to avoid restrictions or the outright exclusion from the UNFCCC lists of possible CDM projects. The CDM is to this day strongly skewed towards investment in China (53% of CERs) and in India (21% of CERs), and mostly on HFC reductions. A similar controversial investment using the CDM concerns N_2O reductions, which also primarily occur in China and India, and where the high rents from CDM projects may have had questionable effects on abatement.

According to Fujiwara (2009) the controversy does not concern so much the fact that HFC or N_2O projects might not be necessary or might violate the additionality principle, but rather concerns the incentives which the price difference between the CERs and the actual cost of abatement have created in the recipient industries. This report highlights the bias towards the 'low hanging fruits' of highly cost-effective interventions in the HFC and N_2O emissions, with associated high rents. This also discourages investments in other more complex investments, either due to costs or monitoring difficulties such as for example, of demand side energy efficiency investments.

Criticisms of HFC and N_2O projects are not new. While abating these greenhouse gases is important, CERs for investments in HFC and N_2O abatement are highly valuable in terms of financial benefits for the recipients. The problems with FHC and N_2O created an outcry on the misuse of the CDM in Europe. This was reflected in a very critical press release by the European Parliament. The concerns have been sufficiently strong as to prompt the European Commission to ban the use of CDM for projects abating HFC and N_2O from 2013 onwards in the EU ETS.[18] According to the European Commission (2010a), CDM rules have been too relaxed and have allowed a number of practices that make the further financing of abatement operations in those gases unacceptable. The European Commission's analysis shows that CERs have a value much superior to the costs of abatement, with a twofold effect: The first has been carbon leakage, where EU FCHC-22[19] production has allegedly shifted to developing countries to take advantage of the rents from CERs. The second has been an expansion of production of FCHC-22 and adipic and nitric acid. In both cases, the CERs are allegedly not promoting emission reductions but emission increases. It is argued that CDM credits have encouraged more production of FCHC-22 to access credits for HFC-23 abatement, while for N_2O, the high rents have shifted production from the EU to developing countries, a sign of carbon leakage, due to the high rents from CDM. Consequently, the CERs for HFC and N_2O have reduced the amount of emissions abatement in the EU, while potentially increasing emissions abroad.

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[18] European Commission, *Draft Commission Regulation of determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, certain restrictions applicable to the use of international credits from projects involving industrial gases* (http://ec.europa.eu/clima/news/docs/proposal_restrictions_final.pdf).

[19] HFC-23 and N_2O are by-products of the production process: HFC-23 is a by-product of FCHC-22, a greenhouse gas which is regulated by the Montreal protocol and meant to be phased out by 2030. N_2O is a by-product of adipic acid and nitric acid production.

In a study for the Stockholm Environmental Institute Schneider et al (2010) have evaluated CDM projects that abate N_2O emissions from adipic acid production. The report finds carbon markets were instrumental in obtaining reductions that had previously not been achieved. At the same time, the study concludes that CDM appears to have caused significant carbon leakage during the economic downturn in 2008 and 2009. Kolmus & Lazarus (2010) in a study for the same institute find for N_2O emissions from nitric acid that CDM projects have lead to abatement in this sector with very little risk of carbon leakage. .

Concerns over the performance of the CDM are also reflected in research by Neuhoff & Vasa (2010) who consider that a substantial amount of the investments financed through the CDM are undermining emission reductions and weakening the EU ETS. The CDM is used to invest in high energy and carbon-intensive industries, which improves their capacity to increase their production rather than encourage a shift to low-carbon production systems. As a result, they consider that the current framework is not appropriate to promote real abatement globally, while at the same time it undermines domestic reductions.

5.2 Potential future flexible mechanisms

Within the EU and elsewhere this has triggered a debate on future mechanisms. Overall objective would remain that new or revised flexible mechanisms continue to aim at advancing climate objectives, i.e. achieving real global emissions reductions and possibly other specific objectives such as sustainable development, technology transfer and financing. Potential exist in a number of areas.

Clean Development Mechanisms: Programmes of Activities (PoAs) are a programmatic version of the CDM, registering a set of activities of the same type under a single umbrella. Sectoral benchmarking in the CDM credits emissions reductions below the baseline based on a pre-determined benchmark for a sector or a sub-sector. Expansion of the scope to sectoral and programmatic activities could help to strengthen the CDM and address more mitigation opportunities. On the other hand, an increase in the number of CDM projects would require improvements in efficiency of administration and an increase in the transparency of governance.

Joint Implementation: JI has faced administrative and organisational shortcoming pertaining to the Joint Implementation Supervisory Committee (JISC) as well as more technical issues such as baseline setting and methodology choices. Existing problems with double-counting must also be overcome (see Sandbag, 2010c).

Most potential to reach EU/EEA objectives is related to sectoral crediting. A sectoral crediting mechanism (SCM) credits emissions reductions from a covered sector against a threshold possibly below the business as usual (BAU) scenario. The main difference from the CDM is to expand the coverage moving beyond offsetting, an SCM could enhance the environmental integrity of the system. An SCM based on no-lose targets means that the host country will be rewarded for its over-performance in the sector above the threshold but will not be penalised for its under-performance, hence ‘no-lose’. By introducing a carbon price signal, an SCM is considered to be a stepping stone in an evolution path of a market mechanism from the CDM or JI via Programme of Activities (PoAs) to a sectoral trading scheme, then to a cap-and-trade scheme.

There are a variety of design options. The baseline can be negotiated as part of an international agreement between parties or domestically set on the basis of a sectoral benchmark. The baseline could be expressed in absolute emission levels, the carbon intensity or technology penetration rates.

A technical merit of sectoral crediting is to circumvent the additionality test on a project basis. An SCM assesses the performance of a whole sector performance instead of individual activities. On the other hand, from a firm perspective, its individual over-performance will not necessarily lead to direct rewards if other firms in the same sector do not live up to the promise they made. Hence, another variation is i) credits are issued to the host country, which benefits participating firms or installations via a cap-and-trade scheme, benchmarking exercise or other domestic measures; or ii) credits are issued directly to these firms or installations.

This concept has been put into the policy context and brought on the negotiation agenda since the Bali Action Plan in December 2007. It has been regarded as one of the possible options to engage developing countries in mitigation efforts with domestic resources as well as support from developed countries. An SCM based on no-lose targets intends to encourage emissions reductions in a key emitting sector in a developing country and create a stream of revenue from its sale of emissions credits on international carbon markets. To date, however, there has been limited take-up outside the EU/EEA although bi-lateral talks between the EU and its negotiation partners continue.

6. Industrial competitiveness

The controversy on the impact of the ETS on 'competitiveness' had already surfaced before the ETS started to operate. While the term has never been defined, roughly speaking 'competitiveness' assumed a micro (i.e. firm or sector-specific) perspective, meaning the ability to sell, keep or increase market, share, profits or stock-market value or all at once. This, however, depends on the sectors, which are very differently affected as a result of the ability to pass-through, i.e. trade exposure or carbon-intensity (see section 4 on rents). Additionally, all sectors face the challenge towards a low-carbon economy. This will require lower carbon-intensity in the short-term but in the long-term also new technologies and practices as well as new products. This transitional effect adds a new dimension to competitiveness as continuing with existing technologies, techniques and know-how – even if constantly improved – will not suffice in the longer term.

The question on the impact of the ETS on 'competitiveness' hides another issue; possible negative impacts on EU/EEA firms are not the result of the ETS – i.e. the instrument – but the fact that the EU had chosen to impose a carbon price on its industries while almost no other country or region had so. This is important to remember because the effect of a carbon price is transmitted directly into the product price, because EU allowances have an opportunity cost. This is different from a situation where governments impose carbon policies other than through pricing. Regulation also carries costs but it is easier for governments to impose costs on some sectors and not on others. A case in point is the power sector in many coal-based emerging economies, which are not faced by a carbon price.

The debate on competitiveness has revealed that a number of trade-exposed sector or sub-sectors could be negatively affected by the ETS (e.g. Climate Strategies, 2007 and Ellerman, Convery and de Perthuis, 2010: p. 195) and subsequently lose market share, profits and/or stock market value. This may then lead to another problem: carbon leakage,[20] which undermines the environmental effectiveness and political acceptability. The *ex-post* analysis by Ellerman, Convery and de Perthuis (2010, pp. 195-234) for phase 1 has only limited relevance because of the shortness of the period, the low and then collapsing carbon price and (generally) the over-allocation. Hence, this issue will remain a major topic for further analysis.

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[20] Carbon leakage occurs when there is an increase in GHG emissions in one country as a result of emission reductions in another country subject to a more stringent climate policy, mostly due to production relocation. Carbon leakage can also occur in countries whose emission targets exceed their expected emissions.

In phase 3, 'competitiveness' is addressed by free allocation. Free allocation constitutes a form of compensation or, as some argue, a subsidy,[21] potentially creating an incentive to continue producing in Europe. This compensation is justified on grounds that if firms in a European industry cannot pass through the allowance price partly or fully, they eventually end up 'paying' for the costs of the allowance price. Failure to pass through would erode benefits from CO_2 abatement as well as producers' competitiveness, transfer allowance value abroad and ultimately lead to carbon leakage.

Yet, even if the additional costs in an industry were 100% compensated by either free allowances or higher revenues or both,[22] free allocation *per se* does not fully prevent industries in global competition from shifting their production, and thereby emissions, abroad. The reason is that production decisions are not based on average industry margins, but on marginal costs for the last unit. In practical terms, two effects are at work: operational (i.e. reducing production in existing installations) and structural (i.e. postponing or abandoning investment or actively pursuing divestment). The evaluation of the structural effect depends very much on the perspective one takes and the assumptions made about the post-2012 situation – how fast a global agreement is forged and how it will look.

'Grandfathering', as the free allocation mode in the first two phases, has led to significant windfall profits and was subsequently abandoned and replaced by auction for the power sector and for industry as of 2013 through benchmarking where firms receive free allowances only up to a benchmark that is calculated on the basis of the '10% most efficient' installations. This was seen as a way to reduce windfall profits. However, free allocation – if based on benchmarks or not – will reduce the incentive to move production abroad *only* in instances where the benchmark is multiplied with recent production on an annual basis (i.e. regular updating), forecasted production or actual production, an option however that has been ruled out by the ETS Directive. This needs to be distinguished from a situation in which a standard load factor or historic production level is applied. In this latter case, the incentive to shift production abroad is theoretically still the same as in auctioning or grandfathering scenarios.[23] This is so – as was argued before - because production decisions are not based on average industry margins, but on marginal costs for the last unit. Still companies might find the compensation attractive enough to continue production in Europe as part of bundle of reasons. However, the way that the ETS has used free allocation as compensation has never been a guarantee as companies are free to invest the receipts anywhere.

7. How can the EU ETS promote innovation and low-carbon technology deployment?

The objective of the ETS is to "promote GHG reductions in a cost-effective and economically efficient manner" (Art. 1 of the ETS Directive). Hence, the over-arching objective is cost-effectiveness of a politically given target. On first view, this could be construed as a call for the lowest possible EU allowance price, for example including as many offsets as possible – provided they reflect real reductions to reach a given objective. While this is true in the short-

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[21] A subsidy is defined as a benefit usually given by the government to groups or individuals generally in the form of a cash payment or tax reduction. The subsidy is typically given to remove some kind of burden and is often considered to be in the interest of the public.

[22] Allocating the majority of the CO_2 allowances for free, combined with the potential of industries to pass a smaller or larger share of the costs on to consumers, limits the economic loss entailed for most industries or can even represent an upside for some of them.

[23] If the standard load factor does not change (i.e. is applied), a company that shifts marginal production abroad will still obtain the same amount of free allowances as if it continues to produce in Europe.

term, for example to reach the 2020 targets, it masks the fact that over the long-term – 2050 and beyond – an efficient climate change policy will need to accelerate the development and diffusion of new and breakthrough technologies. If not, the EU risks being locked-in into high-carbon technologies, which, once carbon carries a higher prices – and explicitly through taxation or emissions trading or implicitly through regulation – with its industry becoming uncompetitive. This has raised the question on what exactly the role of the ETS is to drive this transformation towards the low-carbon economy.[24] Some deplore the apparent failure of the ETS to induce innovation, while others point out that additional innovation policies are required to induce technological change. Ultimately, any climate strategy will however have to be measured against its capacity to foster first the development and then investment in new low-carbon technologies.

Innovation depends on whether a company assumes that an investment in general but also in R&D (including demonstration) will become profitable. Some companies for example, especially if larger, undertake a lot of process research to try and improve efficiency both of material and cost of their processes. They will invest for those investments which are almost immediately generating benefits. Under current ETS rules, this means within the current know period for which the allocation is fixed, i.e. up to 2020. The EU Allowance price is an important element in this calculation but only one; other parameters such as a life cycle analysis, the total cost of ownership (TCO)[25] but also investment years and cash issues, including access and the cost of capital, matter in a decision whether to invest or not. Hence decisions on whether to invest in innovative low-carbon technologies depend on the number of allowances which are allocated for certain, the CO_2 price, which changes the cost/benefit ratio but also market expectations beyond the current allocation period. The ETS seems to score highest in market expectations. By setting an annual linear reduction of 1.74%, it sets a legally binding long-term trend line, i.e. a long-term cap. However, this cap is not in line with EU/EEA and international climate change objectives or climate science. Allocation certainty is provided for eight years. This would not matter if certainty existed on the future rules. While the ETS has gone along way to ensure predictability, even if not certainty, allocation rules are likely to change. This is not at least because there is no legally binding, enforceable global climate change agreement. This is also why the EU has 'reserved the right' to review the unilateral target of -20% GHG reductions by 2020 compared to a 1990 baseline in light of developments in international negotiations. This leaves us with the question on the importance of the EU Allowance price to drive innovation.

The question of whether the EU ETS is leading to innovation would most likely not exist if there were a global CO_2 price or other mechanisms such as a carbon bank, for example, sufficient to make currently expensive technologies such as renewables or CCS profitable. Levels of required CO_2 prices, exceeding €100 per tonne of CO_2, possibly by a wide margin, however do not seem to be a realistic option, unless one assumes good chances for other emissions trading schemes being implemented in other OECD or emerging economies. Unless

[24] The proposal to amend the ETS Directive had identified three major objectives: 1) "Fully exploiting the potential of the EU ETS to contribute to the EU's overall GHG reduction commitments in an economically efficient manner"; 2) "Refining and improving the EU ETS in the light of experience gathered", and 3) "Contributing to transforming Europe into a low greenhouse-gas-emitting economy and creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal" (European Commission 2008: p. 3).

[25] TCO is a kind of financial estimate designed to help enterprise managers assess direct and indirect costs, i.e. a form of full cost accounting.

this happens, the EU/EEA will remain the only major economy that imposes a price on carbon,[26] constraining to some extent the ability to impose high carbon prices.

In the meantime before a global carbon market takes shape, the EU recognised this by establishing a separate policy for the support of renewables – although at member states level - and CCS. . This reflects the consensus that the ETS will not be able to drive innovation in low-carbon technologies on its own, until a legally binding and enforceable global agreement is achieved. This consensus is also reflected in the concepts of the Strategic Energy Technology (SET) Plan[27] – proposed by the European Commission and endorsed by the European Council – and the Strategic Transport Technology Plan, that is currently discussed within the European Commission. While there is a R&D element in these initiatives, they are *principally* meant accelerating deployment of new and low-carbon technologies. This is a consequence of the fact that the EU wants the private sector to speed up the 'natural' rate of investment and technological change, beyond the point what the market would judge as appropriate. While the ETS allowance price increases this rate already, current price levels are insufficient to change this rate of investment consistent with the EU/EEA and global climate change targets.

The economic crisis or "great recession" has brought on the agenda another issue, i.e. price effects due to rapid and dramatic changes in economic output. The European Commission had assumed in its impact assessment that the full implementation of the climate and energy package, including the changes to the ETS, would lead to a carbon price of around €32 (2008 prices) per tonne of CO_2 in the third phase 2013-20. These estimates have been recently revised to €16 in 2020 (European Commission 2010b) to take into account the effect of the economic crisis. Whether this will be the exact figure for CO_2 prices,[28] is uncertain of course but all projections agree that they will be lower than initially expected.

This has raised two issues. The first is about the (right) level of price to provide incentives for innovation and investment. The second is how to curb excessive price volatility. While price volatility is an integral part of any market, if it is 'high', it has a detrimental effect on investment. However, so far volatility – outside the pilot phase – has been rather limited.

Within this context, a number of ideas have been put forward by stakeholders, the European Commission or member states to address either the level of price or volatility or both. This report will not speculate about the 'right' price or the acceptable 'level of volatility' within the tension of creating incentives for innovation and investment in low-carbon technologies and managing competitiveness. Instead it will briefly present a number of ideas that have been put forward to address this vexed question.

Independent Carbon Bank

The most far-reaching idea is the establishment of an independent European Carbon Bank. This idea has been launched by former UK Prime Minister Brown, who wanted it both to set the caps under the ETS but also ensure long-term predictability. More recently, there have been calls for such a Carbon Bank to cope with EUA demand fluctuations by adjusting the supply.

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[26] See also section 6 on competitiveness.

[27] To date, there is a broad consensus to go forward with the SET-Plan but progress is hampered by a lack of finance as well as implementation issues such as on intellectual property rights, patents or more generally, management issues.

[28] Point Carbon (2010) forecasts a price of €15 to €28 (but €30 to €50 if the EU moves to a 30% emissions reduction goal); the UK Parliament Committee on Climate Change (CCC, 2009) has estimated €20 in 2020. However, there are also estimates for higher prices, depending for example on measures regarding CDM and JI or the design of auctioning rules.

Notwithstanding whether such a Carbon Bank is needed or able to manage supply, the establishment of such a body raises important EU institutional issues such to ensure independence, whether it can be set up by legislation or requires a change of the EU.

Price floors and ceilings for EUAs

The idea of price floors and ceilings – sometimes called 'price collar' – has initially been studied as a possible instrument to set up a more flexible response to the threat of climate change with a high uncertainty of costs on a global scale (see Kopp et al., 1999). Economic theory says that, when abatement costs are uncertain, price caps reduce can reduce costs. The result of an IEA simulation has led to similar results (IEA, 2008). There is limited analysis on the utility of price caps and ceilings in the ETS, partly because such a move would raises again complicated EU institutional issues and is difficult to imagine working unless an Independent Carbon Bank or an equivalent organisation existed.

As a way around the institutional intricacies, it has been suggested that the EU should declare that it will auction its future allowances, e.g. in 2030 at a minimum price of say, €40 per tonne of CO_2 of the ETS. This could work as a price floor giving a clear indication to investors that in the future prices will rise at least to around the fixed auction price. Such a system would raise far less institutional complications, but still require further investigation. It would only work if the market took the EU/EEA declaration seriously.

Back to a CO_2 tax?

Another proposal (Larsson & Lönnroth, 2010) – pointing into an opposite direction – is to adjust the ETS more frequently to stabilise the ETS price along a pre-determined trajectory, which is thought to be high enough to trigger innovation and investment thereby creating a positive climate investment framework. This could be done by issuing or withholding emission rights. While such a stabilisation would create a stronger price signal it would be counter to the objective of the ETS to create stability and predictability as to the cap. Hence, this approach is an attempt to bring the ETS closer to become a tax system. It also raises a number of EU institutional issues. While there is a strong economic case for establishing a CO_2 tax and thereby creating a more stable price signal, it is difficult to imagine it being accepted and implemented within a reasonably short period.

Innovation/technology accelerator

The European Commission (2010b) has recently proposed the creation of an "innovation/technology accelerator" under the EU ETS. This new mechanism would support early investors in top performing low-carbon technologies by rewarding them with additional free allowances. The primary aim is to strengthen innovation benefits beyond the carbon price effect. The innovation/technology accelerator could be made operational in a way similar to the demonstration programme supporting carbon capture and storage (CCS) and innovative renewable energy technologies in the revised EU ETS Directive (2009/29/EC, p. 74), which is funded by 300 million allowances from the new entrants' reserve (NER300). The new mechanism would instead work through the benchmarking system of allocating free allowances to industry sectors and would have to rely on surplus allowances left over within the maximum available amount, i.e. after the allocation is complete. These extra allowances would then help finance the investments by companies which commit to outperform the relevant sector benchmark or to make rapid advances towards it, such as by improving carbon intensity. Whether the innovation/technology accelerator will be introduced and what its operational details will be remains to be discussed.

Upping the unilateral EU target to -30%

The failure of the Copenhagen negotiations and the slow progress in Cancún have prompted a general re-thinking of the EU international climate strategy. There is a feeling that instead of waiting for a – possibly illusive – international agreement, the EU should re-focus its strategy on how to best advance its drive towards low-carbon technologies. One of the options that member states and the European Commission are toying with is to increase the EU's unilateral 20% reduction target to 30%, as foreseen in the Directive as possibility. This would most likely mean the ETS cap would be significantly lowered from the current 21% compared to 2005. This would increase scarcity and stabilise the price. The major issues are that the EU made the 30% reduction target conditional to progress in international negotiations, possible negative impacts on 'industrial competitiveness' and the need to convince those member states that remain sceptical to such a move. Finally, some claim that opening the ETS would undermine investment as it undermines predictability.

Member states' complementary measures within and outside the ETS

Member states continue to enjoy discretion in a number of areas that affect ETS emissions. Typically, this applies to land-use decision such as building a new runway for an airport[29] or major infrastructure projects. EU energy policy leaves the responsibility for the energy mix in the hands of member states. Generally, member states are free to adopt additional measures also for the ETS sector, for example to address market failure or provide technology push for certain technologies, e.g. CCS as long as they are compatible with EU laws. There is a risk however of double-regulation, which could result in mixed signals to the investor. Such measures often find their limitations by concerns of competitiveness.

Member states also put in place measures outside the ETS, i.e. for those emissions covered by the EU effort-sharing decision.[30] The UK has gone beyond individual measures and implemented a mandatory carbon trading system for the non-ETS sector. This so-called "Carbon Reduction Commitment" (CRC),[31] in force since April 2010, targets 'non-energy-intensive companies' that use more than 6,000 MWh of electricity. In contrast to the ETS, it covers organisations and companies instead of installations. Organisations that fall under the CRC need to purchase annual emissions allowances for each tonne of CO_2 emitted. Allowances are initially sold by the government at £12 (€14) per tonne, but the objective is to create an auctioning market after March 2013 with a cap on emissions.

In the absence of a global agreement on climate change that could enhance both predictability and the level of the carbon price under the ETS, the ETS in the broader context of EU climate change policy can *contribute* to change the 'natural' rate of investment and technological change towards low-carbon technologies. The extent to which it actually does this depends on the length of the allocation periods, CO_2 prices and market expectations. Additional measures to foster innovation and investment should be considered to also allow the ETS to live up to its promise of reducing emissions in a cost-effective way also in the long-term. There are two schools of thought: one argues for a higher price, while the second believes that the long-term cap, expressed by the linear trend line, will bring the EU over time onto a low-carbon trajectory.

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[29] While the previous UK Labour government had supported a new runway at London's Heathrow airport, partly on the basis that the resulting increase in emissions would be 'covered' by the EU ETS, the new government has since blocked this plan.

[30] Effort sharing refers to member states' obligations to reduce greenhouse gas emissions from sectors not included in the EU ETS – such as transport, buildings, agriculture and waste – as part of the EU climate and energy package, effective as of 25 June 2009.

[31] For details, see the UK initiative's website (http://www.ukcrc.co.uk/index.htm).

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