Harvesting the Low-Carbon Cornucopia:

HOW THE EUROPEAN UNION EMISSIONS TRADING SYSTEM (EU-ETS) IS SPURRING INNOVATION AND SCORING RESULTS

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AUTHORS

Annie Petsonk

International Counsel, Climate and Air Program, Environmental Defense

Jos Cozijnsen

Consulting Attorney, Utrecht, the Netherlands. Email: jc@emissierechten.nl

ENVIRONMENTAL DEFENSE

finding the ways that work

Introduction

In January 2005 the European Union Emission Trading Scheme (EU-ETS) commenced operation. It is the largest greenhouse gas (GHG) emissions cap and trade system in the world, involving multiple countries and sectors. The system caps total carbon dioxide (CO_2) emissions from more than 11,000 installations in the electricity and industrial sectors. Each installation must obtain a CO_2 permit, monitor its emissions, and ensure that its emissions do not exceed the number of European Union Emissions Allowances (EUAs) that it holds. Installations that emit less than their allowable levels may sell their surplus to others. Installations also may purchase certain kinds of emissions allowances and credits via the international carbon market. The system is patterned on the highly successful U.S. sulfur dioxide (SO_2) emissions cap and trade program, with some notable exceptions.

The EU-ETS is just one of a panoply of policies instituted by the EU to tackle climate change. However, according to one recent study, "emissions trading offers the largest emissions savings."[1] (See Fig. 9.) The EU-ETS is operating on a pilot basis through 2007, and will move to a second phase of more stringent caps for 2008-2012, the years covered by the EU's participation in the Kyoto Protocol on Climate Change. Yet the evidence indicates that the EU-ETS already is delivering real greenhouse gas emission reductions while cutting costs. The evidence also shows that the EU-ETS is stimulating a cornucopia of technological and process innovations that will provide low-carbon solutions across Europe and around the world.

1. Evidence for real GHG reductions from the EU-ETS

Preliminary analyses of the EU-ETS indicate that the system already is stimulating real reductions in greenhouse gas emissions. This finding is somewhat surprising, for several reasons. First, the 2005-2007 pilot phase was designed in large measure to provide learning-by-doing rather than to stimulate innovation, and allowances were allocated rather generously to installations; many commentators have suggested that the allowance allocations need to be tightened for the 2008-2012 period.[2] Second, installations that reduce emissions below allowable levels during the 2005-2007 pilot phase are not authorized to carry saved allowances forward for use during the 2008-2012 period. The inability to "bank," or save, unneeded allowances diminishes each firm's incentive to invest in emission reductions now. Nonetheless, the anticipation of tighter caps in 2008-2012, matched with the power of the cap and trade framework, have created significant incentives to reduce emissions.

A preliminary analysis by the European Commission presented in December 2006 concluded that the verified emissions of participating installations amounted to just over 2.0 billion metric tons of CO2-equivalent. This was considerably below the annual average allocation of almost 2.2 billion metric tons.[3]

If the initial allocation had been based on a robust estimate of business-as-usual emissions, the total reduction achieved in the period covered by the Commission's analysis[4] would be on the order of 200 million metric tons. Whether the actual reduction is that large is difficult to conclude, since that requires proving what business-as-usual emissions would have been in the absence of the program. Moreover, as has been noted, it has been suggested that the EU over-allocated allowances in the pilot phase; therefore reductions cannot simply be calculated by subtracting actual from allowable emissions. Some commentators have questioned whether the initial phase is achieving any reductions at all.

Careful scholarly analysis, however, leads to the conclusion that the EU-ETS—even in its pilot phase—has achieved significant reductions.[5] Dr. Denny Ellerman and Dr. Barbara Buchner of MIT (Massachusetts Institute of Technology) and FEEM (Fondazione Eni Enrico Mattei) respectively, analyzed abatement during the 2005 emitting year. They found that it is unlikely that the abatement was as much as 200 million metric tons; but it is also unlikely that there was no abatement at all. Noting that "economic growth since 2002 has been relatively robust in the EU and particularly in the East European accession states," and that better estimates based on more detailed country- and sector-specific research are needed, their tentative calculations suggest 140 million metric tons of abatement, with a possible downward adjustment due to bias in the data. In their words, "An amount half this much—abatement of slightly over 3%—seems not unreasonable, but it is arbitrary and must remain so until better data and more careful assessments can be made. In the meantime, the refutable presumption must be that the EU ETS succeeded in abating CO_2 emissions in 2005."

While increased certainty and predictability are needed, that is still a respectable result for the first year of a three-year pilot phase whose goals, in addition to emission reductions, included (according to the Commission's presentation) a learning period for all parties involved and the creation of a critical mass of experience with an entirely new regulatory paradigm.

EU Commission Environment Director Jos Delbeke also notes that from January through September 2006, 764 million metric tons of CO_2 (metric tons CO_2) traded in the EU ETS, more than double the trading volume of 324 metric tons CO_2 for all of 2005. This trading value in the first three quarters of 2006 was worth €15 billion—a marked increase over the 2005 volume of €8 billion. Those totals amount to 74% of the global carbon market by volume and 88% by value.[6]

2. Evidence for innovation from the EU-ETS

Empirical evidence indicates that the mere anticipation of mandatory emission limits can spur innovation. For example, successive legislative steps to control sulfur dioxide (SO_2) in the United States boosted annual SO_2 reduction patents from zero to 100 (see Fig. 1), even prior to 1995 when the emissions cap and trade market for SO_2 opened its doors.

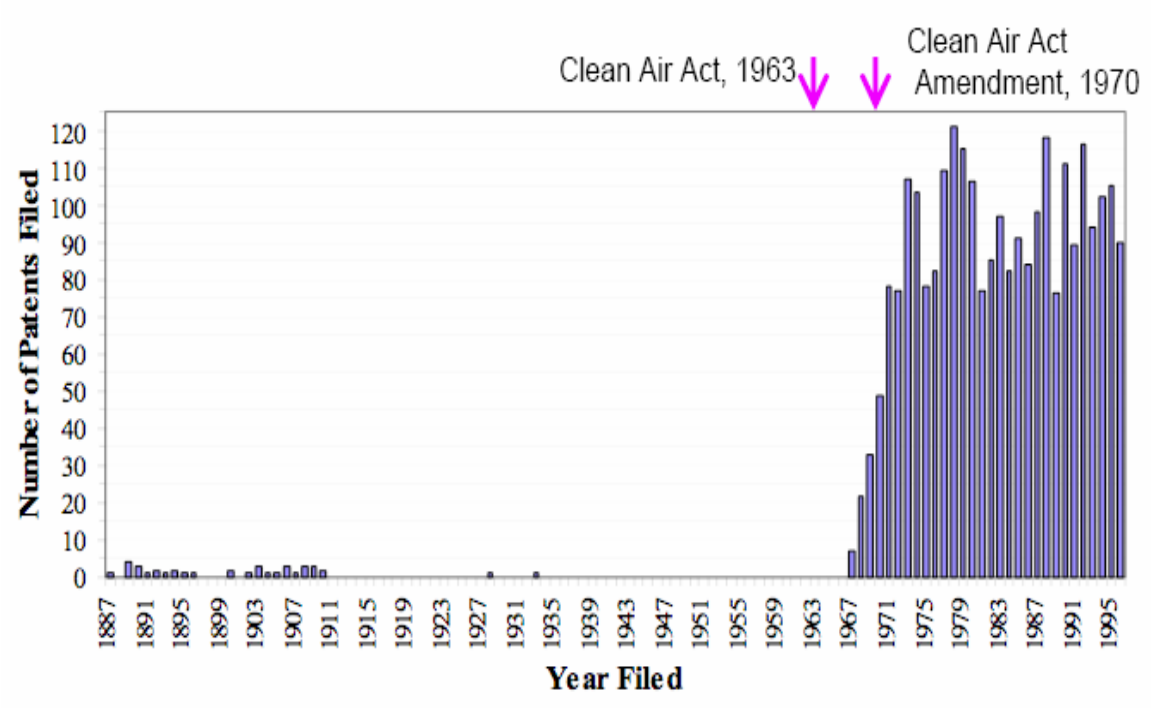

Fig.1. Source: Taylor, M. R., Rubin, E. S. & Hounshell, D. A. Effect of government actions on technological innovation for SO_2 control. Environmental Science and Technology, 2003, 37(20):4527–34

For proof of innovation coming from the EU-ETS, we have examined empirical evidence via case studies. These indicate that the EU-ETS is spurring innovations across large, medium and small enterprises in Europe and among actors outside the EU-ETS. For example, we have seen ample proof of fuel switching in the power sector; Fortis reports that during the Summer of 2005, power companies did replace coal for gas because of relatively low gas prices combined with the carbon cost for coal.[7] And according to a recent study by McKinsey & Company, businesses report that the EU-ETS is already having a significant impact on corporate behavior, in particular on decisions to develop innovative technologies.[8] Key findings of the McKinsey study include the following:

- Under the EU-ETS, emitting CO_2 involves a real cost. About half the participating companies already "price in" the value of CO_2 allowances, and over 70% intend to do so in the future.
- For half of the companies, the EU-ETS is one of the key issues in long-term decisions.
- About half of the companies report that the EU-ETS has a strong or medium impact on decisions to develop innovative technology.

In the next section, we focus on case studies profiling innovations in four EU countries: France, Germany, the Netherlands and the UK.

Case study 1: Transforming Atmospheric Trash into Tulips (the Netherlands)
At Europe's largest oil refinery, the Shell Pernis Refinery in Rotterdam, engineers have been capturing 170,000 metric tons of waste CO_2 per year since 2005 from the refinery's hydrogen factory. The refinery's two tall stacks emit six millions of CO_2 annually, roughly 3% of the total emissions of the Netherlands.

The CO_2 stream is cleaned, compressed and transported through a formerly abandoned oil pipeline and a new infrastructure to 400 large horticulture farms. The farms use the CO_2 as a fertilizer, avoiding the need to import and burn natural gas to generate fertilizer. It is estimated by project participants that the use of CO_2 avoids the burning of 90 million metric tons of natural gas annually, thus 170.000 metric tons of CO_2 [9]. In addition, the CO_2 arrives in a purer form than it would from burning natural gas, namely without polluting traces of ethane and NOx. On top of that, the concentration of CO_2 is higher than with gas, making the method more profitable[10].

Capturing oil refinery CO_2 (at the map named 'PER+) and transferring via pipelines to Westland greenhouses. Clockwise, from upper left: Shell Pernis Refinery; map of pipelines; aerial view of greenhouses at dawn; interior view of greenhouse.
Photo credits: Jos Cozijnsen

LEARNING BY DOING. Shell aims to reduce the Pernis Refinery's CO_2 emissions by 8% or more, saving EUAs, which have value in the ET-ETS carbon market.[11] As reported in the *Guardian*, "the project [gives] new meaning to the term 'greenhouse gas.'"[12] The companies behind the venture, Hoek Loos and Volker Wessels, are expanding the operation to supply 100 more greenhouses with CO_2 from the refinery, at roughly half of what it would cost the greenhouses to generate the CO_2 by burning natural gas.[13] This technology for reducing CO_2 has been known for years, but only became economical when the EU-ETS put a price on CO_2 emissions.

"The debate about CO_2 is changing," Jeroen van der Veer, the chief executive of Shell, told the *New York Times*. "You can either fight it—which is useless—or you can see it as a business opportunity."

LEARNING FROM OTHERS. The Shell success has encouraged four more Dutch factories, pipeline companies and horticulture farms to plan comparable projects that transfer waste CO_2, steam and heat, potentially generating tens of millions of metric tons of CO_2 reductions.

In a comparable UK project, the CO_2 emissions from a British sugar firm combined heat and power (CHP) installation in Wissington are being captured and transferred to four hectares of greenhouses at the Cornerways Nursery[14]. This helps to produce 34 million tomatoes each year between April and November. The Wissington factory will be an EU-ETS participant as of 2008.

Case study 2: Producing Pork—and Power Too (the Netherlands and Germany)

THE NETHERLANDS

Hog farmers in the Province of Brabant in the Netherlands are using fermentation to digest hog manure and capture the methane that is released. The captured methane can be burned for electricity and heat. The electricity can be sold as renewable energy because it avoids burning fossil fuels. The farmers also wish to get credits for avoided methane emissions to sell on the EU-ETS. This can be done starting in 2008 by making use of the EU Linking Directive, which links market mechanisms from the Kyoto Protocol, in this case Joint Implementation (JI), with the EU-ETS. In this specific project in Brabant, the farmers estimate that they will be able to reduce at least 18,000 metric tons (CO_2e) annually with an estimated EU-ETS market value in the range of €360,000 (based on the projected tCO2 price of 20 per 2008).

Methane capture project in Brabant (left) and in Sandbeiendorf near Magdeburg (right)

The farmers are learning that market access is not possible yet, because the Netherlands government is not willing to host JI projects for now; however, they are working to obtain market access for their credits during the years 2008-2012.[15]

GERMANY

In Germany, ARA Carbon Finance GmbH has secured verified emissions reductions (VERs) in a comparable methane capture project near Magdeburg.[16] In total 35,323 metric tons of CO_2e were reduced in 2004 and 2005 and sold in February 2006 to a UK company that wishes to offset its

emissions voluntarily. Though revenues have not been published, the VERs could have brought at least €130,000 (based on the projected tCO2 price of € 20 per 2008; see Fig. 4).

ARA is preparing to bring future emission reductions from this project onto the market as Emission Reduction Units (ERUs) under the JI Programme as of 2008. That may give the farmers an incentive to continue the reduction project and sell for at least €350,000 per year (see Fig. 4)

Swirling to Save Energy – and CO_2

HeliSwirl Technologies' founders continue the great tradition of inventors mimicking the natural world. Five hundred years ago, Leonardo da Vinci sketched the swirling flow mechanism that closes the valves in the heart's chambers. More recently, researchers at Imperial College found that nature also uses swirling flow in blood vessels and that this insight could be harnessed to reduce energy consumption in many industries. The breakthrough observation that blood travels around the body in a spiral motion and the insight that this pattern of flow reduces friction, bubbles and clots, presented them with the challenge of how to replicate the flow at low cost in man-made pipes. In solving this problem, HeliSwirl's technology was born. The technology generates swirling flow, cutting friction in multi-phase flow in pipes. This reduces energy consumption, allows pumps to be downsized, lowers pipe friction and avoids the deposit of sediment which can block pipes. All of these benefits translate into cost savings and lower energy use. The company was conceived at Imperial College, where the researchers were based. Spotting the potential application to industrial fluid handling, they sought to commercialize their ideas. The company expects to take the technology to potential customers including petroleum production, petrochemical processing, water distribution and the food industry.

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More GWP for the Buck: New Ways to Cut N2O Emissions

In May 2005, Water Innovate split off from Water Sciences at Cranfield University with the goal of transferring new technologies out of the laboratory and into the water industry. It spotted a niche bridging the gap between research and industry, and moved into it, identifying, evaluating and exploiting routes to market for new water-related technologies. Innovate's products meet demand created by pollution controls on effluent discharges to rivers and the sea, they address the emissions of climate change-causing gases and reduce the energy use of wastewater treatment processes. To achieve this, it set up a management team with a successful track record in both academic research and utilities management and added expertise in protecting and licensing intellectual property. For funding, it successfully approached the National Endowment for Science Technology and the Arts (NESTA), Oxford Technology 4 Venture Capital Trust, Cranfield Enterprises Limited, and a group of private investors, and raised over £0.5m.Then, earlier this year, it became a Shell Springboard Award winner with its product N-Tox®. The product is a clean technology which meets several needs simultaneously. Ammonia, the same chemical as found in household cleaners, is discharged from wastewater treatment works, but has to be kept at low concentrations to avoid toxicity to aquatic plants and animals. The ammonia levels in effluent are kept down by a process which has a high potential to emit dinitrogen oxide, better known as laughing gas. ***Dinitrogen oxide gas is 300 times more powerful as a greenhouse gas than carbon dioxide.***

N-Tox® measures the performance of the treatment process and warns if the process is becoming poisoned or over-loaded. It takes measurements by passing infra-red light through air, where it is absorbed by even tiny traces of gas, which triggers an alarm. This warning gives plant managers time to re-route flows around the treatment works or to adjust process conditions, well before there is a risk of breaching environmental safety limits or releasing climate change-causing gases. A twofold benefit for the environment. It finds similar applications in landfill leachate and pharmaceutical waste effluent treatment.

The company has identified an expanding market, with water companies continuously investing to reduce ammonia levels in their effluent, under the supervision of environment regulators, and the increasing pressure to tackle climate change.

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Carbon-neutral building materials – and energy savings too

The extraordinary strength of the composite panel at the heart of the Mantle® Building System© was discovered indirectly while trying to create something else. A programme of testing performed in 1999 at the Building Research Establishment near Watford was intended to determine the best load-bearing frame material for an engineered, water-resistant, carbon neutral, highly insulating building component used for walls and roofs.

Mantle Panel Ltd was founded in July 2001 with the aim of developing further and making best use of the technology. The ultra-high thermal insulation properties of the Mantle® Building System© lead the market, its performance abilities being far in excess of existing or envisaged building regulations in the UK or Europe. So airtight and insulated is a Mantle® building that most of the necessary heating is supplied by the occupants of the house. A mechanical Heating/Ventilation and Air Conditioning system fitted with a hypo-allergenic filter must be installed to control air circulation and humidity at a cost comparative to conventional central heating. In combination with other existing and simple technologies to generate power, a Mantle® house can be energy self-sufficient. In some cases it has been calculated it could even return energy to the National Grid.

The Mantle® system cuts carbon emissions by using partly recycled material and using fewer vehicles and lighter-weight transportation to get the material to a site because only just enough material to complete the build is needed. The smaller and lighter foundations also reduce carbon impact and the system will use far less energy when the building is inhabited. Richard Sexton, Director, says 'build it right and you do not need to depend on the occupier to do their bit, because the house that they live in does it for them. Shell Springboard gave us a big boost in public profile, and we are using Springboard funds to broaden our certification throughout Europe.'

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GERMANY

A study of Germany showed that the potential of available domestic projects are limited because of the degree of development of the German climate policy and the risk of double counting the indirect emissions.[17] They state that there are transaction costs involved, but these costs are limited compared to the costs of undertaking offset projects in developing nations through the Kyoto Protocol's Clean Development Mechanism (CDM).

Only some activities fulfill the criterion of policy additionality, i.e., showing that the reductions are new and would not have otherwise occurred as a result of other governmental policies. For the Federal State of Germany, Baden-Wuerttemberg, with 78 metric tons emissions in 2002, the potential for renewables and industrial combined heat and power (CHP) projects was calculated to be more than 1%, less than 1 metric ton. The researchers felt most likely that domestic projects would be of particular interest in countries with a more limited climate policy mix and a binding GHG emissions target. However, they state: "It is possible that even in Germany the economic incentive provided by domestic offsets could stimulate innovative abatement measures in sectors outside the EU-ETS as well as outside other policies and measures, that is, to create additional innovation incentives." They mention for example for projects with easy additionality assessment, e.g. carbon capture and storage, methane and industrial gas reductions.

The study does not address sectors such as agriculture and transportation, which offer large emission reduction opportunities. Further, it appears that the German ProMechG law, which implements the EU directive linking the EU-ETS with the Kyoto's CDM market ("the Linking Directive"), applies even stricter rules than Kyoto's CDM.[18] Currently there are forty-nine JI projects under consideration in Germany, of which forty-six are mine gas (coal bed methane) projects in the Ruhr Area, two are energy efficiency projects and one involves fuel switching. None has been approved yet.

FRANCE

The opportunity for linking reductions from non-capped sectors such as agriculture to the market for capped sectors seems well understood in France. The French Finance Ministry announced in December its intent to establish a regulatory framework that brings domestic JI offsets onto the market, by inviting foreign investors to tap the JI mechanism.[19] They anticipate the potential for 14 million metric tons of CO_2 reductions in agriculture, transportation and decentralized energy projects.[20] This could have a value on the EU-ETS market of about € 280 million, based on the projected CO_2 price in 2008 of € 20 (see Fig. 4).

Cow with SF6 monitoring device offering domestic reduction potential in the agriculture sector (picture taken from a published report by Cozijnsen with CLM and ABAB in 2006)

Domestic emission offset projects: Points for discussion

Several of the case studies profiled above illustrate how innovations are occurring not only at installations covered by emission caps, but also in companies and at installations that are not. Moreover, innovations are occurring at installations that are direct emitters, as well as those that emit only indirectly (e.g., those that consume, but do not generate, electricity).

In the language of emissions trading, reductions earned at direct-emitting entities not formally covered by emission caps are known as "offsets". The emission reduction and innovation potential of offsets in Europe has received relatively little attention from researchers in the field. The focus of research has been more on ETS participants (i.e., installations covered by the ETS emission caps) and on offset projects in developing countries whose national emissions remain uncapped.

This skew in the focus of research in Europe arises partly from the fact that under the Kyoto Protocol, emission credits from offset projects in developing countries are tradable, through the Protocol's CDM, prior to the start of the Protocol's 2008-2012 emission caps; by contrast, credits from offset projects in industrialized countries are not cognizable until 2008. The EU-ETS incorporated the Protocol's differential treatment of offsets. While some EU member states have begun to study the emission reduction potential of domestic offset projects, to date these studies have been undertaken

primarily to provide a foundation for regulations and subsidies, rather than to evaluate the potential of such projects to deliver significant reductions tradable in the carbon market.

The European Commission has moved to facilitate the use of domestic offsets, by adopting a decision in November 2006 on how to avoid double counting of emission credits arising from these projects.[21] The Decision clarifies that member states need to reserve units of their Kyoto Protocol Assigned Amount (AAUs) to cover such projects, and that for projects at installations covered by the ETS, the reductions associated with the projects will become tradable by subtracting the allowances involved.

3. Putting a Price on Carbon: The Pilot Phase and a Maturing Market

By capping carbon and allowing entities to trade, the EU-ETS is putting a price on GHGs in a way that enables those who come up with better, cheaper, faster ways of cutting carbon dioxide emissions to earn greater returns on investment.

Yet when EU-ETS prices tumbled during a two-week period in April-May 2006, news stories trumpeted the "collapse" of the EU carbon market. Since then, prices have recovered moderately, and European industry is calling for tighter emissions caps in the future.[22]

The EU launched its trading market as a pilot for the years 2005-2007. Extending the market for the years 2008 and beyond is a centerpiece of the EU's strategy to fight global warming. The EU market is largely modeled on the highly successful U.S. sulfur dioxide (SO_2) cap and trade market, which since 1995 has cut U.S. acid rain pollution dramatically at a fraction of anticipated costs. A crucial difference, however, is that the EU initially allocated CO_2 allowances to facilities based on their *forecasted* pollution growth, while the U.S. allocated SO_2 allowances to facilities based on *historic* emissions or historic fuel use.

Forecasting is an inherently imprecise business. If emissions increase more slowly than forecasted, on the back of slower economic growth, there will be excess allowances in the system. That is what has happened in Europe during the pilot phase of the EU-ETS. When annual emissions reports, independently verified and filed in late April and early May 2006, showed that companies' actual emissions were less than forecasted, prices dropped (see Fig. 2).

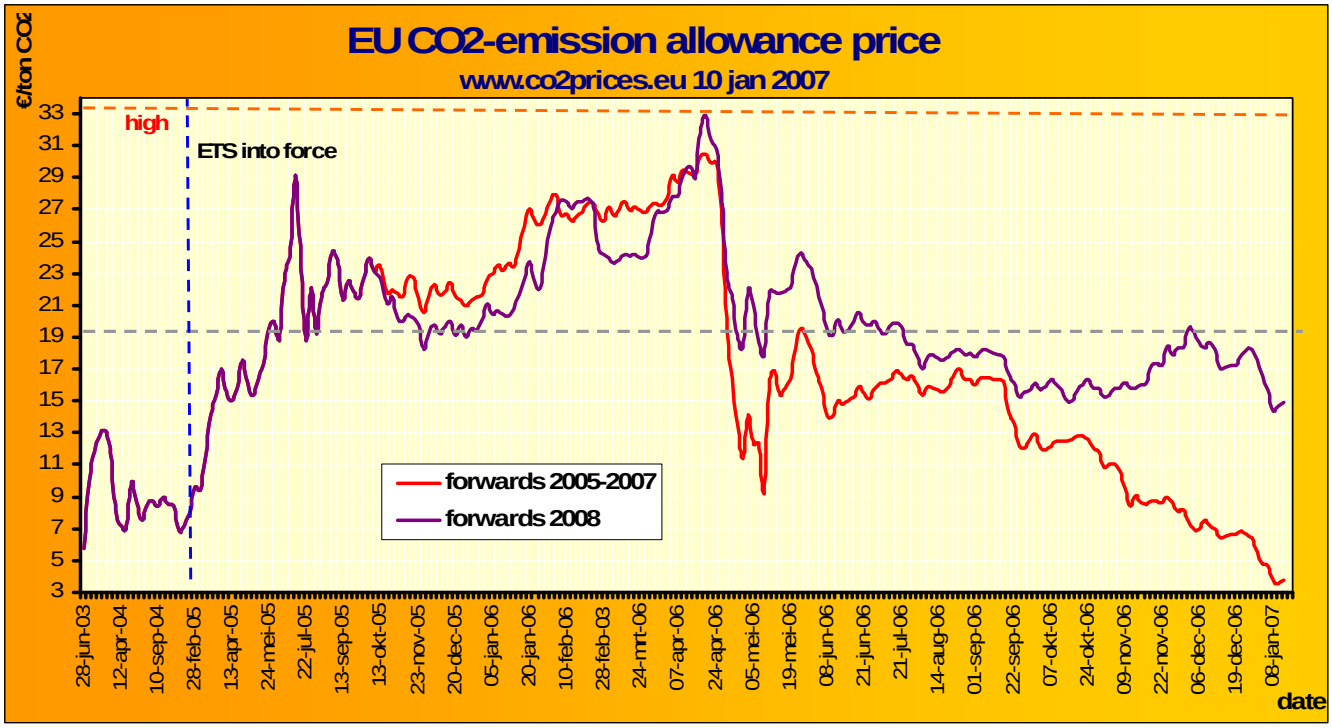


Fig. 2. EU ETS Market Snapshot
Source: Jos Cozijnsen, http://www.co2prices.eu/

Significance of the May 2006 price drop

Some have suggested that the price drop reflects windfall profits realized by European emitters, including large electricity companies, and that therefore the trading system should be changed. Allowances should be auctioned, not "grandfathered" (allocated for free based on historical emissions); and even that the trading system should be scrapped.[23]

Careful analysis indicates, however, that the EU trading system is working. The evidence for windfall profits is quite ambiguous; and tighter emissions caps can and should be adopted in the future.[24] During the roughly two-week period that EU carbon market prices were at their lowest, following the release of emissions data, trading volume jumped. Market prices in the vintage 2008 forward market did not drop as precipitously, and prices in that market have steadied. These trends reflect the market's belief that the system will continue into the future, with tighter caps. (see Figure 3).

Commentators have also suggested that when they tighten the caps and broaden the coverage in the future, EU regulators should take care to avoid double-counting that might otherwise lead to windfall profits, a view the EU appears to have taken on board.

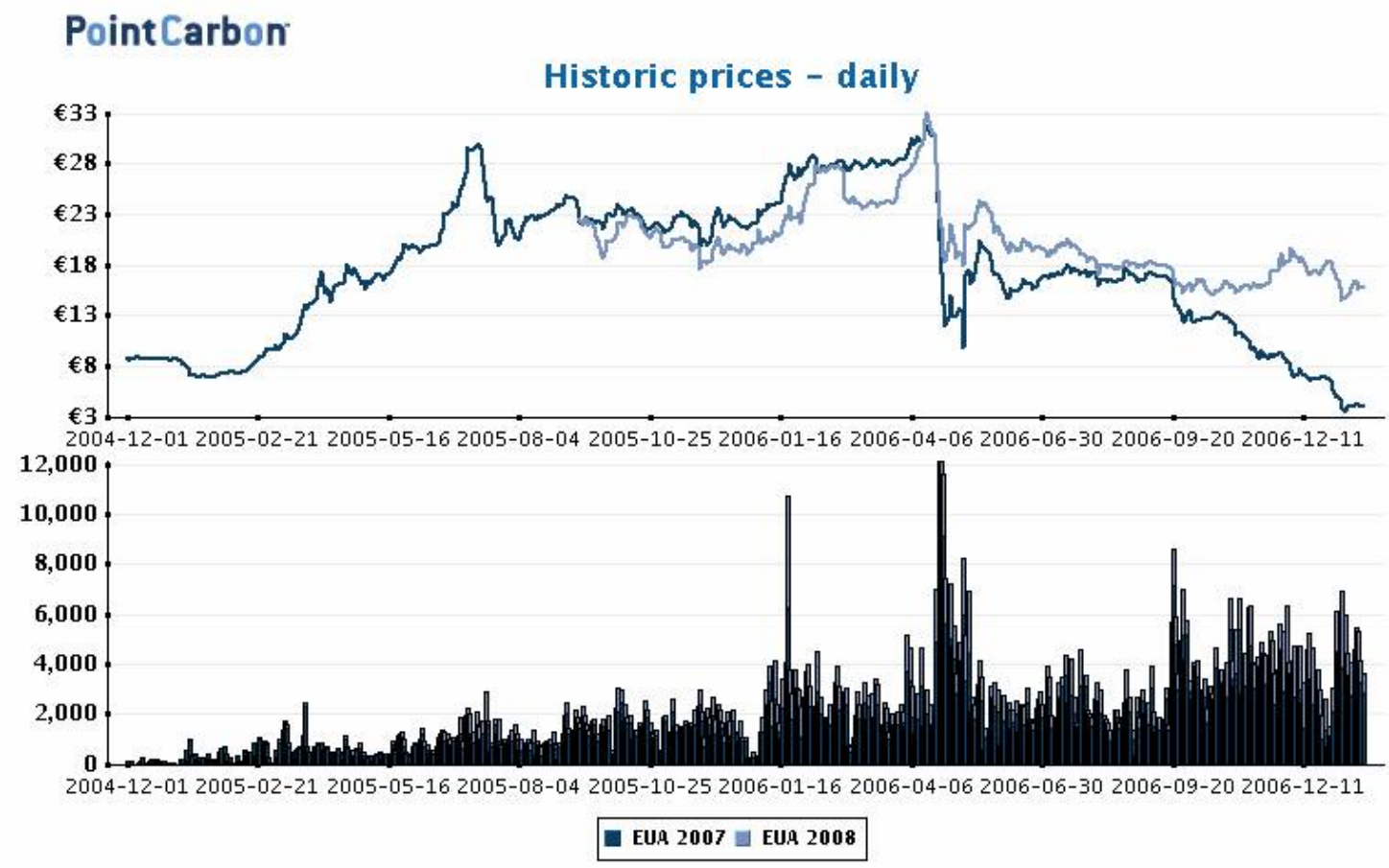


Fig. 3. EU ETS – Price and Volume
Source: Point Carbon 2007 (used by permission)

As noted above, the increase in trading volume reflects market expectations that companies need more allowances for their compliance, that emissions caps will continue into the future, and that caps will in fact be tightened. Overall, the following points should be noted:

- The May 2006 reports showed a better-than-expected emissions management response by firms in 2005. That's good—it means firms are finding better, cheaper, faster ways of cutting emissions, precisely the goal of the ETS. This is reflected by the company Imetric tonech, which said that it devoted its 2005 revenue growth from energy management systems to carbon constraints.[25] Imetric tonech is an international technical service provider with an annual turnover of approximately €2.5 billion.
- Research by Fortis Bank shows that in the summer of 2005 (and repeated in 2006) the "carbon adjusted dark spread" that is, the difference between the coal price plus CO_2 cost per kilowatt-hour and the price of natural gas plus the CO_2 cost, was such that it was preferable to generate power with natural gas, which emits less CO_2 than does coal.[26] Fortis has calculated that around 90 metric tons of emissions were avoided in 2005 because of the carbon market's price signal. The Fortis study notes that in summer gas prices are usually lower because of less demand. The CO_2 price was indeed high during the summer against the background of high oil prices (see Figure 4).
- Firms' ability to cut emissions while maintaining economic growth shows that Europe is starting to achieve the longer-term goal of cap and trade—to de-link economic growth and emissions. The key point is that the atmosphere is not seeing as many emissions as allowed, and firms have begun to innovate in anticipation of a carbon-constrained economy and the economic opportunities created through the cap and trade market.

Did the EU allocate too many allowances to firms in the first place? That may be. The initial National Allocation Plans (NAPs) apply during the pre-Kyoto period, from 2005-2007, a time that the EU has explicitly stated is part of a learning-by-doing phase. Forward prices for vintage 2008 (Kyoto compliance) allowances have remained in the vicinity of €18 per metric ton (See Figs. 2 and 3).

- That may reflect the market's perception that the EU is building a credible infrastructure for compliance over time. Firms know they will be held to mandatory targets under the Kyoto Protocol during the years 2008-2012, and they expect to be held to tighter levels in the future, even if some market players have suffered some recent irrational exuberance and paid for it.
- In the larger view, market downs and ups are part of price discovery. Prices dipped in Europe when firms discovered that they could actually reduce pollution faster, and at lower cost, than they had anticipated. Moreover, not all EU member states have reported their 2006 emissions, so if industries in those states also find they can cut emissions cheaper and faster than they had previously thought, prices may dip again.

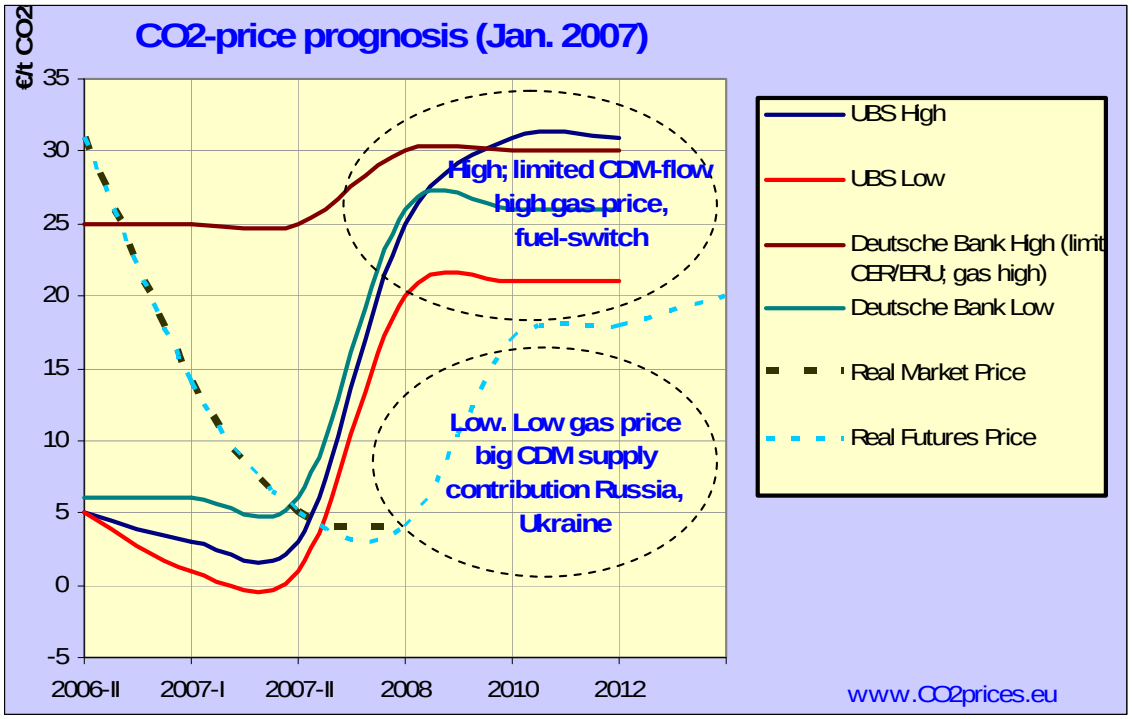


Fig. 4 CO2-price prognosis (Jan. 2007)

Source : Jos Cozijnsen. http://www.co2prices.eu/;
'Carbon Outlook', UBS Utilities team, January 8th , 2007

- The U.S. sulfur dioxide trading market has experienced similar cycles. Early on in the U.S. market, some electricity companies forecasted that compliance would be expensive. When the first auction was held in 1995, prices tumbled, as the public discovered that many firms actually had very low-cost compliance options that simply hadn't been brought forward. Later, as the U.S. government remained firm in its commitment to control acid rain, prices climbed—and have moved up and down partly in response to new innovations coming to the fore (see Fig. 5.) What's crucial is that continued governmental commitment to emission caps, coupled with the flexibility of emissions trading, enables firms to achieve dramatic reductions in pollution while maintaining profitability and growth (see Figs. 6 through 8), while stimulating the kinds of technology and process innovations that are springing up all over Europe.

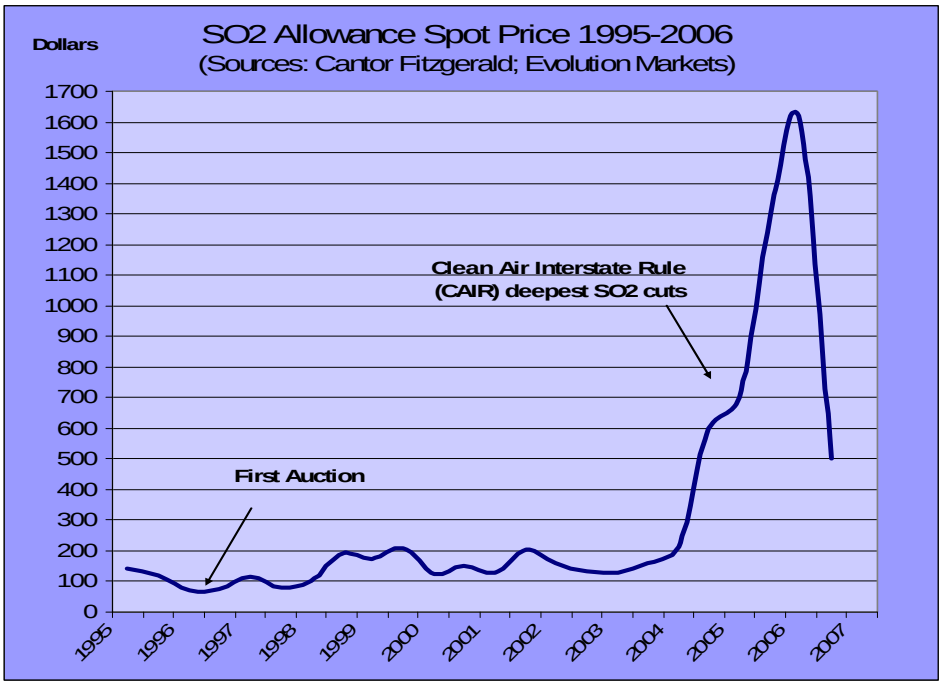


Fig.5. Sulfur dioxide emissions allowances price index, U.S. SO_2 cap and trade program

Sources: Cantor Fitzgerald and Evolution Markets.

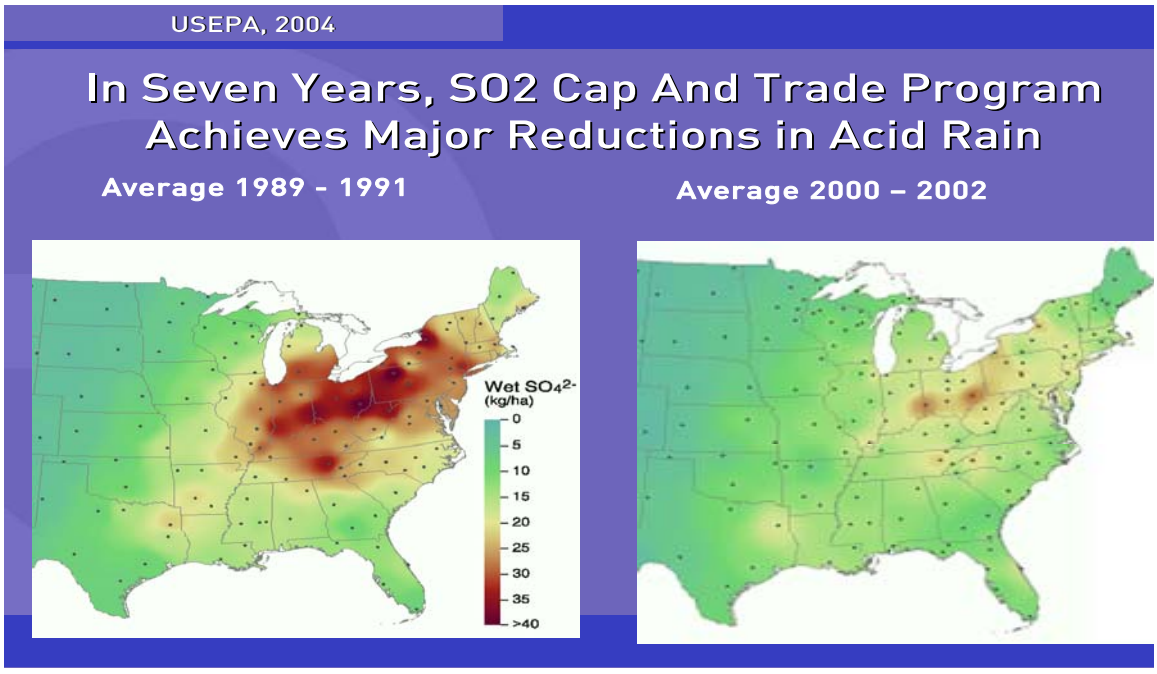
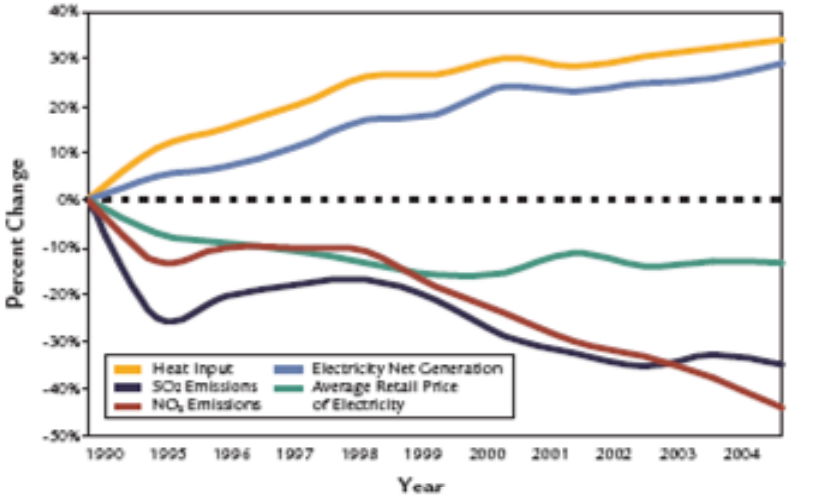


Fig. 6. Results of U.S. SO_2 cap and trade program
Source: US EPA.



Sources: EPA (heat input and emissions) and Energy Information Administration (electricity generation and price values).

Note: Heat input and emissions data reflect Acid Rain Program units. Generation reflects all fossil fuel-fired electricity-only plants in the United States. Retail price reflects full national values for the electricity-generating sector.

Fig. 7. SO_2 and NOx markets and electricity generation

Source: US EPA.

4. Looking Ahead

As the rules and allocations become clearer, it is likely that the EU-ETS will spur even more innovation and technology development.[27] The Commission's Review of the First Phase will be published at the beginning of 2007. Proposals to add more gases and sectors into the system and linkages with other systems are expected in the fall of 2007. The European Commission has issued a draft directive to cover, in the EU-ETS, the emissions of intra-European aviation flights as of 2011 and the emissions of flights between Europe and other points outside Europe as of 2013 (see box below). And the Commission has indicated that it will soon announce several regulatory refinements aimed at stimulating even more innovation. It plans to publish a framework linking carbon capture and storage to the EU ETS, encouraging the development and use of technologies for secure, long-term geologic storage of carbon dioxide. It will revise its methodology for allocating allowances to existing coal-fired power plants, awarding allowances on a CO_2 per kilowatt-hour basis as a means of furthering CO_2–efficient electricity generation. It will require that all new fossil fuel-fired electricity generation be "carbon neutral" – that is, that such facilities reduce their net emissions to zero. And in its Energy Related documents released January 10, 2007, the Commission proposed that the EU will reduce its CO_2 emissions 20% below 1990 levels by 2020, with a further 10% reduction if other nations agree to comparable targets.[28]These announcements send a clear market signal that the EU ETS will continue after 2012, with more stringent targets, delivering more incentives for innovation.

CURBING AVIATION EMISSIONS: AN INNOVATIVE MARKET-BASED APPROACH[29] In December 2006, the European Commission announced a proposed directive to address the greenhouse gas emissions from commercial aviation flights within, coming into, and departing from Europe. Under the proposal, beginning January 1, 2013, all flights landing or taking off from European airports must hold emission allowances sufficient to cover the flight's emissions; to avoid double-counting, flights whose emissions are covered by another jurisdiction's emissions caps will be exempted from this requirement. So, for example, if California decides to limit emissions from commercial flights traveling into and out of California, and a flight from California arrives in Europe, the EU-ETS would recognize the California emission allowances as valid. But flights originating from another jurisdiction that does not cap emissions would be required to procure allowances in the EU-ETS. The proposal uses a market-based approach and provides equal treatment of domestic EU and foreign flights, much as all planes landing in Europe are currently required to procure landing slots, which are tradable.[30]

While the proposal has sparked some controversy, it has won the support of many airlines, who recognize aviation's significant and growing GHG emissions. The proposal is also beginning to stimulate innovations in cutting the GHG emissions of international air travel. For example, at airports in Europe, Virgin Airways is beginning to use efficient, fuel-saving mini-tow trucks to tow planes along taxi-ways rather than using the plane's engines to drive the planes along taxiways. And Virgin's chief, Sir Richard Branson, has announced a $3 billion program to find alternative, lower-emitting fuels and strategies for international aviation. The proposal also appears to provide a powerful model illustrating how trading systems might be linked in the future across national jurisdictions, fostering the rapid spread of innovations around the globe.

Analysts within the EU forecast that if the world does act to curb GHG emissions, the annual expenditure on carbon emissions reduction will grow by between U.S. $10 and 100 billion each year for the next 45 years, giving a market size over the first five years of $1 trillion.[31] Moreover, the analysis indicates that emissions trading provides the best value for money invested—that is, the greatest reductions for the smallest Euro-value market share.

The European Commission is reviewing the Allocation Plans for the period 2008-2012. Analysts already concluded that these Plans were too generous if the EU is to build a market that sustains demand for emission reductions that is a market with a reasonable shortage of allowances that spurs innovation.[32] Others have suggested that because the carbon market rewards the most cost-effective technologies with the lowest risks in the short term, ensuring innovation requires the certainty provided by a more sustained long term price signal for carbon.[33] Indeed, besides an initial shortage, the possibility for companies to bank surplus emissions reductions below their cap into future commitment periods is crucial for a well functioning emissions market.

The decisions of November 29 and January 16 by the European Commission on the first twelve Allocation Plans shows, apart from meeting the Kyoto target, the Commission also seeks to ensure a carbon market with enough sustained shortage to stimulate low carbon solutions and set a price that is less vulnerable, for example to economic drops or weather changes, than in the First Allocation Period.

Environment Commissioner Stavros Dimas said: "Today's decisions send a strong signal that Europe is fully committed to achieving the Kyoto target and making the EU ETS a success. The Commission has assessed the plans in a consistent way to ensure equal treatment of Member States and create the necessary scarcity in the European carbon market. The same standards will be applied to the rest of the plans." The Commission decided that Belgium, Germany, Ireland, Greece, Latvia, Lithuania, Malta, Netherlands, Slovakia, UK and Sweden together have to reduce the amount of allowances to be allocated to companies with 5 to 7% compared to what member states had proposed. It is expected that the allocation plans of the other 13 member states, including Poland and the Czech Republic, the Commission will review, will have to reduce their allocation by 7 to 10% [34].

Carbon market participants—brokers, traders and analysts—forecast the cuts will fuel demand for permits. "It's slightly stricter than I'd expected," said Mats Ahl, head of carbon trading at German utility RWE. "It looks like the second phase is going to be short. We might see a carbon price for 2008 delivery of €25."[35] The 2008 carbon price rose by 45 cents to 18.3 Euros by late afternoon, versus some €8.20 for 2006 delivery. The decision was anticipated largely by the market; the price was already slowly increasing in the previous weeks.

With a reduction in the Allocation Plans, the market could envisage an initial shortage of 400 to 500 metric tons per year, or 2 to 2.5 billion metric tons of CO_2 for the whole period. Whether that will lead to a market price below or above €20 will depend on other market fundamentals, as the scenarios from various analysts show for after 2008 (see Fig. 4). Fortis has calculated that in order to stimulate fuel switching in power generation from coal to gas not only during summertime, when gas prices are typically low, but also in wintertime, the CO_2 price should be at least €100.[36] To stimulate fuel switching throughout the year, some traders assert that the carbon price should be at least €50.

In the aforementioned German study on domestic offsets, the authors assume that the carbon credit price should be between €35 and €62 and last 21 years to make small domestic projects profitable.

In addition, SAM has developed for World Wildlife Fund a model to assess the financial impact of different replacement strategies under different carbon prices. In a future with legislation in place to stabilize carbon emissions at sustainable levels, lower-carbon replacement strategies emerge as winners. Using the large German electricity company RWE as an example, SAM calculated a potential 'value at risk' of 17% of the net equity value in a business-as-usual scenario. The outcome of SAM's recent study shows that a CO_2 price of €33 per metric ton is the breakpoint at which replacing the portfolio with gas-only carries the highest net equity value for RWE.[37].

Looking Ahead: The future of trading with nations that have no emission caps

If nations of the world are to avert dangerous, irrevocable climate changes, nations must reverse the global trend of increases in greenhouse gas emissions; world-wide, global emissions must decline. The longer we wait, the steeper the decline will need to be.[38] As the time-window for reversing global trends in GHG emissions narrows, attention is beginning to focus on how long the EU-ETS will remain open to emission credits earned in nations without emission caps. Because such trades do not drive global emissions downward (they simply shift business-as-usual emissions increases from one location to another), over time, as the EU-ETS matures, it is understandable that the EU will likely explore ways of deepening the potential for linkage with jurisdictions that adopt caps on emissions.

In this paper we have shown that at least in the next decade, low carbon solutions against lower carbon prices will flourish due to the EU-ETS. Governments need to acknowledge that potential, and enable business to make use of it. Recently, leading U.S. companies and environmental groups called upon the U.S. government to unleash the power of cap and trade in America.[39] We see positive developments in France; we see still some reluctance in Germany and the Netherlands. But as a growing number of jurisdictions like California recognize, cap and trade stimulates innovation and spurs competition to deliver emission reductions better, cheaper and faster. As these jurisdictions explore the possibility of

allowing emissions trading across emissions markets, the EU-ETS seems poised to be a powerful player in the transition to the low-carbon economy of the future. Research shows that government funding is essential only in supporting early-stage technologies. Hence European and Japanese firms are investing and growing market share in renewables and the US is increasingly becoming an importer of renewable technologies[40].

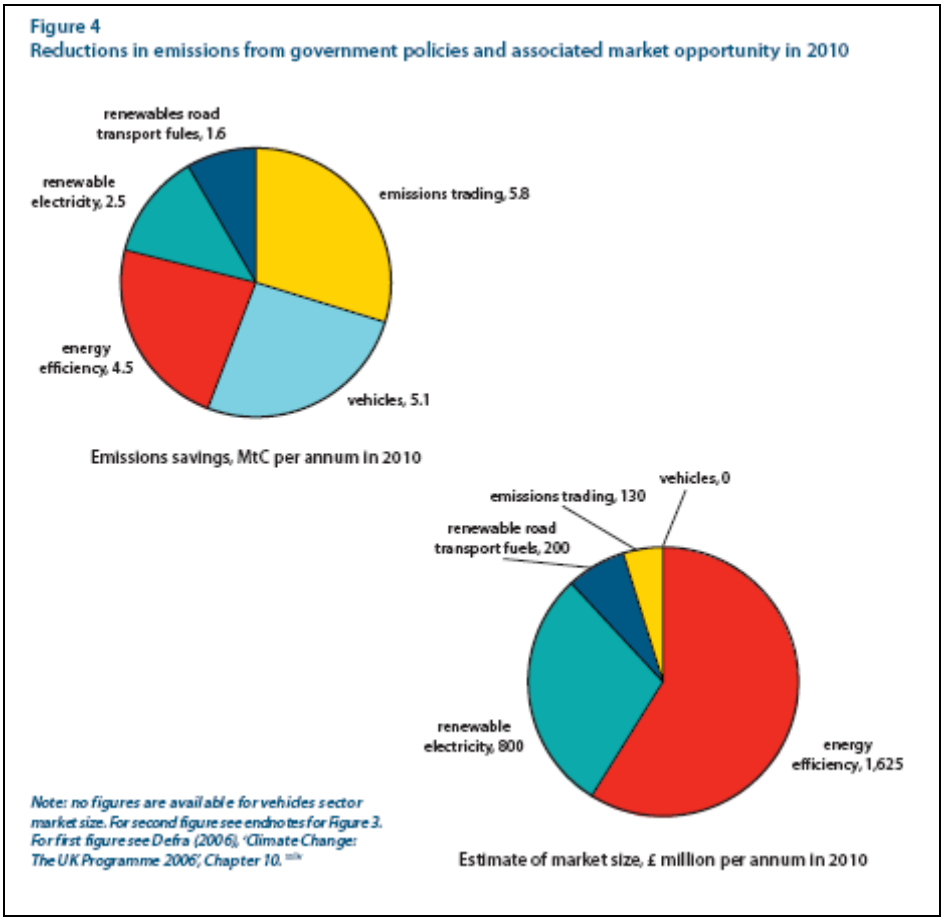


Fig. 8. Emissions trading provides the greatest emissions reductions for the least cost. Source: Opportunities for innovation: The business opportunities for SMEs in tackling the causes of climate change, Shell Springboard/VividEconomics, October 2006.

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[1] Opportunities for innovation: The business opportunities for SMEs in tackling the causes of climate change, Shell Springboard/VividEconomics, October 2006.

[2] See, e.g., "Increasing the Ambition of EU Emissions Trading, An Assessment of the Draft Second Allocation Plans and Verified Emission Reports of Germany, the United Kingdom and the Netherlands," A report to Greenpeace International by Fraunhofer Institute, CEEM and Jos Cozijnsen, June 2006, text available at:
http://www.isi.fraunhofer.de/publ/downloads/isi06b30/Ambition-eu-emissions-trading.pdf

[3] See "Regulatory issues – state of play," by Jos Delbeke, Director, DG Environment, European Commission, presented at the 6th IETA Forum on the State of the Greenhouse Gas Market, Berlin, 6 December 2006 (copies available from Environmental Defense or the European Commission).

[4] The Commission's analysis does not indicate the time period of its analysis, whether January-December 2005, or January 2005-September 2006.

[5] See "Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005 Emissions Data," Denny Ellerman and Barbara Buchner, NOTA DI LAVORO 139.2006 (November 2006), CCMP – Climate Change Modeling and Policy Program of the Massachusetts Institute of Technology and the Fondazione Eni Enrico Mattei (FEEM), see:
http://www.feem.it/Feem/Pub/Publications/WPapers/WP2006-116.htm#summary

[6] Delbeke, supra.

[7] See, e.g., "Fuel Fundamentals in the Carbon Market '05," Fortis Bank Special Report on Energy, 25 January 2006 and New Values Net, December 6th, 2006:
http://community.newvalues.net/2006/12/fortis_during_summer_emissions.html

[8] See "Review of EU Emissions Trading Scheme - Survey Highlights," prepared for the European Commission Directorate General for Environment, by McKinsey & Company (November 2005). Of the 167 industrial companies that responded, 66% fall within the five main sectors covered by the EU ETS. These companies represent a large share of the respective sectors. Power generation and cement respondents cover an estimated 75% of the total market in the EU25 (measured by installed capacity); steel respondents some 60%, refineries 50%, and pulp & paper 40%. Of the companies that responded, about half claim that the EU-ETS has a strong or medium impact on decisions to develop innovative technology. McKinsey asked companies how strong the EU ETS impacts decisions within companies to develop innovative technologies. About half of the companies claim that the EU ETS has a strong or medium impact on these decisions with the strongest impact in the steel industry.

[9] See the project description available at:
http://www.volkerwessels.com/vw_shared/Static_Binaries/VW_DOCUMENT_DOWNLOAD/VW%

20NetWerk%20Engels%202005-2_0.pdf

[10] Ibid

[11] Jad Mouawad, "A Refinery Clears the Air To Grow Roses; Oil Industry Moves To Curb Carbon Emissions," The New York Times, June 30, 2006.

[12] The Guardian, Saturday, August 12, 2006.

[13] The OCAP Project – A Description, http://community.newvalues.net/2006/08/oil_refinery_gives_greenhouses.html

[14] See press release: http://www.britishsugar.co.uk/RVEcb304d8c60384563b83f309627e8e268,,.aspx

[15] New Values.net, Sept 15, 2005: http://community.newvalues.net/2005/09/dutch government_releases_link_1.html

[16] Press release, March 22nd, 2006 (German): http://www.ara-co2.de/downloads/presse220306.pdf

[17] See: "Domestic offset projects: limited opportunities in Germany but potential for others?" Authors: Betz, Regina; Rogge, Karoline; Schön, Michael. Source: Energy & Environment, Volume 17, Number 4, July 2006, pp. 569-582(14): http://www.ingentaconnect.com/content/mscp/ene/2006/00000017/00000004/art00004;jsessionid=6r8ko4m1c44oo.alice

[18] According to Sebastian Gallehr from Gallehr+Partner in Motell News, December 2oth, 2006, see: http://l4.montelpowernews.com/MontelNews/MainNewsStory.asp?id=112894

[19] See Press release, December 4th, 2006: http://www.caissedesdepots.fr/GB/espace_presse/colloque_co2/press_release_climate_2006_dec_4_2nd.pdf

[20] See examples: http://www.caissedesdepots.fr/GB/espace_presse/colloque_co2/fiche_exemples_eng.pdf

[21] COMMISSION DECISION of 13 November 2006 on avoiding double counting of greenhouse gas emission reductions under the Community emissions trading scheme for project activities under the Kyoto Protocol pursuant to Directive 2003/87/EC of the European Parliament and of the Council (2006/780/EC) See: http://ec.europa.eu/environment/climat/emission/pdf/l_31620061116en00120017.pdf

[22] Business Leaders Support Tougher Stance on Climate Change, Letter to Prime Minister Tony Blair, June 6, 2006, http://www.forbes.com/2006/06/06/blair-environment-uk-cx_cn_0606autofacescan02.html

[23] See, e.g., Over-Allocation or Abatement, supra, for some of these views.

[24] See, e.g., Application of the emissions trading directive by EU Member States, EEA Technical report No 2/2006, ISSN 1725-2237; and see LETS | LIFE Emissions Trading Scheme, LETS Update: Decision Makers Summary, April 2006; see also "CO_2 trading and its influence on electricity markets," Final Report For DTE, Frontier Economics, February 2006.

[25] See press release, February 28th 2006: http://documentatie.imetric tonech.nl/pdfppt2005EN/PersberichtEN.pdf

[26] New Values Net, December 6th, 2006: http://community.newvalues.net/2006/12/fortis_during_summer_emissions.html

[27] Currently, it appears that allowance surpluses from the pilot phase may not be carried forward into the 2008-2012 period unless it does not lead to an allocation beyond the total allocation approved by the Commission for the second trading period. Therefore, for each allowance allowed to be banked, an allowance must be deducted from the total quantity issued for the second trading period. In addition, banking has to be examined under EU state aid rules. Where banking is not a result of real emission reductions having been made, it is likely to be found incompatible with state aid rules. This means in fact that allowing banking can lead to a relative shortage switch amongst the participants within a nation, but not increase the overall cap. This became clear in the European Commission's decision on 10 Allocation Plans, November 29th (See Press release: http://ec.europa.eu/environment/climat/ip_1650.htm).

Besides this, emissions debits can be carried forward. For example, according to a recent interpretation, in DG Environment's view, the wording of the second sentence of Article 16(4) ETD ("Payment of the excess emission penalty shall not release the operator from the obligation to surrender an amount of allowances equal to those excess emissions when surrendering allowances in relation to the following calendar year.") does not specify the type of allowances (phase 1 or 2) to be used for making up under-surrendered emissions in addition to the penalty. Accordingly, it is legally possible to use phase 2 allowances to make up for under-surrendering after 1 May 2008 with respect to phase 1 emissions. There are no provisions in the Registry Regulation that could support a different view. This means in other words that if an operator is out of compliance on 1 May 2008 for the years 2005, 2006 or 2007 its entry in the compliance status table in the national registry for 2007 is negative and so its starting point in 2008 is also negative. It goes without saying that the operator will have to pay the excess emissions penalty for being in this situation. However, according to Article 16(4) ETD operators are permitted to surrender phase 2 allowances against the year 2008 in order to bring it back to 0, i.e. back to compliance, for 2008.

[28]See:http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/29&format=HTML&aged=0&language=EN&guiLanguage=en

[29] See: "Tracking the Skies, an airline based-system for limiting greenhouse gas emissions from International civil aviation," Allen Pei-Jan Tsai and Annie Petsonk, The Environmental Lawyer, Vol 6, 2006.

[30] Proposal for a Directive of the European Parliament and of the Council, amending Directive 2003/87/EC so as to include aviation activities on in the scheme for greenhouse gas allowance trading within the Community, Commission of the European Communities, 2006/87/EC
[31] Opportunities for innovation: The business opportunities for SMEs in tackling the causes of climate change, Shell Springboard/VividEconomics, October 2006.

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[34] See Press release:
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[35] Quote from Reuters, November 29th 2006

[36] New Values Net, December 6th, 2006:
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http://www.sam-group.com/downloads/studies/sam_carbonizing_short_e.pdf
[38] B. O'Neill & M. Oppenheimer, "Dangerous climate impacts and the Kyoto Protocol," Science 296, 1971-1972 (2002).

[39] See www.us-cap.org, a group of ten leading U.S. firms and four non-governmental organizations that, on January 22, 2006, issued a call for the establishment of a cap and trade program in the United States for cutting greenhouse gas emissions.

[40] U.S. energy research and development: Declining investment, increasing need, and the feasibility of expansion by Gregory F. Nemet and Daniel M. Kammen, Elsevier Energy Policy, 2006