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Energy Efficiency and the ETS

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Energy Efficiency and the ETS

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POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

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Abstract

The recently adopted Energy Efficiency Directive and other EU and Member State level policy instruments on energy efficiency as well as international greenhouse gas emissions trading systems will have interactions with the EU Emissions Trading System. These are analysed in the present briefing, highlighting possible problems with conflicting or misaligned policy instruments, and providing recommendations on the design of policy instruments, in particular the Emissions Trading System.

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LIST OF ABBREVIATIONS

APCR	Allowance Price Containment Reserve
BEV	Battery Electric Vehicle
CCA	Climate Change Agreements
CCL	Climate Change Levy
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO_2	Carbon Dioxide
COP	Conference of the Parties
CRC	Carbon Reduction Commitment
EED	Energy Efficiency Directive
ERU	Emission Reduction Unit
ETS	Emissions Trading System
EUA	EU Allowances
FCEV	Fuel Cell Electric Vehicle
GDP	Gross Domestic Product
ICAO	International Civil Aviation Organization
ICAP	International Carbon Action Partnership
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LPG	Liquefied Petroleum Gas
NER	New Entrants' Reserve
NZ ETS	New Zealand Emissions Trading Scheme
PHEV	Plug-in Hybrid Electric Vehicle
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
RGGI	Regional Greenhouse Gas Initiative
TWC	Tradable White Certificate
UNEP	United Nation Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
WCI	Western Climate Initiative

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EXECUTIVE SUMMARY

Background

The three headline targets of EU energy and climate policy are to increase the share of renewable energy sources to 20%, to increase energy efficiency by 20% and to decrease CO_2 emissions by 20% by 2020. Furthermore, the EU has the objective of reducing greenhouse gas (GHG) emissions by 80-95% by 2050 compared to 1990.

In order to reduce GHG emissions, the EU Emissions Trading System (ETS) has been established by Directive 2003/87/EC, fixing a cap-and-trade system, which currently involves over 11,000 large emitters covering around 40% of European GHG emissions. In its recent communication to the European Parliament and the Council, the European Commission observes a significant oversupply of emission allowances identifying six options to reform the European carbon market.

The recently adopted Energy Efficiency Directive (EED) establishes a common framework of measures for the promotion of energy efficiency within the Union, and is estimated to have the potential to achieve energy savings of 17-20% by 2020.

Aim

It is the aim of the present briefing to analyse the interplay between improvements in energy efficiency and GHG reductions, to analyse the interactions between EU and international policy instruments on energy efficiency and on GHG reductions, to highlight possible problems with conflicting or misaligned policy instruments, and to provide recommendations on the design of policy instruments, in particular the ETS system.

General analytical approach

Based on the identification and description of a relevant set of energy efficiency policies at Member State and EU levels as well as of carbon trading schemes introduced in different world regions in chapter 1, and based on fundamental technical considerations on direct and indirect effects of energy efficiency improvements on the ETS sector in chapter 2, chapter 3 analyses conflicts and misalignments between different policy instruments on energy efficiency and CO_2 reduction. Chapter 4 provides conclusions and recommendations on the design of policy instruments, in particular the Emissions Trading System.

Policy instruments on energy efficiency and CO2 reduction

Internationally, several GHG emissions trading systems based on the Kyoto Protocol signed in 1997 have been established, including the EU ETS launched in 2005, the New Zealand Emissions Trading Scheme in place since 2010, the Californian Cap-and-Trade Program launched in January 2012, and the Australian Carbon Pricing Mechanism launched very recently in July 2012. Progress in the global integration of carbon markets so far is limited to a few regional initiatives and bilateral agreements.

Europe has implemented a number of energy efficiency instruments. Examples of Member State level instruments include the Italian Tradable White Certificates (TWC) of efficiency improvements in place since January 2005, the Swedish carbon tax established in 1991, and the UK tools mix including the Climate Change Levy, the UK Carbon Reduction Commitment energy efficiency scheme and other instruments. At EU level, the Energy Efficiency Directive (EED), the Ecodesign Directive and the Energy Performance of Buildings Directive are cornerstones of the energy efficiency policy.

Technical interplay between energy efficiency and CO2 reductions

Energy efficiency gains can translate into a wide range of CO_2 reduction values: hard coal savings reduce CO_2 emissions by 40% more than natural gas savings, while saving renewable energy will not reduce CO_2 emissions. This is described by the CO_2 emission factor of each fuel, which can vary regionally. Emission reductions induced by reduced electricity consumption depend on the electricity generation mix, which differs from country to country. In a more detailed perspective, the merit order curve determines which power plants will generate less electricity if demand decreases; the CO_2 emission reductions thus depend on whether e.g. coal fired power plants reduce output, or wind power plants.

Energy efficiency improvements in ETS and non-ETS sectors will reduce overall emissions, but may also shift emissions between the sectors through indirect effects, e.g.:

- The shift of heat generation from non-ETS to ETS installations reduces overall CO_2 emissions and non-ETS emissions, but increases ETS emissions;
- The shift of power generation from ETS power plants to non-ETS small cogeneration units reduces overall emissions and ETS emissions, but increases non-ETS emissions.

Taking a more holistic view, a life-cycle emissions approach to fuels should be preferred including the emissions of fuel extraction, generation, transport/distribution, etc. as e.g. included in the Renewable Energy Directive and the Fuel Quality Directive for biofuels.

Interplay between the ETS and other policy instruments

The economic crisis, progress in achieving the national non-ETS CO_2 reduction targets and the 20% renewables target as well as international credits under the Kyoto Protocol have resulted in lasting negative impacts on the carbon price. Endogenous impacts of the ETS itself or changes thereof, and exogenous interactions between the ETS and energy efficiency instruments as well as Member State level regulations put the carbon price of the ETS under downward pressure.

Endogenous impacts occur as a result of the ETS itself or changes thereof, both on the supply side and on the demand side. On the supply side, the inclusion of international credits or any future mechanism discussed in the United Nations Framework Convention on Climate Change negotiations, and possibly from other emissions trading systems into the EU ETS, will affect the carbon price. On the demand side the implementation of Community Projects under Art. 24a of the ETS Directive brings low-cost projects into the ETS. The proposed temporary suspension of international aviation from the ETS will also reduce the demand for allowances.

Endogenous impacts on the carbon price are also caused by Member State level regulations in the form of carbon taxes or option contracts. The extent to which the ETS is affected depends on their scope, with more severe effects where ETS sectors are covered or where a switch from non-ETS to ETS sectors is caused.

The principal effect of exogenous interactions is that they reduce the demand for ETS allowances putting the carbon price under downward pressure if ETS allowances are not reduced accordingly. With regards to distributional effects, energy efficiency measures in parallel to the ETS benefit energy efficiency equipment producers, somewhat reduce the gains of low CO_2 electricity producers, and are to the detriment of high CO_2 electricity producers. On the other hand, the EED could help to overcome market failures, thereby positively affecting the costs of future emission reductions.

Outside the ETS, the EED may lower the incentive for Community Projects, thus leaving the carbon price closer to the level resulting from the cap. From an EED perspective, the ETS supports the incentive to invest in energy efficiency measures. The size of this effect depends on the composition of the retail electricity price, which is subject to ambivalent pressures.

The EED encourages Member States to use ETS auctioning revenues for the financing of energy efficiency projects while Directive 2009/29/EC amending the ETS Directive states that at least 50% of the ETS auctioning revenues should be used, among various options, for reducing GHG emissions, promoting renewable energy and energy efficiency measures as well as sustainable transport. This may solve the issue of financing of energy efficiency measures, and of private sector under-investing in energy efficiency projects in case downward pressure on carbon prices can be relieved and auctioning revenues increased.

Demand for ETS allowances is also reduced by other policies at the EU and the international levels, the Large Combustion Plant Directive and a possible UN Convention on Mercury being prominent examples.

Conclusions and recommendations on the design of policy instruments, in particular the ETS system

This briefing provides five main conclusions.

First, the current low EU Allowances (EUA) price reflects market participants' perception of regulators' willingness to adopt measures that are additional, either to the activities covered by the ETS or that impact the ETS sectors.

Second, in contrast, the EUA price is only to a limited extent owed to actual or potential interactions between the EED and the ETS Directive.

Third, the EU ETS covers around 40% of GHG emissions while EU and Member State policies directed at energy efficiency in principle aim at the other 60%, i.e. the 'effort sharing' sectors. Hence, the interactions between the ETS and energy efficiency measures are limited. There are important interactions with the EU Renewables Directive and most important, the economic cycle.

Fourth, the EUA supply and demand have been more affected by ETS-inherent parameters than by non-ETS policies and measures including access to international credits from CDM and JI projects under the Kyoto Protocol, and the suspension of inclusion of international aviation and potentially, the implementation of Community projects under Article 24a of the ETS Directive.

Fifth and lastly, there is a strong need for 'risk management' and adjustment on the supply side of EUAs. To predict or even project these multiple interactions seems next to impossible, even though predictability somewhat increases the more EU policies on renewables and energy efficiency are harmonised across the EU and legally binding. The lack of flexibility on the side of the ETS makes it impossible to respond to situations that are outside the boundaries of the ETS such as the economic crisis following the banking crisis or even – as aviation shows – only partly within the parameters of the EU ETS design. This gives support to the idea of having some sort of adjustment mechanism directed at supply, able to deal with changes in demand, be they the result of the economic cycle, impacts of ETS design or policy interaction.

The European Commission has recently identified six options to reform the European carbon market:

1. *"Increasing the EU reduction target to 30% in 2020";*
2. *"Retiring a number of allowances in phase 3";*
3. *"Early revision of the annual linear reduction factor";*
4. *"Extension of the scope of the EU ETS to other sectors";*
5. *"Limit access to international credits";*
6. *"Discretionary price management mechanisms",* such as price floor or price management reserve.

Additional short-term options include a revision of the EED in such a way that it avoids the overlap of coverage of the EED and the ETS sectors; politically, this does not seem to be a likely option, given the EED's very recent adoption. Hence, the only realistic short-term option is back loading, which should be designed and put in a framework that will guarantee good market functioning. However, back loading will not be sufficient to solve the oversupply issue, and thus will need to be combined with set-aside/retiring a number of allowances. Other options are less efficient and/or effective.

In addition, there is a need for an adjustment mechanism in the longer run to avoid the repetition of ad-hoc policy interventions. If rules of an adjustment mechanism are formulated ex ante and are predictable, this will create stability and predictability in the market, which is a key requirement.

1. EU and international policy instruments on energy efficiency and on CO2 reduction

1.1. The EU ETS and international carbon markets

1.1.1. The European Union Emissions trading Scheme

The European Union Emissions Trading Scheme (EU ETS) is currently the largest and most liquid international carbon market in existence. It was designed to be the cornerstone of the EU climate change policy, but by no means the only element. It is the central pillar of a package of regulatory measures to address climate change, energy security and competitiveness, and notably to achieve the EU's 2050 GHG emission reduction target. In this logic, an efficient and effective EU ETS appears to be a precondition for the EU to achieve its short- and long-term climate and other policy goals.

The EU-ETS is a market-based instrument consistent with the principles of emissions trading defined by the Kyoto Protocol (see section 1.1.2). It was introduced by the so-called ETS Directive adopted by the EU in 2003 and subsequently amended (EU, 2003). The EU ETS relies on the principle of "cap-and-trade", whereby participants in the market are mandated to hold allowances ("permits to pollute") corresponding to the amount of CO_2 they release into the atmosphere. The overall amount of EU Allowances (EUA) is capped and progressively reduced. Participants can choose either to implement emission reduction measures or to buy EUAs from other players that have it in excess. In a simplified view, the carbon price serves as a benchmark for participants: If the marginal emission reduction is more expensive than the carbon price, then it becomes cheaper to buy EUAs on the market from participants having lower marginal costs of abatement. Theoretically, that allows emission reductions to be achieved where they are the cheapest, which minimises the overall costs to society and ensures cost-effectiveness. The scheme was launched in 2005 and is now operating within 30 countries, including Norway, Iceland and Liechtenstein with Switzerland possibly joining in 2014 (CPW, 2012). It currently involves over 11,000 large emitters in greenhouse gas (GHG) intensive sectors, including the energy, iron, steel, mineral, wood pulp, paper, and board industries, thus covering around 40% of all European GHG emissions.

The EU ETS is technology-neutral and totally compatible with the rules of the internal market. It provides participants with some degree of flexibility by allowing the use of international carbon credits from Kyoto projects realised in countries outside Europe, such as under the Clean Development Mechanism in the developing world (see section 1.1.2 for more details) (EU, 2004). It has functioned well as measured against some of the criteria that reflect good market functioning, including: a credible level of periodic scarcity in the market; the presence of liquidity in the market, with many participants; a tight spread between bid and ask prices; the ability to enter and exit the market at all times; adequate market transparency and information; and the fact that the market is not driven by market power. Important changes in the EU ETS have been agreed over the last few years and will be fully effective for the third trading period starting in 2013. New sectors are joining, notably aviation[1] in 2012 (see also section 3.2.3) and the petrochemical, ammonia and

[1] An uncertainty remains concerning the inclusion of flights from and to airports outside the European Union. The EU has been facing strong opposition, most notably from China and the United States. The enforcement of the ETS for those flights was put on hold in November 2012 by the European Commission until after the General Assembly of the International Civil Aviation Organization in autumn 2013. During that period, while flights

aluminium industries as of 2013. The allocation process is also going to be profoundly restructured. In the first and second trading periods until the end of 2012, the allocation process used to be managed at Member State level, with allowances distributed for free to national participants. From 2013 onwards, the allocation process will be centrally-managed by the European Commission and the auctioning of allowances progressively introduced for the sectors such as the power sector which are not subject to carbon leakage. For sectors most exposed to international competition and risks of carbon leakage, allowances will continue to be free, on the basis of product-specific performance benchmarks. Finally, the global emission cap will be reduced by an annual factor of 1.74% in such a way that the 2020 cap will be 21% lower than the 2005 cap (EU, 2009a).

The European Commission has recently released an assessment report on the state of the European Carbon market (EC, 2012c). Concerns have been voiced recently about the price of carbon and the level of volatility. Volatility is closely linked to the level of liquidity in the market, with high liquidity dampening volatility. However, it must also be remarked that compared to other energy related commodities, the EU ETS has not been highly volatile, in spite of the perception. Nonetheless, volatility has been observed as a result of policy announcements. The two-day swing between EUR 9.05 on Monday November 12 (before the back loading announcement by the European Commission) and the under EUR 7 level on Friday December 16 (end of week) is but one example. This type of sharp volatility is not seen as contributing to good market functioning. The trading community, which has become disenchanted with the current state of the GHG market is withdrawing rapidly from the market. This may have consequences on the liquidity. Should their withdrawal become significant, it may endanger the liquidity of the market.

On the demand-side, emissions are down by more than 8% as compared to 2008 levels in great part as a result of the unfolding economic crisis. On the supply-side, ample imports of international credits have occurred. Section 3.2.1 presents a detailed analysis of the effects of international carbon credits. Overall, the Commission quantifies the current surplus at 955 million allowances. In other words, the imbalance between supply and demand currently stands at 955 million allowances. This number is expected to increase rapidly in the 2012-2013 period and could potentially reach 1.5 to 2 billion allowances. That poses a significant risk to the third trading period.

The European Commission proposes the use of “back-loading” as a short-term quick fix, postponing some of the auctioning into coming years. This would, however, not affect the total amount of EUAs, which is structurally in surplus. As longer-term and more structural solutions, the Commission proposes six options for reforming the EU ETS (EC, 2012c):

- *“Increasing the EU reduction target to 30% in 2020”;*
- *“Retiring a number of allowances in phase 3”;*
- *“Early revision of the annual linear reduction factor”;*
- *“Extension of the scope of the EU ETS to other sectors”;*
- *“Limit access to international credits”;*
- *“Discretionary price management mechanisms”,* such as price floor or price management reserve.

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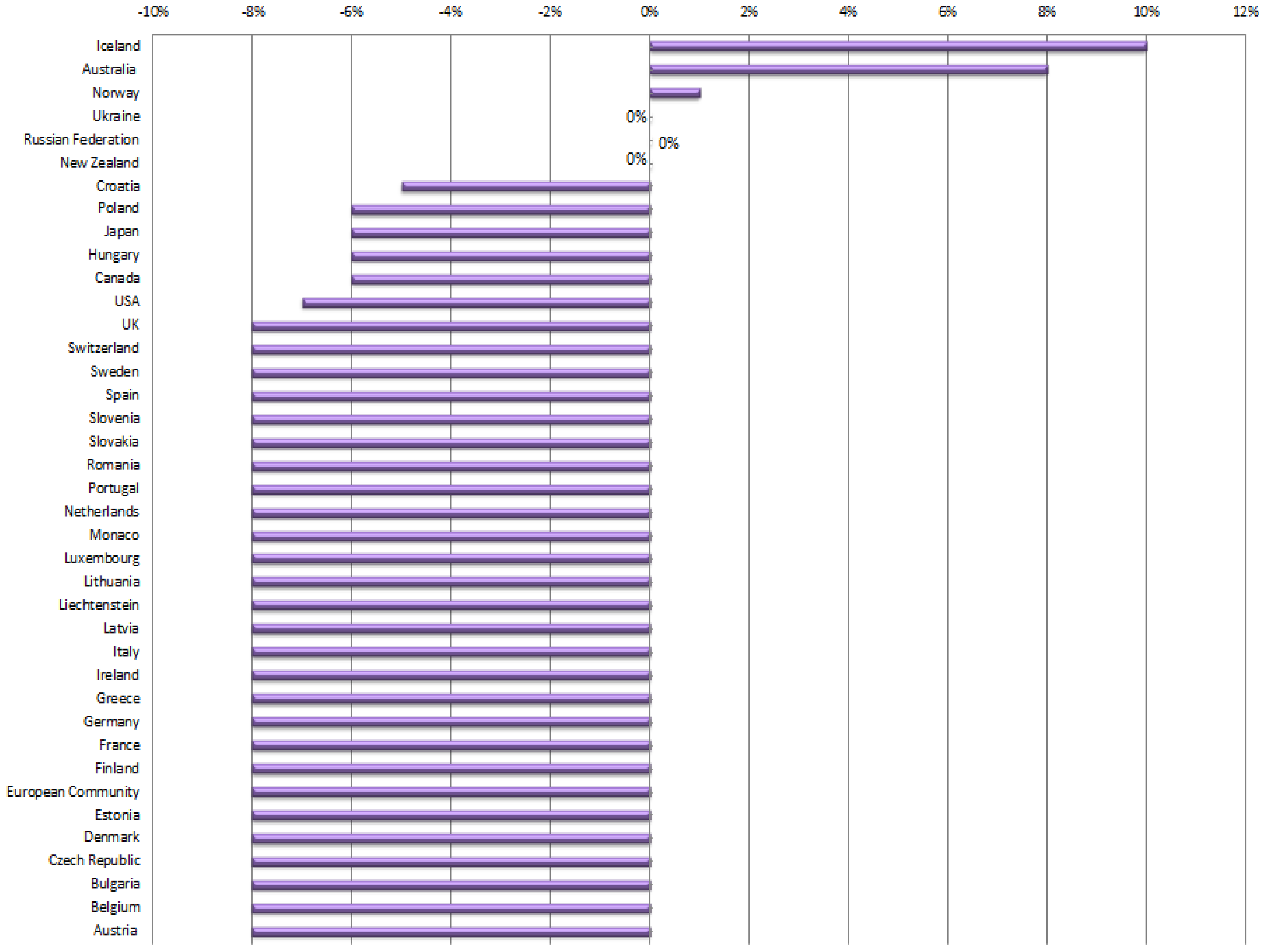
operated between European airports will remain fully covered by the ETS, flights with a destination or a departure point outside the EU will not have to surrender their allowances to the Commission (EC, 2012d).

1.1.2. The Kyoto Protocol and post-Kyoto framework

The Kyoto Protocol was signed in 1997 under the United National Framework Convention on Climate Change (UNFCCC) (UN, 1998). It defines binding emission reduction targets for 37 industrialised countries. The overall objective for industrialised nations (so-called "*Annex B countries*") is a 5% reduction from the 1990 level during the first commitment period until 2008-2012. The global target is broken down and differentiated on a country-by-country basis, depending on specific national circumstances. The following table provides a detailed overview of national objectives:

Figure 1: National emission reduction targets under the Kyoto Protocol



Source: own analysis based on UN data

Following the principle of "*common but differentiated responsibilities and respective capabilities",* no emission targets were assigned to developing countries.

After the signature, the protocol had to be ratified in each individual country, which was successful in all industrialised nations (Australia having ratified in 2007) with the exception of the United States.

In addition to the emission reduction targets, the Kyoto Protocol introduces the three so-called "Kyoto Mechanisms" providing flexibility and cost-effectiveness to industrialised nations while promoting technology transfer and sustainable development in developing nations:

- Emissions trading laying down the foundations for an international carbon market and the EU ETS;
- The Clean Development Mechanism (CDM), which is a global investment scheme whereby industrialised nations can finance emission reduction projects in developing countries and gain certified emission reduction (CER) credits;
- The Joint Implementation (JI) instrument, whose principle is similar to the CDM but with projects occurring in other Annex B countries.

The adoption of the Bali roadmap in 2007 created a general negotiating framework due to culminate at the 15th Conference of the Parties (COP 15) in Copenhagen (Denmark) in December 2009 with the signature of a post-Kyoto agreement. The negotiation process proved mostly unsuccessful as no legally-binding agreement was reached by the parties despite the signature of the Copenhagen Accord. Since then, negotiations have been on-going, with new rounds of talks at COP 16 in Cancún (Mexico) in 2010 and COP 17 in Durban (South Africa). COP 18, held in Doha (Qatar), opened on November 26th ending on December 7th 2012.

The Copenhagen Accord includes a long-term objective to contain global warming at +2°C, which is consistent with the recommendations of the Intergovernmental Panel on Climate Change (IPCC). However, the text does not translate that objective into emission reduction targets, neither for the World as a whole nor for individual countries. Rather, each individual country had to submit its own 2020 emission target to the UNFCCC. 87 countries (Delbosc et al., 2011), including the United States, the European Union, China, India and Brazil (UNFCCC, 2012a&b), representing 82% of total world emissions have submitted their targets or at least a list of mitigation actions. Copenhagen marked an important progress as all major nations have embarked on climate action. However, when combined, all 2020 individual country objectives represent between 12%-18% of emission reductions and fail to meet the 25%-40% GHG emission reductions that the IPCC says is necessary to avert catastrophic climate change.

Importantly, the Copenhagen Accord also set the general architecture of a future climate deal, including all important building blocks, such as the financing vehicles for developing countries; technology transfer; adaptation; measurement, reporting and verification; and the mechanism to address deforestation (known as REDD+) (COP, 2009).

One year thereafter at Cancún, the parties agreed among others on strengthening the two market-based instruments for international projects, namely the Clean Development Mechanisms and Joint Implementation, while as far as the CDM is concerned, ensuring a greater degree of transparency and quality in the certification process and a more balanced geographic spread for projects, as well as extending the scope of the CDM to other sectors like Carbon Capture and Sequestration. Decisions related to the Joint Implementation were more administrative in nature and aimed at improving the procedures. The final text adopted in Durban also opens the door for new market mechanisms such as sectorial agreements whereby companies within the same sector could trade carbon credits at the international level. Finally, no real progress was made concerning the REDD+ mechanism, in particular on the question of the linkage with the carbon market (Delbosc et al., 2011).

In Durban in 2011, the parties agreed to extend the Kyoto period and Kyoto flexible mechanisms for a second commitment period up to 2017 or 2020. However, Canada, Japan and Russia decided not to participate in that second commitment period. The development of a negotiation roadmap by 2015 leading to the adoption of a new legal framework in 2020 was also agreed, together with a number of technical decisions on the creation of the Green

Climate Fund, REDD+, technology transfer, etc. (Morel et al., 2011). After the conclusion of the Doha round in December 2012, parties have confirmed the extension of the Kyoto protocol till 2020, while indicating as an objective the establishment of a post-Kyoto framework after 2020 encompassing all countries (Goswami, 2012).

1.1.3. Emissions trading and carbon markets outside the EU

During the last decade various emissions trading systems have emerged in a number of countries. While the guiding principles behind such schemes including the EU ETS are identical and mostly based on the emissions trading mechanism introduced by the Kyoto Protocol, it is worth mentioning that each system is conceived differently, mostly due to different energy mixes, economic conditions and GHG emission reduction agendas for each country.

The New Zealand Emissions Trading Scheme (NZ ETS), in place since 2010, is a cap-and-trade emission system through which companies regulated by the mechanism can trade New Zealand Units (NZUs). Each NZU is worth one tonne of carbon dioxide of equivalent GHG emissions (t_{CO2eq}) (Venable, 2010). The NZ ETS covers all GHG emissions included in the Kyoto Protocol. Sectors included are industry, agriculture and forestry, energy and transport; the overall emission target reduction is set at 10% to 20% below 1990 levels. For a comparison of the different international trading schemes refer to Table 1 below. With the final "upgrade" in 2015, the NZ ETS will cover all GHGs identified in the Kyoto protocol and sectors of activities, in comparison with only 50% for the EU ETS, currently the most comprehensive system in place (Venable, 2010). While in the EU ETS a large number of allowances were distributed to companies, in New Zealand free allowances are allocated to companies exposed to international trade at 60% or 90% of emissions relative to output. Unlike the EU ETS, the NZ ETS also has an optional price cap for carbon, which will expire by the end of 2012, set at $25 per NZU (Venable, 2010).

Australia has launched carbon pricing under the Clean Energy Act 2011. The Australian Carbon Pricing Mechanism has been effective since July 2012 and targets exclusively the country's largest polluters (emitting beyond 25.000 t_{CO2eq}/yr). Covering almost 60% of Australian emissions the government has set a total emission reduction target of 5% by 2020 (CER, 2012). In the first stage, running three years from 2012 until 2015, the carbon price will be fixed increasing from $23 a tonne to $25.40 a tonne in 2015. In effect, during that first phase, the market is equivalent to a carbon tax as the price of carbon is fixed. From 2015 onwards, the market will be fully functional, the price will be fixed by supply and demand, and units will be auctioned by the Clean Energy Regulator (CER, 2012).

The California Cap-and-trade Program, which started in January 2012, could play an important role in promoting emission reduction policies in the United States, which still has not ratified the Kyoto Protocol. The programme encompassing roughly 600 industrial plants emitting over 25.000 mt_{CO2eq} per year will span over three stages until it finally covers 85% of Californian emissions in the year 2020. In order to promote the reduction of emissions from the transport sector, responsible for almost 40% of the country's emissions, the scheme also includes providers and suppliers of fuels for road transport (Goubet, 2011). Unsurprisingly, given the cautious approach towards climate change that characterises the US, policy makers paid particular attention to designing the system in such a way as to ensure minimal negative impacts on the economy and other externalities (e.g. carbon leakage). An interesting feature is the "set-aside" mechanism, or the Allowance Price Containment Reserve (APCR), consisting of a special reserve of allowances (1% of total in 2013, up to 7% in 2020), whose main objective is to shield companies from unforeseen price changes. The reserved allowances price will be divided in three parts ($40, $45 and $50 in 2013), with a yearly increase of 5% until 2020 (Sandbag, 2011).

As the largest CO_2 emitter in the world, China is also interested in promoting a nation-wide carbon market mechanism. Overall, seven provinces and cities[2] have announced plans for carbon trading mechanisms. Should these be successful the experiment could be reproduced at the national level (Reuters, 2012). Among the Asian countries, South Korea will be launching a national ETS in 2015, the government has set a target of 30% reduction with respect to “business as usual” levels by 2020 (Reuters, 2012). Thailand is also planning to launch a voluntary emissions market from 2014, while Vietnam is planning to start its own ETS mechanism by 2018 with an emission reduction target of 8% to 10% below 2010 levels by 2020. Mexico is also planning to implement a voluntary CO_2 trading scheme to reduce emissions by 30% by 2020, however there is still no indication of when the programme will start (Reuters, 2012).

2 Beijing, Chongqing, Guandong, Hunan, Shangai, Shenzen and Tianjin

Table 1: Comparisons between international ETS schemes

	EU ETS	NZ ETS	AU CPM	California ETS
Start date	January 2005	January 2008	July 2012	January 2012
Targeted emissions reduction by 2020	21% compared to 2005 levels	10% to 20% below 1990 level	5% below 2000 level	25% reduction between 2008/2020
Implementation phases	Three trading periods: 2005-2007, 2008-2012, 2013-2020	4 stages: progressive introduction of industries	2 stages Phase 1: fixed price Phase 2: market price	3 stages: progressive introduction of industries
Sectors	Energy, iron, steel, mineral, wood pulp, paper and board, petrochemical, ammonia and aluminium, aviation, etc. Road transport not included	Forestry, energy (gas, electricity, fossil fuels), industry and agriculture	Power generation, transport, industrial processes, waste and forestry sectors	Industry, energy (gas, electricity, fossil fuels), voluntary inclusion
Share of emissions covered by ETS (at final implementation)	40%	90%	60%	85%
Price Floor	No	No	No	Yes
Banking and Borrowing	Banking permitted, borrowing not allowed	Banking permitted, borrowing not allowed	Banking permitted, borrowing not allowed	Banking permitted, borrowing allowed but restricted
Use of intn'l. credits	Yes	Yes	Yes	No
International linking	Norway, Liechtenstein, Iceland; AU CPM (planned)	No	EU ETS (planned)	Yes (to Western Climate Initiative)
Member of Kyoto	Yes	Yes	Yes	No

Various sources: Flachsland et al. 2008, Venable 2010, Goubet C. 2011, Reuters 2011

1.1.4. Fostering future linkages of carbon markets

According to Behr & Witte (2009):*"A globally integrated carbon market would be the most economically efficient approach to mitigation since it would offer much wider opportunities for abatement and thus reduce the overall cost associated with emission mitigation"*. However, the implementation of a global carbon market is unlikely to occur in the short to medium term, because of uncertain climate talks at the international level due to difficult compromises between nations, poor economic conditions and a general lack of political will to seriously address climate change. It is therefore more likely that countries already implementing ETS mechanisms agree on market linkages on a purely bilateral basis. This bottom-up approach is in stark contrast with the top-down approach initially promoted within the Kyoto framework. Several countries supporting national emissions trading schemes have expressed interest in linking such schemes at the global level or to other national schemes; for instance the EC proposes a "bottom-up linking of compatible emissions trading systems" (DG ENER website, 2012). However, international linking of carbon markets is a very complex operation facing several barriers, mostly due to the specific designs of each trading system, usually adapted to national conditions. In the next section we present several international and regional initiatives that have developed across the globe with the purpose of fostering future linkages.

The most known of these initiative is the International Carbon Action Partnership (ICAP), composed of 15 members (including the EU). The ICAP brings together countries and regions that have already implemented carbon markets or are planning to do so in the near future. The main scope of the forum is to foster "the promotion of well-functioning global cap and trade carbon market" (ICAP website) and knowledge exchange among the different parties.

Focused on North-America, the Regional Greenhouse Gas Initiative (RGGI) and the Western Climate Initiative (WCI) cover a number of states in the US and Canada. The scope of the RGGI includes 10 North-East and mid-Atlantic US States. Launched in 2009, it has established a target of 10% reduction of carbon emissions by 2018 with respect to 2005 being the first initiative of this type in the United States (Behr & Witte, 2010). The WCI involves the state of California and four Canadian provinces. They have all set the target to reduce GHG emissions by 15% with respect to 2005 levels by 2018 (WCI website). The impact of the WCI is considered of relevance for North America given the fact that the four Canadian provinces represent 70% of the country's emissions and that California accounts for 20% of US emissions (Behr & Witte, 2009).

In line with the concepts presented at the beginning of this section, the EU has recently signed an agreement with the Australian government to link their two ETS schemes. EU companies will be able to buy permits from the Australian market and vice-versa. This agreement will create the largest international carbon market.

1.2. Energy efficiency legislation

1.2.1. The Energy Efficiency Directive

The Energy Efficiency Directive (EED) was adopted by the European Parliament on 11 September 2012 and endorsed by the Council on 4 October 2012 (EP, 2012). It constitutes the final piece to the Energy and Climate Package of 2009, after the Renewable Energy Directive and the EU ETS (though the latter already existed at that time). The main objective of the EED is to foster the implementation of additional measures required to achieve the 20% energy efficiency improvement objective by 2020. In other words, the

EED shall contribute to a total primary energy saving of 20% by 2020, compared to a baseline business-as-usual scenario, which was set as an objective in the over-arching "20-20-20" framework, as it was becoming increasingly apparent that Europe was not on track to achieve it (Altmann et al., 2010).

Contrary to the renewable energy and CO_2 targets that are legally binding, the energy efficiency objective remains only indicative under the EED. At Member State level, national targets, taking into account both the headline EU objective of 20% and the national circumstances (including for instance GDP forecasts, the energy saving potential, the energy mix and the export-import balance, etc.), will have to be adopted and notified to the European Commission, which will undertake progress assessments and recommend further measures, if and where appropriate (article 24 of the Directive).

In particular, the European Commission will monitor the impact of the EED on the EU ETS "in order to maintain the incentives in the emissions trading system rewarding low carbon investments and preparing the ETS sectors for the innovations needed in the future". The monitoring will also focus on industry sectors subject to carbon leakage, in order to ensure that they are not negatively affected by the implementation of the directive. This provision is directed in particular at several sectors listed in the Decision 2010/2/EU on carbon leakage (EC, 2009).

The building sector is specifically addressed by the directive. Member States are requested to elaborate a long-term national strategy (beyond 2020) for the deep renovation of their building stock in a cost-effective manner (article 4 of the Directive). On a shorter time-scale, public buildings owned and occupied by the Central Government will need to be renovated at an annual rate of 3% on a floor area basis (article 5 of the Directive).

The directive also contains obligations for Member States to ensure public procurement of energy-efficient goods, services and buildings by central governments (article 6).

One of the most important provisions of the directive is defined in article 7 on energy efficiency obligation schemes, directed to energy distributors and retailers. These stakeholders will be mandated to achieve energy savings equivalent to 1.5% of annual energy sales by volume to end-consumers from 2014 to 2020. Energy efficiency gains within the entire energy chain, from transformation to transmission and distribution can be accounted for in the calculation.

As an alternative to an energy efficiency obligation scheme, Member States can opt for other policy tools such as an energy or carbon tax scheme, provided these schemes meet a number of defined criteria and are demonstrably effective in generating energy savings.

Importantly, at least in the context of the present paper, the text allows Member States to exclude from the calculation the industrial sectors most exposed to carbon leakage as defined in Annex I to the ETS Directive of 2003, namely energy-intensive activities such as the production and processing of ferrous metals, the mineral industry and other activities such as pulp and paper production[3] (EU, 2003).

The EED also contains specific provisions to promote among others: energy audits of all companies, competitively priced individual metering, transparency, customer empowerment, cost efficient cogeneration as well as district heating and cooling.

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[3] Specific thresholds are defined for each sector in the EU ETS Directive.

1.2.2. The Ecodesign Directive

The Ecodesign Directive was adopted in 2005 and amended in 2009 (EU, 2009). It defines a general framework for setting design requirements for energy-related products, with a view on the entire life-cycle from cradle-to-grave. Designated National Authorities are in charge to verify compliance and attribute the CE marking that products have to bear to be authorised on the European market.

Subsequently, implementing regulations are progressively being adopted for each specific category of products. To date, the following categories have been addressed (EC, 2012a):

- Household tumble driers;
- Circulators;
- Water pumps;
- Air conditioners and comfort fans;
- Industrial fans;
- Households dishwashers;
- Household washing machines;
- Lighting Products in the Domestic and Tertiary Sectors;
- Refrigerators and freezers;
- Television;
- Electric motors;
- External Power Supplies;
- Simple Set-Top Boxes;
- Standby and off mode Electric Power Consumption of Household and Office Equipment;
- Water-boilers.

Other types of products should follow, as specified in the Commission's 2009-2011 Work Plan, including air-conditioning and ventilation systems, electric and fossil-fuelled heating equipment, food-preparing equipment, industrial and laboratory furnaces and ovens, machine tools, network, data processing and data storing equipment, sound and imaging equipment, transformers and water-using equipment (EC, 2012b).

1.2.3. Energy Performance of Buildings Directive

Building energy consumption represents 40% of Europe's total energy needs. The Energy Performance of Buildings Directive adopted by the European Union in 2010, repealing Directive 2002/91/EC, aims at improving energy efficiency in the building sector, both for the existing building stock as well as for the newly-constructed buildings (EC, 2010).

Member States are requested to define methodologies to calculate the energy performance of buildings and set minimum improvement requirements, differentiating between newly-constructed and existing buildings, to be reviewed every 5 years. Existing buildings shall be upgraded in order to meet those criteria.

Specific energy performance requirements are also to be defined both for equipment having a significant impact on the energy consumption of buildings, such as ventilation systems, water-heating systems or heating systems, as well as for elements representing important parts of the building envelope such as window frames.

The Directive also sets mid-term objectives for all new buildings, which will have to be nearly zero-energy consumption by 2020.

Finally, the Directive promotes the use of appropriate financial instruments by Member States and mandates the implementation of energy certification schemes to be advertised when buildings or building units are sold or rented.

1.2.4. Legislation indirectly affecting energy efficiency and CO2 emissions

Although not directly related to energy efficiency or CO_2 emissions, two other texts are worth mentioning in this section and will be briefly discussed in following chapters as they may affect the power sector, in particular power plants relying on fossil fuels.

Firstly, the Large Combustion Plants Directive (EU, 2001) is an important instrument of the EU addressing air pollution, acidification and eutrophication, whereby combustion plants over 50 MW are assigned emission caps for SO_2, NO_x and dust depending on their date of commissioning.

Secondly, the Global Mercury Partnership under the United Nation Environmental Program (UNEP) has been working at the international level to tackle the issue of mercury emissions. The Governing Council of the UNEP agreed in 2009 to prepare by 2013 a global legally binding instrument to reduce mercury emissions (UNEP, 2012).

While the objectives of these two legislations differ from the ETS in terms of targeted emissions, in reality their applications actually contributes to global CO2 emissions reduction and overall energy efficiency. In turn, the implementation of the legislations is also affected by the introduction of a carbon price (see also chapter 3).

1.3. Selected national instruments

As mentioned in the beginning of this chapter, the EU ETS scheme is meant to be the main tool to achieve the EU 2050 climate targets. Nonetheless, other policy instruments such as energy efficiency policies and carbon taxes have been applied within the EU and EEA EFTA countries to complement emissions trading. This subchapter describes some of the policy instruments complementary to the EU ETS and attempts to provide also examples of how the policy frameworks have been integrated.

1.3.1. Energy efficiency: Tradable White Certificates

Tradable White Certificates (TWC) schemes have attracted much attention since their first implementation in a small number of EU countries. Via this mechanism, energy savings are imposed on selected economic operators and promoters of energy efficiency measures are rewarded with “certified energy savings units” or TWCs, which can be sold to other enterprises wanting to comply with the savings target (JRC, 2009). In Europe, Italy, France and the UK have introduced TWCs for some years now, while others, such as Denmark and The Netherlands are considering the possibility to introduce such mechanism in the future. According to JRC (2009) a community-wide white certificates scheme could be implemented in different ways along with the EU ETS scheme. The report from the JRC suggests that voluntary white certificates could be used by carbon traders as “external” projects. However, due to the differences between national energy markets and deployment of energy efficiency measures between Member States, equity concerns have been raised, notably on the effect on electricity prices for end-users. In addition, the Energy Efficiency Directive specifically rules out this option due to high administrative costs and the perceived risk that energy savings might be concentrated in a small number of Member States and not evenly distributed across the EU (EP, 2012). Although such risk exists, ruling out this option excludes an evaluation of such a measure. Risks could have been mitigated through a “quota mechanism” (maximum TWC to start with) before further deployment would be envisaged.

While at the international level there are no schemes corresponding exactly to TWCs, various US States have been implementing energy efficiency credits, however for the time being, trading of certificates is only possible in the state of Connecticut (JRC, 2009). Thus it is still very premature to evaluate whether the mechanism has been performing well in the US.

To understand better this tool, we briefly look at the Italian TWCs system, the first to be implemented in the EU in 2005. In Italy, electricity and gas distributors are required to implement energy saving schemes directed at final consumers, via projects promoting energy efficient appliances, boilers, building insulation. Today, three types of certificates exist: certified energy savings in electricity (type I), in gas (type II) and other fuels (type III). Since the launch of the mechanism over 60% of type I certificates have been emitted, in comparison with 26% for type II and 14% for type three (AEEG, 2012). The prominence of type I certificates highlights a possible drawback of the Italian system, not achieving its medium to long-term scope of stimulating more energy efficiency measures in sectors not covered by the ETS. In the UK the government attempted to solve this issue by covering the household sector and in France, the system promotes mostly projects related to thermal and energy efficiency in buildings (EuroWhiteCert Project, 2007). At business level, interventions to increase energy efficiency in large industrial areas are also recommended (AEEG, 2008). To support the costs for the distributors, being affected by both TWCs and ETS, the energy authority also establishes that each year a small contribution from energy tariffs is directed towards energy saving expenses (AEEG, 2008). Each certificate emitted corresponds to 1 ton of petroleum equivalent (tep), whose original price was set at EUR 100/tep (RIE, 2012a). It is to be noted that, unlike with the EU ETS, savings obligations have consistently increased over time, from 0.2 Mtep per annum in 2005 to 6 in 2012, since the year 2008 the number of TWCs was barely sufficient to keep the market in equilibrium, which led to an increase in the price of the certificates (RIE, 2012a).

1.3.2. Carbon Taxes

A carbon tax is another market- based tool that addresses the issue of pollution. Differently from emissions trading, the carbon price is determined by the level of taxation and industries are required to pay on the basis of emissions. While there is no cap, industries are incentivised to reduce emissions due to the extra charges associated with the tax. CO_2 reduction measures are implemented as long as the marginal costs remain below the level of the carbon tax. In an ideal case, the carbon price increases predictably and regularly over time, which provides economic players with sufficient long-term visibility on the price signal to deploy emission reduction investments. That is sometimes seen as an important advantage of carbon tax systems compared to emissions trading schemes, which suffer from inherent volatility, thus impeding investments. The other advantage is a significantly reduced administrative burden and complexity. Some countries in the EU and the EEA EFTA region have introduced carbon taxes as early as the 1990s, like Sweden, Finland and Norway, while others have followed more recently, like the UK (2001) and Denmark (2002). On the global scale, the states of Quebec and British Columbia in Canada, have introduced carbon taxes in 2007 and 2008 respectively.

The Swedish carbon tax, established in 1991, applies to fossil fuels, addressing both sulphur and CO_2 emissions. The tax structure has been adapted over the years and since 2011, after the introduction of the EU ETS, the tax is charged only to industry sectors not covered by the ETS scheme. The tax rate has increased over the years, from EUR 11 to

EUR 27 per ton for households, and EUR 7 to EUR 34 for non-ETS industries, while for sectors within the EU ETS mechanism it is currently EUR 0 (Åkerfeldt, 2011). Moreover, Sweden attempted to apply the so called “double dividend principle”, by promoting a higher level of environmental taxation while reducing income taxes (Åkerfeldt, 2011). This is considered to be the right approach for two reasons. Firstly, it ensures that the overall tax burden remains unchanged, which is a strong argument to pave the way for public acceptance. Secondly, it transfers taxation from desirable activities (jobs) to unwanted (polluting) activities. In other words, it stimulates job creation while promoting CO_2 emission reductions.

Similarly to Sweden, Norway introduced a carbon tax on fossil fuels in 1991. The tax rate differs according to the type of fossil fuel and sectors, and varies between a minimum of EUR 19 to a maximum of EUR 46 per ton of CO_2 (Finsås, 2010). The Norwegian CO_2 tax is often quoted as a valuable example of how taxation can positively influence stakeholders' behaviour. Applied to the offshore sector, the tax has strongly incentivised the industry to pursue technological improvements, notably in the field of Carbon Capture and Storage (CCS), electrification of certain processes and further energy efficiency measures (IEA, 2011). Since 2008, Norway also participates in the EU ETS scheme with roughly 70% of Norwegian emissions covered by the dual system EU-ETS and carbon tax (IEA, 2011). Understandably, the coexistence of a cap and trade system and a coercive CO_2 tax was opposed by those sectors affected by both. In order to avoid an inefficiently high level of taxation for ETS industries, the Norwegian government reduced the CO_2 tax rate by the amount of the expected carbon price within the ETS mechanism (Finsås, 2010). For the future, the government plans to revise the rate of taxation on an annual basis according to the actual ETS market price. The government is also planning to almost double the carbon tax (EUR 27 per tonne) on offshore companies in 2013, only to be reduced if the price of emission allowances was to increase (Carell, 2011).

An interesting case to conclude this subchapter with, it is the example of the UK, where the government has implemented over the past years a mix of national tools aimed at promoting carbon emission reductions and energy efficiency along with the EU ETS scheme. Besides, with the approval of the Climate Change Act in 2008 it has also been one of the first Member States to establish long-term goals for emission reduction, up to 80% by 2050 with respect to 1990 levels. To incentivise large energy consumers, the UK had first opted for the Climate Change Levy (CCL), an energy tax rather than carbon tax. The CCL is charged on intensive energy usage of natural gas, electricity and fossil fuels. To avoid negative economic externalities for UK businesses, especially those exposed to international competition, the UK government has established Climate Change Agreements (CCAs) with 54 energy intensives sectors. CCAs allow for a 65% reduction of the CCL provided that the business involved is in line with national energy efficiency and ETS targets (EA, 2009). To ensure the achievement of its long-term target, the UK government is also planning the adoption of a “carbon floor price”. Starting in April 2013, it will make suppliers of fossil fuels that generate power liable either to the UK Climate Change Levy or petrol duty and should promote low carbon investments. A more detailed analysis of the effect of this policy is presented in chapter 3.2.4.

In parallel, the UK has also introduced in April 2010 a provision for non-ETS businesses, known as the UK Carbon Reduction Commitment (CRC) energy efficiency scheme: an emissions trading and energy saving scheme covering non-energy intensive large businesses paying a minimum of GBP 500 000 per year in electricity (DLA PIPER, 2012). The aim of the CRC is to provide non-ETS companies with incentives to reduce CO_2 emissions. Similarly to other TWC schemes, businesses were supposed to purchase “permits to pollute”, however this has not happened so far and the system was found to be overcomplicated. The government is currently undergoing a public stakeholder consultation to simplify the mechanism and one proposal foresees two sales per year where the price of allowances would be fixed (DECC website). An interesting feature of the CRC system is the fact that at the end of each year the results of companies' efforts are published in a performance "league table", ranking each participant according to its performance (EA website 2012). While in principle revenues had to be "recycled back" into the company that had performed best according to the league table, the government has decided to use the CRC revenues for public spending mostly in environmental projects (DLA PIPER, 2012).

2. Technical interplay between energy efficiency and CO2 reductions

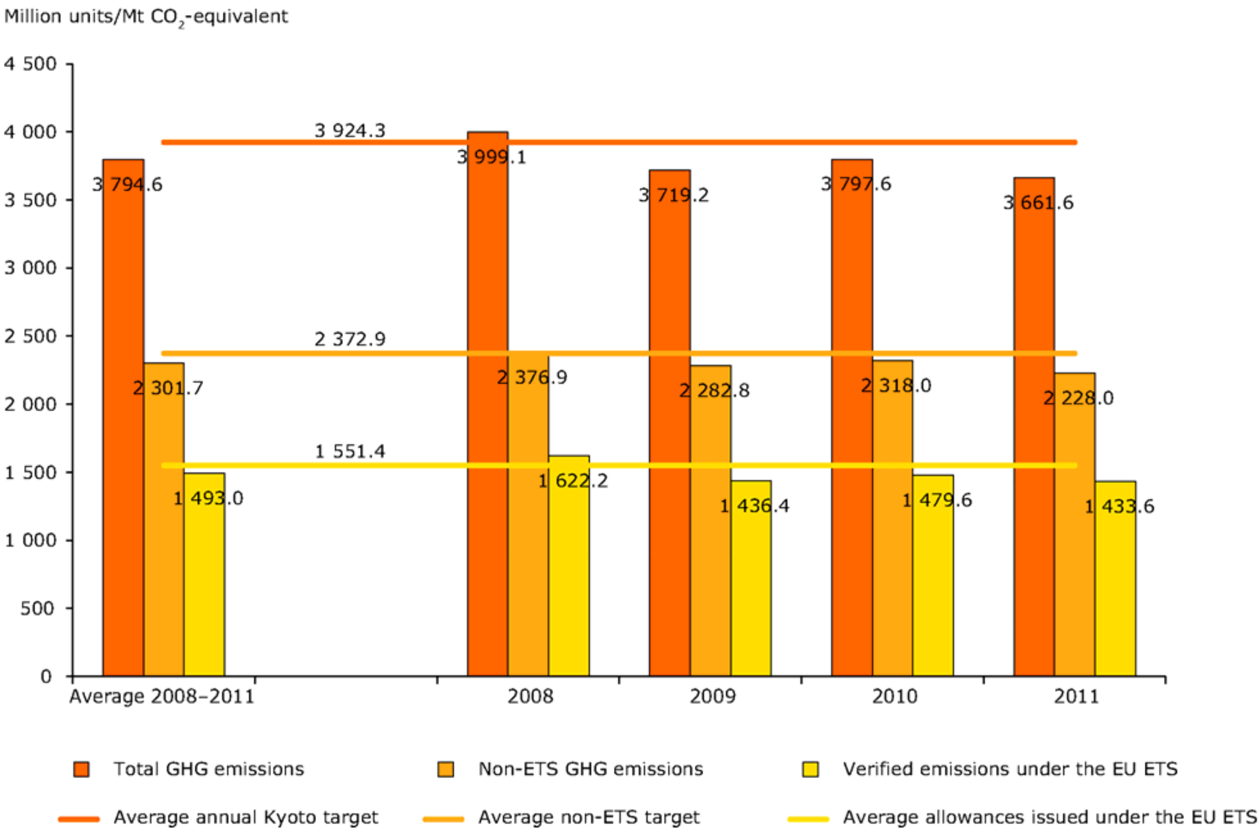
This chapter describes the nature of interplay between improvements in energy efficiency and CO_2 reductions with a clear focus on the ETS sectors.

The CO_2 reductions induced by reducing energy consumption depend on the carbon content of the fuel. This starts from zero for carbon-free fuels such as wind power or solar PV, and covers a range of values for the different fossil fuels with natural gas at the lower and coal at the higher end. In a life-cycle approach, CO_2 emissions include direct emissions taking place during consumption, e.g. by burning coal in a power plant, and indirect emissions caused by energy extraction, transport and conversion. The most prominent example of the latter is electricity, which is emissions-free in consumption, but entails CO_2 emissions depending on the primary source used for electricity generation.

2.1. CO2 reduction in the ETS sectors as a result of energy efficiency improvements

The ETS currently covers more than 12,000 installations in EU27, Norway, Iceland and Liechtenstein.

Figure 2: Total EU15 GHG emissions 2008-2011 of ETS and non-ETS sectors

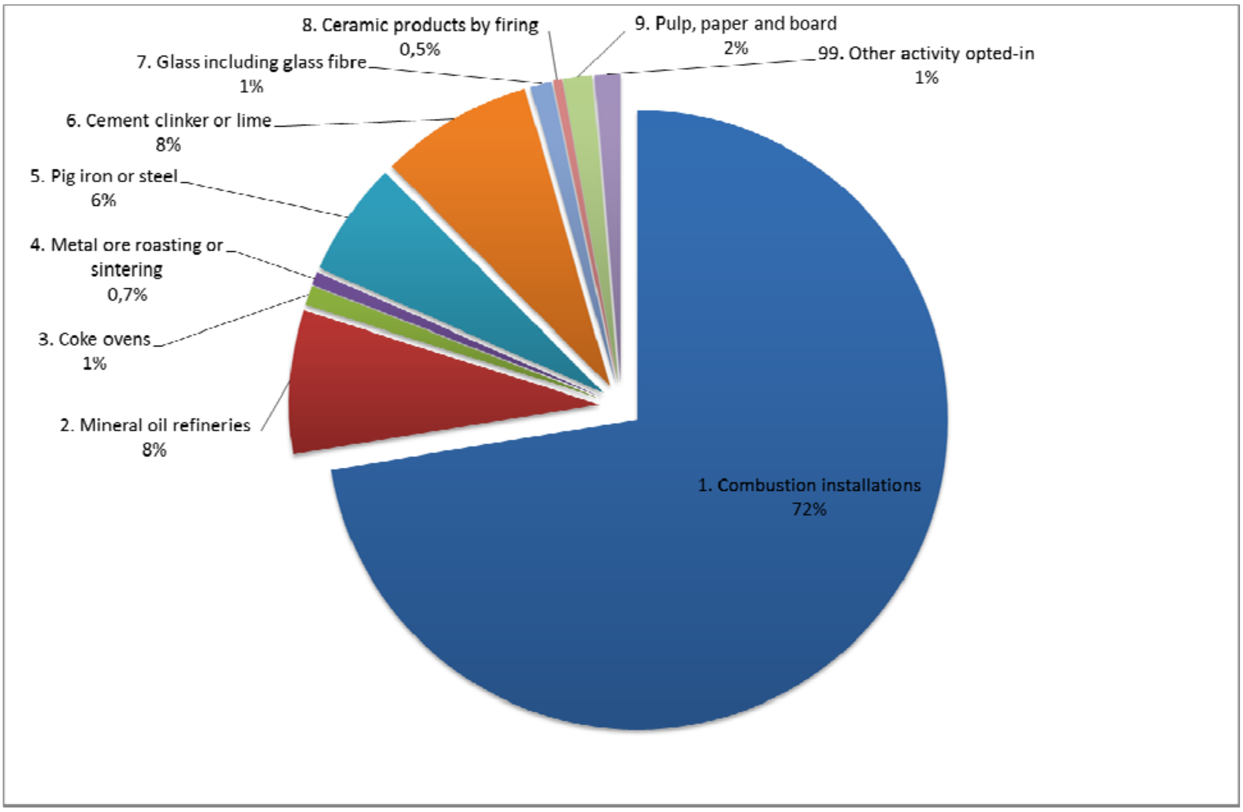


Source: (EEA, 2012)

ETS emissions represent around half of the EU's emissions of CO_2 and around 40% of its total greenhouse gas (GHG) emissions (see Figure 2 for EU15 values[4]). Total GHG emissions in EU27 amount to 4,610 million tons of CO_2 equivalent in 2010 (EEA, 2012b).

The relative contribution of the verified emissions in 2011 to the overall emissions in the ETS sectors of around 1.9 billion allowances is shown in Figure 3. ETS sectors are dominated by the combustion installations representing 72% of the verified emissions in 2011. The next largest contributions to CO_2 emissions stem from cement, clinker or lime (8%), mineral oil refineries (7.5%), and pig iron or steel (6%). The remaining sectors are below 2% each (EC, 2011), (EEA, 2012).

Figure 3: ETS verified emissions 2011 by sector

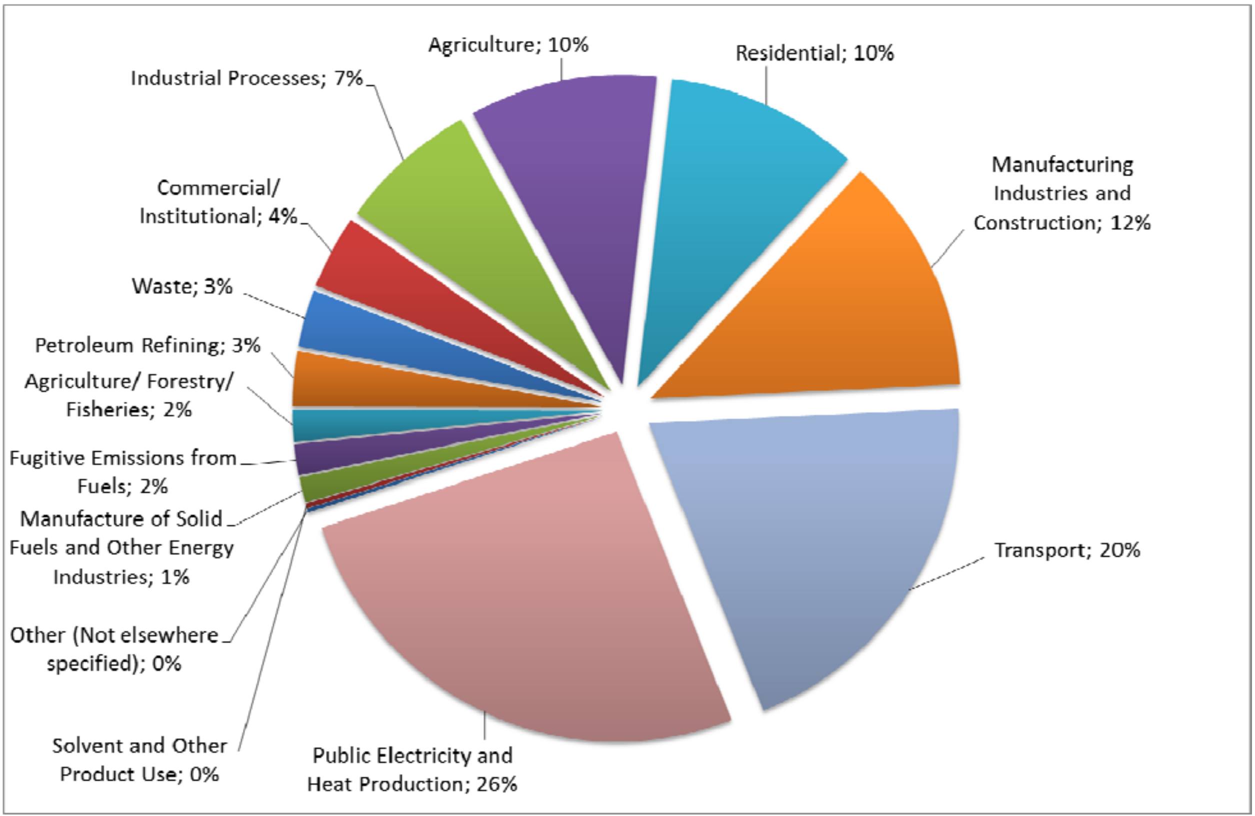


Source: based on (EC, 2011)

In general, reductions of energy consumption result in reductions of CO_2 emissions as long as fossil energies are involved in energy supply. In the present analysis it is of special interest to understand CO_2 reductions in the ETS sectors brought about by energy efficiency. Different mechanisms, both direct and indirect, exist that lead to CO_2 reductions in the ETS sectors. Direct mechanisms involve energy savings in the ETS sectors with related CO_2 reductions in the ETS sectors. Indirect mechanisms lead to CO_2 reductions in the ETS sectors based on energy savings in non-ETS sectors, or in shifts of energy consumption from non-ETS sectors to ETS sectors, or vice-versa, which may or may not involve energy savings. These mechanisms are described in the following.

[4] "Under the KP [Kyoto Protocol], the EU-15 has committed to a common emission reduction target of –8% compared to base-year levels, to be achieved over a five-year commitment period (from 2008 to 2012)." (EEA, 2012)

Figure 4: Total GHG emissions 2010 by sector



Source: based on (EEA, 20122012b)

2.1.1. Direct effects

Reductions in final energy consumption entail different reductions in CO_2 emissions based on the carbon content of the energy, which in general is expressed as CO_2 emission factor. These CO_2 emission factors vary regionally (e.g. the UK provides different regional CO_2 emission factors for natural gas) and depending on the primary energy source and conversion technology. Table 2 and Figure 13 show ETS relevant CO_2 emission factors for different fuels from the UK as an example (DECC, 2012) as well as the emission factor for lignite for the Czech Republic. CO_2 reductions for each TJ of energy saved vary between zero and just below 300 t_{CO2} for the UK; as an example, for the natural gas the CO_2 emissions are 55.22-65.94 tons for each TJ of gas burnt. Figure 13 shows the 40% lower CO_2 emissions per TJ of energy of natural gas compared to coal.

CO_2 emissions in the ETS sectors are caused either by the direct use of the energy bound in fossil fuels or by chemical reactions occurring as part of a production process, the so-called process emissions. Some production steps (e.g. removing carbonate from limestone in order to produce lime) have a constant and determined ratio of CO_2 emitted per output unit (e.g. 0.785 t_{CO2}/t lime) and can therefore not be reduced by energy efficiency (or other) measures (Ecofys 2009a). Thus, in certain ETS sectors such as lime production, the use of 100% renewable energies would not reduce CO_2 emissions to zero.

Table 2: CO_2 emission factors in the ETS for the UK, and the Czech Republic for brown coal/lignite

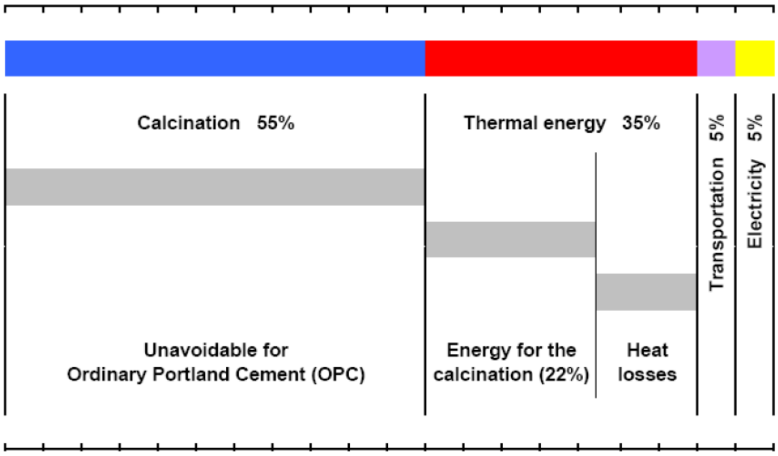
Fuel	CO_2 emission factor [t_{CO2}/TJ (net)]
Solid fuels	
Coke	110.40-132.65
Brown Coal[5]	92.4-103.1
Petroleum Coke	75.34-100.38
Coal	88.09-94.48
Solid smokeless fuel	90.73
Scrap Tyres	59.24
Non-biomass packaging waste	42.00
Municipal Solid Waste	30.47
Biomass	0 (by definition)
Liquid fuels	
Waste Solvents	96.53
Fuel Oil	78.84-80.12
Gas Oil	74.19
Waste oil	73.75-74.19
Lubricants	73.75
Burning Oil	71.82
Petrol	70.08
Naphtha	68.97
Gaseous fuels	
Blast Furnace Gas	298.27
Sour gas	74.55
Colliery Methane	69.84
Liquefied Petroleum Gas (LPG)	64.67
Natural Gas	55.22-65.94
Other Petroleum Gas	57.12
Coke Oven Gas	45.69

Source: UK: (DECC, 2012); Czech Republic: brown coal/lignite (Herold, 2007)

[5] For Czech Republic 2005 [Herold, 2007].

Figure 5 show the shares of CO_2 emissions in the clinker production process. 55% of the total CO_2 emissions (including distribution) are process emissions from the calcination process, and are thus unavoidable.

Figure 5: CO_2 emissions in clinker production



Source: (Ecofys 2009b)

When fossil fuels are used for the generation of final energy, e.g. process heat or process steam, the ratio of emitted CO_2 to output energy can be improved by improving the efficiency of energy conversion. In addition, the amount of final energy needed for the production of a specific good can be improved by improving the efficiency of the production process.

ETS emissions are verified independently for each installation calculating CO_2 emissions from energy consumptions multiplied by the relevant CO_2 emission factors plus process emissions. In order to protect commercially sensitive company information, only the verified emissions are published, but not the related energy consumptions. Consequently, there is no easily available data basis on which to establish a firm relation between energy savings and CO_2 reductions in the ETS sectors. On this basis, average values can only be calculated using a comprehensive econometric modelling approach able to analyse the energy consumptions and changes to it for all sectors including the ETS sectors, which is beyond the scope of the present briefing. The following approaches may be used to provide realistic estimates of the average CO_2 emission factor of the ETS sectors.

The industry sector, including ETS sectors and non-ETS industries and installations, has a fuel mix as displayed in Figure 6. Biomass and electricity have increased their share in industrial energy consumption, while the shares of oil products and coal have decreased between 1990 and 2010.

As far as *direct* ETS emissions of any specific ETS installation are concerned, electricity consumption in industry is not relevant[6]. The same is true for heat in this chart which includes district heating for industry consumption only; other heat consumption in industry is provided by onsite combustion installations, which are included in the ETS as long as installed thermal capacity exceeds 20 MW.

As a rough estimate, the ETS relevant fuel mix in the ETS sectors can be assumed to be similar to industry as a whole, excluding electricity and heat consumption. Such an assumption would lead to an average CO_2 emission factor of the ETS sectors of around

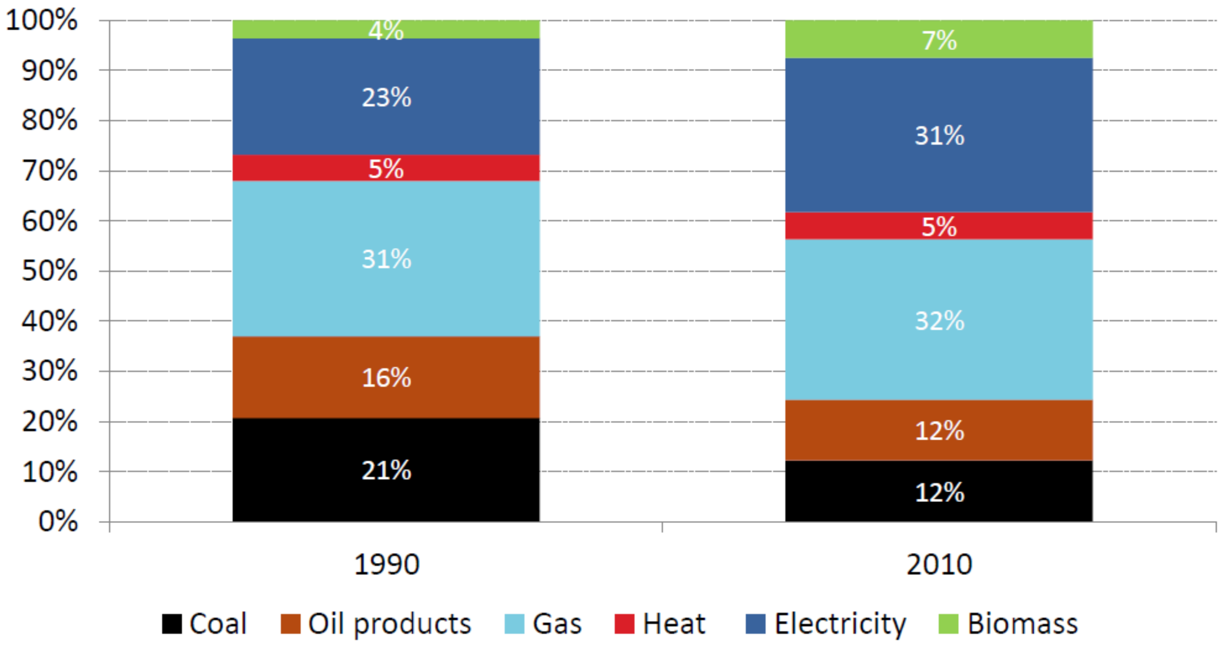
[6] The emissions associated to electricity and heat generation delivered to the installation from the outside are associated to the installation generating the electricity or heat.

63 t_{CO2}/TJ. Simply averaging all emission factors in Table 2 would lead to an ETS CO_2 emission factor of 79 t_{CO2}/TJ.

Combustion installations represent 73% of the ETS CO_2 emissions and are thus a proxy for the ETS as a whole.

Of fossil and biomass-based power generation, heat generation for supply to third parties as well as cogeneration of power and heat in EU27, 50% is based on various coal types, 35% on natural gas (including a small portion of LPG), 6% on various biomass types, 4% on oil products, 3% on waste, and 2% on gas works gas, coke oven gas, refinery gas and blast furnace gas[7]. Based on this combined with the CO_2 emission factors of Table 2 a weighted average CO_2 emission factor of EU27 fossil and biomass-based power and heat generation of 74 t_{CO2}/TJ is calculated. This number may be taken as a good approximation of the average CO_2 emission factor for ETS power and/or heat generation. Thus, for each TJ of energy saved in power and heat generation installations above 20 MW of thermal capacity, 74 t of CO_2 emissions are saved on average.

Figure 6: Fuel mix in the industrial sector in EU



Source: (ODYSSEE, 2012); see also (Ademe, 2012)

The fuel mix for individual ETS sectors may differ significantly from the ETS average or from the industry average.

- Coal (including coke, hard coal, lignite, etc.) is mainly consumed in steel making and power production, where it represents 50% of input fuel in fossil and biomass-based power generation (see above),
- Natural gas is consumed in all sectors; fossil and biomass-based power generation has a 35% natural gas share (see above),
- Oil products may be assumed to be consumed mainly outside the ETS sectors, notably in transport,

[7] Own calculations based on [IEA, 2012], [IEA, 2012b].

- Liquefied Petroleum Gas is consumed to a limited extent in refineries and mainly outside the ETS sectors,
- Blast furnaces, coke oven gas as well as other petroleum gas are probably entirely consumed in the ETS sectors.

As a general conclusion, the effect of CO_2 emission reductions in ETS sectors as a consequence of increases in energy efficiency strongly depend on the sectors and the process technologies within the sectors.

2.1.2. Indirect effects

Energy savings can indirectly influence CO_2 emissions in the ETS sectors no matter whether the savings occur in ETS sectors or in non-ETS sectors such as households, commerce, agriculture, certain industries, electricity and heat consumption in industry not generated onsite, etc. By improving energy efficiency and therefore reducing energy generated by ETS installations and by shifting energy consumption between ETS and non-ETS installations players not covered by the ETS can change the amount of CO_2 emissions in sectors which are covered.

Heat and cogeneration

Cogeneration of electricity and heat can be done by installations in the kW size typical for single households, in the 10-100 kW range typical for multi-family houses, in the >100 kW size e.g. in large office buildings or for district heating, and in the 1-1000 MW size in industry or for district heating. In other words, cogeneration is both done in ETS installations above 20 MW of thermal capacity, and in smaller installations not covered by the ETS.

Depending on the heat use, the temperature level ranges from 40-80°C for space heating, 60-130°C for district heating (which is mainly used for space heating purposes), and process heat and steam generation in industry using temperature levels of up to 400°C and in cases even beyond. Thus, district heating is mainly used for space heating and water heating purposes while process heat is generally generated in onsite installations specific to the purpose.

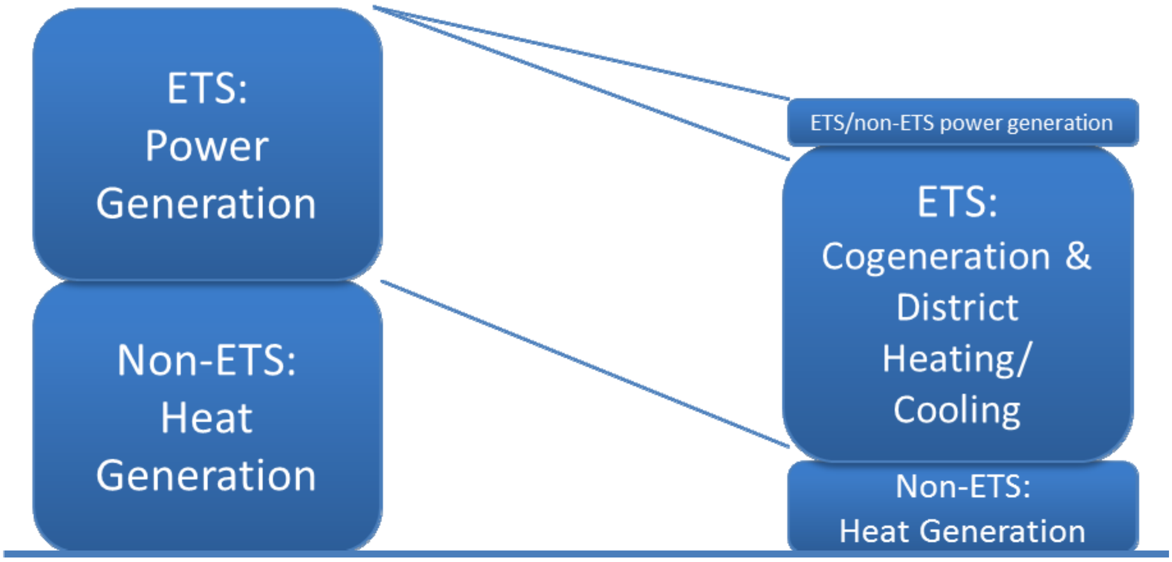
The higher the temperature level of the heat the higher the share of heat relative to power generation in the cogeneration installation. As heat quantity and temperature level are decoupled variables, one kWh of high-temperature heat reduces electricity generation in cogeneration more strongly than one kWh of low-temperature heat.

In order to improve the energy efficiency of fuels burnt in power plants high-efficiency cogeneration and efficient district heating and cooling can be introduced (see article 14 Energy Efficiency Directive (EED, 2012)). The efficiency of an existing power plant can improve from 35% to 60% without cogeneration to up to 80% if cogeneration is introduced. The use of waste heat from cogeneration plants improves overall energy efficiency but also slightly reduces the amount of electricity that is produced. The electricity output will decline typically by about 0.15 kWh_{el}/kWh_{th} due to cogeneration (Kostantin, 2009).

The CO_2 emissions of the installation converted from pure power generation to cogeneration remain unchanged. However, as electricity generation is reduced, other installations need to produce more power; these may be CO_2-free or CO_2 emitting installations covered by ETS.

The consumers supplied by the new district heating system will significantly reduce their direct CO_2 emissions as these are shifted to the ETS installation converted to cogeneration. In the majority of cases, the heat consumers will not have been included in the ETS before the change (e.g. households). Thus, ETS emissions increase, while overall CO_2 emissions and total energy consumption decrease. This is graphically represented in Figure 7.

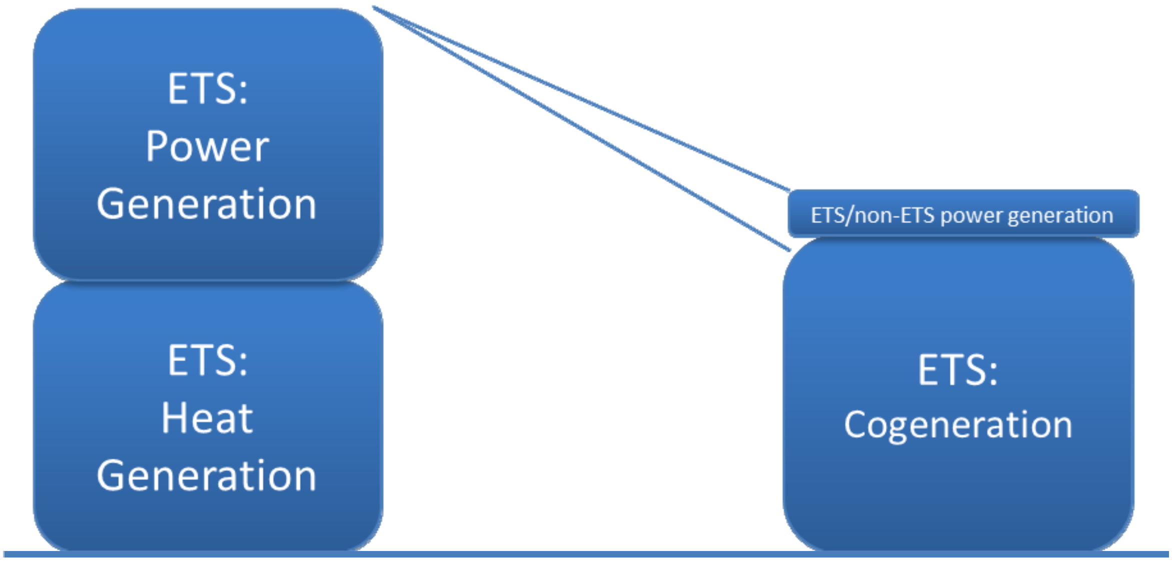
Figure 7: Shift of heat generation from non-ETS installations (e.g. households) to ETS installations (cogeneration and district heating/cooling)



Source: own source

If the heat consumer was included in the ETS before the introduction of cogeneration (e.g. a 30 MW burner to produce process heat or steam) ETS emissions will be reduced (see Figure 8).

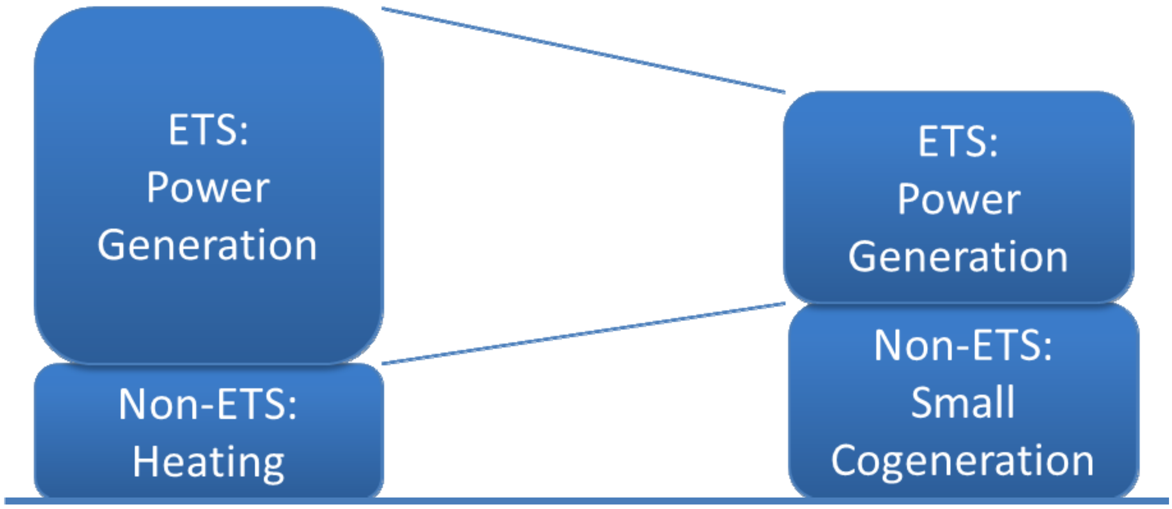
Figure 8: Shift of heat generation from ETS installations (e.g. industry) to ETS cogeneration installations



Source: own source

If on the other hand, ETS relevant large power plants are replaced by decentralised cogeneration units, which are not covered by ETS[8], then overall CO_2 emissions and energy consumption decrease, and ETS emissions decrease as well as depicted in Figure 9. Non-ETS emissions in the decentralised cogeneration units slightly increase compared to heating appliances as the overall efficiency decreases from around 100% to around 80%. On the other hand, power generation by ETS installations is substituted, thus reducing ETS emissions significantly. Overall, emissions are thus reduced, and overall energy consumption is reduced, too.

Figure 9: Shift of power generation from ETS power plants to non-ETS small cogeneration



Source: own source

Electricity

Electricity savings can be achieved in many applications and by numerous energy efficiency measures. Replacing conventional with highly efficient equipment (e.g. LED lighting, RPM-regulated water pumps, highly efficient domestic appliances) is one way to reduce electricity consumption. The optimisation and reduction of the operating hours of electric equipment is another, and there are more. Neglecting the losses in the power grid[9], for each kWh saved by the end-user one kWh less has to be produced. Currently, electricity in Europe is mainly produced by installations with a thermal input above 20 MW, which are included in the ETS. Electricity saved in non ETS sectors therefore indirectly influences the amount of CO_2 allowances required by the power plants.

The reduction of CO_2 emissions caused by electricity savings depends on the type of power plant that reduces its output, which varies depending on the time of day and the geographic area.

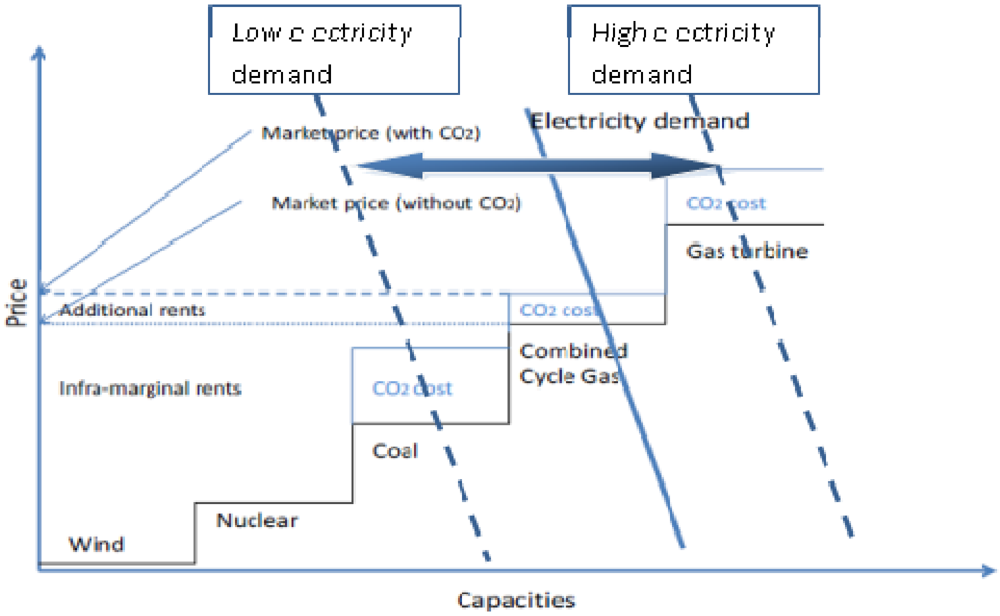
A reduction of electricity demand causes the power plant with the highest marginal costs (mainly the primary fuel price) according to the merit order to reduce its power output (see Figure 10). In periods with low electricity demand it is likely that a coal fired plant will reduce its power output having higher fuel costs than nuclear power. In periods with high

[8] Installations below an installed thermal capacity of 20 MW are not included in the ETS.

[9] Grid losses depend on the voltage level of the grid the consumer is connected to, and on the national grid characteristics ranging typically from 1.5% to beyond 13%; grid losses averaged over all consumers in EU-27 are 6.4% (eurelectric, 2010).

electricity demand it is likely that a peak-load electricity generation plant (e.g. gas turbine) will reduce its power output due to its high fuel costs. The costs for the fuel are mainly influenced by the fuel type (e.g. oil, natural gas, coal) but also by the amount of fuel needed to generate a certain amount of electricity which is a result of the efficiency of the power plant technology.

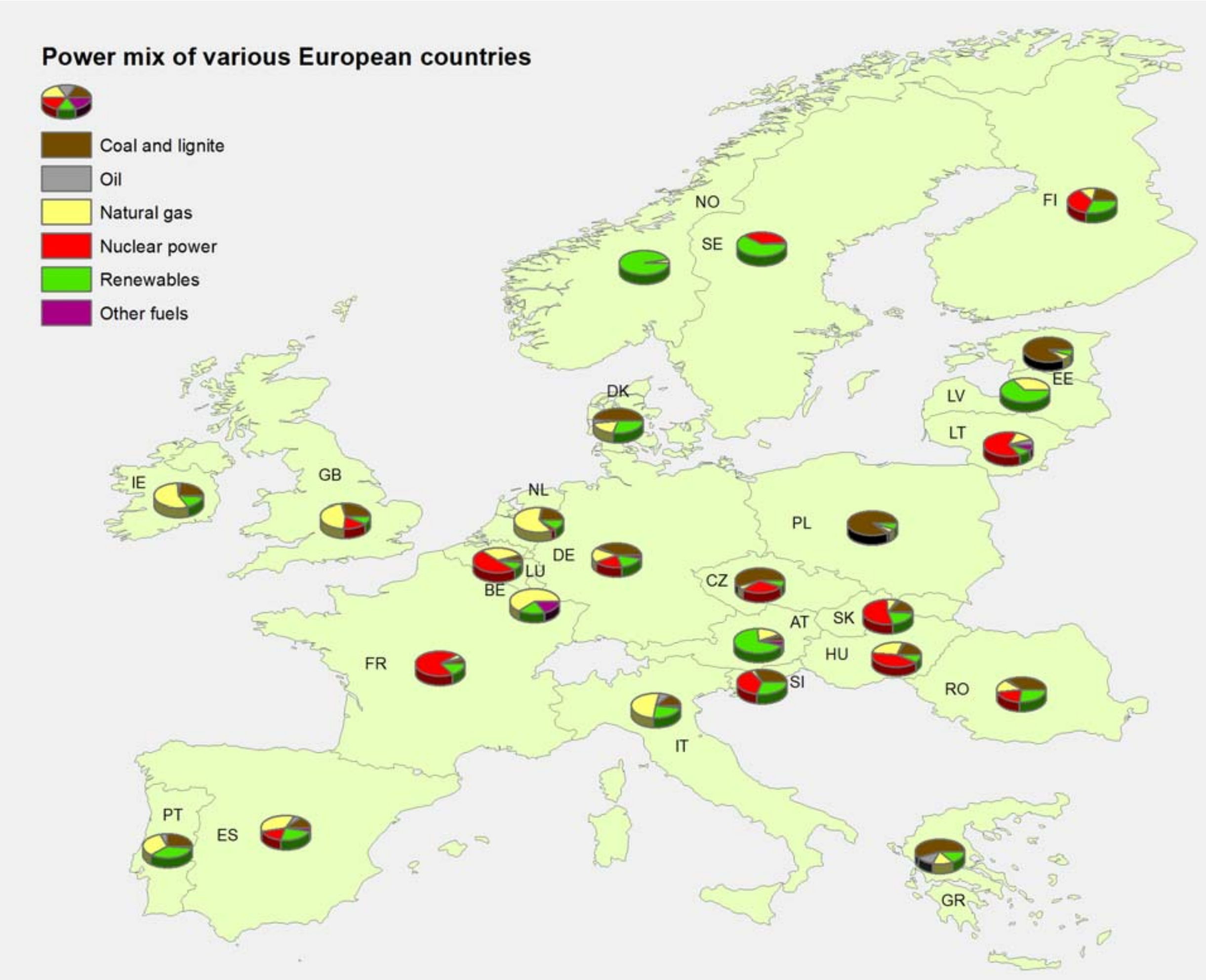
Figure 10: Merit order of power plant activation and deactivation depending on electricity demand



Source: based on (Philibert, 2011)

In different regions of Europe various power plant technologies using different fuels are in operation. Figure 11 shows the mix of fuels used for electricity production in various European countries. Major differences can be detected between e.g. France with mainly nuclear power, Poland with the majority being coal power, Norway having a high share of renewables, the Netherlands using mainly natural gas and Finland having a balanced mix.

Figure 11: Differences in the power mix of various European countries



Source: Eurostat

Due to the limited electric transfer capacities between regions the exchange of electricity is limited. Saving a kWh of electric energy can therefore have a very different impact on the reduction of CO_2 emissions depending on the geographic location. It can range from 0 g_{CO2}/kWh_{el} if renewable energy is saved (e.g. in Norway) to almost 1,200 g_{CO2}/kW_{el} if a lignite fired power plant reduces its output.

Table 3: Specific CO_2 emissions for electricity from different power plants

Fuel	CO_2 emission factor [g_{CO2}/kWh_{el}]
Natural gas	349 to 544
Anthracite	780 to 931
Lignite	946 to 1.190

Source: (BWK, 2007)

Table 3 lists ranges of specific CO_2 emissions from power plants using natural gas, anthracite and lignite. The ranges of the values are caused by varying CO_2 emission factors of one fuel type (see Table 2) as well as by different possible efficiencies of the power plants.

Table 4: CO_2 emission factors for various European countries

Country	CO_2 emission factor [t_{CO2} / MWh_{el}]	Country	CO_2 emission factor [t_{CO2} / MWh_{el}]
Austria	0.209	Bulgaria	0.819
Belgium	0.285	Cyprus	0.874
Germany	0.624	Czech Rep.	0.950
Denmark	0.461	Estonia	0.908
Spain	0.440	Hungary	0.566
Finland	0.216	Lithuania	0.153
France	0.056	Latvia	0.109
Great Britain	0.542	Poland	1.191
Greece	1.149	Romania	0.701
Ireland	0.732	Slovenia	0.557
Italy	0.483	Slovakia	0.252
Netherlands	0.435		
Portugal	0.369		
Sweden	0.023	**EU – 27**	**0.460**

Source: EUROSTAT

In the longer-term, energy efficiency gains will also change the power plant mix, and thus the merit order curve.

Energy efficiency measures do not necessarily reduce the amount of electricity consumed. In some applications, energy consumption and CO_2 emissions may be reduced by shifting from the direct use of fossil fuels to the use of electricity, thus increasing electricity consumption. If the electricity is not produced CO_2 free a shift of emissions from non-ETS sectors to ETS sectors occurs. Depending on the specific CO_2 emissions of the electricity the overall CO_2 emissions are generally reduced[10], while the emissions in the ETS sector (thermal capacity exceeding 20 MW) increase.

An example of such a situation is the introduction of battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV) and fuel cell electric vehicles (FCEV). In order to achieve lower CO_2 emissions per kilometre the internal combustion engine is replaced by an engine using electricity (powered from a battery or a hydrogen fuel cell). Depending on the kind of power plants feeding the vehicles emissions are shifted from the vehicle exhaust pipe (non-ETS) to power plants (ETS if based on fossil energies).

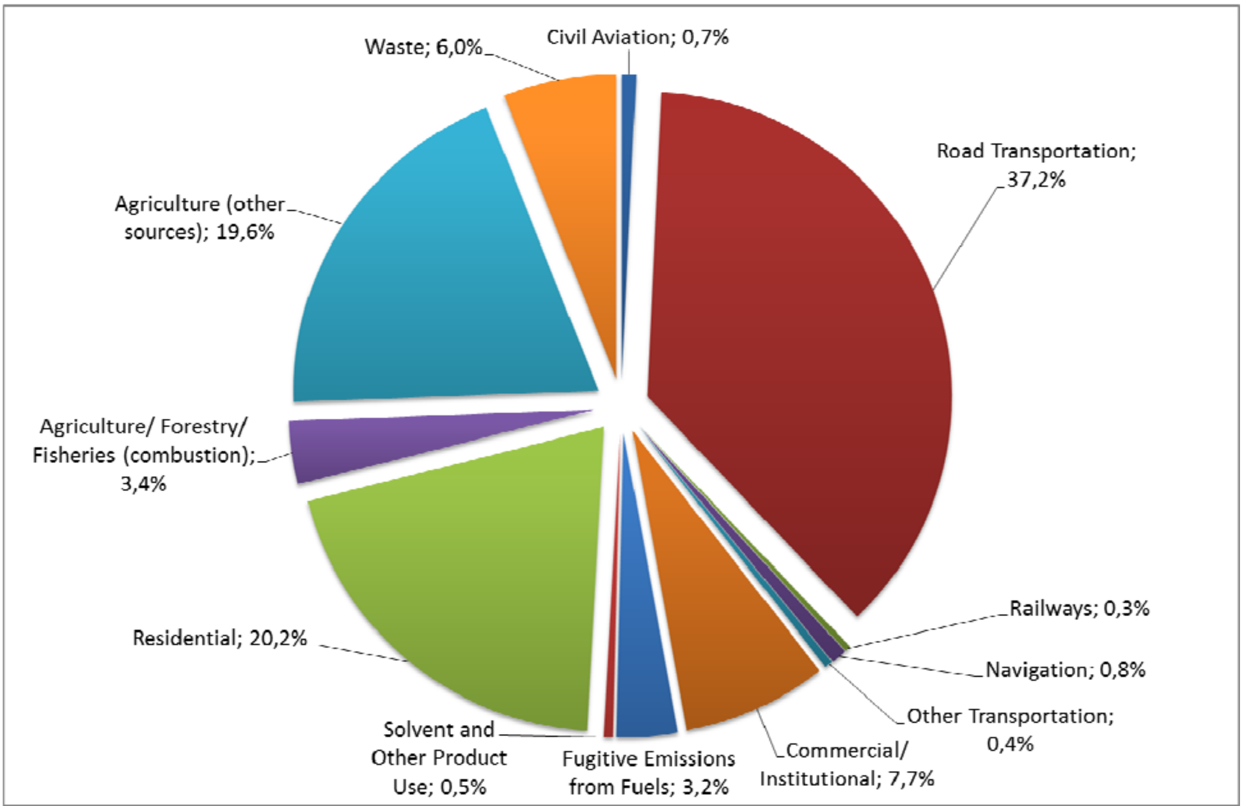
A common but simplified way to estimate the effects of changes in electricity consumption on CO_2 emissions is to use the average CO_2 emission factor for electricity production in the region (see Table 4).

[10] Electricity mixes with a high CO_2 factor, notably because of a large share of coal fired power plants, lead to an overall increase of the CO_2 emissions.

2.2. CO2 reduction in non-ETS sectors as a result of energy efficiency improvements

The non-ETS sectors cover around 50% of CO_2 emissions and 60% of total GHG emissions in EU-27. The definitions of installations falling under the ETS and sector definitions for national emission inventory reporting under the Kyoto protocol are not 100% identical so that a clear separation is complex. As an example, the IPCC sector “1.A.1.A Public Electricity and Heat Production” does include ETS installations, but also includes installations with an installed thermal capacity below 20 MW, which are excluded from the ETS. As a consequence, the breakdown of GHG emissions in the non-ETS sectors presented in Figure 12 is not exact and fails to cover 10% of total GHG emissions in EU-27.

Figure 12: GHG emissions 2010 by sector outside the ETS



Source: based on (EEA, 2012b)

CO_2 reductions in non-ETS sectors as a result of energy efficiency improvements follow the same logic as in the ETS sectors: the amount of CO_2 reduction depends on the CO_2 emission factor of the fuel saved (see Table 2). For electricity, emissions depend on the CO_2 emission factors of the electricity generation mix, which to a large extent is included in the ETS (see Table 4 and the discussion on Electricity in section 2.1.2).

For fossil fuels, life-cycle emissions of GHG are strongly dominated by the combustion emissions, while other emissions associated with extraction and logistics are limited. For bio energies in solid (e.g. wood), liquid (e.g. plant oils) or gaseous (e.g. bio methane) form CO_2 combustion emissions are equal to the amount of CO_2 absorbed from the atmosphere by the plants during growth so that combustion is CO_2 neutral. Life-cycle emissions of bio energies thus need to be compared to life-cycle emissions of fossil energies. For ETS, CO_2 emissions of bio energies are zero by definition.

For transport fuels, life-cycle CO_2 emission factors for bio energies including extraction, generation and transport/distribution, but excluding land-use changes, are defined in the

EU Renewable Energy Directive[11]. As light heating oil used for space heating is chemically very similar to diesel fuel, and bio methane is chemically very similar to fossil natural gas[12], the values of the EU Renewables Directive for these fuels can be used as proxies to heating applications (see Table 5). The values show a large spread from 19% to 82% depending on the bioenergy type and production pathway.

Three examples shall clarify the implications of this:

1. According to Table 2, saving one TJ of light heating oil (very similar to gas oil), e.g. through a better thermal insulation of the building, will reduce CO_2 emissions by 74.19 tons of CO_2.
2. Replacing light heating oil by pure vegetable oil from rape seed will reduce CO_2 emissions by 57%, equivalent to 42.29 t_{CO2}/TJ.
3. Saving one TJ of pure vegetable oil from rape seed will reduce CO_2 emissions by 43%, equivalent to 31.90 t_{CO2}/TJ.

[11] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[12] The final compression stage of bio methane (called „biogas“ in the EU Renewable Directive) for refuelling of vehicles is not needed for heating applications; the values for heating will thus be slightly better than the values listed in the table.

Table 5: CO_2 reductions of different biofuels compared to fossil benchmarks

Biofuel production pathway	Typical GHG emission saving	Default GHG emission saving
rape seed biodiesel	45%	38%
sunflower biodiesel	58%	51%
soybean biodiesel	40%	31%
palm oil biodiesel (process not specified)	36%	19%
palm oil biodiesel (process with methane capture at oil mill)	62%	56%
waste vegetable or animal oil biodiesel	88%	83%
hydro-treated vegetable oil from rape seed	51%	47%
hydro-treated vegetable oil from sunflower	65%	62%
hydro-treated vegetable oil from palm oil (process not specified)	40%	26%
hydro-treated vegetable oil from palm oil (process with methane capture at oil mill)	68%	65%
pure vegetable oil from rape seed	58%	57%
biogas from municipal organic waste as compressed natural gas	80%	73%
biogas from wet manure as compressed natural gas	84%	81%
biogas from dry manure as compressed natural gas	86%	82%

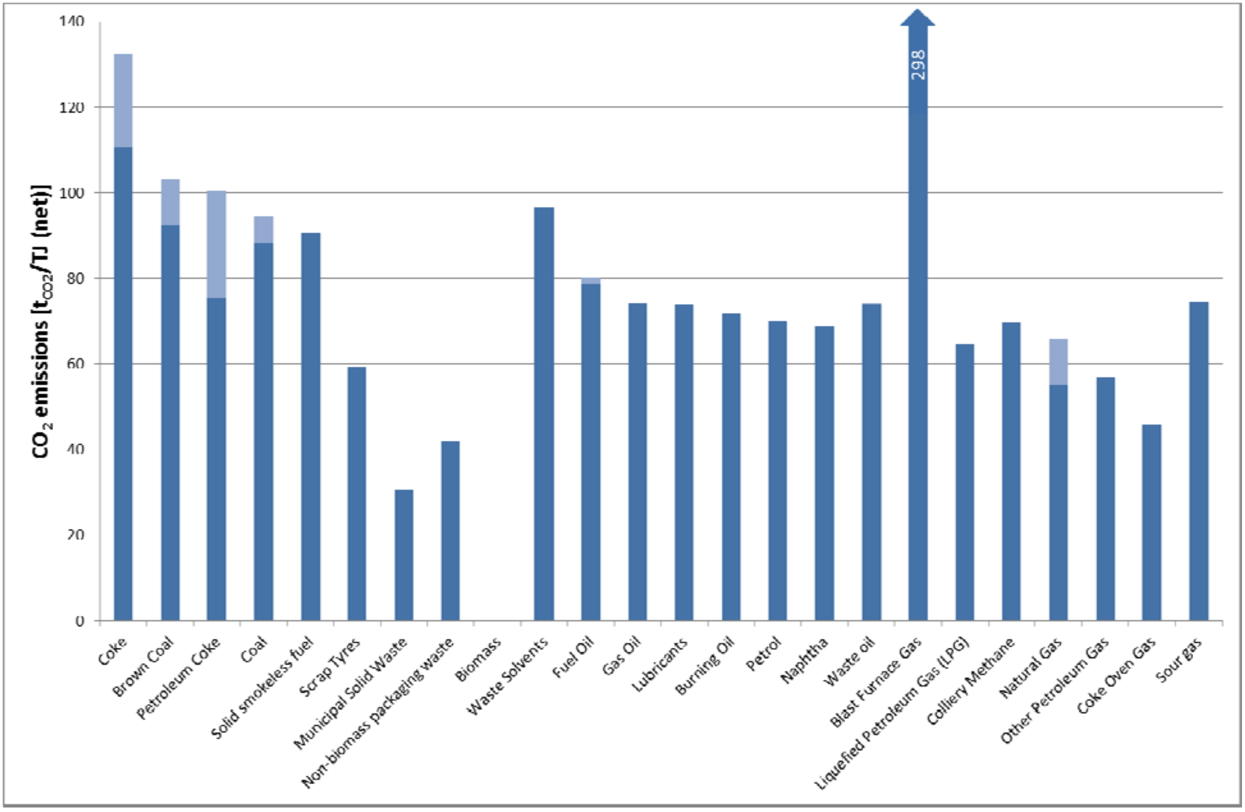
Source: EU Renewables Directive

2.3. Main drivers of CO2 reduction in the ETS sectors

2.3.1. Large relative effects

The largest CO_2 emission reductions per TJ of energy saved take place where very CO_2 intensive energies are saved. The CO_2 emission factors displayed in Figure 13 show that avoiding the combustion of blast furnace gas provides the largest relative saving in CO_2 emissions. In general, coke, lignite and hard coal allow for large relative CO_2 reductions, while saving natural gas has a 40% lower relative effect. Municipal solid waste has an even lower CO_2 emission factor based on the biogenic share in that fuel.

Figure 13: CO_2 emission factors in the ETS for the UK, and the Czech Republic for brown coal/lignite



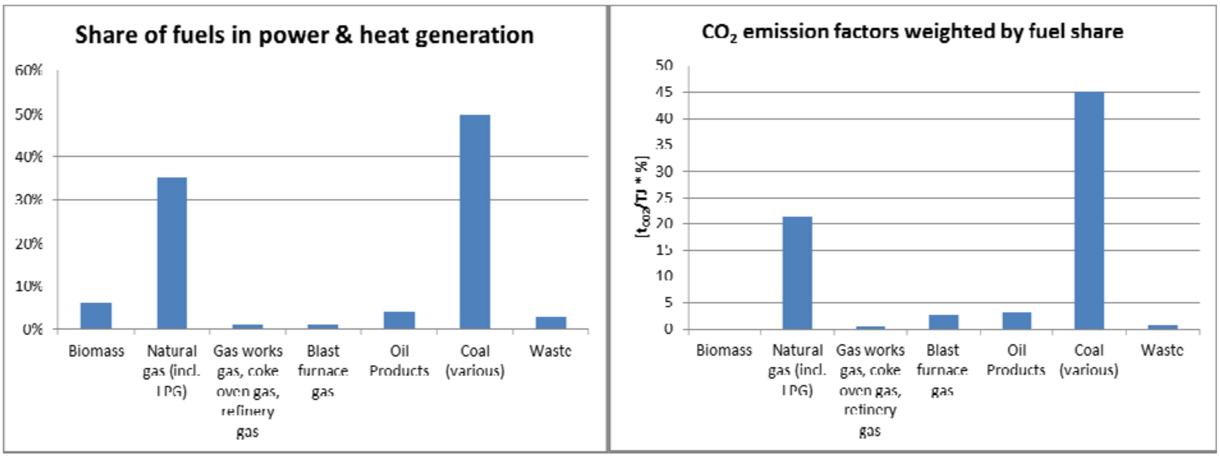
Note: light blue indicates bandwidths of values.

2.3.2. Large total quantities

In spite of the large relative CO_2 emission reductions possible by replacing blast furnace gas, the availability and use of this fuel is very much lower than e.g. natural gas consumption. This is related to the fact that blast furnace gas is a by-product of iron ore refining, where coal is the primary fuel used.

As described in section 2.1.1, 72% of the ETS emissions in 2011 were caused by combustion installations, which generate power and/or heat. In the latter, 50% of fuels consumed are various coal products with an average CO_2 emission factor of around 91 t_{CO2}/TJ; 35% of fuel consumption is natural gas with an average CO_2 emission factor of around 61 t_{CO2}/TJ (see Figure 14 left). In Figure 14 (right) the fuel shares are multiplied by their respective emission factors. Summing all weighted emission factors results in the average emission factor of power & heat generation of 74 t_{CO2}/TJ. The graph shows that the single largest contribution is provided by coal and the second largest by natural gas; the other fuels rather make negligible contributions.

Figure 14: Share of fuels in EU27 power and heat generation (left); CO_2 emission factors weighted by fuel share (right)

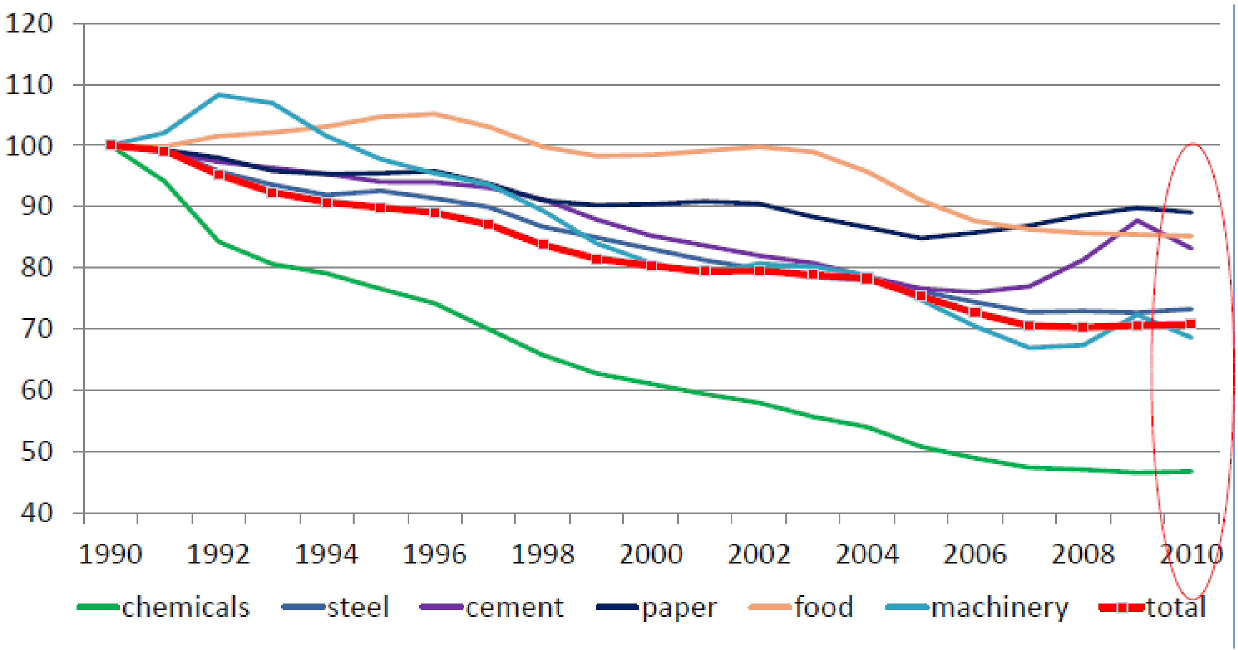


Source: own analysis based on (DECC, 2012), (Herold, 2007), (IEA, 2012), (IEA, 2012b)

2.3.3. Energy efficiency trends and potentials

Energy efficiency in the European industry has progressed by some 30% from 1990 to 2010 as illustrated in Figure 15, which provides an overview of the improvements by different industrial branches, and by industry as a whole based on the ODEX index[13].

Figure 15: Energy efficiency trends in EU industry



Source: (ODYSSEE, 2012b)

Energy efficiency has made slower progress between 1998 and 2007 of 1.9 %/yr than between 1990 and 1998 of 2.2%/yr. No progress was made since 2008 with even a reverse trend in 2009 (+0.5% for the index after a stability in 2008 and +0.2% in 2010).

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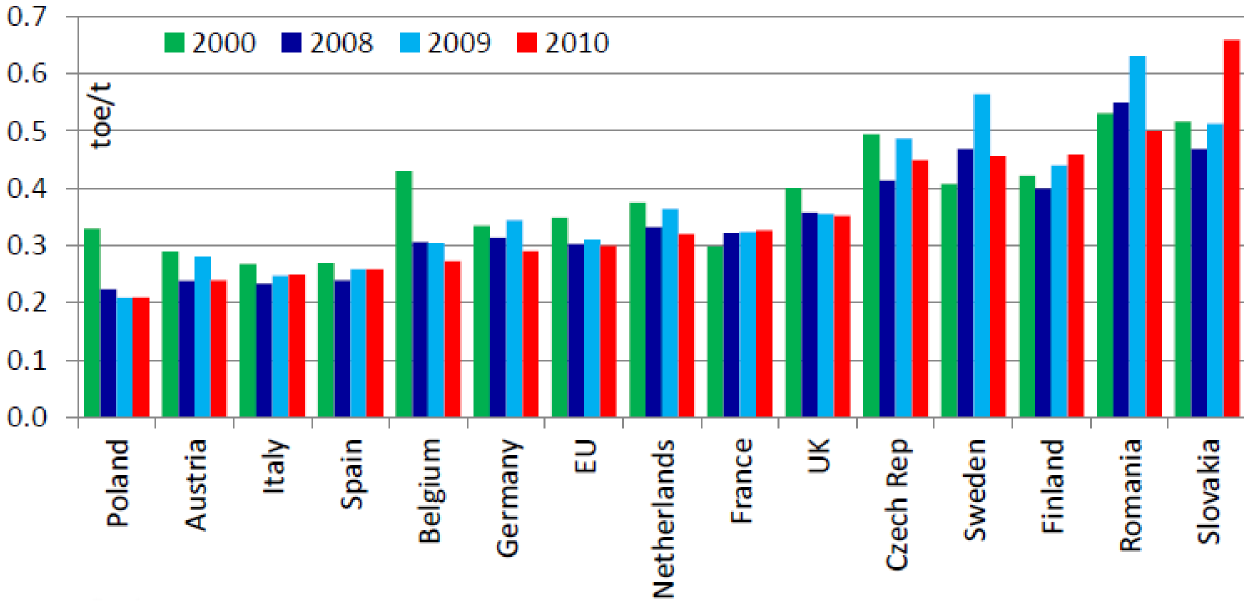
[13] ODEX is an index developed by the ODYSSEE-MURE project. It measures the progress realized in energy efficiency in total (final energy consumption) or by sector (industry, transport, households). For a full definition of the ODEX, please see: http://www.odyssee-indicators.org/registred/definition_odex.pdf.

"The reaction of countries to the industrial recession in 2009 was quite diverse: structural changes were generally significant but not all in the same direction." (Ademe, 2012). The economic recession contributed to an increase in the specific energy consumption in industry and other sectors, which is equivalent to negative savings. In 2010, the return of industrial growth slowed this trend, but "energy efficiency in industry is not back to its historical trends." (Ademe, 2012).

Figure 16: Specific energy consumption per ton of steel



Source: (ODYSSEE, 2012b)

Specific energy consumption in steel making reflects this trend as shown in Figure 16. Crude steel making in Europe went down by 30% in 2009, and recovered by 24% in 2010. The drop in energy efficiency in 2009 may be due to an uneven impact of the recession on the two different types of steel making: the oxygen process and the electric process. The oxygen process for steel making is 2-3 times more energy intensive than the electric process.

Altmann et al. (2010b) analyse the potential for energy savings in the steel sector in Europe. A technical energy savings potential per ton of steel of 7% by 2020 compared to 2004 is found. Economic potentials are 5-7% by 2020 depending on assumptions for economic parameters and for policies adopted in Europe. In addition to process improvements, increased shares of electric furnaces and increasing recycling rates are the major means to increase energy efficiency.

For the industry sector as a whole, Altmann et al. (2010b) conclude in general: „Industry has a **limited future potential for energy savings** compared to households, transport and the tertiary sector. Based on the European Commission funded ODYSSEE MURE project future final energy savings potentials of the European industry of 5.9% to 6.6% by 2020 compared to the baseline scenario are estimated. In addition to energy savings, **switching to low carbon fuels, renewable energies and carbon capture** are options to reduce greenhouse gas emissions from industry."

An analysis of the interactions between EED and ETS is provided in the next chapter.

3. Interplay between the ETS and other policy instruments

The EU ETS is the central pillar of the EU package of regulatory measures to address climate change, energy security and competitiveness, but in particular to achieve EU's 2020 GHG emissions reduction target. Consequently, the 2008 Review was meant to adapt the ETS so that it could cope with the uncertainties of international climate change negotiations as well as the fluctuations of the economic cycles. However, primarily due to the unprecedented recession and the accompanying decline of demand for EU allowances, the EU carbon price has fallen to substantially lower levels than expected. The European Commission's Carbon Market report (EC, 2012c) notes that by the end of 2011 a total of 8,720 emissions rights[14] were available for compliance purposes while verified emissions in the period 2008-2011 were only 7,765 million tonnes of CO_2-eq. While there is no doubt that the principle reason for this 'oversupply' has been the economic crisis, this situation has also highlighted various impacts and interactions between EU, member state and even international policies. However, these effects are difficult to quantify because many of these policies are only being shaped or are still in their early implementation. Moreover, even where quantification is possible, available data is scarce, partial and generally has not been subject to extensive review.

There are many impacts on and interactions between the EU ETS and other policies. They can relate to i) international, ii) EU, both climate and non-climate related, and iii) to Member State policies. Primarily analysing the interactions with policies on energy efficiency, this section focuses on the following issues:

- International carbon markets, notably crediting mechanisms
- ETS, notably changes in design such as the use of community projects (Art 24a ETS Directive) and the suspension of aviation
- EU energy efficiency policies, notably the EED
- Non-climate related EU legislation, such as the Large Combustion Plant Directive
- International policies and conventions, such as a possible UN Mercury Convention
- National policies related to climate and non-climate policies

They will be grouped into impacts 'endogenous' to the ETS and interactions 'exogenous' to the ETS.

It is important to note that the endogenous (to the ETS) impacts can have bigger or at least equally as big impacts as policies for energy efficiency, and thus will be dealt with in a separate sub-chapter below.

3.1. Putting the effects in perspective

Numerous policies and policy changes affect the ETS either at demand or supply side. In many instances, laws and policies that are undertaken at Member State, EU, or international level for other than GHG reduction purposes interact with the ETS by reducing demand for allowances. The EED is but one example. Also, the Large Combustion Plant Directive and the UN Mercury Convention increase energy efficiency and reduce GHG emissions although their primary objectives are different.

[14] 8,171 million allowances in addition to 549 million international credits.

In addition to impacts external to the ETS, parameters within the ETS can generate impacts on ETS supply and demand. Examples are access to Kyoto credits from CDM and JI, community projects of article 24a, or the potential suspension of inclusions of international aviation. In some cases, parameters within the ETS can have a bigger or at least equally big impact on ETS supply and demand than policies for energy efficiency. While the EED is estimated to reduce ETS demand by around 450 Mt CO_2 until 2020, credits from the Kyoto mechanisms (CERs and ERUs) amount to about the same in additional supply from 2008-2011 while growing fast. The suspension of the inclusion of aviation, if made permanent, would reduce supply by more than 200 Mt until 2020. Impacts arise due to changes in the international context as in the case of aviation or the Kyoto crediting mechanism, where non-EU demand collapsed, or due to implementation, as it could be the case for community projects.

Finally, the proposed UK price floor for the ETS is an example for an impact of a Member State policy, which is oriented neither at the supply nor the demand for allowances but the price. That price impact for the ETS as a whole – outside the UK – is however likely to be small.

The policies identified above will not lead to an overall reduction of GHG emissions in sectors covered by the ETS. This is because emissions under the ETS are fixed by the cap. Emission reductions that occur in the ETS sector through measures that are additional to the ETS will however 'free-up' ETS allowances that can be used by other market participants or will be banked. This results in a lower carbon price in the ETS sector. Whether the lower price is seen as a good or bad thing depends on the situation and preference, e.g. the sector in question or whether one takes a short-term or long-term perspective. This will be discussed in chapter 4.

3.2. ETS-related impacts

This section covers impacts that occur as a result of the ETS itself or changes thereof. Such 'endogenous' effects are listed here because their impact on ETS demand and supply may be more important than the ones originating from energy efficiency policies.

3.2.1. International credit policies: Other emissions trading systems and Kyoto mechanisms

Access to international credits under the Kyoto Protocol has been meant to reduce the EU ETS carbon price in order to address competitiveness concerns. Occasionally this is referred to as a 'safety valve'. While in the past the impacts stemmed from CERs and ERUs, in the future the same effect can be expected from certificates under any future mechanism discussed in the UNFCCC negotiations, or from other emissions trading systems. If, for instance, a system linked to the ETS had lower carbon prices, EU allowance prices would also decrease. This depends, however, on the relative sizes of the EU ETS and the ETS with which it is linked. Hence, this effect will quantitatively only matter if the number of allowances in the linked system is big enough to generate an impact. The reverse is true if the system linked to ETS has higher carbon prices than the EU ETS.

The figures on Kyoto credits (ERUs for JI and CERs for CDM projects) illustrate this. The supply of these credits has increased over the past years with the majority of the credits being generated under the CDM. While CERs were ranging between 123 and 132 million in 2008-2010, they increased to 320 million in 2011 with average projections of more than 500 million annually from 2013-2020. At the same time, ERUs increased from 5 million in 2009 to 88 million in 2011 (EC, 2012f). Although also used by EU Member States and other countries to fulfil national Kyoto obligations, both types of credits have been increasingly used to comply with the ETS (see Table 6).

Table 6: International credits used for ETS compliance 2008-2011, EU (all figures in million credits)

	2008	2009	2010	2011	Total 2008 -2011
International credits used for compliance*	**82**	**81**	**134**	**252**	**549**
CERs	82	78	114	177	450
ERUs	0.05	3	20	75	98
*Amount of international credits surrendered in the registry by 30 April year x+1					

Source: (EC, 2012f)

At the beginning of 2012, more than 50% (450 million of 877 million) of all issued CERs had been used for this purpose. In restricting the use of credits from certain projects under the ETS from 2013 onwards,[15] the EU might not only incentivise that these credits are used for ETS compliance before April 2013 (end of phase 2), but also try to prevent the European carbon market from being flooded by international credits (EC, 2012f). For example, the Commission's 2008 impact assessment of the GHG and renewables policies estimated the carbon price to fall by EUR 13.2/t_{CO2} if up to a quarter of the emission reduction effort was derived from Kyoto credits (EC, 2008).

Table 7: Build-up of a surplus of unused allowances 2008-2011, EU

(in Mt)	2008	2009	2010	2011	Total
Issued allowances and used international credits	2076	2105	2204	2336	8720
Reported emissions	2100	1860	1919	1886	7765
Annual change of surplus allowances	-24	244	285	450	955

Source: (EC, 2012f)

In order to give an indication of the magnitude of price effects[16], the Commission estimated in its baseline scenario that allowances (including international credits) would not be scarce before 2018. The reason is the economic recession, due to which not all allowances have been used, but are carried into the future (EC, 2012f). Even by 2020 there would still be enough of them in the system to prevent a serious reduction of emissions (see Figure 17).[17]

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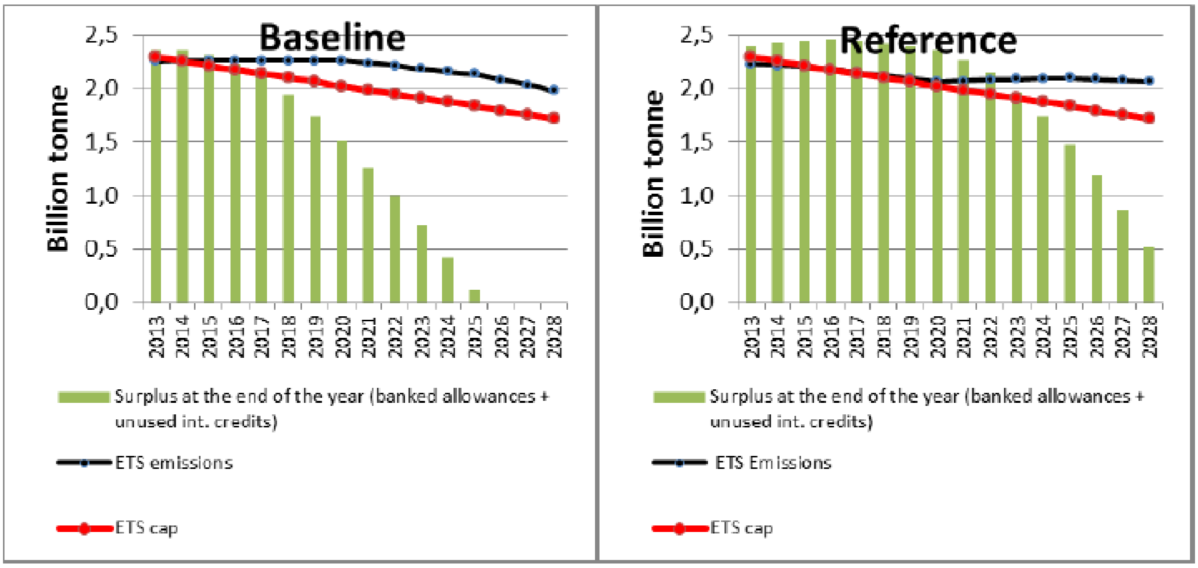
[15] E.g. allowing only for CDM credits 'earned' in least developed countries and limiting the use of credits from HFC-23 and N_2O projects. See (EC, 2012f).

[16] These calculations are indicative only of the nature and level of impacts. EU allowance prices in the meantime have fallen due to the effects of the economic crisis.

[17] Ongoing legal cases may add 110m allowances to the cap of the second ETS phase. See (Curien & Lewis, 2012).

Figure 17: 2010 Baseline and reference projections of the EU ETS*



*Baseline scenario: Full implementation of the ETS Directive; Reference scenario: Full implementation of the ETS Directive, national non-ETS reduction and 20% renewables targets.

Source: (EC, 2012f)

The graph also shows that the allowance surplus built up during the recession allows for emissions above the cap. If GHG and renewables targets are met (the so-called reference scenario), the banking of allowances and international credits would continue until 2016, with a lasting effect on carbon prices (from EUR 25 in the baseline scenario to EUR 16.5 in the reference scenario, not to mention a further decrease to EUR 14.2 or, depending on the model, even a drop to zero if the impact of the EED is considered). Even when the impact of the EED is not taken into account, the reference projection of the carbon price in 2030 would only be around EUR 20 (EC, 2010). For Member States this would further mean throughout the third phase of the ETS an annual loss of more than EUR 1 billion in auctioning revenues (EC, 2012f). In this vein, the Commission's '2 for 1' plans, meaning that "for every tonne emitted in an ETS installation, two tonnes of CDM credits would have to be surrendered", could not only be interpreted as a multiplier to reduce emissions in developing countries, but also as a counter-measure against international credits in the ETS (EC, 2010b).

3.2.2. EU policies: Community projects

Under article 24a of the revised ETS Directive, Member States may issue ETS-tradable allowances for projects, which are undertaken to "reduce greenhouse gas emissions not covered by the Community scheme" (EU, 2009a). They mirror the concept of the project mechanisms articulated in the Kyoto Protocol, but are within the same jurisdiction to reduce emissions in the non-trading sectors (e.g. transport and buildings). The principal aim of this arrangement is to reduce total compliance costs by bringing hitherto non-identified low-cost reduction sources into the field. Thereby, they serve as a market search and price discovery function outside the ETS.

The precondition to achieve this objective in an efficient and effective way is that reductions are truly additional. This means that 'Community-level projects' should not be counted twice (i.e. under the effort sharing decision) nor should they be the result of already existing Member State or EU regulation (e.g. the Energy Efficiency Directive).

This creates two interactions that work in different directions.

Implementing 'Community-level projects' would lower the EU ETS allowance price because they bring low-cost projects, certified by additional allowances, into the ETS. At the same time, costs in the non-ETS, i.e. the effort sharing sector, go up the same way that costs in the ETS sector decrease, unless both targets, i.e. caps, are adjusted (taking into account the transfer between the ETS and the non-ETS sector). In addition, there are concerns that 'Community-level projects' are potentially complex and incur transaction costs inherent in all project mechanisms.

More stringent rules for energy efficiency reduce the incentives to undertake Community projects, therefore potentially reducing the likelihood that additional credits enter the ETS. Hence, more onerous requirements on energy efficiency, e.g. by the EED would tend to reduce the additional supply that could arise if Community projects are implemented. The other side of the same coin is however that the EED can also be seen as crowding out Community projects and therefore foregoing their market search and price discovery function outside the ETS. This point is further discussed from the perspective of the EED under 3.3.1.

'Community-level projects' are different from the 'opt-in' in article 24 of the ETS Directive. Art. 24 gives Member States the possibility to include new gases and activities into the ETS ('opt-in'). Contrary to the 'Community projects', there should be no effects on the total number of allowances, as for the 'opt-in' gases and activities, sectorial baselines exist that allow adjusting the cap.

3.2.3. EU policies: Suspension of aviation

The proposed temporary suspension of international aviation from the ETS constitutes a change in design, which, if implemented, has implications for the ETS. Concretely, the Commission has recommended freezing the inclusion of external flights in the ETS until the outcome of next year's general assembly of the International Civil Aviation Organization (ICAO) (Curien & Lewis, 2012). The Commission's proposal reflects current developments in the ICAO towards reaching "a global agreement on aviation emissions based on a market mechanism". Since this endeavour includes countries, which are against their aviation companies being treated under the ETS, the proposal to suspend this rule can be understood as a support of the ICAO negotiations by the Commission.

However, this measure will probably cut demand and boost the size of an expected glut of allowances in 2020 (Curien & Lewis, 2012). Under a scenario where flights to or from non-EU countries are not included until 2020, demand would fall by 217 million tonnes and increase the oversupply by 17 per cent to 1.48 billion tons. This would put the already low carbon price under further downward pressure. However, the exact effect will depend on whether this suspension will be maintained beyond 2013 since the proposal of the Commission foresees an automatic return to the current scheme if the outcome of the ICAO negotiations is not satisfactory (Nielsen, 2012).

3.2.4. Member State policies: ETS price floor in the UK

The UK carbon price floor proposal is a regulatory/taxation policy that is intended to complement the ETS. Starting in April 2013, it will make suppliers of fossil fuels that generate power liable either to the UK Climate Change Levy or a fuel duty (see HM Treasury, 2010; MacKenzie, 2011). The carbon price support rates[18] for the UK Climate Change Levy and the fuel duty reflect the differential between the future market price of

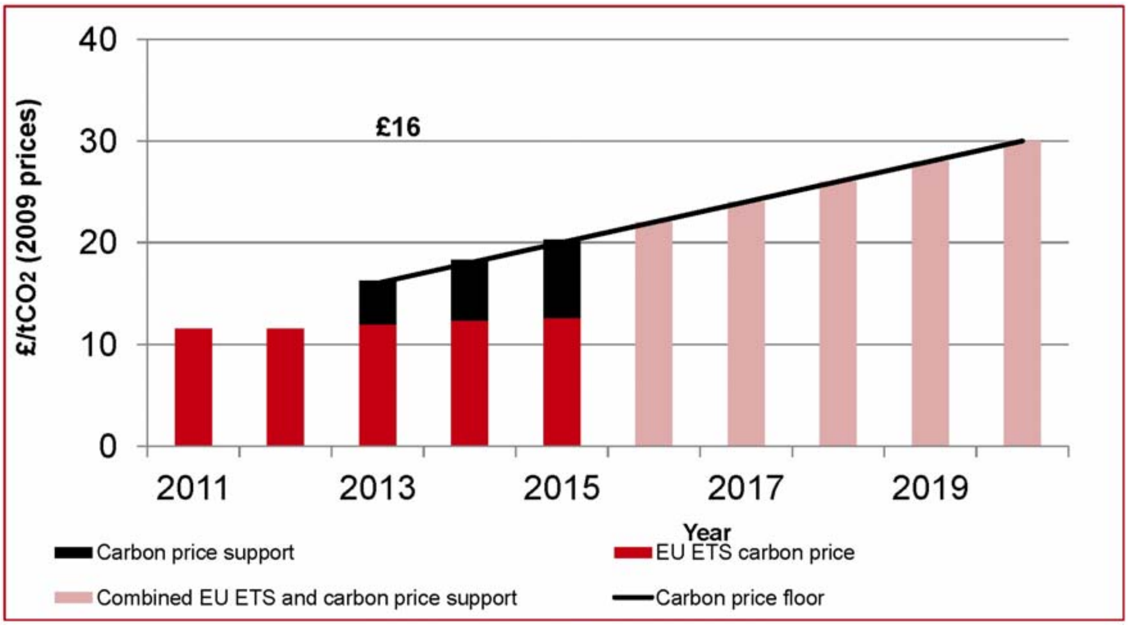
[18] Carbon price support rate will be applied to fossil fuels based on their carbon content. The rate will be determined by the average carbon content of each fossil fuel.

carbon and a specified floor price (see Figure 18). While essentially a tax, it has the effect of supporting the carbon price, although only in the UK.

This means that there will be different carbon prices under the ETS across the EU, with UK companies paying higher rates than their neighbours, raising intra-EU competitiveness issues for the private sector. Such a unilateral move further reduces the carbon price for the other member states, thereby reducing their auction revenues and compromising least-cost abatement in the UK (Sartor and Berghmans, 2011). As the difference between the ETS price and the UK floor price is collected by the national government as revenue, the 12% redistribution to eastern European countries required from EU ETS auctions is foregone for that difference (Grubb, 2012).

Another criticism is that the carbon floor price overlaps with aspects of the contracts-for-difference provisions, a type of the option contracts also introduced as market-stabilising aspects of the UK's electricity market reform. Option contracts describe the establishment of bilateral contracts between public institutions and investors regarding low-carbon solutions. The public institutions would guarantee a certain carbon price to an investor through such a contract. In case the realised carbon price is below the guaranteed price, the public institution (the option writer) would pay the difference to the investor (the option holder). In case of a low carbon price, potentially detrimental to the competitiveness of low-carbon investments, the investor gets some compensation and reduces his risk. Price floors are a way of hedging the government against financial liability in option contracts, but the options themselves could be sold, generating revenue upfront for the government (Pizer, 2011).

Figure 18: UK Carbon price floor illustration (in real 2009 prices and calendar years)



Source: (HM Treasury, 2011)

3.3. Interactions with non-climate policies

This section will cover interactions between the ETS and non-climate policies or policies that are not motivated exclusively by climate concerns. It provides an indirect analysis of how energy efficiency measures affect the EU allowances and also looks at effects in the other direction, i.e. of the EU ETS and the carbon price impacts on energy efficiency measures. The analysis mainly focuses on the EED, but provides also examples from other EU, global, and national regulations.

3.3.1. EU policies: Effects of increasing energy efficiency on the EU ETS

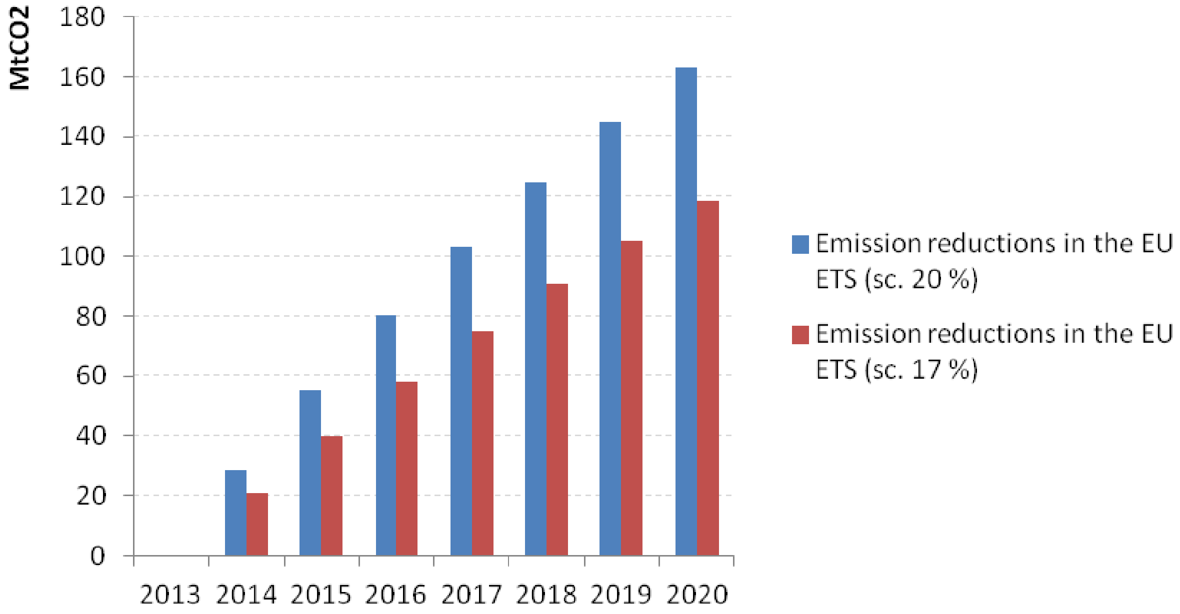
As far as it affects activities that are covered by the ETS, the EED will not lead to an overall reduction of GHG emissions. On the one hand, it will simply ‘free’ ETS allowances, allowing other ETS participants to emit at a lower allowance price. At the same time, the carbon price signal gets blurred while jeopardising the objective of achieving the GHG target in the ETS at least cost. On the other hand, energy efficiency obligations could also help to overcome market failures, thereby positively affecting the costs of future emission reductions. This could be done for example by stimulating innovation and diffusion of energy-efficient technologies (Sorrell et al., 2009).

Energy efficiency measures reduce electricity demand and hence demand for allowances, i.e. EUAs are less scarce since less electricity has to be produced under the same cap. Thereby, energy efficiency measures partly pay for compliance with the ETS (NERA, 2012; Sorrell et al., 2009). As a result, the price for allowances decreases with surplus allowances being banked[19], thereby possibly further reducing the carbon price in the future. For example, after approving the draft EED the EUA price dropped by 20% (Sartor, 2012). What the exact price effect will be is however difficult to assess as the price also reflects market participants’ expectations about regulators to intervene (Curien & Lewis, 2011). So is the general impact of the EED, which relies on uncertain factors, such as the use of exemptions from the directive for industries under the ETS, policies on renewables, weather patterns, and economic activity in the EU (Berghmans, 2012; Curien & Lewis, 2012). The Commission estimates that the binding measures under the EED would reduce primary energy consumption by around 17% across the ETS scope until 2020 (European Union, 2012). This would correspond to approx. 450 Mt_{CO2} compared to 650 Mt_{CO2} if the 20% target was reached (see Figure 19) (Berghmans, 2012; Curien & Lewis, 2012).

With around 500 Mt_{CO2}, which corresponds to 10% of the 5 Gt_{CO2} emission reduction target envisaged by the Climate & Energy Package, the EED’s impact on the carbon price would be less pronounced than the one of achieving the renewables target (2 Gt_{CO2} corresponding to 40% of the reduction target). Yet it should not be underestimated (Berghmans, 2012). In its impact assessment of the EED, the Commission projected carbon prices of EUR 14.2/t in 2020 (compared to EUR 16.5/t when only the emission and renewables targets are reached) or even a drop to zero (EC, 2011c).

[19] Estimates of the Deutsche Bank project 201 Mt additionally banked allowances if the EED decreases ETS emissions (Curien & Lewis, 2012).

Figure 19: EED annual reduction impact on CO_2 emissions across the ETS scope



Source: (Berghmans, 2012)

The carbon price is not the only indicator possibly affected by energy efficiency measures. The decrease of electricity demand could feed back on the composition of electricity prices. Already without energy efficiency measures, the ETS reduces electricity demand, as a result of higher (retail) electricity prices due to the carbon mark-up (Sorrell et al., 2009). Additional administrative or transaction costs of the energy efficiency measures resulting from the EED might further raise the electricity price.

Interactions regarding electricity prices are also reflected in the distribution of costs and benefits between different industries. However, this can only be presented in a very simplified way. Generally, energy efficiency equipment producers profit both from the ETS (due to a higher retail electricity price) and from the energy efficiency measures. Electricity producers with high CO_2 emissions lose under both policies. Mostly because their gains from higher wholesale electricity prices, subjected to a carbon price only approach lowered by energy efficiency measures, are outweighed by the two policies' costs (Sorrell et al., 2009). Low CO_2 emitters win somewhat less when the ETS and energy efficiency measures are both in place, but their gains from higher wholesale electricity prices (which are less high with energy efficiency measures) are still likely to surpass the costs of the two policies. In case of a very strong commitment to energy efficiency, it might even be the case that, depending on demand, merit order, and other policies, efficiency measures could crowd out low-emitting low-carbon generation while putting high CO_2 emitters on the margin and hence amplifying the ETS impact. However, other effects on (marginal) producers may be more pronounced in the long run, "e.g. new plants brought to the market" (NERA, 2012).

A specific feature of the ETS is that, unless market failures exist, it achieves the reduction target at least cost. It is assumed that additional energy efficiency measures are not the same as the measures incentivised by the ETS, otherwise they would be obsolete. Overall compliance costs principally increase when both policies are in place (NERA, 2012). However, according to the Commission's impact assessment of the EED, the overall increase is limited. It estimates that "[a]dditional costs to the total energy system rise by between 2.6% and 4.7% compared to the [PRIMES 20% emission and renewables] reference scenario" (EC, 2011c).

Finally, the EED could affect low-cost emission reduction solutions outside the ETS, which are envisaged, for instance, by the idea of community projects under article 24a of the ETS Directive.

In reducing energy demand not only inside but also outside the ETS, the EED reduces the need for certain community projects, i.e. the ones that overlap with the coverage of the EED. While there would be a smaller incentive to further lower emissions in non-ETS sectors covered by the EED, in which energy efficiency measures would have already lead to reduced emissions, the incentive for community projects in non-ETS sectors not covered by the EED would persist. An overall reduced incentive for community projects would leave the carbon price closer to the level resulting from the cap. In the extreme case, this means that if no community projects were to be put in place, no additional allowances would be issued and enter the ETS. This mechanism remains theoretical since community projects do currently not exist.

3.3.2. EU policies: Effects of the EU ETS and the carbon price on energy efficiency measures

So far, this chapter has mainly dealt with the impacts/interactions of the energy efficiency measures and the EED on the ETS, however, there are also impacts in the opposite direction, i.e. of the ETS and the carbon price on energy efficiency measures.

The emphasis of this interaction lies on the electricity sector as the main point of overlap between the two policies. As pointed out in the previous section, the ETS carbon mark-up results in a higher wholesale and thus also in somewhat higher retail electricity price. Higher retail electricity prices in turn present an incentive for efficiency investments at the level of the end-user. It is generally acknowledged that such incentives are often weak, but nevertheless increase with the carbon price (Sorrell et al., 2009; Gaudioso, 2007).

In fact, it has been observed by Boland and Duquesnoy (2012) that amongst the many barriers for energy efficiency investments, carbon costs ranked amongst the least important stated by 982 companies surveyed from Forbes Global 2000. At the same time, for most energy intensive industries energy efficiency is considered as a core business activity and is a large component of the operational budget. In these cases, companies pursue energy efficiency projects for purely financial reasons focusing on specific goals to reduce energy usage per specific unit of output or product (Boland and Duquesnoy, 2012).

The EED does not impose binding measures to solve the issue of under-investment in the private sector, however Article 20(1) of the directive states that “Member States shall facilitate the establishment of financing facilities, or use of existing ones, for energy efficiency improvement measures to maximize the benefits of multiple streams of financing”. It also encourages Member States to set up National Energy Efficiency Funds or use ETS auctioning revenues for the financing of energy efficiency projects (Article 20(7) of the Directive). On the other hand, Directive 2009/29/EC on how to improve and extend the greenhouse gas emission allowance trading scheme, states that at least 50% of the ETS auctioning revenues should be used, among various options, for reducing GHG emissions, promote renewable energy and energy efficiency measures and sustainable transport. This option is in line with the “polluter pays principle”, whereby the polluter is required to pay for the negative externalities caused by pollution. To solve the issue of financing of energy efficiency measures, and if the private sector is indeed under-investing in energy efficiency projects, European Member States could allocate a fixed amount of ETS revenues to the deployment of energy efficiency projects or to create National Energy Efficiency Funds, like the EED suggests. The European Commission estimated that ETS revenue could amount to roughly EUR 20 billion per year (EC, 2011a), which could provide an interesting source of financing for energy efficiency measures to be implemented in the context of the EED.

Nevertheless, these estimates are based on the assumption of a carbon price of EUR 30 per ton_{CO2}. Since average price is currently much lower these estimates are considered too optimistic (Enting and Reich, 2012).

Currently, most Member States have not yet specified how the auctioning revenues will be used. However, Germany has earmarked 100% of ETS revenues for climate change and adaptation measures. German ETS auctioning revenues will be deposited into a "Special Energy and Climate Fund", which will serve the purpose of financing various environmental and energy efficiency policies (Germanwatch, 2012). For what concerns specific energy efficiency measures, the French government has announced only very recently that all the proceeds from ETS auctioning will finance the renovation of at least 500 000 homes per year, with scope to achieve the EU energy efficiency objectives (French Government, 2012). Specific details of how this will be implemented are not yet available.

More generally, if the ETS Directive and the EED work in parallel, the incentive to invest in energy efficiency measures increases, although the retail electricity price is subject to ambivalent pressures. On the one hand, it is under upward pressure by the ETS via the wholesale electricity price and by the administrative as well as transaction costs of the energy efficiency measures. On the other hand, the energy efficiency measures also reduce the wholesale electricity price due to lower demand, thus exerting a downward pressure on the retail price. In sum, the carbon mark up, the level of ambition of the energy efficiency target and the respective costs of the measures determine the size of the incentive for energy efficiency measures. On the whole, the incentive to invest in energy efficiency is higher when both the ETS and the measures foreseen by the EED are in place. The downside is that the GHG gas reductions might less likely be achieved at least cost.

3.3.3. Other EU and international policies

Beside the EED, a number of other policies influence ETS demand and therefore price. Since examples have already been elaborated in chapter 1 this section points out the potential negative interactions only. Similar to the EED, policies reducing electricity demand affect the ETS carbon price, in principle. However, the extent may be very limited if electricity-related impacts represent only a small share of a certain policy's coverage. This is true, for example, for the Ecodesign Directive or for the Energy Performance of Buildings Directive.

More importantly, there are policies at the EU and the international level, which are not oriented at climate change, but nonetheless affect ETS demand. Consequently, these policies indirectly promote GHG emissions reductions, thereby reducing allowance demand. At EU level, the emission standards set by the Large Combustion Plant Directive, while geared at pollutants and not greenhouse gases, "will [still] drive more than 30 GW of coal and oil plants to retire by 2015, and will thereby drive indirectly large carbon emission reductions" (Roques, 2012). This would leave EUAs unused and hence reduce their price.

At the global level, greenhouse gases could be reduced 'through the back door'. Burning fossil fuels and mainly coal, for instance, not only emits CO_2, but is also the largest source of mercury emissions (Pazyna et al., 2006). In the dawn of a global legally-binding agreement on mercury, which is supposed to be concluded in 2013, repercussions on the European allowance market are to be anticipated (United Nations Environment Programme, 2012).

3.3.4. Member State policies

As already elaborated in chapter 1, there are a number of Member State policies in place that are either oriented at emission reduction or energy efficiency. Some general conclusions can be drawn.

The extent to which Member State policies have an impact on the ETS or interact with it depends on the sector in which they are applied. The more they cover the scope of the ETS or cause a switch from non-ETS to ETS sectors, the more they affect the demand/supply balance of the ETS. Member State policies can be distinguished according to their objective: Geared at emission reductions, e.g. by means of a carbon tax, they have an endogenous impact on the ETS when operating in its realm or causing a switch to its sectors. Since the price floor and the option contracts in the UK already cover ETS sectors, they constitute a negative example in this regard (see chapter 1 and section 3.2.4). While the tax systems in Sweden and Norway (see section 1.3.2) are rather complementary in principle, they may cause a sector switch, such as from fossil fuel to electric vehicles, and then impact on the ETS.

If Member State policies are oriented at energy efficiency, as it is the case for the TWC schemes in Italy, the UK, and France (see section 1.3.1), the reduction of energy demand represents the main issue. The consequences of this indirect interaction with the ETS, i.e. mostly again a lower carbon price, have been explained in detail against the backdrop of the EED (see section 3.3.1). As for the impacts, the extent to which interactions negatively affect the ETS depends on their scope, with more significant outcomes if ETS sectors are covered. Consequently, comprehensive TWC schemes, also covering electricity distributors (e.g. Italian case), should be expected to lower the ETS carbon price more than TWC schemes only covering the residential sector (e.g. British case) or mainly promoting thermal and energy efficiency measures in buildings (e.g. French case). In sum, exact impacts and interactions differ, depending on the design of the respective Member State policy. The degree of overlap with ETS sectors represents the key factor in this regard.

4. Conclusions and recommendations on the design of policy instruments, in particular the ETS system

4.1. Interactions between EED and ETS

This briefing provides five main conclusions.

First, the current low EUA price reflects market participants' perception of regulators' willingness to adopt measures that are additional, either to the activities covered by the ETS or that impact the ETS sectors. Because the ETS is an entirely government made market, price developments very strongly reflect market participants' expectations about regulators to intervene rather than what actually happens. This may explain the fact that following the EED adoption, the ETS allowance price fell by 20%.

Second, in contrast, the EUA price is only to a limited extent owed to actual or potential interactions between the EED and the ETS Directive. The EED will be one of the many contributors to reduce demand for EU allowances (EUAs). The available estimates project a EUA demand reduction of a bit less than 500 Mt CO_2eq. However, this is considerably less than the impact of access to international credits – i.e. an impact due to ETS-inherent parameters (see the 4th point below) – or let alone the impact of the recession (see the 5th point below) on the EUA demand reduction. As for two exceptions to the 'limited' impacts of the regulatory interactions, see Box 4.1.

Third, a large number of interactions exist between many different policies (see Chapter 3). The EU ETS covers around 40% of GHG emissions in the EU, although increasing somewhat until 2020. EU and Member State policies directed at energy efficiency such as the EED, Eco-design or Energy Performance of Buildings Directive in principle aim at the other 60% of EU emissions, i.e. the 'effort sharing' sectors. Hence, the interactions between the ETS and energy efficiency measures are limited. There are important interactions with the EU Renewables Directive and most important, the economic cycle. Member states' policies such as national CO_2 taxes (e.g. Sweden and Norway) or the proposed UK ETS price floor generally have a very limited impact on EUA demand or supply, mainly because of the limited quantitative impact. They may however blur the European-wide carbon price signal and increase costs of domestic industries compared to their other European competitors. The policies in question include not only energy efficiency policies of the EU and member states – as discussed in this Briefing Paper – but also non-climate policies at EU or international level. The most prominent examples for non-climate policies have been the Large Combustion Plant Directive and the potentially forthcoming UN Mercury Convention. Their impact is, however, smaller than the one from the international credits (see the 4th point below) and the economic crisis (see the 5th point below).

Fourth, the EUA supply and demand, however, have been more affected by ETS-inherent parameters (see Box 4.2) than by non-ETS policies and measures: such parameters include access to international credits from CDM and JI projects under the Kyoto Protocol (see 3.2.1), and the suspension of inclusion of international aviation and potentially, the implementation of Community projects under Article 24a of the ETS Directive.

Fifth and lastly, since predictability about impacts of regulatory interactions is limited, there is a strong need for 'risk management' and adjustment on the supply side of EUAs. The EC (2012c) has estimated this structural surplus throughout the Phase 3 of the ETS (2013-2020) to be around 2 billion tonnes of EUAs. To predict or even project these multiple interactions seems next to impossible, even though predictability somewhat increases the more EU policies on renewables and energy efficiency are harmonised across the EU and legally binding. Because the cap of the ETS is fixed over the very long-term, there is no flexibility to adjust supply unless the ETS Directive is changed. This lack of flexibility on the side of the ETS makes it impossible to respond to situations that are outside the boundaries of the ETS such as the economic crisis/ the recession following the banking crisis[20] or even – as aviation shows – only partly within the parameters of the EU ETS design. This gives support to the idea of having some sort of adjustment mechanism directed at supply, able to deal with changes in demand, be they the result of the economic cycle, impacts of ETS design or policy interaction.

Box 4.1: Exceptions to the limited impacts of the regulatory interactions

1. *The interactions with electricity prices*. EU energy efficiency legislation such as the Directives on Energy Efficiency, Ecodesign or Energy Performance of Buildings have an impact on the composition of electricity prices or on distribution between different groups of consumers or industries. They interact with the ETS because they reduce fossil-fuel based power demand and therefore EUA demand.
2. *The EED coverage overlaps with the EU ETS sectors.* The ETS and EE Directives pursue different objectives: one aims at reducing GHG emissions and the other at energy consumption. As long as the supplied energy is based on fossil fuels, reductions of energy consumption will also reduce carbon emissions. The overlap could emerge, for example in the following examples of activities:
   a. Energy savings that will result from the EED will reduce demand for EU allowances in ETS sector (see also section 3.3). By extension, this has a dampening effect on EUA prices. To which extent depends both on the market fundamentals and the market expectations. The latter is particularly important in the EU ETS as opposed to other markets as it is a market created by governments. As a result, the market tends to react very strongly on actual or perceived government policy changes. This is why the EUA price fell 20% after the EED was adopted.
   b. Covering the same activities by two instruments can amount to double regulation, thereby blurring the carbon market signal. This therefore makes the achievement of GHG emissions reductions more costly than they would otherwise be. Whilst under the ETS, firms can optimise their investment over the longer term – they have a choice between investing and buying allowances – under the EED they are forced to apply technological solutions to comply with the regulation. This may be in conflict with the optimising investment over the longer term.
   c. On the other hand, introducing an additional layer of regulation such as the EED on top of the ETS can and has been justified on grounds of market failures, i.e. the market fails to create incentives for energy efficiency measures that have a short pay-back period. Those arguing against double regulation hold that as long as the carbon price is high enough, market failures will be overcome, i.e. there is always a EUA price that is able to overcome the market failure. Hence, there is no need for additional regulation such as in the EED. Those arguing for additional regulation argue that 'realistically' the EUA price would not reach the levels needed to overcome the market failures. Hence, important reduction potentials are not addressed. In return, this would make achievement of longer-term targets more expensive. As this question cannot – or not entirely – be settled by (quantitative) analysis, it remains an issue of political decision. By adopting the EED, the EU has taken this decision.

[20] This has led to a dramatic demand reduction for EUAs in comparison to what has been expected when the ETS was revised in 2008.

Box 4.2: EU ETS-inherent parameters

Other large supply of EUAs coming into the ETS in 2012-13 that has been within the parameters of the ETS includes:

- Early auctioning that was introduced at the request of industry to meet hedging needs,
- Member States' New Entrants' Reserves (NER) that will likely be auctioned at least by some Member States,
- The NER 300, describing the EU allowances destined for auctioning by the European Investment Bank with the proceeds to be used to accelerate the introduction of innovative renewable energy technologies and investments in Carbon Capture & Storage (CCS),
- Some CERs (from industrial gases) will come in large quantities, as their eligibility the EU ETS comes to an end in April 2013,
- The suspension of inclusion of aviation to the ETS.

Additional supply from within the parameters of the ETS could theoretically also come from the Community-level projects, a type of intra-EU Joint Implementation that has been introduced in Article 24a of the revised ETS Directive.

4.2. What policy actions should be undertaken on the short and long run?

Numerous options have been proposed and discussed in the literature and in policy circles on how to address the current ETS challenges. The European Commission formally proposed to 'backload' the auctioning of EU Allowances (EUAs), i.e. to stagger the release of large numbers of EUAs to address the 'temporary' market imbalance, on 25 July 2012 (EC, 2012e). This would mean that fewer EUAs are released initially and a larger number would be released at a later date towards the end of the trading period in 2020. At the same time, the European Commission initiated a discussion on the need for 'structural' measures, in particular to address the root cause of the current imbalance in its Carbon Market Report from October 2012 (EC, 2012c).

The options can be distinguished into one-off re-setting and longer-term structural measures. The choice between the two depends on whether one assumes that the current 'market imbalance' is the result of a unique situation that is unlikely to happen again or whether such imbalances might occur again in the future. This Briefing Paper takes the view that although the current imbalance is due primarily to the recession, future imbalances, not at least because of the pervasive interactions between policies cannot be ruled out. Others hold that the depth of the recession was unique and the ETS is able to cope with the other influences that have been analysed in this Briefing Paper.

4.2.1. Short-run options

In the perspective of the interactions between EED and ETS, two short-term options are possible.

The first option is to adapt the EED in such a way that it avoids the overlap of coverage of the EED in the ETS sectors. That way, the two instruments would cover entirely separate sectors. The remaining interactions would be confined to the – relatively limited – interactions in the power markets, i.e. on composition of power prices and distributional effects. Politically, this does not seem to be a very likely option, given that the EED in its existing is brand new, having been adopted as recently as 2012.

This leaves back-loading as the only short-term option on the table. It is a one-off re-setting measure that can be put in place rapidly, i.e. without revising the ETS Directive, to allow the large incoming supply and existing oversupply in the market to be absorbed in an orderly fashion.

If it is to be an effective tool, it should have a number of characteristics (Marcu, 2012).

- First, it should be designed and put in a framework that will guarantee good market functioning;
- It should be significant and forceful to ensure a strong political and economic signal.
- Communication musty be clear and unambiguous;
- A significant time lag between when the set-aside takes place and when the volumes may be returned to the market;
- The volume of back loading should be largest in 2013 as a result of the additional supply that comes into the market;
- If implemented on its own, back loading will in the future likely lead to the need for further one-off interventions, which risks making the ETS subject to political interference.

4.2.2. Long run options proposed by the European Commission

In its Carbon Market Report, the European Commission (EC, 2012c) has proposed a number of options to be considered as long-run structural measures (see chapter 1.1.1). They all would require a revision of the ETS Directive.

Set-aside – retiring a number of EUAs in Phase 3

The set-aside also constitutes a one-off supply-side measure, removing from the current allowance surplus around 1 billion or more allowances from the auctions in Phase 3 (2013-20), to i) restore a price signal; and ii) in doing so to raise revenues envisaged for climate finance in support for international mitigation action. This would however require a review of the EU ETS.

In order to avoid another (ad-hoc) intervention that risks undermining confidence in the market, the set-aside should be combined with either long-term (beyond 2020) tightening of the emissions reduction trajectory, i.e. a 2030 GHG emissions reduction target, or with new ETS design provisions that may have – depending on the exact details – more direct impact on stabilising carbon prices, or both.

The set-aside could be designed in such a way that energy efficiency improvements mandated by the EED could be counted in. This could mean, for example, that the exact level of the reduced demand of EUAs resulting from the EED would be set aside in addition to any other volume that is to be set aside as a result of the recession or other policies. In principle this would be relatively easy to implement. A principal question would be whether the figure of the EUA demand reduction could be accurately calculated ex ante. In addition, such a solution would not do away with the risk of double regulation of the ETS sector, once by the ETS and once by EED.

Revision of the annual linear reduction factor

The current linear reduction factor, 1.74% annual reduction from 2013 onwards is not in line with the EU's 2050 long-term climate change target of 80-95% GHG emission reductions compared to 1990. According to the European Commission 2050 Low-carbon Roadmap (EC, 2011b) consistency would require power sector emissions by 2050 to be at 93-99% below 1990 levels and industry emissions should be down by 83-87%, if only to achieve the lower end of the full EU ambition at -79% to 82%. To bring the current linear reduction factor in line with the EU 2050 target, the rate of 1.74% annual reduction may be revised from 2020. Suggested rates range from 2.5% for the decarbonisation of the power sector to 2.25% as proposed by the European Parliament Environment Committee in the context of the EED. Analysis (Öko-Institut 2012) suggests that at 2.25% without additional measures, the effect on the price in 2013 would be very low and only slightly higher in 2020.

One of the measures suggested in line with the revision of the linear reduction factor from 2020 is an increase of EU 2020 reduction target from 20% to 30%. Whilst this is politically uncertain at best and therefore does not appear to have a chance of being implemented in the short-term, it is most likely not compatible with the objective of providing predictability and regulatory stability to the market. By the time such a decision to move to 30% would to be implemented, most of the investment decisions up to 2020 are most likely already taken.

It would also not address the issue of ETS oversupply. The set-aside would be a better solution.

A legally binding unilateral 2030 reduction target

Another proposal is to set a legally binding 2030 absolute reduction commitment – as has been done for 2020 – in line with the EU's 2050 GHG emissions reduction objective. Such a move would over the longer term provide more credibility to this objective, and would eventually also require the adjustment of the EU ETS cap. The additional advantage of a 2030 target is the extended time-frame for new investments and subsequent reductions of compliance costs, and its versatility in combination with other options such as rolling emission caps.

However, a 2030 target would not address the oversupply of EUAs, which for example the set-aside does (e.g. Grubb 2012, IETA 2012, Öko-Institut 2012).

Discretionary price management mechanisms

Since it is difficult to project the impact of interactions between the ETS, EED and the other policies that have been described, some argue for some sort of adjustment mechanism, which are able to deal with changes in demand for EUAs, i.e. arrest supply fluctuations ex-post. The European Commission (EC, 2012b) has included this option in the Carbon Market Report (EC, 2012c).

Several ideas include more permanent dynamic adjustment provisions (e.g. price floors, option contracts and rolling emissions caps):

- Price floors: Minimum prices for allowances can be established. In the current debate on the EU ETS, there are two approaches: an EU-wide auction reserve price and unilateral member state price floors such as those in the UK.
- Auction reserve: The auction reserve price proposal suggests setting a minimum reserve price below which EUAs are not auctioned.

- Option contracts: Options contracts describe the establishment of bilateral option contracts between public institutions and investors in low-carbon solutions. The public institutions would guarantee a certain carbon price to an investor through such a contract. In case the realised carbon price is below the guaranteed price, the public institution (the option writer) would pay the difference to the investor (the option holder).

Whilst these instruments all have in common that they would address current low prices via supply, they also constitute elements of discretionary price management mechanisms, leading to a somewhat more 'political' price. This would lead to lobbying from different stakeholders and possibly to political interference at the time the price floor is set or reviewed. Around these periods, discussion on the ETS would become highly political, raising issues of the credibility of the long-term price. There is also a major question of whether the EU could agree on the level of a floor price. Another problem with a price floor in the EU ETS is the considerable complexity it would create for linking with other cap-and-trade systems. The recent agreement for removal of price floors in the Australian ETS in order to link with the EU ETS is a point in time

Theoretically, options contracts could be written at EU level. Politically, this seems unlikely as it would require a consensus. Hence, there is a risk that option contracts in the same way as member states price floors will undermine the EU-wide carbon price signal.

The principal question is however whether the continued existence of a reserve price would be more credible to investors than the current system. What is a 'fair' reserve price on which stakeholders and member states could agree, and why should a pre-agreed level be preferred to the market's assessment? Introducing an auction reserve price may also put downward pressure on future price expectations and it would keep prices at or close to the level of the reserve price for longer than otherwise would be the case.

Extension of the scope of the EU ETS to other sectors (i.e. non-ETS sectors)

The EC (2012c) as well as the Polish government have suggested that coverage of the EU ETS could be expanded to other energy-related CO_2 emissions in non-ETS sectors by, for instance, transport. The merits, as the Commission argues, are that i) it is possible to target sectors, which are less affected by economic cycles in terms of their emissions, ii) this is in line with potential energy system changes, iii) this contributes to the expansion of the EU ETS, and iv) therefore enables the EU to raise the overall ambition level if the caps for the additional sectors are stringent enough. This option, however, will – at least in case of sectors covered by the EED – have a direct impact on the implementation of the EED and raise operational questions regarding the reporting and surrendering obligations. Limiting access to international credits

The European Commission (2012b) also explores an option to develop a regulatory framework to allow no or a much more limited access to international credits at the start of Phase 4. If a strong price signal is restored and sustained, additional flexibility regarding the access to international credits could be considered. The merit, as the Commission argues, is that it will create more certainty about potential rewards for investment in mitigation measures in Europe and could spur indigenous investments in low carbon technologies.

A disadvantage is that there will most likely be international reactions to such a unilateral move. It is also likely to be in opposition to the EU's ambition of expanding carbon markets worldwide. Finally, it should not be forgotten, that carbon credits are a safety valve for the case that carbon price rises to very high levels.

It has been proposed to discount credits, e.g. mandating 2 international credits for an EUA. Such discounting however would reduce the attractiveness of the ETS for those countries that generate them. It would also require a harmonised approach across linked ETS. Finally, discounting could undermine the safety valve function, was it ever needed.

4.2.3. Other options

Stakeholders have proposed additional long-run measures, which also require a revision of the ETS Directive. For a review see Egenhofer et al (2012). The most relevant for this briefing is the rolling emissions cap, which could deal with interactions ex-post. It is implemented in Australia and the UK.

For example, the Australian ETS now being introduced is built upon a fixed 5-year emissions cap, which is annually updated 5 years in advance for each subsequent year, but is always consistent with a longer-term reduction target already fixed by the Parliament. As there is little experience to date, it remains to be seen how well this approach will balance the competing demands of long-term visibility and medium-term flexibility. For the EU the rolling caps approach raises significant issues of governance. Nevertheless, the central idea of a five year forward rolling target could be discussed by the EU, and could be a way to address the issues with the linear reduction factor mentioned in the sections above.

4.3. One or several GHG-related targets and instruments?

The EU's Energy and Climate Package had agreed on three headline targets, on GHG emissions, renewable energies and energy efficiency. As this briefing and other papers have shown, the three targets lead to overlapping and sometime conflicting policies. It has been suggested to replace the set of three with one single target, e.g. on GHG emissions. Whether this will address the issue of interactions and overlap can be doubted. The targets as such are not the problem, policies are. Even without EU-wide targets on energy efficiency or renewables, policies to address energy efficiency and renewables will continue either at EU or Member State level. While without EU wide targets, the ambition might be lower and therefore interactions reduced as well, they will nevertheless continue. Moreover as this briefing has shown, there are additional interactions with the ETS – typically impacting on demand – through non-climate policies at EU, Member State or international level as well as through policies directed at the effort-sharing sector. Since interactions will always exist and cannot be projected, this briefing suggests assessing the possibility to create some sort of 'adjustment mechanism' that addresses the currently inflexible ETS supply side. Precondition would be that this mechanism to address supply/demand imbalances works in a predefined and predictable manner, not at least to ensure predictability and regulatory stability, a precondition for any market to function.

One obvious solution for such an adjustment mechanism would be translating EE in reductions of GHG emissions by introducing conversion factors. The complication is, – as shown in chapter 2 – that the actual relationship between energy efficiency and GHG emission reductions depends on the carbon intensity of the energy that is displaced. This will vary between member states, sectors and even processes. Most likely, this would require a very complicated benchmarking process as has been done for the allocation of allowances within the ETs industrial sector. A somewhat more practical approach would be to calculate the potential of GHG emissions reductions due to the EED ex ante. This could be done in the context of the Impact Assessment of new legislation to be proposed by the Commission in the future.

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