FACULTY OF BUSINESS AND ECONOMICS

KATHOLIEKE
UNIVERSITEIT
LEUVEN

THE EUROPEAN UNION EMISSIONS TRADING SCHEME
AND
THE IMPLICATIONS FOR INDUSTRIAL COMPETITIVENESS IN BELGIUM

DEMANDT PIETER

Thesis submitted to obtain
the degree of Master in
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Promotor: Prof. Dr. C. CROMBEZ

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In order to reduce its greenhouse gas emissions in an economical manner, the European Union introduced the European Union Emissions Trading Scheme (EU ETS) in 2005. Many companies feared that this would negatively influence their global competitiveness. Furthermore, the EU decided in 2008 to reduce its CO_2 emissions by 20% by 2020. Their main instrument in reaching this objective will be the EU ETS. This master thesis provides an overview of the struggle against climate change during the 20^{th} century, herafter it gives a detailed summary of the introduction, functioning and future developments of the trading scheme. Finally, it investigates the consequences of the introduction of this EU ETS on the competitiveness of four major emitting industries in Belgium.

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Table of contents

General Introduction

In January, 2005 the European Union introduced the European Union Emissions Trading Scheme (EU ETS) as its major instrument in tackling climate change. Many industries covered by the EU ETS feared that this scheme would have a negative effect on their profitability and their competitiveness if companies in other industrialized nations would not face such stringent environmental legislation. But there were also other reasons for this anxiety. Different rules regarding credit usage and auctioning of allowances could lead to a distortion of the European market. In this thesis it will be investigated what the effect of this introduction has been over the past few years for the most emitting industries in Belgium.

Chapter one will deal with the EU ETS in general and is divided into five subchapters. First, we will discuss the growing awareness about climate change and the most important steps taken during the 20th century to fight it – i.e. the Montreal Protocol, the establishment of the Intergovernmental Panel on Climate Change (IPCC) and finally the Kyoto Protocol. Hereafter the legislative history of the establishment of the EU ETS will be described. Thirdly, we will elaborate on the functioning of the scheme by discussing the emission allowances, the linking directive, the national allocation plans and the different phases of the scheme. Then, we will enumerate some adjustments to the EU ETS and consider some possible developments for a post-Kyoto agreement by describing the stances of four other major emitting nations – i.e. the US, Russia, China and India. Finally, we will evaluate the EU ETS by mentioning its achievements and benefits, as well as its shortcomings and disadvantages.

The aim of this chapter is to provide the reader with an understanding of the subject of climate change and its consequences, in order for him to comprehend the aim and purpose of the EU ETS. Furthermore, this chapter will give the reader a detailed summary of the functioning of the EU ETS and its possible future developments.

After this brief overview of the problem of climate change and introduction to the EU ETS, chapter two will investigate the impact on the competitiveness of industries in

Belgium. First, we will describe which factors determine a sector's inherent exposure to the EU ETS. Then we will investigate these factors in detail for the four most emitting industries covered by the EU ETS in Belgium – i.e. the electricity producing industry, the steel industry, the cement industry and the petrochemical industry. For each of them, we will introduce the sector and demonstrate its dimension and importance to Belgium. We will also give some possible abatement opportunities for companies in each industry and mention some recent activities regarding the EU ETS. For the electriticy producing sector in particular, we have conducted a case-study to look at the impact of the EU ETS on a company level and to compare this information to our earlier theoretical findings. Main source for this case-study was an interview with the Senior Advisor European Affairs of Electrabel. The choice for this company and industry was a clear one. Electrabel is not only the largest electricity generating company in Belgium; it is also an important subsidiary of GDF-Suez - the French world-wide energy giant - since 2007. The industry was chosen because of its influence on other industries, as electricity represents a considerable cost to all companies, and because it represents the largest share of CO_2 emissions of all sectors covered by the EU ETS.

The aim of the second chapter is to present the reader an assessment of the consequences of the EU ETS on the competitive positions of the largest CO_2 emitting industries in Belgium, on a global, as well as on a European scale.

At the end of this thesis, a glossary has been added to explain certain terms and abbreviations.

Chapter 1: The European Union Emissions Trading Scheme

The European Union Emissions Trading Scheme (EU ETS) is the largest multinational 'cap-and-trade' system for trading in emissions of carbon dioxide (CO_2) and other greenhouse gases in the world. This chapter will provide a detailed overview of the system and explain why it has become the driving force behind the expanding global carbon market. First, we will describe the origin of the EU ETS in a chronological order. Next, the establishment of the EU ETS will be discussed. Then, we will clarify the functioning of the EU ETS. Hereafter, some possible developments for the EU ETS will be considered together with some likely agreements for a Post-Kyoto Protocol. Finally, we will evaluate the EU ETS up till now.

1.1 The Origin of the EU ETS

In this paragraph, we will give an overview of the understanding of climate change and measures taken to prevent it during the 20^{th} century. In the next paragraph, we will describe the Kyoto Protocol.

1.1.1 Climate Change

During the last decades, a great deal has been written on the subject of climate change. The first author to make the connection between carbon dioxide concentrations and temperature, however, was the Swedish scientist Svante Arrhenius (1896). He suggested that a doubling of the CO_2 concentration would lead to a 5°C temperature rise. This is a remarkably accurate figure, as the most recent estimations of the Intergovernmental Panel on Climate Change (IPCC) are a likely increase between 2 and 4,5°C. But whereas Arrhenius thought it would take 3000 years for the CO_2 concentration to double, this is now expected to happen within the century. Arrhenius also realized that emissions from human industry could lead to a future global warming, even though he saw this as a positive evolution, it was an idea far ahead of its time and it would thus be neglected for many years to come.

Even though Arrhenius forecasted temperature increases that now seem highly precise, it would still take more than sixty years for an environmental awareness to arise in the Western world. The classical starting point of the current awakening to environmental problems is the publication of the book Silent Spring by Rachel Carson (1962). In this book Carson documents the harmful effects of synthetic chemical pesticides on the environment – particularly on birds, as the title refers to a year when no bird would sing anymore, because they had all died from pesticides passed through the food chain – and challenges the malpractices of the government, agricultural scientists and the chemical industry.

This awareness further increased after the publications by Crutzen (1970) and by Rowland & Molina (1974) on ozone depletion. As the ozone layer absorbs ultraviolet light from the sun, ozone layer depletion is generally expected to lead to health problems like skin cancer because too much ultraviolet light reaches the surface of the earth. Crutzen (1970) pointed out that nitrous oxide (N_2O) emitted by human activity could affect the amount of nitric oxide (NO) – a free radical that destroys ozone - in the stratosphere and he suggested that the increase in these gases could be explained by the increased usage of fertilizers. Four years later, and building on this work, Rowland & Molina (1974) suggested that also chlorofluorocarbons – more commonly known as CFCs – behave in the same way as nitrous oxide, i.e. they live long enough to reach the stratosphere, where they are dissociated by ultraviolet (UV) light and release chlorine (Cl) atoms that destroy ozone.[1]

In 1976, a few countries, including the United States, Canada, Norway, and Sweden, decided to eliminate the use of CFCs in aerosol spray cans. Even though worldwide production of CFCs fell sharply after this decision, progress slowed in subsequent years and by 1985 CFC production had returned nearly to its 1976 level. A first step towards a global legally binding agreement on CFC production was taken by the signing of the Vienna Convention by 20 nations and also the EU in 1985. This agreement founded a framework for negotiating international regulations on ozone-depleting substances. According to Morrisette (1989), three factors made it possible to reach a solution. First, there was an evolving scientific understanding of stratospheric ozone that made a

[1] In 1973, Stolarski & Cicerone had discovered that Cl has a higher ozone destruction efficiency than NO.

generally accepted consensus possible. Second, there was an increased public concern about the threat of skin cancer after the 1985 announcement that an Antarctic ozone hole was discovered, forcing politicians to take action. Third, acceptable substitutes for CFCs were becoming available in a near future. This global agreement was named the *Montreal Protocol on Substances that Deplete the Ozone Layer* and was designed to control and decrease the global production and use of CFCs. It was signed in 1987 by 46 countries and entered into force on January 1, 1989. At present 194 of 196 UN members have ratified the Montreal Protocol and the implementation has been very successful. Human produced ozone-depleting substances, like CFCs, are declining and as a consequence the ozone hole is also recovering. A statistically significant decrease of the area is expected to arise around 2024, whereas a full recovery to 1980 levels will occur around 2068 (Nash, Kawa, Montzka & Schauffler, 2006).[2] According to scientists (Velders et al, 2007), the reductions achieved by the Montreal Protocol have benefited the climate more than the reduction target set for the first commitment period (2008-2012) of the Kyoto Protocol, as the ozone-depleting substances are also greenhouse gases. But its impact will decrease, whereas the emissions reductions post-2012 will probably have much larger effects.

Only one year after the signing of the Montreal Protocol in 1987 the United Nations – by means of the WMO and the UNEP - established the *Intergovernmental Panel on Climate Change* (IPCC). It was installed to provide objective information about the complex and important issue of climate change, especially to policy-makers, and to deliver realistic response strategies. The IPCC was requested to prepare a report on all aspects relevant to climate change, based on the latest scientific, technical and socio-economic information. It would in this way present information that reflects the current consensus about the matter within the scientific community.

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[2] Although it is hard to forecast exactly when the ozone hole will recover, these dates are consistent with the dates used in the 2006 scientific assessment report, which is the most recent report of ten scientific assessments prepared by the world's leading experts in the atmospheric sciences. It was made under the auspices of the United Nations Environment Programme (UNEP) and of the World Meteorological Organization (WMO) and serves directly as input to the Montreal Protocol process.

The first IPCC Assessment Report of 1990 served as the scientific basis for negotiating the *United Nations Framework Convention on Climate Change* (UNFCCC), which was opened for signature at the Rio de Janeiro Summit in 1992 and entered into force in 1994. The UNFCCC provides the overall policy framework for dealing with climate change issues, but it originally set no mandatory limits on greenhouse gas emissions for individual nations and was therefore considered legally non-binding. The treaty did however include provisions for updates – which were called 'protocols' – that would set mandatory emission limits. The second IPCC Assessment Report of 1995 presented key input for the negotiations of the Kyoto Protocol in 1997. This is the principal update of the UNFCCC and will be discussed more extensively in the next chapter.

In 2006 the very influential 'Stern Review on the Economics of Climate Change' was released. Its main conclusion was that there is still time to tackle climate change, but that strong action has to be taken now, as the evidence on the subject is overwhelming. Lord Stern of Brentford estimated that the costs of climate change will be between 5 and 20% of global GDP each year, whereas the costs of action can be limited to around 1% of global GDP each year (Stern, 2006).

According to the latest Assessment Report (AR4) of the IPCC (IPCC, 2007), there are three certainties regarding climate change. The first certainty is that global warming exists and that it is unequivocal, as is observed from augmentations in global average air and ocean temperatures, rising global average sea level and widespread melting of snow and ice (Figure 1). Regarding temperature, studies have estimated that the total global average temperature increase between 1906 and 2005 amounts to 0,74°C, furthermore 11 of the last 12 years (1995-2006) can be found in the top twelve of warmest years since the beginning of instrumental recording of global surface temperature in 1850. Moreover, and as mentioned before, the IPCC expects temperature to rise between 2 and 4,5°C during the next century, compared to the levels of 1990.

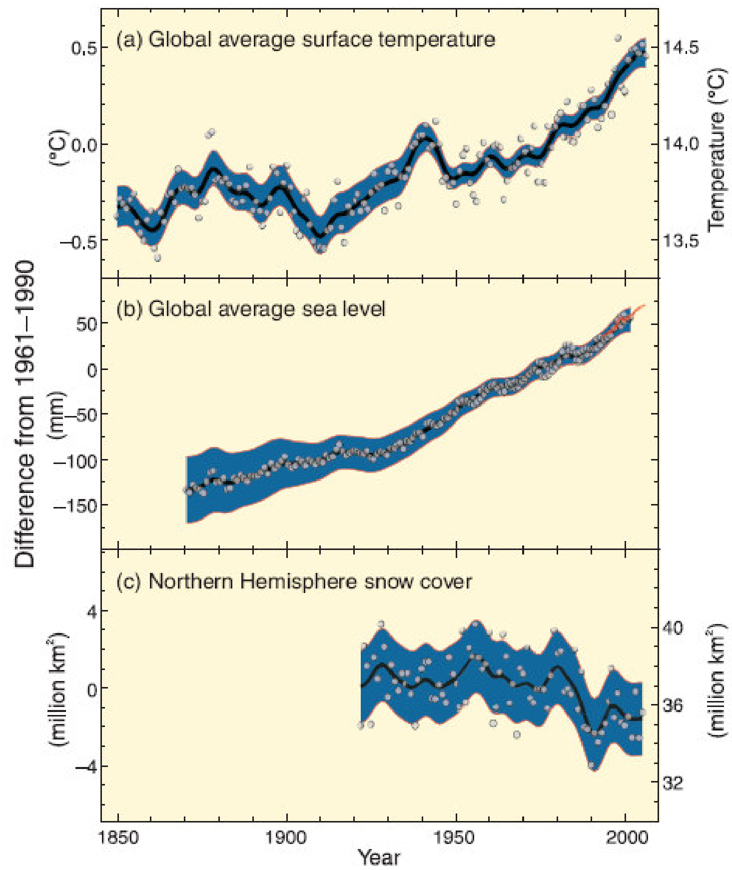

Figure 1: Changes in temperature, sea level and Northern Hemisphere snow cover (IPCC, 2007)

Closely linked to the increased global average temperatures is the rising sea level, because of melting glaciers, ice caps and polar ice sheets (the annual average Arctic sea ice extent has decreased by 2,7% per decade). According to Assessment Report 4, sea level has risen at an average rate of 1,8 mm/year since 1961 and at an even higher rate of 3,1 mm/year since 1993.

The second certainty is that human kind is causing this global warming and this with 'very high confidence' (i.e. a probability higher than 90%). Anthropogenic Global greenhouse gas (GHG) emissions have kept rising since pre-industrial times, with a sharp augmentation of 70% between 1970 and 2004. It is very likely that these increases in anthropogenic GHG concentrations are increasing global average temperatures since the mid-20th century. Of these GHGs, CO_2 is the most important one, as we can see in figure 2. CO_2 is a colorless, odourless gas that has always been present in the Earth's atmosphere, because it is used by plants during photosynthesis, but also emitted by volcanoes or geysers. The annual emissions of CO_2 even grew by 80% in that period. The atmospheric concentrations of CO_2 in 2005 (379ppm) by far exceeded the natural range over the last 650,000 years. This global increase is primarily caused by the combustion of fossil fuels and to a lesser extent by land-use change, like deforestation. Without new climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to increase over the next few decades. Possibly leading to an increase of global GHG emissions by 25 to 90% (CO_2-eq) between 2000 and 2030 (SRES, 2000), as fossil fuels will remain the dominant element in the global energy mix, causing further warming and very likely leading to changes in the global climate system larger than those observed during the 20th century. Even if GHG concentrations were to be stabilised, it would take centuries for anthropogenic warming and sea level rise to stop because of the time scales associated with climate processes and feedbacks. In figure 3, we can see the CO_2 emissions and equilibrium temperature increases for a range of stabilisation levels. According to Stern, the risks of the worst impacts of climate change can be considerably reduced if GHG levels in the atmosphere can be stabilised between 450 and 550 ppm CO_2 (Stern, 2006). Such a stabilisation could prevent global temperature from increasing to not more than 2°C above pre-industrial levels. A level seen as critical, as higher increases could imply abrupt climate changes (This is also the objective of the EU (European Commission, 2007).).

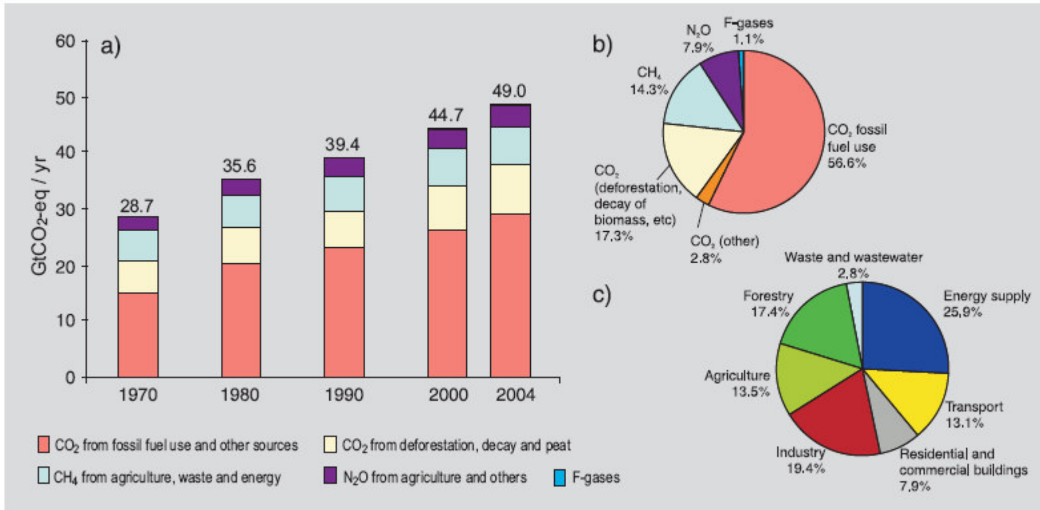

Figure 2: Global Anthropogenic GHG Emissions (IPCC, 2007)[3]

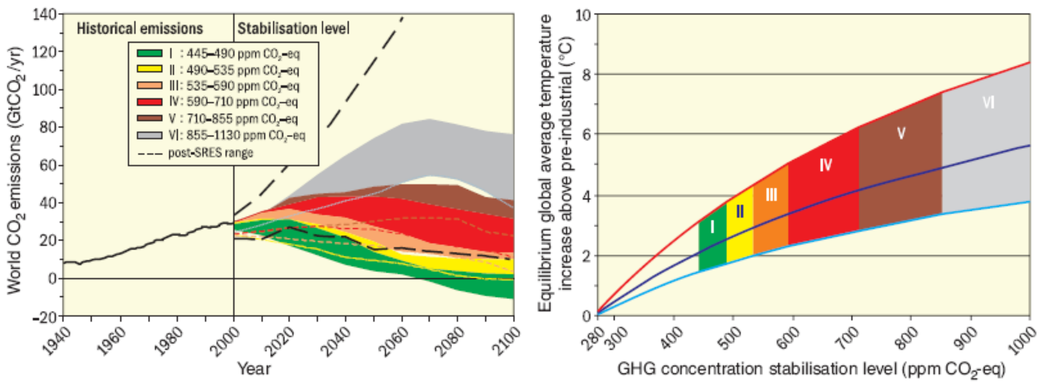

Figure 3: CO_2 emissions and equilibrium temperature increases for a range of stabilisation levels (IPCC, 2007)

Finally, the third certainty is that there will be very negative consequences for mankind. Among the most important ones are the following: Heat waves and extreme droughts, as well as tropical storms and hurricanes, are more likely to occur more frequent, possibly destabilizing food production and water resources in many parts of the world; tropical diseases will become more widely spread; heat-related mortality will increase

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[3] (a.) Global annual emissions of anthropogenic GHGS from 1970 to 2004. Includes only carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF_6). (b.) Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO_2-eq). (c.) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq. (Forestry includes deforestation.)

(McMichael, Woodruff & Hales, 2006); millions of species will become 'committed to extinction' (Thomas et al., 2004); due to the rising sea level, densely populated areas like the Nile Delta, the Netherlands and parts of Bangladesh could become uninhabitable, obliging hundreds of millions of people to migrate; a 'very likely' slow down of the meridional overturning circulation (MOC) of the Atlantic Ocean (although an abrupt transition is unlikely during the next century, persistent changes in the MOC could lead to changes in marine ecosystem productivity and ocean CO_2 uptake, the latter could then feed back on the climate system); etc.

It is unrealistic to believe that all regions and people will face the same impacts. There are large differences across regions and the appalling truth is that the poorest regions and populations will suffer earliest and most from climate change – which is by the largest part caused by the emissions of the strongest economies in the world. In Appendix I, a table showing examples of regional specific impacts associated with global average temperature changes is added. Groups such as the poor and elderly will not only face larger difficulties in less developed areas, but also in developed countries.

1.1.2 The Kyoto Protocol

We will now further elaborate upon the Kyoto Protocol. As mentioned above, the Kyoto Protocol, adopted in Kyoto, Japan, on December 11, 1997, is the main update of the UNFCCC, which only encouraged industrialized countries to stabilize GHG emissions. The Protocol, on the contrary, established legally binding targets for the reduction of four greenhouse gases (CO_2, methane, nitrous oxide and sulphur hexafluoride) and two groups of gases (hydrofluorocarbons and perfluorocarbons) for industrialized countries (the so-called 'Annex I' Nations), but also general commitments for all member states. The Protocol was opened for signature on March 16, 1998 and closed on March 15, 1999.

Although the United States (U.S.) is an initial signatory to the Kyoto Protocol, it has never ratified it, and thus making it non-binding for the nation with one of the highest per capita GHG emission levels. The reason for this is that the US Senate opposed signing the Protocol, because they feared it would "result in serious harm to the economy of the United States" when developing nations would not have to participate.

Anticipating this negative vote, the Clinton Administration never submitted the Protocol to the Senate for ratification.
The successor of President Clinton, George W. Bush also opposed submitting the Protocol for Senate ratification for the same reason. President Bush stirred up bad feelings when he additionally stated that there are too many uncertainties present in the climate change issue to ratify the Kyoto Protocol. He was thus neglecting the findings of the IPCCs first three Assessment Reports.

At the seventh Conference of the Parties (COP 7, 2001) of UNFCCC in Marrakesh in 2001, the detailed rules for the implementation of the Protocol were adopted. These are commonly known as the "Marrakesh Accords".

The Protocol would enter into force when two conditions would be fulfilled. The first condition was that not less than 55 parties would ratify the protocol. The second condition was that the total emissions of these parties would account for at least 55% of the total CO_2 emissions by 'Annex I countries' for 1990. The former was reached on May 23, 2002 when Iceland ratified the Protocol. The latter was reached after the Ratification by Russia on November 18, 2005. This made the Kyoto Protocol enter into force 90 days after the condition was fully reached. Russia agreed upon ratification after the European Union promised that it would support Russia's wish to join the World Trade Organization. Another motivation for Russia was the fact that 1990 – one year before the collapse of the Soviet Union - was taken as the reference year. That year the Soviet economy was still operating at full force and thus made it easier for Russia to reach their target. Another industrialized country that refused ratifying the protocol for many years, Australia, ratified it on December 3, 2007 after Prime Minister Rudd got elected.

In general, we can say that the Kyoto Protocol consists of three levels. The first one is the 'Cap'. The Protocol stipulates that during 2008-2012 global GHG emissions have to be reduced by 5,2% compared to 1990. Of course there are different targets for different countries. This is the second level, i.e. the 'distribution'. The European Union for example has to reduce total emissions by 8%[4], whereas Canada is obliged to reduce its emissions by 6%. Australia can even increase its national emissions by 8%. The third level is 'trade'. In essence there are three market-based mechanisms that are added to ensure efficient allocation and to offer countries additional means of meeting their emission targets. First there is emissions trading. Companies receive 'carbon credits' from their national government, this allows them to emit a certain amount of CO_2. If they have carbon credits left, they can resell them to companies or other groups that exceed their emission allowance. In theory, everyone will search for the cheapest way to reduce emissions, leading to a pollution reduction at the lowest possible cost to society. This is known as 'cap-and-trade' and works in accordance with the extensively studied 'Coase Theorem' (Coase, 1960). The second mechanism is known as the Clean Development Mechanism (CDM), it allows countries with an emissions-limitation commitment to finance an emission-reduction project in a developing country. For financing these projects, the countries can receive saleable 'Certified Emission Reduction' (CER) credits, equivalent to one tonne of CO_2. Since CDM became operational in the beginning of 2006, more than 1000 projects have been registered and the total amount of CERs is estimated to surpass 2.7 billion tonnes of CO_2-eq during the period 2008-2012. The third mechanism is known as Joint Implementation (JI), it allows an Annex I country to invest in an emission reduction project in any other Annex I country. Instead of CERs, they receive 'Emissions Reduction Credits' (ERCs) for these investments. In this way countries can invest in projects to reduce emissions in countries where reductions are cheaper to achieve. JI is another mechanism to increase flexibility and cost-efficiency for countries trying to achieve their targets, but also host Parties benefit from the foreign direct investment and the technology transfer.

As of 2008, 183 countries have ratified the Kyoto Protocol, but it also raised a lot of criticism during the last few years. The opponents of the Protocol believe that the reductions are not sufficient to curb global warming, that there are no plans for the post-2012 period (Nordhaus, 2001) and that it is a "flawed agreement that manages to be

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[4] This is the commitment of the EU-15. The 12 new member states of the EU (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia since 2004 and Romania and Bulgaria since 2007) have their own reduction targets of 6% or 8%, except for Malta and Cyprus which have no targets.

both economically inefficient and politically impractical" (McKibbin & Wilcoxen, 2002).

1.2 The Establishment of the EU ETS

In 2000 the European Union drew up a 'Green Paper on Greenhouse Gas Emissions Trading within the European Union' (COM, 2000), in which the benefits of emissions trading are considered. The member states of the EU wanted to commence with internal trading by 2005 - three years ahead of the planned trading within the Kyoto Protocol – enabling them to gain experience and reduce costs. This Green Paper was considered to be the start of the legislative history of the EU ETS, which would become a major pillar of the European climate policy. Three years later the European Parliament adopted Directive 2003/87/EC, which established the EU ETS, a community-wide emissions trading scheme that would start in January 2005, for a testing phase until December 2007. The Directive repeated the aim of the Kyoto Protocol to reduce GHG emissions by 8% by 2008 to 2012 compared to 1990 levels and also stated that in the long-run, global GHG emissions will need to be reduced by approximately 80% compared to 1990 levels. It did not, however, state precisely when this reduction would have to be reached. All 27 member states of the EU are currently full participants in the EU ETS.

1.3 The Functioning of the EU ETS

In this paragraph, we will take a closer look at the functioning of the EU ETS, the links with the mechanisms set up under the Kyoto Protocol and the allocation of allowances between the member states of the EU. As mentioned above, the trading scheme became operational in January 2005 for a testing phase that would last until end 2007. The system operates in phases of several years to neutralise annual irregularities in emissions caused by extreme weather events. In this first phase, the EU ETS covered some 10,500 installations – making it the largest multinational, multi-sector GHG emissions trading scheme in the world - including energy activities (combustion plants, mineral oil refineries and coke ovens), production of metal and steel, mineral industry (cement and glass production) and pulp and paper production.[5] Almost half of Europe's CO_2 emissions were covered by the ETS during the testing phase and around 40% of total GHG emissions. These numbers can still be increased in the future by adding other industries or gases, but in this first phase the EU wanted to restrict itself to the CO_2 emissions of big industrial emitters as their emissions can be measured, reported and verified with a high level of accuracy. In figure 4 the total GHG emissions by sector in the EU in 2005 are shown. Energy industries are responsible for the largest share of these emissions (32,3%), followed by other industries (21,2%) and transport (19,1%).

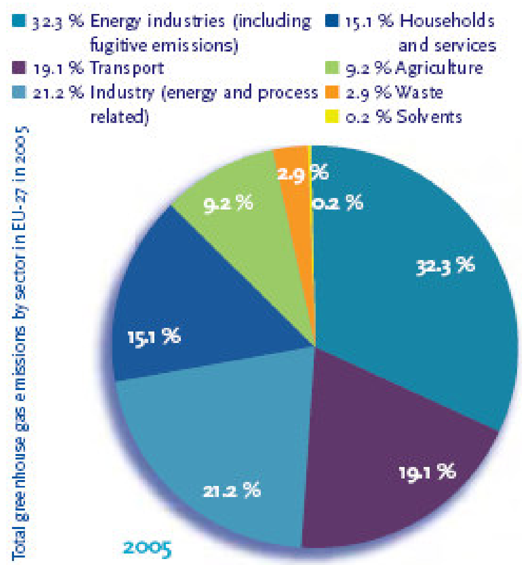

Figure 4: Total greenhouse gas emissions by sector in EU-27 in 2005 (European Environment Agency, 2007)

1.3.1 EU Emission Allowances and the 'Linking Directive'

By establishing the EU ETS, the European Union created a price for CO_2 in the most cost-effective way for member states – i.e. by using supply and demand. This made it easier for them to achieve their emission targets and prevents the atmosphere from reaching dangerous GHG levels. The center of this ETS is the trading of emission allowances. One such allowance, called an 'EU Allowance Unit of one tonne of CO_2' (EUA) gives the holder the right to emit one tonne of CO_2. These EUAs are only

[5] A complete list of the included categories of activities is added in Appendix II.

allocated to companies, who can use the allowances themselves or sell them to another party – i.e. other companies, individuals, investors or non-governmental organisations. During the first trading period, banking (using allowances in future years) and borrowing (using allowances of previous years) was allowed. This system builds on the flexible mechanisms set up under the Kyoto Protocol (Clean Development Mechanism (CDM) and Joint Implementation (JI)). By means of Directive 2004/101/EC of the European Parliament and of the Council of October 27, 2004, the so-called 'Linking Directive', the EU amended Directive 2003/87/EC and established a connection between the EU ETS and these Flexible Mechanisms. Operators were now allowed to use a certain amount of CERs from the CDM from 2005 and ERUs from JI from 2008 in order to help them comply with their obligations under the ETS. One CER or ERU can be exchanged with one EUA. The amount of CERS/ERUs a certain company can use is limited, so that sufficient domestic action is made. This linking increases the diversity of compliance options leading to a reduced overall cost of compliance with the Kyoto Protocol and creates more certainty to legal entities. By including JI, companies within the EU will be stimulated to invest in advanced environmentally friendly technologies in other member states, leading to know-how transfers. By including CDM, developing countries that have ratified the Kyoto Protocol will benefit from hosting more CDM projects. It should be noticed that the linking between the EU ETS and the Kyoto Flexible Mechanisms is not that obvious as it are two completely different frameworks. First, they have a different nature, as the EU ETS makes use of an ex-ante allocation, whereas the Kyoto Protocol uses an ex-post verification. Second, they have a different timing. Finally, different units of trade and different institutions are involved.

1.3.2 National Allocation Plan

The EU obliges its member states to draw up a 'national allocation plan' (NAP) to cover each of the two first trading periods, i.e. the testing phase of 2005-2007 and the second phase of 2008-2012. These NAPs, which have to be approved by the European Commission, allow each installation in the system to emit a certain amount of CO_2 during that period. In Appendix III a complete list of the emission allowances and Kyoto targets of the 27 EU member states is included. Two matters are important to bear in mind here. First, to be effective, the EU government has to keep the total number of allowances allocated below the amount that would have been emitted without a trading scheme. By setting such a cap on the total allowances allocated a scarcity is created that enables a trading market to arise. Second, the NAP has to be in line with the country's Kyoto target.

During the first phase of the EU ETS, at least 95% of emission allowances were allowed to be allocated free of charge, a practice also known as 'grandfathering'. For the second phase, this number was reduced to at least 90%.

In order to ensure compliance with the allocations given by the NAPs, a robust framework of measures is incorporated into the EU ETS. At the end of each year, institutions must surrender the number of EUAs equivalent to the CO_2 emitted that year. When a company does not surrender sufficient allowances, it is fined for each excess tonne of CO_2 emitted. This penalty amounted to €40 per tonne during the testing phase and to €100 from 2008. These operators also have to acquire additional allowances in the following year to make up shortfall and their names are also published in order to 'name-and-shame' them.

1.3.3 Second Phase of the EU ETS

In the second trading period, that started in 2008 and lasts until 2012, a number of changes were introduced. Norway, Iceland and Liechtenstein joined the EU ETS. A larger share of emissions allowances would be auctioned. Some new industries (aluminium and ammonia producers) were included in the ETS as well as two further greenhouse gases, namely nitrous oxide and perfluorocarbons.

There is also an ongoing legislative process to include aviation emissions into the ETS as of 2012 (Directive 2008/101/EC was published on January 13, 2009, so that the European Commission can adopt it as soon as May 2009). Even though aviation represents a limited 3% of total GHG emissions in the EU, its actual impact on climate change is much larger, as indirect warming effects, like those from NOx emissions and cirrus cloud effects, are not included in this figure (IPCC, 1999). Because of increased traffic, the EU's GHG emissions from aviation have increased by 73% between 1990 and 2003, whereas the EU's total GHG emissions fell by 3% in the same period (European Commission, 2005). This augmentation by far offsets the significant improvement in aircraft technology and operational efficiency. If emissions keep growing at this rate, they would neutralize more than a quarter of the reductions that will be made by the EU-15 under the Kyoto Protocol by 2012.

1.4 The Future of the EU ETS

In this paragraph we will first discuss some reforms initiated and planned for the third phase of the EU ETS. We will then consider the likelihood of a global agreement on climate change after the Kyoto Protocol closes in 2012.

1.4.1 '20-20-20' Objectives

In January 2008 the European Commission proposed some far-reaching measures regarding climate action and renewable energy for the coming decades. This ambitious climate-energy legislative package was agreed upon in December 2008 by the European Parliament and the European Council and adopted by the latter on April 6, 2009. It contains three main objectives - the so-called '20-20-20' objectives - designed to transform the EU into a low-carbon economy and to make it less energy-dependent. First, the EU commits itself to reduce its overall emissions by at least 20% below 1990 levels by 2020. This reduction will be scaled up to 30% when a global agreement regarding climate change is reached between other industrialised countries, especially the US, who have not yet ratified the Kyoto Protocol. Second, the EU wants to increase the share of renewables in its energy-mix to 20% by 2020. Finally, the EU dedicated itself to improve energy efficiency by 20% by 2020.

The package is composed of six measures to reach these objectives. The most important one will be the strengthening and expansion of the EU ETS by means of the following adaptations. As from 2013, when the third phase starts, power installations will have to buy all their emission permits at auction. This decision is made to correct the substantial 'grandfathering' during the first two phases of the ETS, through which businesses could sell their remaining credits, which they initially received free of charge. A practice leading to windfall profits for businesses (Sijm, Neuhoff & Chen, 2006). Other sectors covered by the ETS will only have to buy 20%, but this figure will be gradually increased to 70% by 2020. (Full auctioning is not expected before 2027.) Several derogations to industries that will probably be exposed to a significant risk of 'carbon leakage' – i.e. increased CO_2 emissions in one country, because of environmental regulations in another country - have been negotiated by Member States with considerable coal-based production, e.g. Poland. Emissions from sectors covered will be reduced by 21% by 2020 compared with 2005 levels. Furthermore, an 'effort-sharing' decision is taken by obliging sectors not covered by the ETS, such as transport and agriculture, to decrease their emissions by 10% compared to 2005 levels by 2020.

We will only briefly enumerate the five other measures that the package contains as the first measure is discussed more extensively in chapter two and the four other measures go beyond the scope of this thesis. First, the directive establishes a regulatory framework for 'carbon capture and storage' (CCS). Second, it promotes renewable energy by setting out targets for the proportion of renewables in the energy-mix of each member state. Third, the directive imposes a 10% renewable share in the transport sector. Fourth, CO_2 emission limits are set for new passenger cars. Finally, standards for fuel quality are set (Press Release European Council, 2009).

1.4.2 Post-Kyoto Agreement

From December 7-18, 2009 the 15th Climate Change Conference of the UNFCCC (COP15) will be held at Copenhagen, Denmark. This will be a crucial conference in the quest for a global response to climate change, as it is seen as the last chance to achieve an ambitious global agreement, before the Kyoto Protocol expires in 2012. The ambition of the Danish government is to establish an agreement that substantially reduces the total quantity of anthropogenic GHG emissions, while incorporating all countries of the world (COP15, 2009). An essential condition for reaching such an agreement is the support of the five largest emitters of energy-related CO_2 (China, the United States, the European Union, India and Russia), who together account for two thirds of global CO_2 emissions. The EU has displayed its good intentions by adopting its climate-change legislative package and by explicitly stating that it will scale up its emission reductions by 2020 when a global agreement is reached. But what are the stances of the governments of the other major emitters?

The election of Barack Obama as US President in 2008 revived hopes in the EU and other parts of the world that the US would soon be agreeing with an agreement on climate change. During his campaign, Senator Obama proposed implementing a mandatory economy-wide cap-and-trade system that would reduce GHG emissions by 80% by 2050, as well as a re-engagement with the UNFCCC, in order to make the US a world leader on climate change again (Campaign Website Barack Obama, 2008). President Obama also received praise for appointing Steven Chu, a former Nobel Prize laureate in Physics and an advocate of renewable energy, as his new 'Secretary of Energy'. The new President also signalled a priority shift in March 2009, by increasing the 2010 budget of the Environmental Protection Agency (EPA) by $10,5 billion, a 35% increase (US Office of Management and Budget, 2009). On March 31, 2009, Democratic Congressmen Henry Waxman and Edward Markey released a new climate and energy bill, which would reduce US emissions by 20% below 2005 levels by 2020 (American Clean Energy and Security Act, 2009). The bill is perceived as the first ambitious 'cap-and-trade' proposal with a considerable chance of success. But the Congressmen will face strong opposition from Members of Congress from coal-intensive Midwestern states. Furthermore, it is unlikely that these reduction targets would satisfy the EU leaders' call for 'comparable emission reductions by other developed nations', as a reduction of 20% below 2005 levels is comparable to a 5-6% cut below 1990 levels, i.e. the benchmark the EU uses (EurActiv, 2009). In April, 2009, President Obama indicated that passage of climate legislation in the US will not happen before the Copenhagen Conference (The New York Times, 2009).

On November 7, 2008, Wen Jiabao, Premier of China, held a speech at the 'Beijing High-level Conference on Climate Change' in which he repeated the Chinese stance on the matter of tackling climate change. Premier Jiabao first enumerated the measures already taken by his country, but then reminded industrialized countries that they should fully consider their historical responsibilities, whereas China is still developing and has very low per capita emissions. He therefore proposed that the developed countries should mitigate their over-consumption of energy, reduce their GHG emissions and help developing countries to grow in a sustainable way and to eradicate poverty. The Premier concluded by expressing the full support of the Chinese Government for the Copenhagen Conference in 2009 (Speech Chinese Premier Jiabao, 2008). The message of the speech is still the same as the 'Chinese National Plan for Climate Change' of 2007, in which the country explained how it would achieve its aim of reducing energy consumption by 20% before 2010 (National Climate Change Plan, 2007). Analysts add that China has never realized an environmental target it has set to itself.

Even though Russia was reluctant at first to ratify the Kyoto Protocol, it has been able to benefit from it. The reason for this is that 1990 was set as the base year, as we have mentioned earlier. That year, Russia – as part of the Soviet Union – emitted 2.376 million tons of CO_2, whereas at present they emit around 1.700 million tons (EIA, 2008). This enables Russia to easily reach its emission targets and to sell the remaining permits. Despite these benefits, Russia keeps displaying unwillingness to take climate change seriously. Some Russian experts (Kotov, 2004) even believe that Russia could benefit from increasing temperatures. General Pulikovsky, Chairman of the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor) has also claimed that climate change will not be a threat to Russia during the 21th century and even former President and current Premier Putin has made jokes about his country benefiting from global warming. It is therefore no wonder that Russia is not taking decisive action. Another factor leading to this passive stance is the fear that global climate agreements will restrict the economic growth of the country. Therefore a post-Kyoto agreement should increase the possibility of the Joint Implementation mechanism and show Russia that tackling climate change can be an opportunity for the country (Kefferpütz, 2008). But President Medvedev, who is in office since May 2008, has taken some positive action. It looks like climate change is the only matter in which he does not pursue the same policy as his predecessor Putin. He has increased budgets for clean energy and has stated that Russia must respond to global warming. Sergei Mironov, speaker of the upper house of parliament, has even called upon the US, China and India to join the battle against climate change (Reuters, 2008). It should also be noted that Russia can sharply reduce its emissions by improving its energy efficiency (some estimate that up to 40% of its annual energy consumption can be saved (Kefferpütz, 2008)). Russia needs 3,2 times as much energy to produce one unit of GDP than any member of the European Union, because of the legacy of its squandering Soviet infrastructure (UNDP, 2007).

India’s stance on the subject is comparable to the Chinese. They have frequently stated that they have the right to emit the same per capita emissions as ‘the historical polluters in the industrialized West’ and that they will not sacrifice their economic development and poverty alleviation programs. Therefore it is unlikely that India will agree with mandatory emission caps, even though Prime Minister Singh released India’s first National Action Plan on Climate Change in 2008 (NAPCC, 2008). The plan is composed out of eight national missions, ranging from improving energy efficiency to increasing solar thermal power generation.

It is clear that reaching an ambitious global agreement on climate change at the Copenhagen Conference in December 2009 will be a complex assignment. A compromise will have to be found between industrialized nations, who focus on allocating emissions mitigation targets, and developing nations, who focus on the responsibility for, and the division of climate impact burdens (Müller, 2002). These developing nations, like China and India, emphasize linking an agreement to per capita emissions, whereas the US would like to relate these to GDP per capita, to justify their high emissions. Even though the political negotiations will be very challenging, the carbon industry itself is rather positive. According to Carbon 2008 - an annual report on the state of the carbon market based on the world’s largest ever carbon market survey - around 70% of their survey respondents believe a global post-2012 climate agreement will be reached before 2012 (Carbon, 2008). The economic slowdown of 2009 will make it even more difficult to reach an agreement. In May, 2009, Australian Prime Minister Rudd delayed the introduction of a cap-and-trade system by one year under pressure of industries (The New York Times, 2009). But it is unlikely that their example will be followed by other nations, as many large emitters – like the US or the EU – consider the economic crisis as an opportunity to develop a green economy.

1.5 Evaluation of the EU ETS

In this paragraph we will first consider the achievements and benefits of the EU ETS to the present day. Secondly, we will describe the shortcomings and disadvantages of the

EU ETS, without forgetting that the first trading period from 2005 to 2008 was still a trial period.

1.5.1 Achievements and Benefits

First, the EU ETS has the merit of constructing an international trading system that puts a visible single price on CO_2, a pre-requisite for an efficient market for a homogenous product without transportation costs to emerge (Ellerman & Joskow, 2008). When we consider the short term in which the scheme was developed, it has worked remarkably well, with market institutions, registries, monitoring, reporting and verification working efficiently and a growing number of European industries incorporating the price of CO_2 emissions in their production decisions (Ellerman & Joskow, 2008). The success of the ETS also becomes clear when we look at the figures. More than 10.000 installations are covered across all 27 Member States of the EU, Norway, Iceland and Liechtenstein, covering some 2.000 million tons of CO_2. The traded volume of the ETS in 2007 amounted to 1,6 Gt and to a value of €28 billion. Representing a volume increase of 62% and a value increase of 55% compared to the year before. The ETS currently represents more than 60% of the physical global carbon market and 70% of the financial market (Point Carbon, 2008).

Second, a complete new range of businesses is being created throughout Europe as a result of the carbon trading. Positions like carbon finance specialists, carbon auditors and verifiers, carbon management specialists or carbon traders are new and will only become more numerous in the future. Furthermore, the European Commission predicts that almost a million jobs will be created in the renewable energy industry, when the EU's energy mix attains a 20% share of renewables (European Commission, 2008).

Third, the early commencement of the ETS will give European and foreign-owned businesses based in the EU a 'first-mover' advantage through their early experience with emission reduction and trading. Possibly enabling European companies to become world leaders in the field of carbon trading, clean technology and efficiency. This accords with the so-called 'Porter Hypothesis', i.e. by setting strict environmental regulations, governments can induce efficiency and encourage innovations that will improve commercial competitiveness and that will eventually offset the cost of compliance with these environmental standards (Porter, 1991).

Fourth, a 20% share of renewable energy in the EU's energy-mix would sharply reduce the dependency on foreign oil and gas, hereby increasing the EU's energy security. The European Commission estimates that € 50 billion can be saved by reducing imports by 2020. In 2006, the EU's dependency on energy imports amounted to 50%. Half of these imports came from Russia, the EU's neighboring energy giant that caused a commotion in Europe when it suspended gas supplies to Europe in 2006 and 2009, because of a conflict with Ukraine (European Commission, 2008).

Finally, and most importantly, the EU ETS does what it is developed for. It reduces CO_2 emissions – albeit modest reductions up till now – in the most cost-effective way, i.e. by using supply and demand, and consequently tackles human induced climate change.

1.5.2 Shortcomings and Disadvantages

It is obvious that the EU ETS has also attracted criticism. It must be said, however, that most of these comments deal with goals, conditions or the design of the ETS and not with the actual purpose of the system.

First, grandfathering should be reduced, as this leads to the above mentioned windfall profits for businesses (Grubb & Neuhoff, 2006). Action has been taken regarding this problem and in the third phase free allocation will decline and more permits will be auctioned (Press Release European Council, 2009). Researchers have shown that auctioning more allowances will increase the efficiency of the ETS, without increasing adverse competitiveness effects (Hepburn et al, 2006). Discussions are still being held about the allocation of revenues from the auctioning of emission allowances, but the ETS Directive recommends that at least 50% of these revenues should be dedicated to the fight against climate change (European Commission, 2008). Second, according to a review by the European Commission of the EU ETS, a large majority of companies and associations would prefer longer trading periods in order to reduce uncertainty and in this way create a stable investment climate (EU ETS Review, 2005; Grubb & Neuhoff, 2006). Longer trading periods would also increase the liquidity in the CO_2 permits market. It is therefore important that the EU has concentrated on creating a stable and predictable regulatory framework for the third trading period, which will last until 2020 (Opening Speech Carbon Market Insights, 2009). Another issue is the partial coverage of the ETS. Especially government bodies would like to see more GHG and sectors included into the system (EU ETS Review, 2005). An important step would be the inclusion of aviation in 2012, as mentioned earlier. Fourth, emission allowances have been over-allocated in the past, leading to low carbon prices and little incentives for business to increase efficiency or develop new technologies (Ellerman & Buchner, 2006; Grubb, Azar & Persson, 2005). Politicians should have the courage to set strict, ambitious goals for business in Europe in order to tackle anthropogenic GHG emissions. During the phase I allocations, however, they succumbed to pressure from European industry to enfeeble reduction targets. Finally, a much discussed disadvantage of the ETS is its suppositional negative impact on competitiveness of carbon-intensive industries in Europe. We will investigate this problem in detail in the second part of this thesis.

1.6 Conclusion

In this chapter, we have described the evolving awareness of climate change that started with the research performed by Svante Arrhenius in 1896. During the second half of the 20^{th} century, decisive action was taken on several topics – e.g. the Montreal Protocol - but it would last until the fourth assessment report of the IPCC in 2007 before almost the entire scientific community agreed upon the fact that human activity is causing climate change. The Stern Report of 2006 showed the world a year earlier that tackling climate change is not only necessary, but that it is also still possible to avoid the worst consequences if measures are taken right away to reduce GHG emissions. Hereafter we discussed the establishment and functioning of the EU ETS. The scheme has become the most important instrument in the EU's fight against climate change and in achieving its so-called '20-20-20' objectives. We then forecasted some future developments, especially with regard to a possible post-Kyoto agreement. Finally, we evaluated the scheme up till now.

Chapter 2: Implications for Industrial Competitiveness in Belgium

The biggest concern for many industries across Europe is that the EU ETS will negatively impact their competitiveness. If this would be the case, it would not only be detrimental from an economic point of view, but also from an environmental one. Disadvantaged industries would move abroad to regions with less strict environmental regulation and will consequently – besides harming European economies and employment levels – have no, or an adverse, impact on global GHG emissions (the so-called 'carbon leakage'). But is this anxiety justifiable? This will be investigated in this second chapter. First, we will describe which factors determine a sector's inherent potential exposure to the EU ETS. Second, we will consider the implications of the EU ETS for four carbon-intensive sectors in Belgium.

2.1. Drivers of Competitiveness

A sector's inherent potential exposure to competitiveness effects from the EU ETS is determined by three factors (IEA, 2004).

The first factor is the energy intensity of a sector, i.e. the amount of energy that is needed per unit of production. Energy intensive industries will see their input costs rise because of a direct and an indirect effect. The direct effect only applies to sectors that are currently covered by the ETS, as a price is now set on the CO_2 they emit. If the emissions of a company exceed their initial allowance, they will have to acquire additional permits or invest in abatement activity, hereby increasing their production costs. The cost of compliance with the EU ETS is thus the sum of the internal abatement cost and the allowance cost (or allowance revenue) (IEA, 2004). Moreover, there is an indirect effect coming from electricity prices. As almost any industry consumes electricity, production costs are likely to rise because electricity companies might pass increased costs through to consumers. This indirect effect might have greater consequences for most sectors than the direct effect of the scheme (Carbon Trust, 2004). This will be explained more in detail in the discussion of the electricity sector.

The next factor determining a sector's competitiveness under the EU ETS is the ability to pass cost increases through to prices. We can partition this factor in three elements: the price elasticity of demand, the market structure and the sector's exposure to international markets. First, sectors that face a price inelastic demand will be able to pass cost increases through to consumers. Secondly, markets with few players will face less competition and this will also increase the possibility to pass through costs increases. Finally, players in a globally traded commodity market, e.g. like steel, will find it hard to pass through cost increases.

The final factor influencing a sector's competitiveness is the opportunity to abate carbon. By investing in abatement, businesses can limit their exposure to the EU ETS and benefit from the future cost savings of their abatement investment.

2.2 Sector Findings

We will now describe our four selected sectors - electricity, steel, cement and the petrochemical industry – and discuss the implications of the EU ETS on their competitiveness. These sectors were chosen because of their large extent, their energy and carbon intensity and their relative importance to the Belgian economy. Furthermore, we will also enumerate some abatement opportunities for each sector.

2.2.1. Electricity

The electricity producing sector is an important sector, but also a remarkable one, as any cost pass-through affects all other sectors. Total electricity production in the EU-27 amounted to 3.353TWh in 2006 and around 30% of total GHG emissions are emitted by the energy sector (Figure 4). Electricity production in Belgium, as shown in figure 5, amounted to 85,4TWh in 2004, generated mainly from nuclear power (7 reactors producing 47,4TWh or 55% of total electricity generation) and gas (23,8TWh or 28% of total electricity generation). The share of electricity generated by renewables has more than doubled between 1995 and 2004, but is still negligible. The energy industry is responsible for 20,5% of total GHG emissions in Belgium, as we can see in figure 6 (National Communication on Climate Change 4, 2006). The total amount of electricity generated over the period 1990-2004 has grown by 21% (European Commission, 2004; Eurostat, 2009).

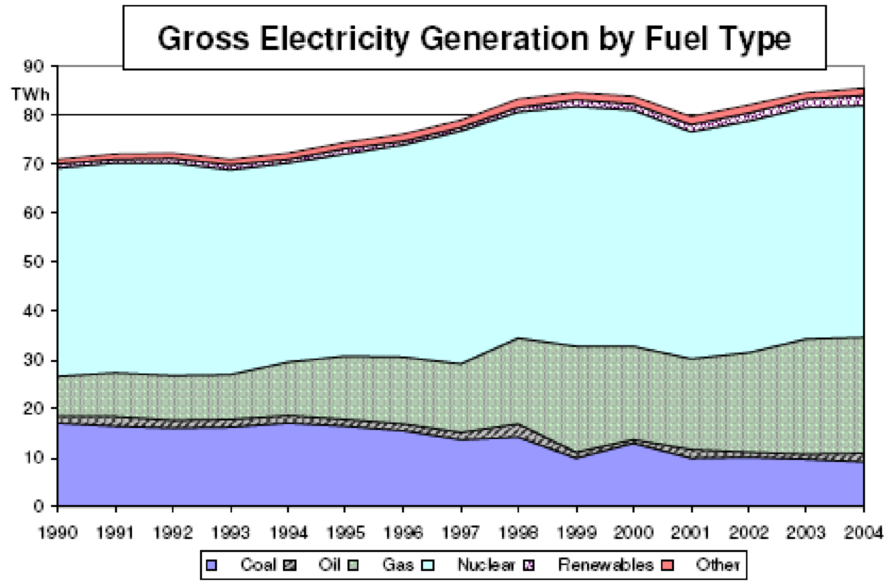

Figure 5: Gross Electricity Generation in Belgium by Fuel Type, 2004 (European Commission, 2004)

But despite this high energy intensity and its subsequent GHG emissions, the electricity generating sector displays several characteristics that make it unlikely that the industry suffers from the implementation of the EU ETS or will suffer from the adopted phase III adaptations to the scheme.

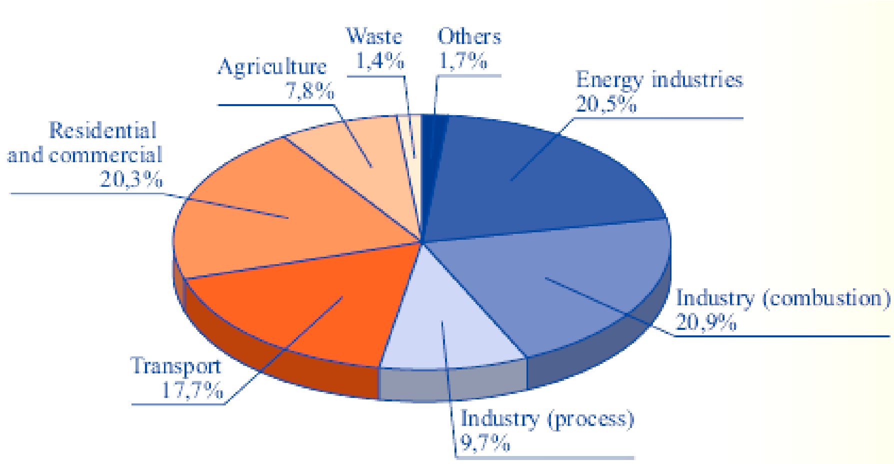

Figure 6: Total GHG emissions by sector in Belgium in 2003 (4th National Communication on Climate Change, 2006)

Firstly, electricity generating companies will be able to pass increased costs through to consumers, as mentioned earlier, for three reasons. First, electricity faces a relatively inelastic demand, as individuals and enterprises do not reduce their electricity use when prices increase. Second, the sector consists of a limited number of large firms. This reduces fierce price competition between these major players and gives them market power with regard to their numerous customers. In Belgium, Electrabel – the country's largest generator – had a market share of 83,9% in 2007 (Eurostat, 2009). Third, electricity, by its nature, is not a globally traded commodity, as it can not be stored or exported over long distances. The sector is therefore not exposed to foreign competition from companies that do not face strict environmental regulation.

Secondly, there are many abatement opportunities in the industry that we can divide into four broad categories: renewable energy, carbon capture & storage (CCS), nuclear energy and demand reduction through energy efficiency (McKinsey & Company, 2009). According to analysts, these measures have the potential to reduce CO_2 emissions 40% to 60% below 2005 levels by 2030, if the full potential were to be captured. In Belgium, the share of nuclear energy is already quite high (55%), as we saw in figure 5, and increasing nuclear capacity is a politically sensitive issue, so emission reductions will have to come from the three other measures. Generating electricity from renewable sources is still not cost competitive with fossil fuels without high subsidies by national governments, but by charging GHG emissions, this may become economically interesting in a near future. CCS is still in its infancy – even though the technology exists and is already being applied in the oil- and gasindustry - and should not be expected to become competitive before 2030, but it is seen as one of the most promising technologies to reduce CO_2 emissions and it could be a very important tool in the global transition to renewable energy. CCS sequestrates CO_2 that otherwise would be released in the atmosphere, then compresses it into liquid form, transports it to a given location via existing pipeline networks or via ships and finally injects it into geological formations deep underground or into depleted gas fields (EurActiv, 2009). The EU plans to launch 10 to 12 large-scale demonstration projects for coal and gas-fired power plants by 2015. In 2008, Member States also agreed upon using 300 million allowances from the ETS to subsidise the construction of these plants (European Commission CCS Directive, 2008).

Studies have shown that the electricity generating companies need to pass only a relatively small proportion of their cost increase through to prices to maintain their pre ETS profits and that these firms can maximize their profit by passing through 90% of this cost increase and thus benefit from the implementation of the EU ETS (Carbon Trust, 2004). As mentioned earlier, this leads to ‘windfall profits’. The EU has also realized this and therefore decided that all allowances for the sector will be auctioned as from 2013, when the third phase commences. Executives from electricity generating companies stated at the beginning of the ETS that some costs may be passed through, but that large price increases are unlikely (Carbon Trust, 2004). When we look at Belgian electricity prices in Table I, we see that these have increased by more than 30% between 2005 and 2008. This evolution may be due to increasing energy prices or historical low electricity prices, therefore we compared the price evolution in Belgium to the average price evolution in the EU-27 over the same period.

Table I: Electricity Prices in Belgium and EU-27, 2005-2008, Euro per kWh without taxes (Eurostat, 2009)

Medium Size Households			
	2005	2008	Change
Belgium	*0,1116*	*0,15*	*34,41%*
EU-27	*0,1013*	*0,1211*	*19,55%*
Medium Size Industries			
	2005	2008	Change
Belgium	*0,0695*	*0,0988*	*42,16%*
EU-27	*0,0672*	*0,09*	*33,93%*

We can observe that prices in Belgium have increased significantly more than in the EU as a whole. The electricity price for medium size households has changed by 34% in Belgium, whereas this only changed by 20% in the EU. For medium size industries, the price increased by more than 40%, compared to a 34% increase in the EU. It is hazardous to conclude out of this data that Belgian companies have passed cost increases through to consumers, but it is clear that there has been a substantial difference in price evolution. These price increases will be discussed more elaborately in the following paragraph about Electrabel.

In March 2009, NMBS, the Belgian railway company, sued Electrabel. It stated that the electricity producer abused its market power and has overcharged them for € 28,7 million during the period 2005-2007 by charging them for emission allowances that Electrabel received for free. NMBS was the first Belgian company to sue Electrabel for this practice (De Tijd, 2009). The company's claim was backed up by energy watchdog CREG, which stated that Electrabel has overcharged its customers for 'grandfathered' emission allowances by more than € 1 billion (CREG, 2009).

Concluding, we can be certain that Belgian electricity generating companies have been benefiting from the implementation of the EU ETS up to the present, because of their ability to pass cost increases through to consumers. It is therefore important that all emission allowances for the sector will be auctioned as from 2013. This will also prevent unfair competitiveness effects from occurring between companies of different countries, because all firms will be treated equally.

2.2.1.1. Case Study: Electrabel

In order to verify these findings, we conducted an interview with Mr. Paul Van De Heijning, Senior Advisor European Affairs, of Electrabel. The questionnaire used for this interview is added in appendix IV. In this paragraph we will first describe the company and then give a summary of the interview. The viewpoints of some politicians, non-profit organizations and the Belgian energy watchdog will also be provided in order to compare them to Mr. Van De Heijing's standpoint and to give a comprehensive overview.

Electrabel is the dominant player in the Belgian electricity generating sector, with a market share of around 80% (Eurostat, 2009). The company currently employs 10,000 workers in the Benelux and 5,000 more throughout Europe. It was founded in 1990 when three companies - Intercom, Ebes and Unerg - merged. Since July 2007 the company is a 100% subsidiary of French utility group GDF-Suez. In that year total revenues of Electrabel amounted to €15 billion. Each year the company produces 140TWh of electricity (Electrabel, 2009).

In figure 7 the electricity generation of Electrabel by fuel type is given. One third of total generation comes from natural gas, another third from nuclear and the remaining third from coal, renewables and other sources. Total CO_2 emissions of Electrabel amounted to 31,78 million tonnes in 2007. The CO_2 emission of Electrabel in Belgium amounts to 227g/kWh. This is a decrease of 63% since 1980, as figure 8 indicates, even though total electricity production has increased by 45% since that year. Electrabel states on its website that it would like to reduce CO_2 emissions by 1,7 million tonnes by 2015. Compared to 2007, this would be a decrease of 5,35%.

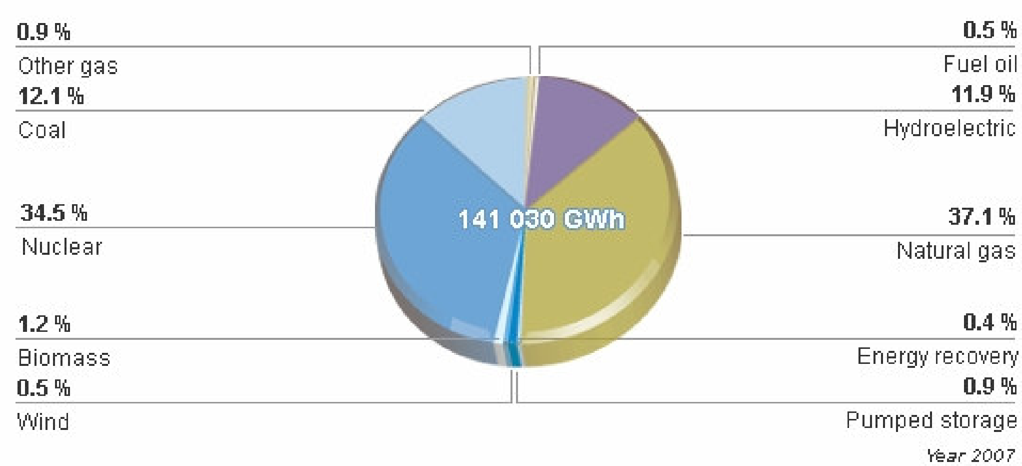

Figure 7: Electricity Generation of Electrabel by Fuel Type, 2007 (Electrabel, 2009)

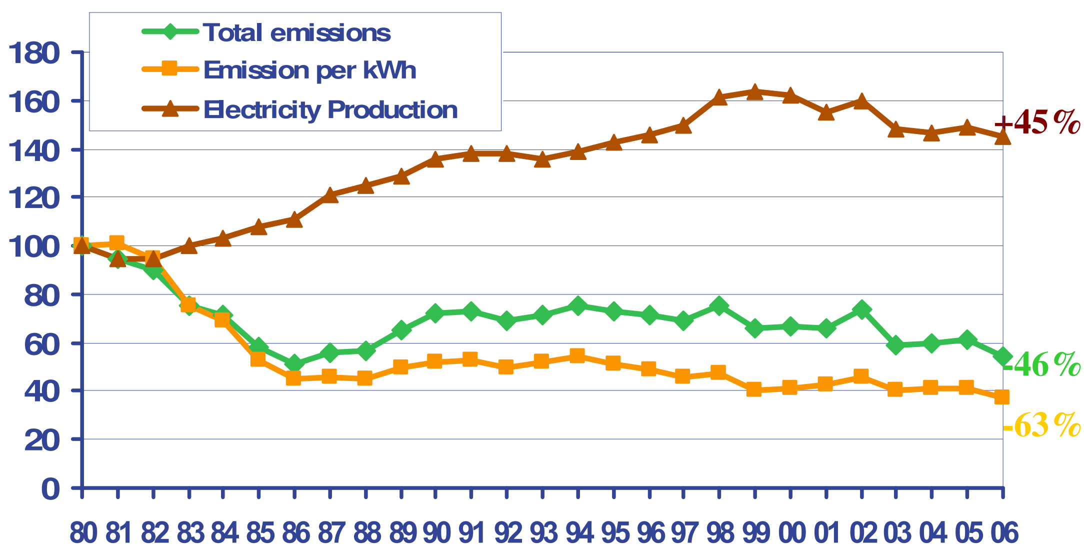

Figure 8: Evolution of CO_2 emissions by Electrabel in Belgium, 1980=100 (Electrabel, 2007)

Electrabel considers the introduction of the EU ETS in 2005 to be very positive for two main reasons. First, the system is the only fair and effective way to reduce CO_2 emissions, because it internalizes an external cost for companies. In this way it enables firms to put a real value on their carbon footprint, without distorting competition between the different operators in the market. In that respect, the ETS is seen as the ideal system. Second, the EU ETS is a cheap manner of reducing CO_2 emissions, because it does not require the establishment of large administrations or high taxes, but lets the free market put a price on CO_2. Electrabel now considers CO_2 emissions - or pollution in general - as a commodity, by which money can be made or lost. Because of the ETS, the company has an incentive to be economical with its emissions, leading to lower prices or a larger margin for the company and thus benefiting them. In the long run, Mr. Van De Heijning believes, companies with a production park that emits as few emissions as possible, will have a competitive advantage compared to those with high emissions.

The largest shortcoming that Mr. Van De Heijning mentioned is the different implementation of the ETS throughout the 27 Member States of the EU. During the first two phases of the ETS some countries grandfathered all emission allowances, whereas other countries only gave away a certain percentage for free. This was also the case with the credit usage. In some countries there was a large possibility to use credits, whereas in other countries this possibility was rather limited. These problems are likely to be resolved with the third phase adaptations. As one EU-wide emissions cap will be set and all emission allowances for the electricity sector will be auctioned, Electrabel believes that all companies will be treated equally throughout Europe as of 2013. It is therefore that Electrabel – by means of Eurelectric, the association of the electricity industry in Europe - was an advocate of auctioning all allowances during the third phase, as it was seen as the only possible way to prevent any distortion of the market. Not all companies in the industry were happy with this advocacy of Eurelectric. The German company RWE, for example, strongly opposed it, because a large share of their production park is based on coal and lignite.

Mr. Van De Heijning answered personally on the question about windfall profits being made, as he did not know the official standpoint of Electrabel. He could not say if windfall profits have been made, because it can not be proven. He did not believe, however, that they have been made, despite the higher electricity prices. Reason for this is that the price is being set by a free market. If Electrabel would have charged higher prices, competitors could have entered the market and made a dent in their profits, but this has not happened. According to Mr. Van De Heijning, the EU ETS has probably increased prices, but there is no correlation between the costs of the ETS for Electrabel and the price of electricity, as this price is not being set by the cost of production, but by the market price of the marginal unit. So where did this higher electricity price come from? Mr. Van De Heijning believes that this is caused by a too low capacity of the European market and that governments have a large responsibility to solve this by stimulating the construction of new stations. In Belgium, production facilities are relatively old, with an average age of the total production park somewhere around 30-40 years, whereas demand keeps rising year after year.

But his standpoint is not shared with the Belgian unions ABVV, ACV and ACLVB, nor with the environmental activist groups Greenpeace and Bond Beter Leefmilieu or with the consumer organizations OIVO and Test-Aankoop, who cooperatively organized a demonstration against the energy company in 2008, blaming them for setting high energy prices and asking the Belgian government to take action against this. The organizations proposed to cream off the large profits of Electrabel and to redistribute this money to energy consumers (BBL, 2008). As mentioned earlier, also energy watchdog CREG believes that Electrabel has overcharged its customers for ‘grandfathered’ emissions allowances for more than €1 billion (CREG, 2009).

The most important manner for Electrabel to reduce its CO_2 emissions is by combining fuel-switch - i.e. changing from coal based power stations to stations based on gas – with a maximal nuclear capacity and with a higher introduction of renewable energy. Electrabel would like to increase the share of renewable energy in its generation mix, but at the moment renewables are only profitable with large subsidies (‘green certificates’). There are technologies that might become profitable, like wind energy at sea, but this will only be in the long run. The investment of such a production park is comparable to the investment for a nuclear power station, but in the long run the operational cost will be close to zero. In the longer run Electrabel will switch its complete production park to non-polluting units, but for the moment it still considers all sources of energy, including coal. This has led to heavy criticism from Greenpeace (Greenpeace, 2005).

GDF-Suez, Electrabels parent company, would like to become operator of a second third generation nuclear reactor that will be built in France. Real innovation in the nuclear industry, however, will come from nuclear reactors of the fourth generation. GDF-Suez is closely following and participating in the development of these reactors. But these will not become operational during the next 25 years.

Electrabel itself is trying to obtain some of the funds that are made available for energy projects by the European Recovery Plan in 2008. The company is a candidate to receive funds in order to equip a new power station in the Netherlands with CCS. Member of European Parliament (MEP) Bart Staes from the Belgian green party has stated in the past that CCS is a 'foolish' and 'futuristic' plan, but he especially blaims the European Commission for promoting the concept. Other green MEPs fear that recognizing CCS might lead to a legitimation of the usage of very polluting coal in the future (Knack, 2009).

2.2.2. Steel

Of all the sectors covered by the EU ETS, the steel industry was expected to be the one most exposed to it, because of its high CO_2-intensity and its relative openness to international trade (Demailly & Quirion, 2007). In this paragraph, we will first describe the CO_2-intensity and the extent of the European and Belgian steel industry. Then we will evaluate the impact of the ETS on the industry up till now. Finally, some possible developments and abatement opportunities for the sector will be enumerated.

There are currently two processes to make steel, that account for approximately all the steel produced world-wide: the integrated route (blast furnace) and the Electric Arc Furnace (EAF) route (IEA, 2004). The former is the most capital intensive – because of a high minimum economic scale and very specific investments - and most polluting. It involves the production of liquid iron from iron ore, limestone and coke. This liquid iron is then transformed into steel in an oxygen converter (a Basic Oxygen Furnace). This process is also known as the 'primary route'. The majority of CO_2 emissions with this process come from the production of pig iron in the blast furnace and from coal coking. Around 1,6-2,8 tonne of CO_2 is emitted and around 375kWh is needed to manufacture one tonne of steel by the primary route. The latter produces crude steel directly from recycled scrap, by melting it in an Electric Arc Furnace. This is known as the secondary route. This process emits only a limited amount of GHG and uses electricity. The CO_2 emissions that are emitted come from rolling and finishing of products and from the use of solid and gaseous fuels, like coke and natural gas. They amount to 0,6-1,8 tCO_2 to manufacture one tonne of steel. The last few years, reduced iron substitutes have been increasingly used as scrap substitutes, in this way significantly reducing CO_2 emissions, but increasing electricity expenditures. In 2005 they had a market share in the EU-25 of 60% and 40% respectively (IISI, 2006). Of total emissions from the steel industry, 84% comes from process and fuel-combustion emissions (direct emissions), primarily from the primary route, whereas the other 16% come from indirect emissions, mainly related to electricity consumption in the secondary route (McKinsey, 2009).

In 2008, world crude steel production amounted to 1.329,7 million metric tons, of which most was produced by China (38%). When we consider the EU-27 as one nation, it ranks at a second position with almost 200 million metric tons or 15% of world production, as we can see in figure 9.

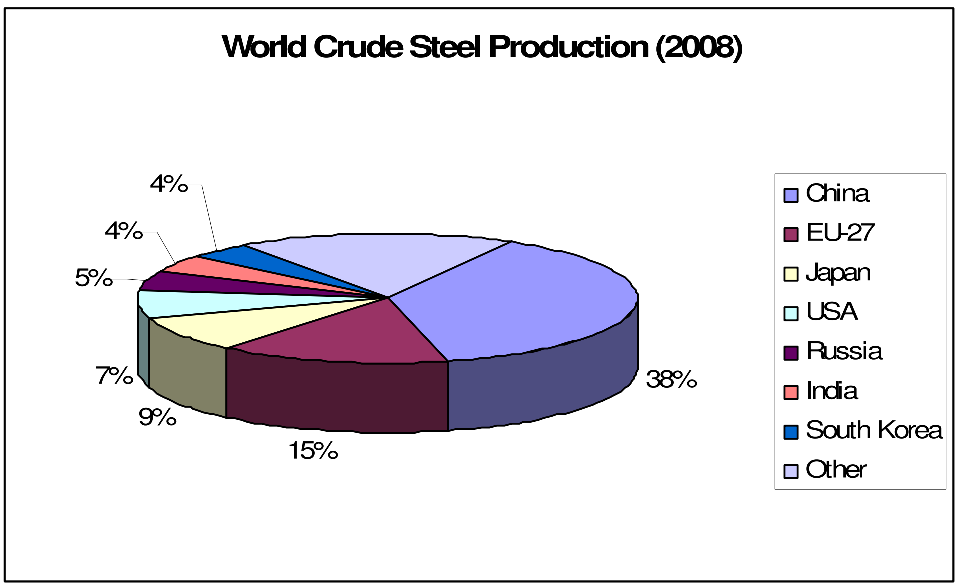

Figure 9: World Crude Steel Production in 2008, in million metric tons (World Steel Association, 2009)

In the EU, Belgium is the 6th largest producer of crude steel after Germany, Italy, Spain, France and the UK, as table II shows. In 2004, it was also the 5th largest exporter of crude steel in the world, as well as the 5th largest net exporter (IISI, 2006). The industry still employs more than 10,000 workers in Belgium, especially in Ghent and Liège. Around three quarters of all crude steel produced in Belgium is processed by the blast furnace route and only one quarter by the cheaper electric arc furnaces or 'mini-mills' (IISI, 2006).

Table II: EU-27 Production of Cruce Steel by Country, in 2008 (World Steel Association, 2009)

EU-27 Production of Cruce Steel (2008)		
Country	**Production**	**Percentage**
Germany	*45,8*	*23,06%*
Italy	*30,5*	*15,36%*
Spain	*19*	*9,57%*
France	*17,9*	*9,01%*
UK	*13,5*	*6,80%*
Belgium	*10,9*	*5,49%*
Other EU	*61*	*30,72%*
Total	*198,6*	

These numbers indicate that the steel industry is still important for the Belgian economy, but its significance is fading, because of the decreasing cost-competitiveness of the obsolete Belgian production facilities. Especially in Wallonia this is the case, as they have neglected renewing their production park after the flourishing industrial times of the 19th century. Producing one tonne of crude steel in Belgium costs €100 more than in other Western European countries. The Belgian industry is also heavily struck by the economic crisis of 2008 and 2009. Because of decreasing demand for cars and a world-wide collapse of steel demand, production dropped by 70% during the first quarter of 2009, compared to the same quarter a year earlier (World Steel Association, 2009). Main reason for this plunge is the decision of ArcelorMittal in April 2009 to temporarily shut down a second blast furnace in Liège, after they had reopened it a year before. But instead of renewing the facilites to reduce their emissions and to make them more cost-competitive, Belgian governments decided to subsidize the extra emission allowances for the company. Also in Ghent and Geel, the company decided to temporarily close down production facilities as a response to the declined demand for steel world-wide. But whereas production in the technologically advanced facilities in Flanders will probably resume when the economy revives, this might prove to be the end for production in Wallonia.

Steel companies feared the introduction of the EU ETS because it would be impossible to increase prices, as steel is such a homogeneous commodity (Carbon Trust, 2004). But researchers point out that there already exist large price differences of up to 40% between EU Member States and low cost countries, without leading to high imports of crude steel – non EU imports of steel amount to 11% (IISI, 2004; CIRED, 2007). So despite this global trade in steel, it remains a regional market with different prices in the large economic regions, i.e. EU, North America, Asia, etc. This is because production decisions are not only based on production costs, but also on transportation costs, export tariffs and other risk factors like political instability or volatile exchange rates (CIRED, 2007). This fact reduces the likelihood that the introduction of the EU ETS significantly reduced the competitiveness of Belgian factories, but that obsolete technology did.

Intra-EU competition could be distorted, however, by a different allocation and electricity prices across Europe. This could have much larger effects than the threat of imports from outside the EU, but this impact will be reduced as of 2013 when the earlier discussed adapted third phase commences (Carbon Trust, 2004).

There are two factors that decrease the likelihood that cost increases can be passed through to consumers, namely the highly fragmented market and the elasticity of demand. The top ten producers in the world account for only 25% of production (McKinsey, 2009), this fragmentation leads to an increased competition between players. Because of this extensive supply, the elasticity of demand is relatively high, as customers will easily swich to a different supplier when he offers a lower price for the same product.

Currently there are few abatement opportunities for the steel industry, except for limited fuel substitution, i.e. the injection of gas into blast furnaces (Carbon Trust, 2004). But several European steel groups are funding an industry wide collaborative research study to develop innovative lower carbon production routes and to improve existing technologies. In the long run there are two main abatement opportunities, namely increasing efficiency and CCS (McKinsey, 2009). Energy-efficiency measures make up 62% of the total abatement potential by 2030 for the industry. These include better maintenance, insulation of furnaces, improved process flows, oxygen injection into Electric Arc Furnaces, improved recuperative burners, etc. All these measures could lead to a reduction of total energy-consumption of 15% to 20%. CCS accounts for 34% of the total abatement potential, but will still take many years. Experts estimate that around 25% of all steel mills will be equipped with CCS in 2030. We will not further discuss CSS, as we have already done this extensively when desribing the abatement opportunities for the electricity sector.

Despite the introduction of the EU ETS, no switch in crude steel production from primary route to secondary has been observed, even though this is a less capital-intensive and less GHG emitting process. This is because this decision depends on the world scrap market which is not expected to be able to satisfy the projected long-term increase in global steel demand (Carbon Trust, 2004).

Most models predicted that the steel industry would not face negative competitiveness effects as a result of the introduction of the EU ETS, despite the high CO_2-intensity and the homogeneous nature of steel. Because of the relatively high caps that have been set in the first two trading phases, this is possible, despite the differences in allocation and credit usage throughout the Member States. When carbon prices rise to high levels, i.e. above €30/tCO_2, it becomes more likely that European production facilities will suffer from competitiveness effects. It could be necessary for governments to set up incentive mechanisms for companies that already suffer from competitive disadvantages to persuade them to switch to emissions-reducing technologies and to intensify their research into CCS.

2.2.3. Cement

Cement is the main ingredient in concrete - the material most often used to construct buildings and infrastructure - and thus very important to economic growth and development. The cement industry is not one of the largest sectors in the EU regarding employment levels as it has a low labour intensity, but it is a very significant sector covered by the EU ETS, because of its high CO_2-intensity. In this paragraph we will first illustrate this importance. Hereafter we will investigate the impact of the EU ETS on the industry's competitiveness. Finally, we will describe some possible abatement opportunities for the sector.

The cement industry is currently dominated by Asian countries - especially China with almost 50% - because of their rapid economic growth and urbanization. The production of the European cement industry amounted to 283 million tonnes in 2007, representing around 10,5% of the world production, but this share is expected to decrease because of a growing production capacity in China and to a lesser extent in the Middle East. The largest producer in the EU-27 is Spain, followed by Italy and Germany (Cement Industry Market Report, 2008). The industry represents 52.800 direct jobs and is responsible for around 3% of all anthropogenic emissions of energy-related CO_2 in the EU-27 (Cembureau, 2009).

In Belgium, the industry employed 1.096 workers directly in 2007 and around 15.000 in industries that are in connection with the cement sector. Febelcem, the federation of the Belgian cement industry, estimates total turnover to be around 486,2 million euro. Since 1990 the Belgian cement production has remained stable at around 6 million tonnes each year, produced by three companies (CBR, CCB and Holcim). These companies have their headquarters and main querries in Wallonia, because of the proximity of raw materials (Febelcem, 2009).

Cement manufacture emits CO_2 in three ways. To produce cement, calcium carbonate is heated in a kiln at very high temperatures and is converted into lime and CO_2. This CO_2 comes from two direct sources. The first one is the de-carbonation of limestone in the kiln (this emits about 525kg of CO_2 per tonne of clinker). The second one is the combustion of fuel in the kiln (responsible for 335 kg of CO_2 per tonne of cement). To produce one tonne of cement, also 60 to 130 kilogrammes of fuel oil-equivalent is required, as well as about 105 kWh of electricity. The third source of CO_2 comes from this electricity and is an indirect one (about 50kg of CO_2 per tonne of cement). In 2006, direct and indirect emissions amounted to about 0,8 tonne of CO_2 per tonne of cement. All these energy costs together account for 30% of the total production cost (Cembureau, 2009). It must also be said that Europe is a world leader in the cement industry in its technical level, because of the large usage of the dry method which saves more energy. Only Japan and South Korea can approximate to the energy efficiency of Europe. In Belgium, the dry method is used for 64% of total production (Febelcem, 2009).

We will now investigate the impact of the EU ETS on the competitiveness of the cement industry. Despite the fact that cement is a homogeneous product - making price the most important parameter next to service differentiation - we believe that there are several reasons for the cement industry as a whole not to be at risk from the EU ETS.

First, studies show that companies only need to pass relatively small cost increases through to customers to maintain their current levels of profitability (Carbon Trust, 2004). In the longer run, larger cost increases might be expected when carbon prices would rise significantly, but these are not likely to reduce their profitability.

Second, because of the local nature of many cement markets, it will be possible for companies to pass these cost increases through as international pressure reduces. When we look at figure 10, we can see very large price differences between different markets. Prices range from more than $110 per tonne of cement in Western Africa, France, the UK and Australia to prices between $20 and $40 per tonne of cement in Russia and China. Main reason why these differences remain, are several trade barriers, i.e. service differentiation, cost of instability, import restrictions and transport costs. Therefore the non EU import ratio is still relatively low – between 5% and 10%. These trade barriers have even increased because of a doubling of freight costs for cement – from $17/t to $40/t – between 2001 and 2005, followed by a further increase to $60/t in 2007 (Demailly, 2007; Ponssard & Walker, 2008).

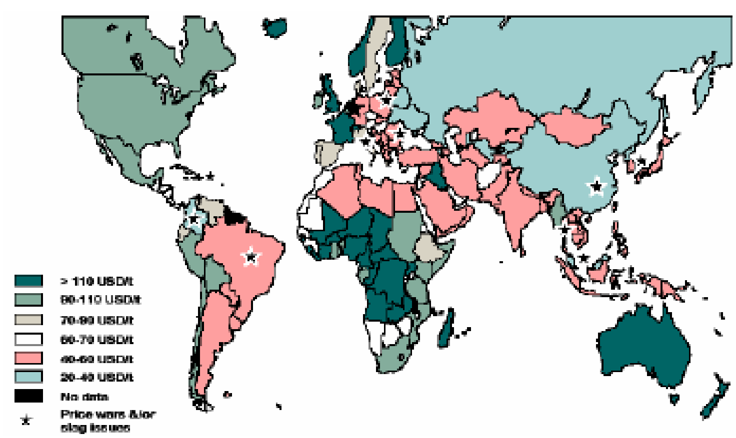

Figure 10: Cement prices around the world, 2007 (Demailly, 2007)

But defining the geographical markets for cement is a very complicated task. Reason for this is the fact that cement, by its nature, can be transported over long distances at sea at reasonable prices, but transporting it over long distances at land is not economically. It is even cheaper to deliver 35.000 tonnes of cement over the Atlantic Ocean than to transport it by road for 300km (Cembureau, 2009). Therefore it can become economically to ship cement to coastal regions from countries that do not face stringent environmental regulations when compliance costs rise for European cement companies. This could lead to carbon leakage, possibly offsetting more than 70% of all emission reductions in the European cement industry. Especially after 2012, when grandfathering will be gradually reduced, this may become a serious threat for companies in coastal regions. Regions further away from the coast will not face that pressure and will not have difficulties to increase their prices in order to maintain their current profitability (Ponssard & Walker, 2008).

When we look at possible abatement opportunities for the industry, we can distinguish three different categories in the short run and one in the long run. All abation levers could reduce emissions by 25% during the next 20 years compared to business as usual (McKinsey, 2009). First, cement producing companies can invest in energy-saving technologies like waste-heat recovery, but this represents only 1% of total abatement potential. A much larger abatement can be reached by improving the energy efficiency in clinker kilns. Second, companies can increase the share of alternative fuels, like municipal and industrial waste and biomass, in their energy mix. This represents 27% of the total abatement potential. Third, companies could substitute clinkers with recycled raw materials like granulated blast-furnace slag or fly ash. Thus, by lowering the clinker/cement ratio, this would also significantly reduce the emissions from the clinker production. This measure represents 50% of the total abatement potential. The abatement opportunity in the long run is CCS, representing 22% of the total potential. But we will not explain this measure for the same reason as mentioned earlier. It should be noted that these percentages are world-wide abatement opportunities; therefore the exact numbers for Europe are likely to be lower.

The cement industry itself, however, has stated that the design of the EU ETS has obstructed significant emission reductions because there have been inadequate incentives for these abatement opportunities. First, it will take 3 to 5 years for the energy efficiency measures to be operative. Second, they accuse the EU of having a too narrow view, as it does not recognize reductions outside the EU ETS regarding alternative fuels. Third, the allocation of allowances should be based on absolute historic emissions from clinker production instead of on current emissions. Finally, the industry believes that new installations are punished, because they receive fewer allowances than incumbent installations. As a consequence, this has created an uncertain business environment, a deferral of investment decisions and additional costs without additional reductions (Presentation Holcim, COP11, 2005).

2.2.4. Petrochemical Industry

This industry has been selected because of its importance to the Belgian economy and its considerable emissions. First, we will describe the industry. Then, we will investigate the impact of the EU ETS on the sector. Finally, some possible abatement opportunities will be proposed.

The petrochemical industry is of utmost importance to the Belgian economy. It accounts for 160,000 direct and indirect jobs and has an annual turnover of €33 billion. Furthermore it represents more than 20% of all Belgian exports. When we compare it to the European sector, the Belgian activities are responsible for 8% of the total turnover in Europe and even for 17% of all European exports of chemicals. Due to its proximity to the North Sea, the industry (with multinationals like BASF, Bayer, Borealis, BP, DuPont & Total) is situated mainly in Flanders, stretching from Ostend - down through Ghent - to Antwerp. The Port of Antwerp even hosts the largest cluster of petrochemical activity in Europe with more than 85 large petrochemical facilities. There are five refineries and four crackers situated here, making it a major producer of the six main petrochemical commodities, i.e. ethylene, propylene, butadiene, benzene, toluene and xylene. The Port is also the main hub of the Western Europe pipeline network (Flanders Investment & Trade, 2007). Companies are still investing in Belgian facilities to increase their capacity. In the beginning of 2008, BASF for example, expanded the capacity of its naphtha steam cracker at Antwerp, making it the largest single-train steam cracker in Europe.

According to market reports, the Belgian petrochemical industry is exposed to the market cycle and oil price trends because of its export orientation and its lack of domestic fuel supply. But the high level of integration and the ongoing capacity expansion still protect the industry (Belgium Petrochemicals Report, 2009).

There are three main reasons to believe that the petrochemical industry has not suffered from the introduction of the EU ETS in 2005.

Firstly, cost increases due to CO_2 are relatively small – around 1 to 3% of running costs if 10% extra allowances would have to be acquired – when we consider the large amount of grandfathered allowances. In the long run - when all allowances will be auctioned - they could reach between $1 and $2 per barrel of crude oil (bbl) entering the refinery. When we compare this with the regular refinery margins in North West Europe of $-1/bbl and $+6/bbl at current crude oil prices of around $45/bbl (Bloomberg, 2009), this represents a relatively high cost (Reinaud, 2005). But full auctioning is not expected to be implemented in the refinery industry in the next 20 years and therefore does not threaten current profitability.

Secondly, there are several European countries that almost exclusively depend on European refineries for certain products – e.g; aviation gasoline or kerosene. This increases the possibility for these players to pass a large share of their CO_2 costs through to consumers, hereby possibly triggering additional profits (Reinaud, 2005).

Thirdly, there are two barriers that prevent imports of foreign finished products to the EU. The first is one is due to other European environmental specifications, like the sulphur specification. In China and India, finished products like gasoline or diesel are allowed to contain two to three times the amount of sulphur that these products may contain in the EU. Therefore, Indian and Chinese companies have to invest in desulphurisation in order for their finished products to be in compliance with the EU legislation. This implies an additional cost of $2/bbl to $4/bbl, which makes it uneconomically to export these products. It must be stated however, that these required EU specifications also demand more CO_2 intensive refinery configurations for European refineries, leading to increased costs to comply with the EU ETS. This correlation between desulphurisation and increased CO_2 emissions from gasoline and diesel is shown in figure 11. The second barrier comes from the relatively high freight costs for 'clean vessels' (Reinaud, 2005).

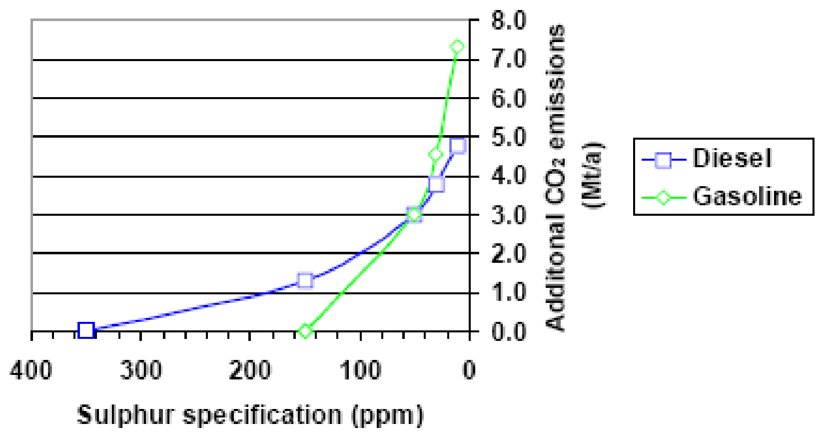

Figure 11: CO_2 emissions increases following higher environmental specifications (Concawe, 2005)

Despite these three reasons, the industry itself is still concerned about the impact of two indirect consequences of the EU ETS. Their first concern is about rising electricity prices, as this affects all refineries that purchase electricity from the grid instead of generating it themselves. This will certainly have an impact on these refineries as of 2013 when all allowances for power generators will be auctioned. We have already shown that it is very likely that electricity generating companies will pass these cost increases through to consumers and thus also to refineries. Their second concern comes from the possibility that natural gas prices will rise, because a growing number of refiners and electricity generating companies will be switching to cleaner fuels, like natural gas. This rising gas price on its turn will probably lead to higher electricity prices (Reinaud, 2005).

The main abatement opportunities in the petrochemical industry in the short term come from energy-efficiency improvements, like waste-heat recovery, replacing or upgrading equipment, etc. Over the past 15 years, the industry has already substantially reduced its GHG-emissions intensity (McKinsey, 2009). In the long run also CCS becomes viable, but also in this sector the main obstacles for this technology are the technological maturity and the funding. Again we will not further discuss CSS.

2.3 Conclusion

In this chapter, we first enumerated the factors that determine an industry's inherent exposure to competitiveness effects caused by the implementation of the EU ETS, i.e. the industry's energy intensity, the ability to pass cost increases through to consumers and the amount of abatement opportunities. Hereafter, we described our four selected industries and investigated to which degree these factors apply to these industries. For the electricity industry in particular, we also conducted a case study of Electrabel. We will shortly sum up our main findings for each sector.

Electricity producing companies can easily pass cost increases, due to the EU ETS, through to their consumers, because of a low price elasticity of demand, their own market power and the nature of the product. They also have several abatement opportunities available, which will limit their overall cost increase. Our case-study of Electrabel has also showed that this particular company was not reluctant to the trading scheme. Other sources, like the energy watchdog CREG, believe that Electrabel has even been able to benefit from the introduction of the EU ETS, because they received grandfathered allowances. Luckily, this practice will be eliminated as of 2013, when energy companies will have to acquire all their allowances.

The steel industry was expected to suffer the most from the EU ETS and production and employment levels have indeed been falling, but this is more likely to be caused by the decreasing cost-competitiveness of the obsolete production facilities in Wallonia. Reason for this is that there are a number of other barriers, like transportation costs or political instability, which prevent companies from relocating their facilities. It could be however that steel companies will suffer from the EU ETS when carbon prices would heavily increase.

The cement industry is also not likely to suffer from the EU ETS for a number of reasons. Firstly, only small cost increases will have to be passed through to consumers to maintain current profitability. Secondly, there already exist large price differences around the world, thus many cement markets have a local nature. Furthermore, there are also a number of abatement opportunities for the industry. This reduces the likelihood that the profitability of cement manufacturers will decrease because of the EU ETS.

Finally, the petrochemical industry is also not expected to suffer from the introduction of the EU ETS for several reasons. First, the petrochemical companies will only have to pass small cost increases through to consumers, because of the large share of grandfathered allowances they receive. Furthermore, companies from China or India would have to invest in desulphurisation, before they can export their products to Europe. This investment would offset their cost advantage compared to the more expensive European petrochemicals. Finally, there are relatively high freight costs. But the industry is still worried about some indirect effects of the EU ETS, i.e. increasing electricity and natural gas prices.

Overall, we can conclude that most industries will not suffer from the EU ETS when carbon prices do not rise sharply.

General Conclusion

In this conclusion, the major findings of this master thesis will be summarized together with some implications for policy-makers and our evaluation of this thesis.

Hopefuly, the reader of this master thesis will now understand that the problem of climate change is not an issue discovered during the second half of the 20th century, but that scientists, like Svante Arrhenius, have already published their findings on the topic at the end of the 19th century. Since then, there has been a growing awareness and understanding of the subject, probably culminating when former US Vice-President Al Gore released his documentary *An Inconvenient Truth* in 2006 (for which he received the Nobel Peace Prize, together with the IPCC, a year later). As we have explained in chapter one, there are currently three certainties regarding climate change. First, global warming exists and it is unequivocal. Second, human kind is causing this global warming. Third, very negative consequences will occur for mankind as a result of this global warming. For all these reasons, it is very important that international agreements to reduce CO_2 emissions - like the Kyoto Protocol - are being signed and that the European Union is playing a leading role in the global transition to a climate-friendly economy. Europe has committed itself to reducing its CO_2 emissions by 20% by 2020 and even by 30% when other major emitters engage themselves to comparable reductions. The main tool for the EU in reaching this commitment will be the EU ETS, which we have extensively dealt with in the first chapter. But many national politicians are frightened of implementing demanding emission reductions, even though we have shown in chapter two that the EU ETS has had little negative effect on the competitiveness of the most emitting industries in Belgium, i.e. the electricity producing industry, the steel industry, the cement industry and the petrochemical industry.

To conclude we can say that the climate change problem will be the most challenging issue of the 21th century. But the worst consequences can still be avoided if decisive action is taken now. Therefore the EU should remain urging for a bald and far-reaching international agreement that can succeed the current Kyoto Protocol when it expires in 2012. Hopefully, the economic crisis of 2008 and 2009 will not have an adverse effect on the quest for such an agreement. National politicians of EU Member States should not try to tone down some aspects of the EU ETS for specific industries. We have shown in chapter two that most industries will not face negative impacts as a result of the introduction of the EU ETS and could possibly even benefit from it. This is in line with the Porter Hypothesis which states that governments can induce efficiency and encourage innovations that will improve commercial competitiveness by setting strict environmental regulations. In our opinion, the adaptations to the EU ETS, that will come into operation as of 2012 (when the third phase starts) will ensure an equal treatment for all companies covered by the EU ETS and will also benefit consumers as all allowances for the electricity sector will be auctioned.

Overall, this document has not become a searching econometric analysis of the competitiveness effects of the EU ETS, as this would go far beyond the scope of the master thesis, but hopefully it does provide the reader an interesting and useful overview of the problem of climate change, an introduction to the mechanisms of the EU ETS and the main consequences for the competitiveness of our four selected industries in Belgium.

Appendices

Appendix I : Examples of some Projected Regional Impacts associated with Global Average Temperature Changes (IPCC, 2007)

Africa	• By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change. • By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition. • Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of Gross Domestic Product (GDP). • By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenarios (TS).
Asia	• By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease. • Coastal areas, especially heavily populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers. • Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation and economic development. • Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle.
Australia and New Zealand	• By 2020, significant loss of biodiversity is projected to occur in some ecologically rich sites, including the Great Barrier Reef and Queensland Wet Tropics. • By 2030, water security problems are projected to intensify in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions. • By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia, and over parts of eastern New Zealand, due to increased drought and fire. However, in New Zealand, initial benefits are projected in some other regions. • By 2050, ongoing coastal development and population growth in some areas of Australia and New Zealand are projected to exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding.
Europe	• Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods and more frequent coastal flooding and increased erosion (due to storminess and sea level rise). • Mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses (in some areas up to 60% under high emissions scenarios by 2080). • In southern Europe, climate change is projected to worsen conditions (high temperatures and drought) in a region already vulnerable to climate variability, and to reduce water availability, hydropower potential, summer tourism and, in general, crop productivity. • Climate change is also projected to increase the health risks due to heat waves and the frequency of wildfires.
Latin America	• By mid-century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savanna in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. • There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America. • Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones, soybean yields are projected to increase. Overall, the number of people at risk of hunger is projected to increase (TS; *medium confidence*). • Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.
North America	• Warming in western mountains is projected to cause decreased snowpack, more winter flooding and reduced summer flows, exacerbating competition for over-allocated water resources. • In the early decades of the century, moderate climate change is projected to increase aggregate yields of rain-fed agriculture by 5 to 20%, but with important variability among regions. Major challenges are projected for crops that are near the warm end of their suitable range or which depend on highly utilised water resources. • Cities that currently experience heat waves are expected to be further challenged by an increased number, intensity and duration of heat waves during the course of the century, with potential for adverse health impacts. • Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution.

continued...

Polar Regions	• The main projected biophysical effects are reductions in thickness and extent of glaciers, ice sheets and sea ice, and changes in natural ecosystems with detrimental effects on many organisms including migratory birds, mammals and higher predators. • For human communities in the Arctic, impacts, particularly those resulting from changing snow and ice conditions, are projected to be mixed. • Detrimental impacts would include those on infrastructure and traditional indigenous ways of life. • In both polar regions, specific ecosystems and habitats are projected to be vulnerable, as climatic barriers to species invasions are lowered.
Small Islands	• Sea level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities. • Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources. • By mid-century, climate change is expected to reduce water resources in many small islands, e.g. in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods. • With higher temperatures, increased invasion by non-native species is expected to occur, particularly on mid- and high-latitude islands.

Note:
Unless stated explicitly, all entries are from Working Group II SPM text, and are either *very high confidence* or *high confidence* statements, reflecting different sectors (agriculture, ecosystems, water, coasts, health, industry and settlements). The Working Group II SPM refers to the source of the statements, timelines and temperatures. The magnitude and timing of impacts that will ultimately be realised will vary with the amount and rate of climate change, emissions scenarios, development pathways and adaptation.

Appendix II: Categories of Activities referred to in Directive 2003/87/EC (European Commission, 2003)

1. Installations or parts of installations used for research, development and testing of new products and processes are not covered by this Directive.

2. The threshold values given below generally refer to production capacities or outputs. Where one operator carries out several activities falling under the same subheading in the same installation or on the same site, the capacities of such activities are added together.

Activities Greenhouse gases

Energy activities

Combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations)

Mineral oil refineries

Coke ovens

Production and processing of ferrous metals

Metal ore (including sulphide ore) roasting or sintering installations
Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour

Mineral industry

Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day

Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day

Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m3 and with a setting density per kiln exceeding 300 kg/m3

Other activities

Industrial plants for the production of
(a) pulp from timber or other fibrous materials
(b) paper and board with a production capacity exceeding 20 tonnes per day

Appendix III: Emission Allowances and Kyoto Targets in the EU 2005-2012 (European Commission, 2007)

EU member state	Kyoto target (% change against base year)	2005-2007		2008-2012	
		Allocated CO_2 allowances (MT per year)	Share in EU	Allocated CO_2 allowances (MT per year)	Share in EU
Austria	-13%*	33.0	1.4%	30.7	1.5%
Belgium	-7.5%*	62.1	2.7%	58.5	2.8%
Bulgaria	-8%	42.3**	1.8%	42.3	2.0%
Cyprus	-	5.7	0.2%	5.48	0.3%
Czech Republic	-8%	97.6	4.2%	86.8	4.2%
Denmark	-21%*	33.5	1.4%	24.5	1.2%
Estonia	-8%	19	0.8%	12.72	0.6%
Finland	0%*	45.5	2.0%	37.6	1.8%
France	0%*	156.5	6.8%	132.8	6.4%
Germany	-21%*	499	21.7%	453.1	21.8%
Greece	+25%*	74.4	3.2%	69.1	3.3%
Hungary	-6%	31.3	1.4%	26.9	1.3%
Ireland	+13%*	22.3	1.0%	22.3	1.1%
Italy	-6.5%*	223.1	9.7%	195.8	9.4%
Latvia	-8%	4.6	0.2%	3.43	0.2%
Lithuania	-8%	12.3	0.5%	8.8	0.4%
Luxembourg	-28%*	3.4	0.1%	2.5	0.1%
Malta	-	2.9	0.1%	2.1	0.1%
Netherlands	-6%*	95.3	4.1%	85.8	4.1%
Poland	-6%	239.1	10.4%	208.5	10.0%
Portugal	+27%*	38.9	1.7%	34.8	1.7%
Romania	-8%	74.8**	3.2%	75.9	3.6%
Slovakia	-8%	30.5	1.3%	30.9	1.5%
Slovenia	-8%	8.8	0.4%	8.3	0.4%
Spain	+15%*	174.4	7.6%	152.3	7.3%
Sweden	+4%*	22.9	1.0%	22.8	1.1%
United Kingdom	-12.5%*	245.3	10.7%	246.2	11.8%
Total		2298.5	100%	2080.93	100.0%

* Under the Kyoto Protocol, the EU-15 (the group of 15 countries that were EU Member States before May 2004 has to reduce its collective greenhouse gas emissions to 8 % below 1990 levels during 2008–12. This target is shared among the 15 Member States, marked with (*), under a legally binding agreement (Council Decision 2002/358/EC of 25 April 2002). The 12 Member States that have joined the EU since 2004 have individual targets under the Kyoto Protocol with the exception of Cyprus and Malta, which have no targets.
** Only for 2007

Appendix IV: Questionnaire for the interview with Mr. Paul Van De Heijning, Electrabel (20/4/2009)

- How does Electrabel evaluate the introduction of the EU ETS so far?
- What does Electrabel considers as the largest shortcomings of the system uptil now?
- Are these shortcomings being resolved by the adaptations to the system that will come into force in phase 3?
- Which effect did the introduction of the EU ETS have on the performance of the company? Will this change when all emission allowances will have to be purchased as of 2013?
- Does regulation like the EU ETS lead to innovation?
- Which measures has Electrabel taken to reduce its emissions of CO_2,
- Has electrabel passed cost increases through to its customers? Did this lead to the any windfall profits?
- Are renewable sources already profitable for Electrabel?

List of figures

List of tables

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Glossary

Anthropogenic: Caused or Produced by humans

Bbl: Barrel. Unit of volume for crude oil and petroleum products (equals 159 litres).

Carbon Leakage: Occurs when CO_2 emissions in one country increase as a result of a reduction of emissions by a second country with stringent environmental legislation. Carbon leakage can occur for a number of reasons. By reallocating CO_2-intensive production to third countries with a less stringent environmental legislation than in the country of origin or by an increasing demand for products with a price premium, because of the more relaxed rules in their country.

CCS: Carbon Capture & Storage. CCS sequestrates CO_2 that otherwise would be released in the atmosphere, then compresses it into liquid form, transports it to a given location via existing pipeline networks or ships and finally injects it into geological formations deep underground or into depleted gas fields

CDM: Clean Development Mechanism allows countries with an emissions-limitation commitment to finance emission-reduction projects in developing countries (See CER).

CER: Certified Emission Reduction. Credits countries with an emissions-limitation commitment receive for financing projects under the CDM.

CFCs: Chlorofluorocarbons.

COP: Conference of the Parties. Term used for meetings of the UNFCCC.

EAF: Electric Arc Furnace

Energy Intensity: The amount of energy that is needed per unit of production. Often defined as the ratio of Primary Energy Supply to Gross Domestic Product.

ERC: Emissions Reduction Credits. Countries receive ERCs for financing projects under JI.

EUA: EU Allowance Unit of One Tonne of CO_2. Credits used under the EU ETS, gives the holder the right to emit one tonne of CO_2. EUAs can be used, sold or banked.

EU ETS: European Union Emissions Trading Scheme

GHGs: Greenhouse Gases. Trace gases that absorb infra-red radiation, herby controlling energy flows in the Earth's atmosphere. Some GHGs occur naturally in the atmosphere, while others result from human activities. Six GHGs are covered under the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). CO_2 is the most important GHG released by human activities.

Grandfathering: Emissions Rights are given away free of charge by governments, instead of auctioning them. This can lead to windfall profits, as businesses receive these allowances freely, but can sell their remaining ones.

IPCC: Intergovernmental Panel on Climate Change.

JI: Joint Implementation. Allows an Annex I country to invest in emission reduction projects in any other Annex I country (See ERCs).

Linking Directive: Directive 2004/101/EC of the EU established a connection between the EU ETS and the flexible mechanisms set up under the Kyoto Protocol (CDM and JI).

MOC: Meridional overturning circulation.

NAP: National Allocation Plan

‘Porter Hypothesis’: By setting strict environmental regulations, governments can induce efficiency and encourage innovations that will improve commercial competitiveness and that will eventually offset the cost of compliance with these environmental standards.

Price Elasticity of Demand: Percentage by which demand changes when price goes up by 1%.

UNFCCC: United Nations Framework Convention on Climate Change.

Windfall profits: A type of windfall gains. Windfall profits can stem from unforeseen circumstances in the market, like unexpected demand or government regulation.