Climate Innovation Impact of the EU Emission Trading Scheme and Danish companies – A 10. Semester Master

Author: Lars Madsen

Department of Development and Planning

Aalborg University

September 2012

Department of Development and Planning

M.Sc. Sustainable Energy Planning and Management, 4nd semester

Vestre Havnepromenade 5, 1.

9000 Aalborg

Telephone: (+45) 99 40 84 29

Title:

Climate Innovation Impact of the EU Emission Trading Scheme and Danish companies

Project Period:

01-05-2012 to 10-09-2012

Project group:

SEMP42012-15

Group Member:

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Lars Rysgaard Madsen

Supervisor:

Per Christensen

Martin Lehmann

Number of copies: 4

Number of pages: 75

Hand in date:

10. September 2012

Abstract

This report investigates the effect of the EU ETS on Danish companies. More specific the impact a specific allocation method on the strategies used by companies towards the EU ETS. To investigate this, the following research question was created: *"How does the choice of allocation method influence the EU ETS's ability to incentives Danish companies to reduce GHG-emissions?"*

The study is done on the basis of survey conducted among 68 companies, where 29 companies participated. The study is split into two parts, part 1 investigating the impact of grandfathering in the first and second period of the EU ETS. Part 2 investigates the expected effects of the introduction of benchmarking allocation method in the third period.

Part 1 of the project shows that the EU ETS has an impact on Danish companies. Companies have adapted to the system by trading in the market and investing in reducing their GHG-emissions. However the current EU ETS will not bring about a change in the technology companies use.

In part 2 it is uncovered that the changed to stricter benchmarking allocation method from 2013, for some companies, will not change significantly in the behaviour of companies towards the EU ETS. Other support policies are needed to incentivise a change to less carbon intensive technology.

1. Preface

This report is a master thesis made as part of the 4nd semester at the M.Sc. programme Sustainable Energy, Planning and Management at Aalborg University.

Special thanks to

During the project period, my supervisors, Per Christensen and Martin Lehmann have been helpful in giving guidance and advice to the project. I would also like to give my thanks to the people in the 29 companies participating in the survey. The project would not have been possible, if these people had not spent their time to fill out the survey.

Reading guidance

References to sources of information follow the Chicago style. If the reference is used for only one sentence, it is placed at the end of this sentence, however if the reference is used for the entire paragraph, it is placed at the end of the section. A complete bibliography is found in the end of the report. References to chapters, figures, tables and appendixes in the text follows the below principles;

- References to chapters are indicated by chapter or section and the number (e.g. chapter 5 or section 5.3).
- Figure and table referencing are numbered throughout the report starting with 1.
- Appendices are numbered with letters starting from A and are to be found on the attached CD.

Target group

Firstly, it is written with respect to the supervisor and external examiner attached to this project. In addition to this it addresses multiple audiences, as it can be directed to students interested within the EU ETS and its future development. It can also be directed on a broader scale; to everyone interested in the field of energy planning; to industries or Non-Governmental Organisations (NGOs) seeking information on the EU ETS market.

2. Acronyms and abbreviations

CDM	Clean Development Mechanism
CO_2	Carbon Dioxide
ECCP	European Climate Change Program
EEX	European Energy Exchange
CFA	Constant free allocation
RFA	Reducing free allocation
ETS	Emissions Trading Scheme/System
EU	European Union
EU ETS	European Union Emissions Trading Scheme/System
EUA	European Union Allowance
GHG	Greenhouse Gas
JI	Joint Implementation
N_2O	Nitrous Oxide
NAP	National Allocation Plan

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1. Introduction

Climate change is one of the most important treats the human race and the earth. It will have a large environmental, social and economic impact, if the challenge is not meet. The main reason for climate change can be tracked back the burning fossil fuels, livestock farming, deforestation, aviation and so on, which result in the emission of greenhouse gases (GHG). Carbon dioxide (CO_2) is the main contributor, but there are several other gases (e.g. methane gas). (IPCC, 2007) The EU Emissions Trading Scheme (EU ETS) is the EU's answer to help solve the climate change issue, by reducing GHG-emissions from industry.

The EU ETS is the largest multi-national carbon trading market in the world. It was launched in 2005 based on the mechanisms outlined in the Kyoto Protocol however it is an EU policy. The EU considers the EU ETS a "corner stone" of the European climate policy in order to reach the Kyoto goals, according to which the EU has to reduce its greenhouse gas emissions (GHG) from the 1990 levels by 8 % by 2012 and by 20 % by 2020 (Ramakrishnan, 2008).

The EU ETS covers almost 12.000 energy intensive installations in 30 countries (27 EU member states, Iceland, Norway, Liechtenstein), including power plants, iron and steel factories, oil refineries, cement and glass installations as well as paper mills, lime, bricks, ceramics, pulp and board making installations. These correspond to almost half of Europe's CO_2 emissions and 40 % of EU's total GHG emissions (European Commission, 2010; Ramakrishnan, 2008).

The EU ETS is based on a cap-and-trade principle. This is a market based instrument, where an installation is allowed to emit an established limit of GHGs and can trade potential surplus of allocated allowances. The emission trading system is an instrument based on political legislation and is seen to be efficient to manage and reduce GHG emissions. An industry within the scheme has a cap to what it is allowed to emit and if it exceeds the limit, it is forced to buy additional allowances to cover the excess emissions. On the other hand, if the industry manages to emit less than the limit, then it can sell the extra allowances – the selling and buying of allowances creates a market with a price on emissions, which encourages a continuous increase in efficiency of the industry within the scheme (International Emissions Trading Assosiation, 2011).

It is quite ironic that the EU ETS became the corner stone of the EU climate policy. The European Commission already proposed a tax on carbon emissions in the 90s, but failed due to unanimity, required for every fiscal decision taken by the Commission. In 1997,

in the same year as the carbon tax proposal was officially declined by the Commission, the Kyoto protocol was ratified, including an outline for the flexible mechanisms to reduce emissions. Exactly these flexible mechanisms, including emissions trading have been unsuccessfully opposed by the European Union during the Kyoto negotiation process (Convery, 2009). Convery (2009, pp. , 393) relates it to the Bible quote: *"the stone which the builders rejected had become the corner stone." (Psalm 118:22).*

If the EU ETS is the corner stone of the EU climate policy, the question whether the EU will reach their emission reduction goals or fail doing so is mainly connected to the question of effectiveness of the EU ETS. Since the EU ETS has been in effect for soon 8 years, many authors have already evaluated the effectiveness and failures of the ETS. Zhang and Wei (2010) and (Ellerman, Convery, & Perthuis, 2010) give a comprehensive overview of the literature, where many problems have been identified and traced back to the ETS allocation mechanisms; mainly based on free allocation of allowances. The problems, which have achieved the most attention of researchers and critic's, are price volatility and over-allocation of allowances.

These problems are merely problems for an overall achievement of an emission reduction, and not for all the individual actors within the EU ETS. On the contrary, some actors benefit from these problems. Mainly the polluting industry has an interest in an ineffective EU ETS. These industries have from design process of the EU ETS fought against a strict allocation method, as this could affect their competitiveness outside the EU. Skoerseth and Wettestad (2008) and Rusche (2010) find evidence of how industry interests have shaped the EU ETS from its very beginning. The loss of competitiveness could result in carbon leakage, which the closing and move of production and carbon emissions will "leak" out of the EU to the surrounding world.

However problems with the EU ETS emerged after a short time and in 2009 a review was completed. This process have lead to new and stricter rules, which from 2013 will harshly cut down in the number of free allowances (Ellerman, Convery, & Perthuis, 2010). It will be interestingly to see, if tightening in allocation method will solve mentioned problems and create an EU ETS, which will lead to reduction in GHG-emissions from industry.

This will be the focus of this project to try to assess the effectiveness of the EU ETS to reduce emissions from industry. Solving the climate change issue will requires rapid and significant technological change, because a "business-as-usual" strategy is not sufficient to generate the required GHG-emission reduction. The question is if the

current and future design of the EU ETS will create sufficient incentive to companies to reduce their emissions.

With this in mind an interesting study was conducted in 2009, which had a focus on Danish companies and their cooperate strategies towards the EU ETS (Zhang & Than Tran Thi, 2009). This study concluded that Danish companies up until 2009 had a compromising approach to the EU ETS and tried to find ways to manoeuvre within the system. The companies had not adopted new less carbon intensive technology, because of the EU ETS. It will be interesting to see, if three more years in the system and newer more strict allocation methods from next year, will get companies to invest in technology and reduce their emissions.

This report will is divided into 8 chapters, where the introduction is the first. Chapter 2 will look at the design and success of the three periods of the EU ET and chapter 3 will look at the EU ETS and its implementation in a Danish context. In Chapter 4 the problem formulation and method will be described and Chapter 5 and 6 will present the results of the project. In chapter 7 the main conclusions of the project will be drawn up and few interesting perspectives will be looked at.

2. The EU ETS

This chapter will focus on the overall development and design of EU ETS. First the design of the EU ETS in the two trading periods will be covered. This followed by section looking in detail on the main problems seen in the first two periods of EU ETS and carbon leakages, which is the industry main concern relating the EU ETS. Than the coming third period will be described, which is the future of the EU ETS and should help solve the problems generated in the two first periods. Next a section will look at the three different allocation methods used in the EU ETS. Lastly a short summary will sum up this chapter in a table.

2.1 First trading period of the EU ETS

The first trading period of EU ETS ran from January 2005 to December 2007 in all three years. It was implemented as a 'learning by doing' period in order to get prepared for the second trading period (European Commission, 2008). This trial period was characterized as a warm-up phase for the participants (companies and countries) involved with the EU ETS. The scope was not to achieve significant reductions in CO_2 emissions, especially in a three year period, but to have a first-hand experience with the emissions trading instrument and prepare the necessary infrastructure for the First Commitment Period (second trading period) under the Kyoto Protocol (Ellerman & Joskow, 2008) (Ellerman, Convery, & Perthuis, 2010).

Due to insufficient data in the first trading period, it was decided that 95 % of allowances were allocated freely and only 5 % could be auctioned[1]. However, this allocation process was not run by the EU, but from each member state separately via its own NAP. Although all NAPs had to be approved by the Commission, this led to serious variation and difficulty in the allocation process (Ramakrishnan, 2008) (Ellerman, Convery, & Perthuis, 2010).

Since this trading period was a trial period for the preparation of EU ETS to achieve the Kyoto protocol's target, there was no official reduction target other than the 8 % reduction below 1990 levels by 2012. The cap was set at 2,29 billion tons per year in more than 10.000 facilities in 27 EU member states (European Commission, 2007). Important features of the period were the quick development of private markets for the trading of European Union Allowances (EUA) and the start of a spot market in 2005.

[1] Allocation methods will described in the end of this chapter.

The total emissions were verified at almost 2 billion metric tons each year of the trading period (European Commission, 2008). After the submission of the emission reports by the member states, it was found that the total verified emissions from EU ETS installations in the EU-25 (excluding Malta) had actually been increased by 1,9 % during the first period (Ramakrishnan, 2008). As stated by the European Environment Commissioner, Stavros Dimas, studies indicated that without the use of EU ETS, emissions would be much higher. However, the emissions increase showed how important it was to establish a stricter emission cap in the second trading period, in order to reach the Kyoto emission targets by 2012 (European Commission, 2008).

2.2 Second trading period of the EU ETS

The second trading period of EU ETS runs from January 2008 to December 2012 in all five years and is thereby not yet complete. It is known as the "commitment period", because it runs at the same time as the Kyoto Protocol's commitment period, during which, all involved countries have to decrease their GHG emissions. Moreover, in this period, three non-EU members were integrated in the scheme, namely Iceland, Norway and Liechtenstein (European Commission, 2008; Ramakrishnan, 2008).

On November 29th 2006 the EU Commission approved NAPs II for the second trading period (Duerr, 2007), but many changes have been implemented since NAPs I. These changes are considered improvements and the main are the following: a) the European Commission made clear "objective" projections (based on 2005 verified emissions data from all member states), and established an EU-wide formula to achieve equal treatment to all member states, b) allocation is limited in order to meet the Kyoto target, but benchmarking is slightly increased (although still limited to the power sector), c) auctioning is concentrated on the power sector, d) reducing the cap often results to reduction of auctioning and e) NAPs II were stricter than NAPs I.

Finally, one might notice important things and lessons during NAPs II. Firstly, the Commission revised the NAP guidance in the form of "suggestions", but with mandatory rules to all member states, both for the allocation as well as national caps. Secondly, ex-post adjustments no longer exist and if one NAP II is not able to comply with one criterion, then all of it will be rejected. Thirdly, the general demand was to end free allocation (especially for sectors transferring emission costs to their customers) and some NAPs II had far stricter reduction targets in the energy sector (e.g. Germany and Netherlands) than in NAPs I. NAPs II based their allocation on benchmarking rather than grandfathering (historical emissions) (Duerr, 2007).

The allocation of allowances in the second period was also mostly for free, like in the first period. However with the slight difference that in second period, 90 % of allowances was distributed freely and 10 % should be auctioned, which means a 5 % difference from the first period. In addition, after the so- called "Linking Directive" was revised in 2004, companies have the option to use credits from projects related to CDM and JI but only to a limited proportion of their allocation of emission allowances. More specifically, this credit is set to 10 % of the member state's overall allowances. (European Commission, 2008; Ramakrishnan, 2008).

According to the Kyoto Protocol, the 15 countries which were EU members at the time (EU-15) had to reduce their emissions in the second trading period by 8 % below 1990 levels. The monitoring of the emissions indicated that this target will be achieved by 2012 (European Commission, 2010).

The cap in the second trading period is set at 2,08 billion of allowances, which means 10,5 % less than the cap for the first period (European Commission, 2007).

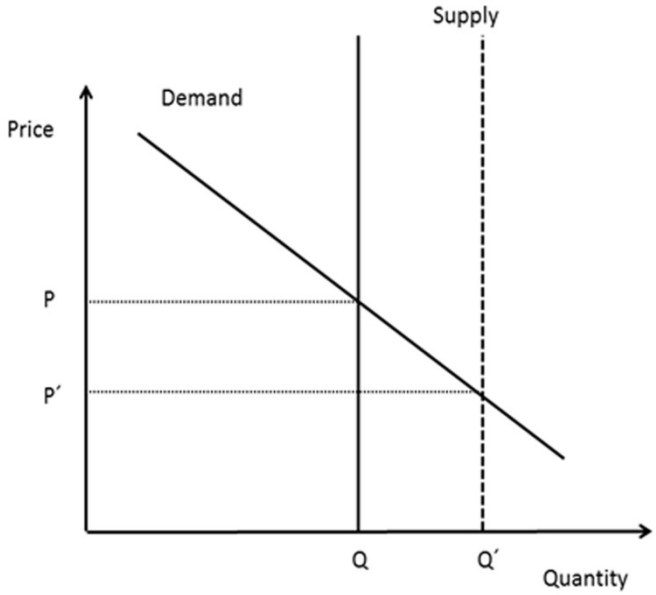
The total emissions so far until 2010 are calculated at approximately 5 billion metric tons from 2008 until 2010 (Carbonmarketdata, 2011).

2.3 Problems of the EU ETS

This section will as mentioned above look at three different problems related to the EU ETS. Two of the problems are connected to the design of the EU ETS, over-allocation and volatile carbon prices. Carbon leakages, the last problem, is a potential consequence if the EU ETS regulation is to tight and harm industry competitiveness.

2.3.1 Over allocation

For a market based instrument like the EU ETS to function the demand and the supply will meet in an optimal equilibrium, fixed by the "invisible hand of the market". But if allowances are not auctioned, the market cannot be considered as a real market, as the supply curve is set artificially by the NAPs. This can lead to over-allocation of allowances, as shown in the figure below:



As the supply curve is set by the NAPs, the market mechanisms that would lead to the quantity of Allowances Q, are cancelled and replaced by the distributed amount Q´. If quantity Q´ is higher than Q, it is over-allocation. This means that more allowances are allocated than used, so a high potential of emission savings is wasted. Another result is lower prices of allowances. In the figure above this is the difference between Q and Q´.

To set CO_2 emission reduction goals for companies covered by the ETS Directive, a certain amount of data is required. The emission baseline must be determined, projected emissions of each sector must be defined to assess their potential for reducing emissions and thus determine the amount of effort that would be required. The problem is that such data is difficult to collect and its validity has been disputed. Especially before the first period, reliable data and emission measures were rare. To determine the baseline, it was necessary to take account of recent historical emissions of each installation, for which details were available, and it is essential to monitor, verify and report emissions data for installations subject to the cap (Tabau, 2008).

These problems of modelling and data reliability and the uncertainty connected to predictions, explain that during the first trading period of the ETS, the member states underestimated the capacity of reduction of GHG-emissions. All these allowances during the first period, led to the market collapsing because of an "over-allocation" of allowances. This over-allocation of allowances led to a high drop of allowance prices, as it will be described below. For example, if it is estimated that a company has low reduction capacity, whereas in reality it is higher, then this company will be allocated too many allowances. If this is the case for many companies, they can sell their free

extra allowances and, as a result, the demand disappears from the market and the price of allowances falls (Tabau, 2008).

The NAP reduction goals had to be re-evaluated and to be more ambitious in order to avoid creating a surplus and not having a sharp decrease in allowances prices. For the first trading period, the EU ETS was expected to achieve a reduction of only 1 to 2 %, which is a low reduction capacity as mentioned before, and that is the reason why the system failed. To optimise the system, the European Commission and the member states had to find an appropriate amount of reduction. This was difficult, as needed data was not available and the system was based on predictions. For these reasons, some member states and sectors received more allowances than necessary in the first place (Ellerman A. J., 2008).

2.3.2 Price volatility

The allowances price in the market depends on the confrontation between supply and demand, and since conditions of supply and demand can develop in unpredictable ways, price volatility can be a result. This volatile price can be a problem, as companies want a stable business environment and the unstable price creates uncertainty. This leads to a lack of action from the companies, as they will be less likely to invest, if the future market conditions are unknown and uncertain.

The price of allowances for each day since the beginning of the EU ETS is published by the European Energy Exchange (EEX) (EEX, 2012), one of the main trading places for allowances. The prices started at around € 20 until the beginning of 2006. At this date, the winter in Europe was really cold, and had a positive impact on the EUA prices, which increased to € 30. When the verified emissions from each member state for the year 2005 were announced in April 2006, the allowances price decreased to almost € 15 at the end of the spring. In addition, a warm summer in 2006 and winter in 2007 affected the market, less electricity and heat was demanded, thus fewer allowances were needed for the production. In 2008, allowances for the new period were allocated, and over-allocated allowances from the first period became useless, as they were not valid for the second period. This meant the market in beginning of 2007 was flooded with cheap allowances and the prices dropped to approximately € 0 to the end of the first trading period (Ellerman A. J., 2008).

The prices started to rise at the beginning of the second trading period, in 2008. The EU Commission controlled and verified the NAPs for the second trading period more strictly than in the first period and the price began to stabilize. This development continued until the middle of 2011, where the price started decreasing to between € 6

and € 10. It is interesting if this is the beginning of a new marked crash, as at the end of the first period, but this is not likely as companies can transfer unused allowances to next period and thereby they do not need to sell now. However the resent decrease in carbon price seems to suggest that still is problems with the EU ETS marked.

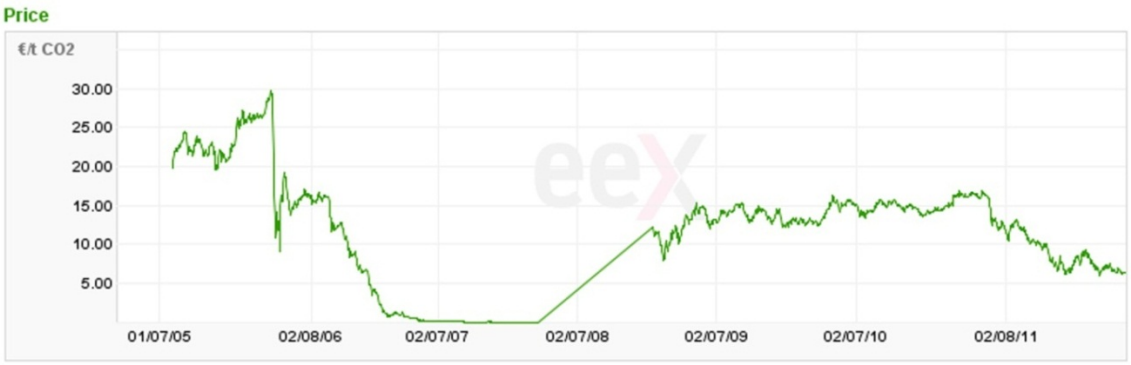


Figure 1 Plot from EEX marked with the allowances spot price from 2005 to 2012 (EEX, 2012).

It is not likely that this price level will be sufficient to create incentive for companies to invest in green technology. In the directive, which is the basis of the EU ETS, goal is price of € 30 (EU Parlement and Counsil, 2009). With this in mind the current price level is far from the goal. It is hard to predict if the carbon prices will increase in third period, as this connects to the economic development in the Europe and future weather conditions (Ellerman A. J., 2008). However it is clear that a higher price in the carbon market will give companies greater incentive to reduce their emissions.

2.3.3 Carbon leakage

Carbon leakage occurs, when a company cannot pass-on the increased cost of GHG-emissions from the EU ETS. In certain sectors there is a high level of global competition between companies and it might not be possible to pass-on the added cost to consumers. The companies will then have to move their production to places in the world with no price on GHG-emission.

This can for example be from an EU country to East Asia. The movement of production means a decrease in GHG-emissions in the EU, but on a global scale there will be no reduction, as the GHG-emission just have been moved to East Asia. In some of these countries you can see a less restrictive regulation of industry, for example on the environment and GHG-emissions. This weak regulation can cause an increase in GHG-emissions from the moved industry, as the technology used might be less effective. This will mean an increase the global GHG-emission, so the movement of carbon intensive industry should be avoid, when there is no global regulation of GHG-emission.

When designing the EU ETS the argument about carbon leakage came up. The industry did not want a tough regulation, which would lead to a high price of GHG-emission. They argue that a high price would lead to the moving of production outside the EU. The moving of production of course leads to a reduction of emissions in the EU, but the emission is just happening in another part of the world. Another consequence of moving production is the loss of jobs and potential export of goods. So the industry had a strong argument against the use of auctioning as the main allocation method.

The potential problem of carbon leakage means the EU in the design of the EU ETS had to create regulation, which found a balancing point between reducing GHG-emissions from companies and at the same time avoid closing or moving of these companies to other parts of the world. It was this balancing act which led to an EU ETS system, which is based mostly on free allocation allowances. The regulation should not be too harsh towards the industry, because carbon leakage and loss of jobs should be avoided. However, this lead to the over-allocation problem and volatile allowance prices, as described above.

In the third trading period the carbon leakage problem will be handled in a different manner. The result is the earlier described, allocation methods for the third trading period. The EU commission created in 2009 a list of industrial activities, which is deemed in danger of carbon leakage (European Commission, 2009). For activities on this list allowances will still be given for free based on a benchmarking method. Meaning companies will likely not need to buy allowances in the market. The list of activities with the risk of carbon leakage consists of 168 of the total 258 activities covered by the EU ETS (D'Oultremont, 2010). So a high share of production industry in the EU ETS will continue get most of their allowances for free.

It is question, whether all the activities on the list is in risk of carbon leakage? The list is the result of a political negotiation among the EU countries and not based on a specific method and analysis of each activity, as is the case of the benchmarking allocation method. Some have argued that only 13 of the 168 activities are in real danger of closing or relocation outside the EU (D'Oultremont, 2010). This could mean a serious over-estimation of the carbon leakage problem. A lot of companies might be running under rules, which could be more restrictive. This could lead to companies taking a wait and see approach to the EU ETS and not reduce their GHG-emission.

2.4 Revision of the EU and the new design post 2012

As, an answer to the problems uncovered in the previous section the EU commission did a revision of the EU ETS in 2009. The result of this process was the EU ETS described in the following section.

The third trading period runs from 2013 to 2020 in all eight years. It is longer compared to the previous periods, because it is understood that longer periods are needed, as short ones up to five years caused problems to the industry's investors. NAPs will no longer exist after the second trading period. Instead, one EU-wide cap will be implemented and the European Commission will decide the individual allocation to each installation. This means that only one EU wide cap will exist instead of 27 national caps in the previous periods (Parker, 2008; Ramakrishnan, 2008). Auctioning was limited in the first and second trading period, but here it will play a very important role. It will become a rule that no free allocation will exist for electricity production and it will here be based on a 100 % auctioning. With this the share of allowances auction in the EU ETS should reach 50 % in 2013.

In the non-electricity producing sectors or energy intensive sectors, two different methods will be used. The choice of which method is used depends whether the sector is deemed in risk of carbon leakage, as the described in the previous section. The main allocation method for these sectors will changed from grandfathering to benchmarking. The benchmarking method is based on BAT (best available technology), which is the 10 % most effective technology used in each sector (D'Oultremont, 2010). The difference in the two methods used is in the share of benchmarking used, as illustrated in the figure below.

- If a sector is deemed in risk of carbon leakage it will continue with constant free allocation of allowances and will be based a 100 % on benchmarking.
- For the other sectors, which is no deemed in risk of carbon leakage, there will be a gradual introduction of auctioning as the main allocation method. As seem on the figure below the free allowances will start at 80 % in 2013 and decrease to 30 % in 2020.

Figure 2 the share of free allowance used in the third period for non-electricity sectors.

The reduction target for GHG emissions is set to 20 % below 1990 levels by 2020. This means that emission reductions from EU ETS installations will be cut by 21 % by 2020 compared to 2005 levels (EurActiv, 2010).

The goal of the European Commission is to reduce the cap linearly through time in order to meet the 20 % reduction target. This however is subject to change, as countries increase the number of facilities included in the EU ETS and the European Commission will include more sectors and more types of GHGs (Parker, 2008). The cap has already been set for year 2013 at approximately 2 billion allowances as seen in Figure 3. This will decrease annually by 1,74 % of the average annual total quantity of allowances (average cap) that were announced by the member states for the time period from 2008-2012. More specifically, each year the number of allowances will be decreased by almost 37 million allowances. This annual decrease may be revised, if the decrease in emissions happens to slowly. This linear factor of 1,74 % will also determine the cap for the fourth trading period between 2021 and 2028 (Ellerman, Convery, & Perthuis, 2010) (European Commission, 2011).

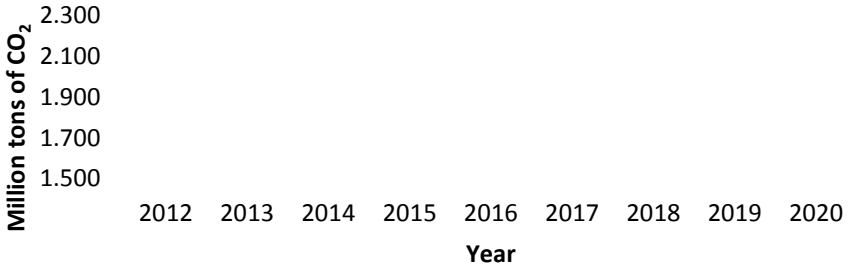


Figure 3 Annual EU ETS caps for proposed third trading period (European Commission, 2009).

2.5 Allocation mechanisms

The focus of this section is to describe different allocation methods, which can be used in market based cap and trade systems.

There are three main methods, which are being discussed in relation to the EU ETS.

- Grandfathering (free allocation based on historical emissions)
- Benchmarking (free allocation based on the best available technology)
- Auctioning (buying allowances in the carbon market)

2.5.1 Grandfathering

The grandfathering allocation mechanism is allocating the allowances for free to the companies in the EU ETS based on historical emissions data. These data comes from a range of years and is used to establish a baseline emission for each company, according to which allowances are allocated afterwards (Point Carbon Advisory Services, 2008).

The use of grandfathering with free allocation can be seen as a government subsidy to the industry, as it is a value allocated for free. This generates extra income to the industry and this money stays within the companies. When money stays within the industry, it helps ease the impact of the inclusion of CO_2 costs in the companies' expenses. The consequence of this is that grandfathering tends to favour old carbon intensive technology, and there is little incentive to invest in new technology. This can mean a potential delay in the introduction of CO_2 reducing technology (Clò, 2010; Hepburn, Grubb, Neuhoff, Matthes, & Tse, 2006; Eurelectric, 2005).

2.5.2 Benchmarking

In benchmarking, the allowances are still allocated for free, however the allocation happens according a baseline defined from the best available technology. More specific, it is defined as 10 % of the most effective technology used by the companies. It will be specific for each sector, as a lot of different technologies are used in the sectors involved in the EU ETS (Point Carbon Advisory Services, 2008; CAN, 2006) (Ellerman, Convery, & Perthuis, 2010).

In general, benchmark allocation supports the introduction of new technology, as it is based on the best performing technology. This means fewer allowances allocated to each installation than with grandfathering. The allowances are allocated according to the lowest possible emission from the type of installation. The installations with old technology will have to buy allowances to cover the extra emission they have compared to an installation with newer technology (CAN, 2006; Eurelectric, 2005) (Ellerman, Convery, & Perthuis, 2010)

When defining the benchmark for a technology or sector, the cap for an installation is defined based on the maximum production capacity. However, the installation may not operate to a 100 % capacity, which means lower emissions and lower demand for allowances than projected. This can give an extra income from the surplus of allowances to the owner of the installation. This also applies to grandfathering allocation (CAN, 2006) (Ellerman, Convery, & Perthuis, 2010).

2.5.3 Auctioning

With auctioning the allowances are sold through an auction, where the companies can make a bid for the allowances and the price is set from whoever bids the most. The cap for the emission can be calculated with the same methods, as with grandfathering or benchmarking. The big difference is that the installation has to pay for the allowances, which means the external cost of the emission have to be included in the company's production cost. This means that auctioning follows the principle of "the polluter pays". Auctioning is the only one out of the three allocation mechanisms, where this is the case (Point Carbon Advisory Services, 2008; CAN, 2006; Hepburn, Grubb, Neuhoff, Matthes, & Tse, 2006).

Auctioning gives the installation a high incentive to reduce its emissions, as it is forced to pay the full price of the emissions. Therefore, this mechanism provides incentives to invest into more efficient technologies to reduce CO_2 emissions. Since there is a public income from auctioning of allowances, the question rises how this money is used. This is very important, as it has been argued that, if the money is removed from the companies, then they will not have the money to invest in reducing their emissions. The money collected from the auctions could be used for research or investment in emission reduction. The problem arises when the money is added to the countries treasury's and spent on other purposes. A consequence of this could be a slower reduction in emissions. The same argument can be used with free allowances, as it is not certain, that the companies will use the profits from selling the free allowances for reducing their emissions. In auctioning, the money will go to the public sector and the question about where to spend the money will be a political decision (Hepburn, Grubb, Neuhoff, Matthes, & Tse, 2006; CAN, 2006; Eurelectric, 2005).

2.6 Summary of the EU Trading periods and problems

Table 1 is a summary of key characteristics of the three trading periods of the EU ETS. The table gives an overview and shows very clearly the important changes in the EU ETS by scope, allocation mechanism, emissions caps, total emissions included in the EU ETS. The table includes only the most significant sectors and changes and it is thereby noted that the table is not complete.

Table 1 Changes during the three trading periods of the EU ETS.

	1st trading period	**2nd trading period**	**3rd trading period**
Time	2005-2007	2008-2012	2013-2020
Scope	Trial/learning by doing period Goal: Not significant reduction but a first-hand experience with EU ETS	Commitment period Goal: To comply with the Kyoto protocol	Full and efficient operation Goal: To achieve significant reductions
Allocation mechanism	95% Free allocation 5% Auctioning (By each member state)	90% Free allocation 10% Auctioning Use of credits from CDM and JI	Auctioning of at least 50% of total allowances: Power generation (auctioning 100%)), other industry (auctioning 20% in 2013, auctioning 70% in 2020; benchmarking 80 % in 2013, benchmarking 30 % in 2020) Free allocation based on benchmarking: up to 100% if risk of carbon leakage
Reduction target	8% below 1990 levels by 2012	8% below 1990 levels by 2012	20% below 1990 levels by 2020
Caps	27 national caps 2,29 billion tons/year	27 national caps 2,08 billion tons/year	1 EU wide cap at 1,974 billion allowances for 2013, decreasing annually by 1,74%
Problems	Over allocation of allowances Volatile prices Market crash at the end of period	Over allocation of allowances Decreasing price throughout 2011 New market crash?	Carbon leakage because of new allocation methods?

3. EU ETS in a Danish context

This chapter will look at in more detail how the EU ETS have been implemented in a Danish context. The first section will look at the allocation methods used in Denmark covered in the two NAPs for first and second period. The two following sections will look the number of free allowances given to overall in Denmark and specific to the Danish companies, which is the focus of this project. At the end of this chapter a section will look at the results from the earlier mentioned study from 2009.

3.1 Allocation methods in Denmark

In Table 2 below the total number of free allowances for each of the three periods can be seen. Also the allocation method use towards the industry and the number of installation covered can be observed.

Table 2 the Danish allocation budget, allocation method and number of installations in the three periods. (Danish Ministry of Environment, 2004) (Danish Ministry of Environment, 2007) (Energistyrelsen, 2012)

	First period	Second period	Third period
Allocation budget (number of free allowances)	100,5 M t over 3 years	122,5 M t over 5 years	89 M t over 8 years
Allocation method	95 % Grandfathering (free allocation based historical emissions.) 5 % Auctioning	For industry: Based on different fuel and process related marks. An average: 89 % of cap No auctioning	EU wide allocation methods For industry: Benchmark BAT (10 % most effective technology) Carbon leakage risk: 100 % of cap No carbon leakage risk: 2013: 80 % of cap, 2020: 30 % of cap
Number of installations	357	374	380

The allocation method in used in Denmark has developed over the three periods. In the first period the main guidelines of the overall EU was followed and Denmark was the only country to reach the 5 % auctioning limit. Only four countries in all used the option to auction out allowances (Ellerman, Convery, & Perthuis, 2010). In the second period

different approach was used; as too many allowances had been give out in the first period. In the Danish NAP2 different marks were created for the energy sector and for different industry sectors (e.g. steel sector). This lead to industry on average to getting 89 % needed allowances in relation to the cap (Danish Ministry of Environment, 2007). In the third period the same method will be used in all EU countries as describe above.

3.2 Number of allowances given in Denmark

In the two first trading periods most allowances in the EU ETS were allocated for free. In Figure 4 below the number of allowances give for free in the first three trading periods in Denmark is shown. It shows a clear picture. In the first period a large number of allowances were allocated the first year and a down adjustment was done for the two following years. In the second trading period an even lower number of allowances was given, but was a stable amount throughout the 5 year period. For the third trading period a lot less allowances are given away and the amount will be reduced each year.

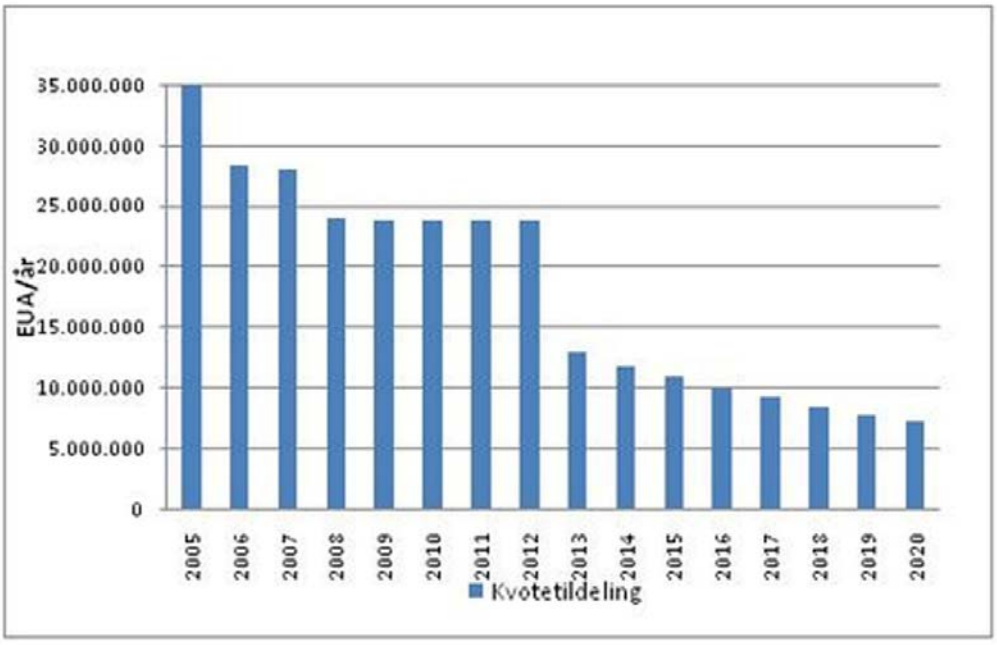


Figure 4 the volume of free allowance allocated in between 2005 and 2020 (Energistyrelsen, 2012).

The large decrease in the number of free allowances given is the answer to the above mentioned problems with the EU ETS. It should give companies more incentive to invest, as they will need to buy a bigger share of the needed allowances in the marked instead getting them for free.

3.3 Allowances for Danish production companies

The focus in this project is on companies, which in principle, can move their activities to anywhere in the world. These companies are different from other Danish companies in the EU ETS, as they produce some form of products and not electricity or heat, which is the case for most of the Danish companies in the EU ETS. These companies can present, as mentioned above, a risk of carbon leakages, which is the wish to avoid. It is therefore also harder to affect them through the EU ETS. There are 68 companies of this type in Denmark, which are part of the EU ETS. These companies are from a variety of industry sectors; including food, building materials, steel, chemicals and others. Data for the graphs in this section are combined from data from the European Commission (European Commission, 2010) and the Danish Energy agency "Energistyrelsen" (Energistyrelsen, 2012).

When leaving out the energy sector and offshore activities, the tendency off a reduction in the number of free allowances in the third period changes. Firstly, only a small fall in the number of free allowance given can be seen in the third period (2013 – 2020), when comparing to the second period. As seen Figure 5 below, the 68 companies have together been given around 4.8 million allowances each year in the two first periods. This will be reduced to a little over 4.1 million in 2013 and then slowly decrease to 3.8 million in 2020. The large decrease shown in Figure 4 above is not found. The main reason for is that many of the companies are on the list with risk of carbon leakage and they are therefore still given most of their allowances for free based on a benchmarking method, as mentioned in the sections above.

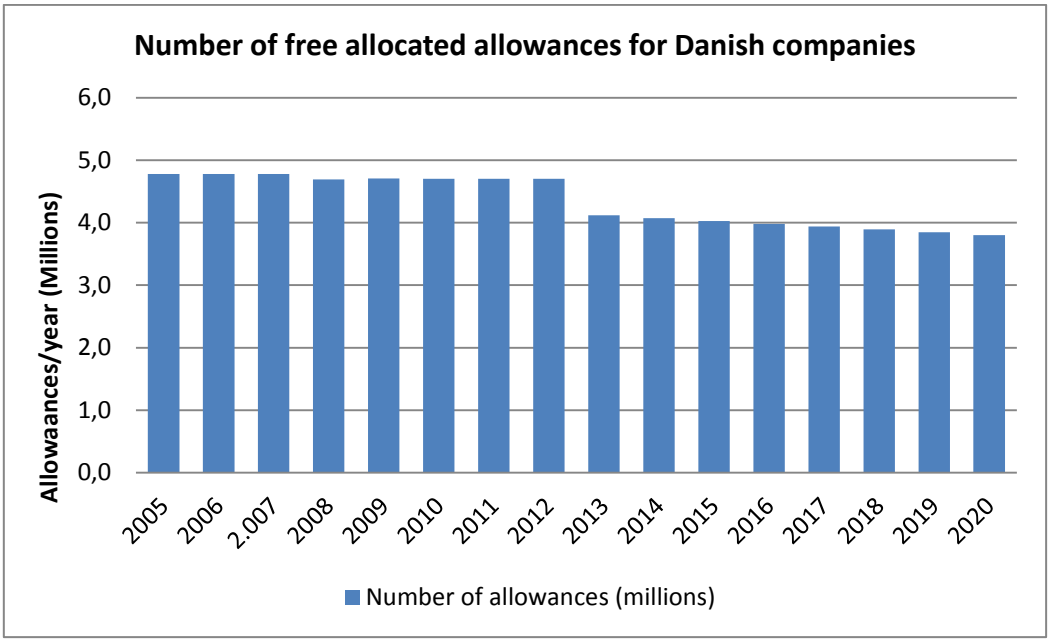


Figure 5 Number of allocated free allowances for Danish companies in the three periods.

An over allocation of allowances is still found in the second period. This can be seen in Figure 6 below where the volume of free allowances for the entire period has been around 4.8 million. The verified emissions from the companies have in the same period been between 0.5 million and 1.5 million below the number of emissions allocated. This is a clear over allocation, which can have given the companies a surplus of allowances, which can be transferred to the third period. This can give the companies a smaller incentive to reduce their emissions.

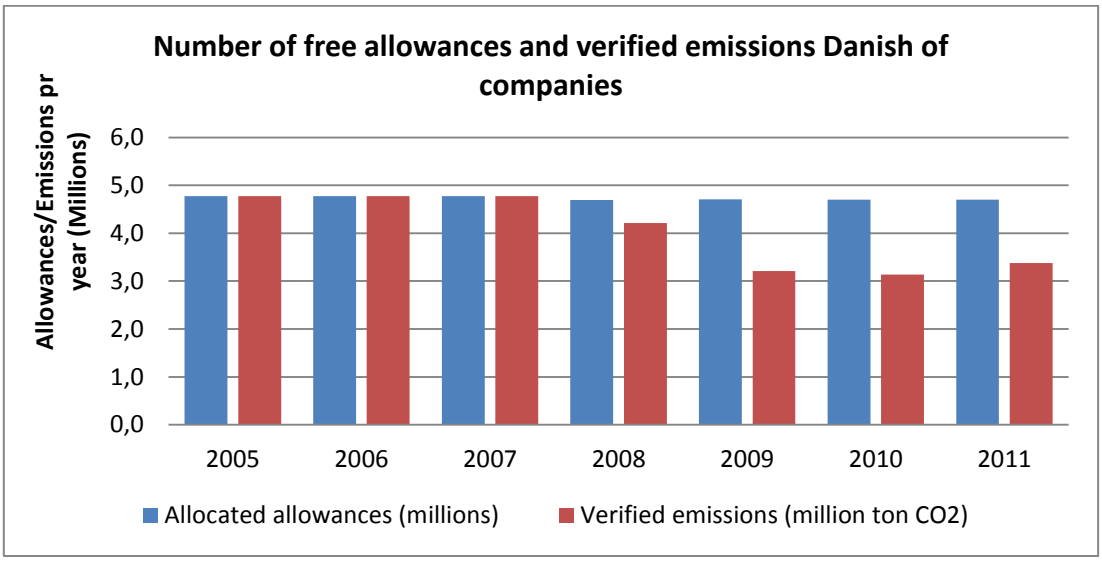


Figure 6 Number of allocated allowances and the verified emissions for Danish companies (free allowances/year – emissions from companies/year).

3.4 The 2009 study

As mentioned in the introduction, a study of Danish companies' cooperate response to the EU ETS was conducted in 2009 (Zhang & Than Tran Thi, 2009). The focus of the study was to identify what strategies the companies employed towards the EU ETS and with the help of organisational and behaviour theory understand why the strategies were chosen. It was an empirical study based on a survey of 20 Danish production companies covered by the EU ETS.

This study is very relevant, as it creates a point of reference for the company behaviour towards the EU ETS up until 2009 and the future behaviour companies expect to use to handle the EU ETS at the time. The main conclusions from the 2009 study:

"Although EU ETS is somehow undermined by the exceeding free allocation and low quota price in the market, it has imposed several aspects of impact on companies' business, especial in increasing production cost and loss of price competitiveness." (Zhang & Than Tran Thi, 2009, s. 61)

Some impact of the EU ETS was identified, primarily on increased production cost and decreasing competitiveness on product market price.

"although 30% of companies have identified change in their production patterns due to EU ETS, it has not yet successfully induced firms to initiate substantial technological changes." (Zhang & Than Tran Thi, 2009, s. 61)

Production pattern was affected by a share of companies, however not enough to get companies to introduce new technology.

"Yet, neither long-term technology investment nor long-term strategy was of companies' current concern. Instead, they practically chose to conduct low-cost abatement and participated in the trading market to compromise the institutional demand. In addition, other flexible mechanisms (CDM and JI projects) have not been well functioned either, as most companies expressed no interest in them; probably, the complicated process for technology transfer, the high capital investment, and the limited credit earning drove companies away from so." (Zhang & Than Tran Thi, 2009, p. 61)

"companies kept their business-as-usual stance while taking such actions into consideration as trading CO_2 quota, finding cheaper energy supply, and perhaps substituting the current energy with more environmental friendly ones or initiating technology innovation." (Zhang & Than Tran Thi, 2009, pp. 61 - 62)

The companies used an adaption strategy and manoeuvre within the by trading in the market and pick the low hanging fruit with emissions reduction.

"the exceeding free allowance makes it relatively easy for companies to comply with EU ETS. Actually, 40% of them haven't had any specific strategy to deal with it. Since companies are determined to maximize their economic revenue; as long as EU ETS hasn't threatened their business-as-usual, a weak commitment would be foreseeable." (Zhang & Than Tran Thi, Corperate strategies of Danish companies towards the EU Emissions Trading Scheme, 2009, p. 62)

The use of grandfather allocation (free allowances based on historical data) made it easy for the companies to comply and therefore large technical innovation should not be expected.

"Therefore, policy-makers need to ponder seriously about the future adjustment of EU ETS (eg. The percentage of free allowance) in order to activate stronger incentive while avoiding carbon leakage due to companies' relocating their production units as well." (Zhang & Than Tran Thi, 2009, p. 62)

It was important to get a stricter allocation method in the future, if the EU ETS should create incentive for Danish companies to innovate on the climate area.

"EU Commission is going to significantly cut off the amount of free allowance as well as centralized allocation at the EU level in the post 2012 period; thus, the quota price in the market would probably surge up, and a substantial impact on industrial companies would be brought about. (Zhang & Than Tran Thi, 2009, p. 62)

It could be expect that the planned reduction in the number of allowances, increase allowances prices in the carbon market and thereby generate a large impact on business and a large incentive to introduce new technology.

"*Indeed, the post-2012 period is currently non predictable; not only the EU ETS regulatory setting is under debate, but also the stance of other countries may change the institutional environment."* (Zhang & Than Tran Thi, 2009, p. 62)

The uncertainty connected to the future design was in 2009 a barrier for companies to change their behaviour, as they were not certain about the post-2012 design of the EU ETS.

Overall, the study identified several areas of impact of the EU ETS on the companies' business. However, companies mostly adapted to the system and continued their usual practices, as the EU ETS did not create sufficient for companies to introduce new technology. These results open up the questions about the effectiveness of the EU ETS to create sufficient incentive for companies to innovate in the climate area.

4. Problem formulation Research design

This chapter will describe the problem formulation; including research question corresponding hypothesis. The next section covers the research methodology used in the project, including data collection and the last section covers the scope of the research.

4.1 Problem formulation

As shown in the chapters above several problems with the EU ETS have been identified in the first and second period of the EU ETS and these problems was for a large part connected over allocation of free allowances and the resulting volatile prices. A solution has been created in the form the use of benchmarking allocation in the third period, however this have led to a differential in the allocation methods used Danish towards companies. Some will continue to run under a stable constant allocation of allowances and others get their share of free allowances slowly reduced throughout the third period.

In the earlier mentioned 2009 study, Danish company behaviour towards the EU ETS up until 2009 and the expected future behaviour were described. This study concluded that the EU ETS had some impact on company business, but did not generate sufficient incentive for companies to introduce a shift into the use of less carbon intensive technology. Companies found room to manoeuvre within the system and picked the low hanging fruits.

This opens the question, if the EU ETS is work according to its purpose? Is it promoting reduction in GHG-emissions from companies in a cost effective manner or is just another environmental regulation systems the companies have to content with?

This project will focus on the connection between the allocation method use and how the companies react towards the EU ETS. As long there are problems with the design of the system, which result in low incentive, you cannot expect companies to change their behaviour. Most companies are driven to maximize their economic output and it is not likely they will invest in new technology, if it does not help to increase the companies' earnings.

This leads to the following research question:

How does the choice of allocation method influence the EU ETS's ability to incentives Danish companies to reduce GHG-emissions?

To answer this questions the investigation splits into two parts covering the current allocation method and the post-2012 allocation method.

1. Part 1: How has the use of a grandfather allocation method affect the EU ETS's ability to create incentive for Danish to reduce GHG-emissions?
2. Part 2: How will the shift to a benchmarking allocation method affect the EU ETS's ability to create incentive for Danish companies to reduce GHG-emissions?

4.1.1 Part 1: The current grandfather allocation

The focus here is as indicated by the question to investigate how the current grandfather allocation method has affected the effectiveness of the EU ETS. What strategies have the companies covered by the EU ETS chosen to employ? Here the 2009 study (Zhang & Than Tran Thi, 2009) can form the basis for a comparison between 2009 and 2012. This comparison will give a more detail picture of how the use of grandfathering allocation method affect cooperate behaviour. As shown earlier in section 3.3 the number of free allowances for Denmark has been nearly constant since 2005, so the behaviour should not have changed significantly between 2009 and 2012. Between 2009 and 2012 companies will also have gotten more experience with the system and should have developed an even better understanding of the impact of the EU ETS.

On this basis the following hypothesis is setup:

1. *As the number of free allowances allocation to the companies has not changed between 2009 and 2012, it should be expected that companies use the same strategies towards the EU ETS today, as they did in 2009.This behaviour results in a less effective EU ETS, which in itself does not create sufficient incentive for the companies to reduce their GHG-emissions.*

A series of topics are chosen to investigate to see, if company behaviour have change:

- Observed impact of the EU ETS
- Market strategies
- Non-market strategies
- Organisational impact
- Impact on investment decisions
- Barriers for GHG-reduction

This will be investigated in the following chapter 5.

4.1.2 Part 2: Post 2012 Two Benchmarking allocation methods

Part 2 of the analysis will focus on how companies will react to the new benchmarking allocation method, which will be introduced in the third period. The interesting consequence of this new allocation method is the fact that companies will now be administrated under two different allocation methods. On group will as mentioned continue with a constant allocation of free allowances and the other group will get a slowly reducing amount of allowances. This opens the interesting possibility to compare the behaviour of the two groups and draw up a picture if the stricter allowances method will create a more effective EU ETS. According to theory you would expect, the added cost from the need to buy an increased share of allowances in the carbon market, will result in an increased willingness among companies to invest in reducing their emissions.

The analysis will split the companies in two groups according to the two allocation methods used on companies in the third period. The two groups:

- **Constant free allocation group** (abbreviated: CFA group), which a type of company conducting activities, that are on a list of carbon risk activities developed by the EU commission. In the third trading period this group will continue with the stable allocation of allowances, as in they did in the second period.
- **Reducing free allocation group** (abbreviated: RFA group), which is companies conducting activities, which are not on the carbon risk list. These companies will in the third period get a gradual reduction in the share of free allowances. They should therefore be forced to buy more allowances to cover their need or invest in reducing their emissions.

With this in mind the following two hypotheses are created:

2. *As the **constant free allocation group** will continue with constant level of free allowances throughout the third period, it should be expected that companies in this group will continue to behave as they did in the second period. This behaviour results in a less effective EU ETS, which in itself will not create sufficient incentive to companies to reduce their emissions.*
3. *As the **reducing free allocation group** get a reducing free number of allowances throughout the third period, it should be expect that companies in this group will have a more active approach and do more to reduce their GHG-emission. This behaviour should result in a more effective EU ETS, which should generate sufficient incentive for companies to reduce their emissions.*

Three topics are investigated to see how the companies in the two groups expect to react towards the EU ETS in the third period.

- Perception of the third trading period
- Market strategies
- Non-market strategies

4.2 Research method

This section will describe the two main data collection methods used in the project.

4.2.1 Literature review

This project started, as many projects, with a comprehensive literature review of reports, journal articles, books and websites related to the EU ETS. This process was guiding when creating the focus for this project. It has also been important in the process of describing the design, implementation and development of the EU ETS. A host of official documents have also been investigated, including the Danish NAPs and relevant EU Directives and EC Decisions. These documents have helped understand the regulatory setting and design of the EU ETS. The literature review also helped create the frame used to understand the results from the survey. Here different information about environmental economics, behaviour theory and organisation theory have played a role.

4.2.2 Survey Method

The other major data collection source in this project has been a survey conduct among the Danish companies, which is the focus of the study. An online survey questioner has been designed and distributed with of the Internet based survey tool SurveyXact (Rambøll, 2012).

The survey method has been chosen, as it is the most effect way to reach a huge number of different people and collect their knowledge about a certain subject. It is about collecting information about how the EU ETS functions in the real world and affect the companies. This information can only be collected by communicating with the people, who spent their everyday working in the companies and observe the effect of the EU ETS. Of course the information needed for this project could be collected in greater detail by conduction interviews with the relevant people, but the scope of such a large

number of interviews is not possible with the resource available for this project. A survey is a more effective way to reach a large number of people with fewer resources.

As mentioned has the SurveyXact platform been used in the creating and distribution of the survey. This tool includes an effective design tool to create questioner. It also makes it easy to distribute the survey to the companies via. e-mail and later doing data analysis of the answers.

The survey has been distributed by first compiling a list of the 68 companies. Then contact information for the companies is found and the relevant contact person, to send the survey to, is identified. However in most cases it was difficult to directly identify the person responsible for the EU ETS. It is important to identify the correct person responsible for the EU ETS in the company, as this person have the correct information, which it is the goal to collect via, the survey. It is also more likely that a person with the correct knowledge will answer the survey. The company is contact by phone and the correct person is identified. This person is contacted by phone and permission is asked by to send a presentation email with a link to a website, where the survey can be filled out.

The survey has been design in with mostly multiple choice questions or questions, where the respondent is asked to fill out a scale. These types of questions are more accessible for most people, than if they have to write a lot of text in a form. With accessibility in mind it has also been chosen to make the survey in Danish as surveyed people are most likely Danish speaking. This has also been the case, as all people contact were Danish speaking.

4.3 Scope of the research

As mentioned this project will focus on Danish production companies, which is part of the EU ETS. It is the same group of companies, which were surveyed in 2009 study (Zhang & Than Tran Thi, 2009). This means Danish companies in the industrial sectors, which produce some form of physical product. Companies in these sectors are more vulnerable to environmental regulation, as they operate in competitive markets against other companies and the EU ETS might affect their ability to compite.

The Danish Energy Agency handles the administration of the EU ETS in Denmark and provides a comprehensive list of installation covered by the EU ETS (Energistyrelsen, 2012). This list covers 380 installations, where 280 are connected to electricity, heat production or offshore activities. When these are excluded there are 100 installations left, which is owned by 68 different companies. The project will focus on these 68

companies. When looking at split between companies, used in part 2 of the analysis, 43 companies are in the “constant free allocation” group and 25 companies are in the “reducing free allocation” group.

Another important limitation for this project is the fact that there has not been access to the original data material from the 2009 survey. It has not been possible to follow the answers from the individual companies in the survey, even though some companies have participated in both surveys.

5. Part 1: The current grandfather allocation

This chapter will investigate the results related to the current design and the use of grandfathering as the main allocation method. The results are compared to the results from the survey from 2009 (Zhang & Than Tran Thi, 2009) to see if the companies still follow the same strategies or if they have changed their behaviour towards the EU ETS. It should help answer if the conclusion from the 2009 studies still valid. However, first we will look at the overall survey participation.

5.1 Survey participation

The survey was relatively successful, as 29 of 68 companies or 42 % choose to participate. A list of the participating companies is found in the appendix B in the back of the report. It is important to note that 8 of the 29 companies also were part of the survey in 2009. Some difference could be expected in the results between the two samples, because of the difference in what companies have participated.

5.2 Observed impact of the EU ETS until now

This sections looks at how the companies perceive the impact of the EU ETS on their business. The companies were asked about the impact of the EU ETS up until now on five business factors and 5 competition factors. The goal is to map out if the companies are seeing a positive or negative effect of the EU ETS. It might also be the case that there is no impact at all. Companies are more likely to take action and change their behaviour, if their business is affected by a policy, such as the EU ETS.

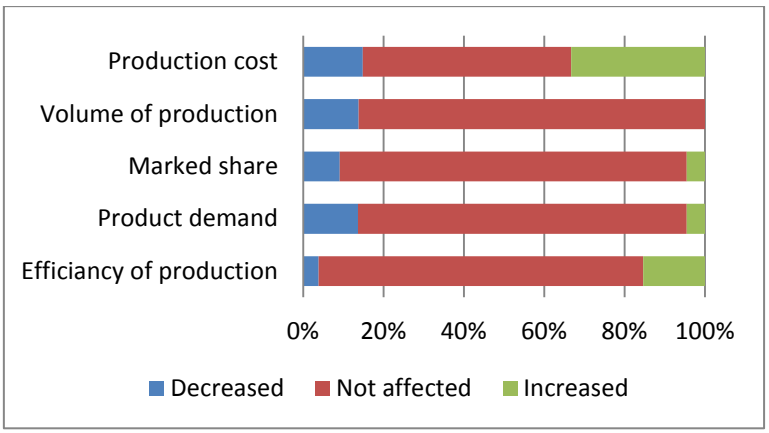


Figure 7 Influence of the EU ETS on 5 business factors for companies since 2005.

In Figure 7 the observed impact of the EU ETS since 2005 on five business factors is shown and these factors are related to production and the product. Overall for most factors only small impacts have been observed. On volume of production, market share, product demand and efficiency of production only 20 % or less of the companies have observed any effect. This indicates a weak impact of the EU ETS on the companies' business up until now on these factors.

Production cost stance out as around 50 % of the companies observe an effect of the EU ETS on this factor. 33 % of the companies have seen an increased production cost since 2005 and 15 % have seen a decreasing production cost. In 2009 60 % of companies observed an increased production cost, so a smaller impact of the EU ETS is identified today (Zhang & Than Tran Thi, 2009, p. 42). This is also the case for the other four factors, where only very small changed can be seen.

This could be expected that production cost would be the most affected factor, as it is directly affected by investment made by the company to reduce its GHG-emission.

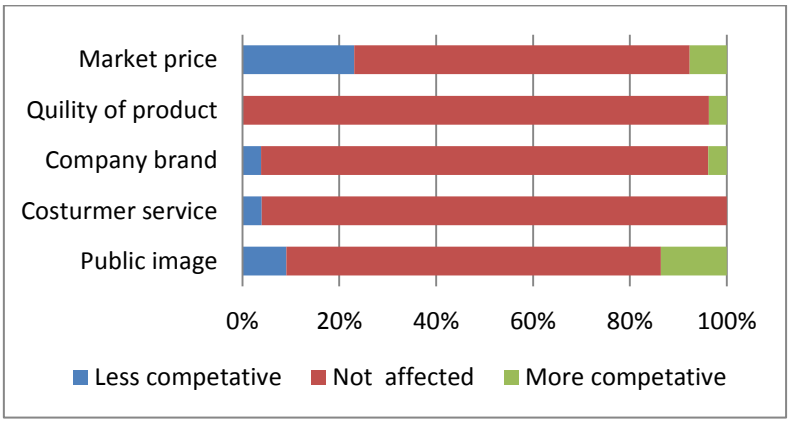


Figure 8 Influence of the EU ETS on 5 competition factors for Danish companies since 2005.

In Figure 8 the observed impact of the EU ETS on 5 production factors is shown. These factors are related to the companies' competition with other businesses of the same type. The overall picture is the same as with the five business factors, as for most factors only a limited impact can be seen. On the quality of product, company brand and customer service less than 10 % of companies observe any effect. Two factors stand out.

The largest impact can be seen on the market price of the companies' products. Here around 30 % of the surveyed companies identify an effect of the EU ETS. 23 % observe a less competitive market price and 8 % observe a more competitive market price. This should be expected, as the companies' identified an increase production cost in Figure 7

above. The market price of a product and production cost have a cause-and-effect relation, as an increase or decrease in production cost often will lead to change in the market price of a product. Of course this is not always the case, as it depends on the competitiveness of the market the company is operating in. A shift has happened for this factor, when comparing to 2009 (Zhang & Than Tran Thi, 2009, p. 42). In 2009 60 % of companies observed an effect of the EU ETS on the market price and this is the double of what is seen in 2012.

A smaller impact can be seen on public image, where around 24 % of companies observe an effect. 9 % of companies less competitive image and 14 % observe a more competitive public image. In 2009 only 5 % of companies mentioned positive affect of this factor, so companies find this factor important today. This might be connected to the growing awareness among companies about climate change issue and it importance for a company's public image. All these factors are interconnected and changes in the production cost can of course have an effect on the market share or the quality of a product. If a product becomes cheaper by cutting down on quality a company might get a short term increase in market share. This might however harm the company brand in the long run and less money is made. All these factors play together and are important for most companies.

5.3 Non-market strategies

The focus of this section is on the how the companies respond to the EU ETS with strategies, which are not related to the carbon market. This is actions, which companies can use to decrease their GHG-emissions from production and the use of more negative strategies, where production is moved out of the country. The technology used in the companies will also be described, as this will help draw up a picture of how far the companies are in the transition to the use of less carbon intensive technology.

In Figure 9 the share of companies, which up until now in 2012, have used the listed non-market strategies. If we look at the activities in order R&D is the first. In 2012, 28 % of companies have invested in R&D in reducing GHG-emissions. In 2009 30 % of companies expected to invest in R&D, so the Danish companies have done what they said they would (Zhang & Than Tran Thi, 2009, p. 53). When so few companies are investing in R&D, it might be connected to the fact that a third of the companies in the sample are relatively small companies. The size of surveyed companies can be seen in appendix B at the end of the report. Companies need to have certain size before they have the resources to invest in R&D. The smallest company performing R&D has a

yearly turnover of 100 million Kr., so companies need a certain turnover before doing R&D. However this does not explain why the last 45 % of companies have not invested in R&D even though they seem have the size.

When we look at Figure 9 it becomes clear that the EU ETS have had some effect, as 80 % of companies have invested in reducing their emissions from production. This is significantly more than in 2009, where only around 50 % of the companies expected to invest in new technology (Zhang & Than Tran Thi, 2009, p. 53). It is difficult to access if this large share of companies in both groups actively investing is because of the EU ETS or if it is because of other policies. It is not defined how big an investment the companies have made. It can be a small investment or a large significant investment. This has not been investigated in the survey.

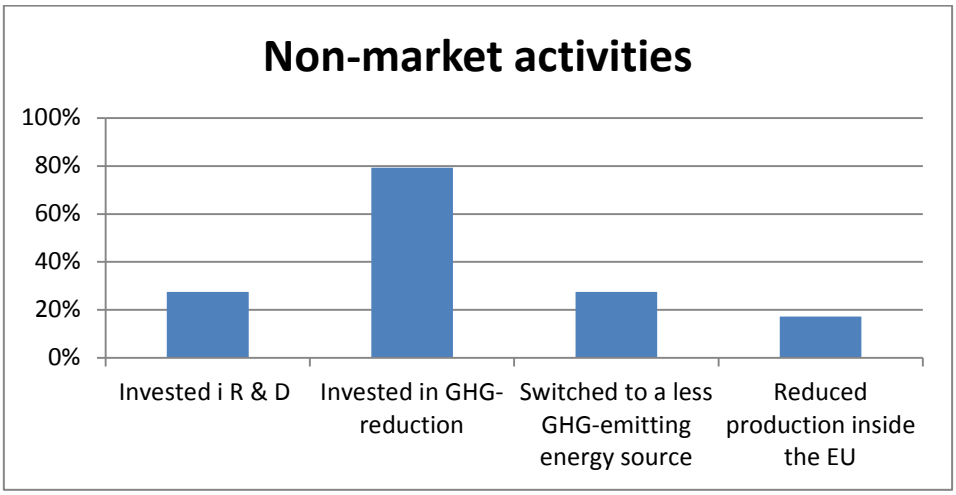


Figure 9 The companies actions to reduce their GHG-emission in the second period of the EU ETS.

Switching to less carbon intensive fuel can be an easy why for a company to reduce its emission. 28 % of the companies have used this option and this is lower than what should be expected. In 2009 50 % of companies expected to use this option, so fewer companies used this option (Zhang & Than Tran Thi, 2009, p. 53).

Few of the surveyed companies have reduced their production because of the EU ETS, as only 17 % of the companies have done this so far. This result would seem to indicate a weak impact of the EU ETS, but it a little higher than in 2009, where 10 % of the companies expect to use this strategy (Zhang & Than Tran Thi, 2009, p. 53).

As can be seen in the Figure 10 most of the energy sources are used in the companies. It is important to note that the figure shows whether the energy source is used or not in the company. It does not show to which extent the energy source is used.

The dominating energy source is natural gas, which is used by 75 % of the companies. Coal and oil is used by between 25 % and 35 % of the companies. This result indicates, that fossil fuel based energy sources are still the dominating energy sources. The use of these energy sources have not changed significantly since 2009, where natural gas, coal and oil were used by 80 %, 20 % and 25 % of companies (Zhang & Than Tran Thi, 2009, p. 54). The difference might be connected to the fact, that it was a slight difference in companies participating in the survey.

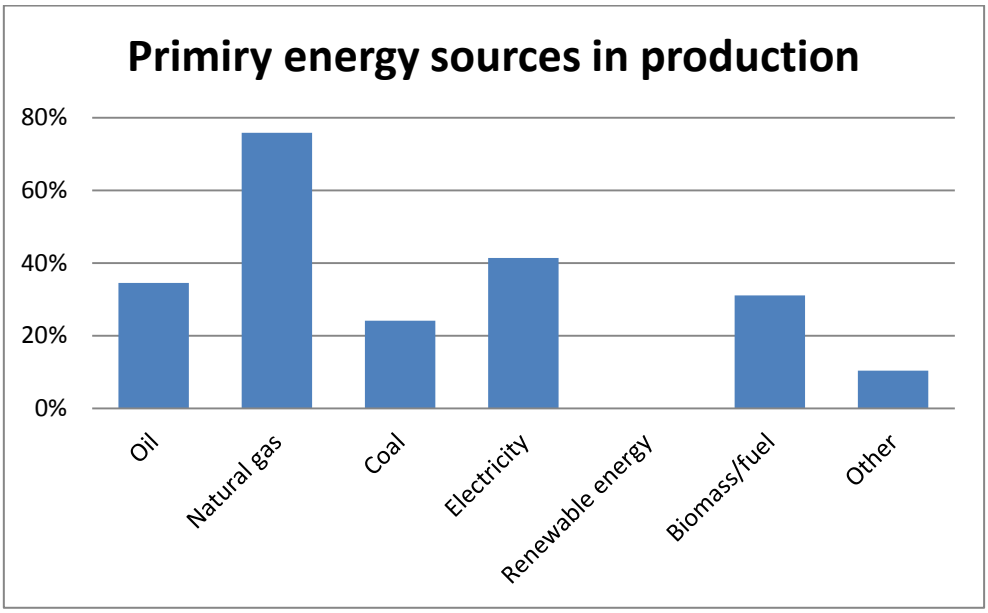


Figure 10 the share of companies using difference energy sources in their production.

30 % of companies use some form of biomass fuel and 10 % of companies use some other form of fuel, which is either specific form of gases and mixed waste/biomass. This means there has been an increase in use of biomass from 10 % in 2009 to 30 % in 2012 (Zhang & Than Tran Thi, 2009, p. 54).

No companies use any renewable energy. This makes sense, as these energy sources (solar, wind etc.) primarily produces electricity. It is cheaper to buy electricity from the grid than to produce it yourself from renewable energy sources. However some electricity produced from renewable energy sources might be hidden in the electricity consumption, which is used in production by 40 % of the companies.

Overall the result seem to indicate that the companies are still very depending on carbon intensive energy sources and only a miner increase in the use biomass has happened between 2009 and 2012. It would seem that the EU ETS have not created a large change in technology.

5.4 Market strategies

In this section the focus is on the companies' participation in the EU ETS market. The section will describe the activities in the market, participation in the market, the used of CMD/JI and the banking of allowances.

As shown in Figure 11 the most common activity is the selling of allowances, as around 50 % companies have primarily used this market strategy. This result is very interesting, when comparing to the result from 2009. In 2009 around 60 % of companies had primarily been selling allowances in the first period, but only 10 % expect to sell in the second period (Zhang & Than Tran Thi, 2009, p. 52). However the same share of companies is observed selling today in 2012. It would seem the companies' expectation of a reduced number of surplus allowances in the second period was wrong. As shown in Figure 11 around 10 % of companies either bought or had a balanced approach with both selling and buying. This result is result is also very similar to how the companies traded in the first period of the EU ETS (Zhang & Than Tran Thi, 2009, p. 52). These results seem to indicate a lower effect of the EU ETS today in 2012 than the companies expect back in 2009. As shown earlier in the report the companies have gotten an over allocation of allowances in the second period (see 3.3) and this is probably why the market behaviour in the first period have repeated in the second period.

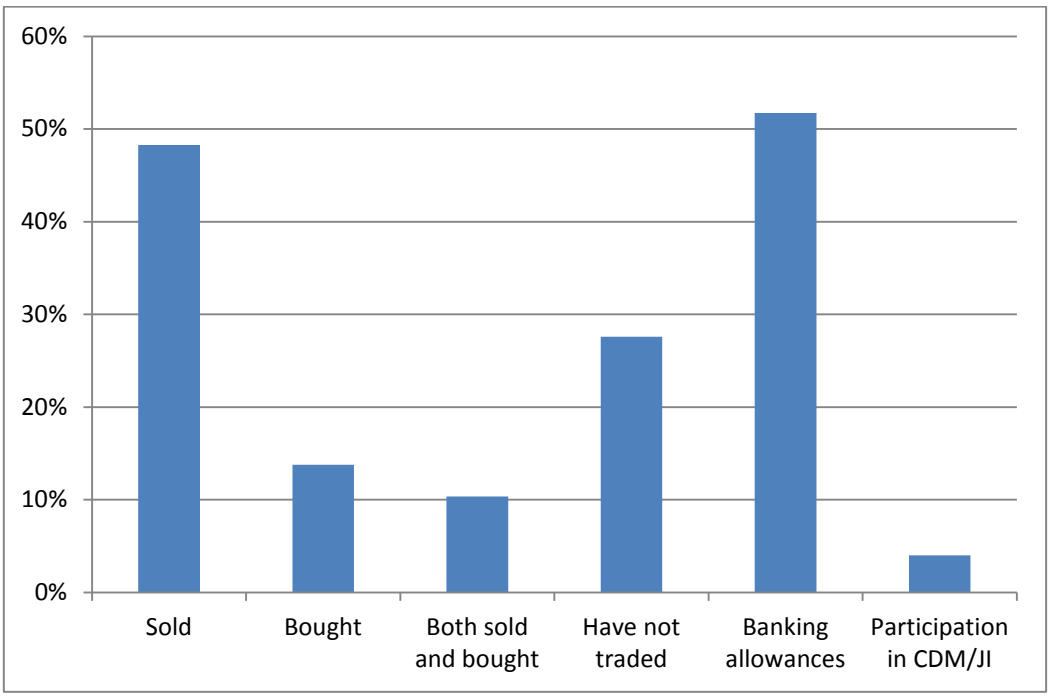


Figure 11 Company market strategies in the second period

28 % of the surveyed companies have not participating, as it can be seen in Figure 11. This share is higher than the result from 2009, where 20 % of the companies did not

trade in the first period and all companies expected to trade in the second period (Zhang & Than Tran Thi, 2009, p. 52). This result seems to indicate a weaker impact of the EU ETS, as a higher share of companies than expected did not participate in the market. More companies than expected simply choose to ignore the market. Interestingly the companies, which are not participating in the market, are all large companies with more than 300 million in yearly turnover. It could be expected that smaller companies might just ignore the EU ETS, but this is not the case.

Another result can be linked to the problem of over allocation in second period, when we look at the share of companies banking allowances for the future. Here, as seen in Figure 11, more than 50 % of companies have used this option. This result is very different than what companies expect in 2009, where only 10 % of the companies expected to bank allowances in the second period. The extra allowances given have resulted in a saving up of allowances to the third period.

Finally, there has been a very small use of the CDM/JI mechanism. Only 1 company have used this option in until now. This result falls in line with the results from 2009, where a very low share is also observed (Zhang & Than Tran Thi, 2009, p. 52). For some reason the companies are not using this option, but it is difficult to say why. It might be connected to the fact that most companies have a surplus of allowances and they have no need for the extra allowances, which can be generated by these mechanisms.

When looking at the companies market activities a clear pattern can be seen. You see a repeat of the same company behaviour in second period, as was observed in the first period. Companies did not do as they expect, as the stricter grandfather allocation used in the second period, did not result in more pressure on the companies. Companies expected a large effect of the EU ETS, because of the tightening of the allocation method between the first and second period.

5.5 Organisational impact

This section will look at the organisation impact of the EU ETS up until now. When companies have to adapt to a new policy, like the EU ETS, some changes should be expected. If the policy has a significant impact the company will need to change its organisation. This section will look at who is responsible for decisions related to the EU ETS and the presence of an EU ETS strategy.

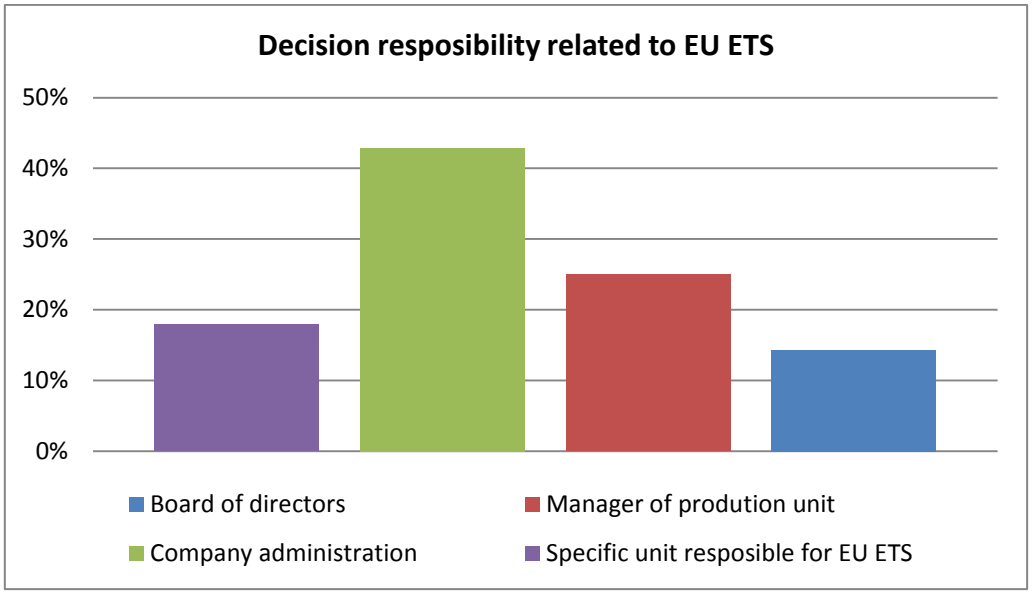


Figure 12 Responsibility of decisions related to EU ETS among the companies.

When looking at who is responsibility for decisions related to EU ETS, the largest group is, as shown in Figure 12, company administration with 43 %. The second largest is the manager of the impacted production unit with 25 %. The third is special unit with 18 % and the last is the board of directors with 14 %. This result is also different from the 2009 result, as this study found it clear that the responsibility lay with top management in the companies (Zhang & Than Tran Thi, 2009, p. 46). This can be seen as a weakening in the effect of the EU ETS on companies, as the responsibility is delegated to people further down in the company organisation (company administration or production unit managers). The responsibility is not taken by the top management and only a small share of companies has a specific unit to handle the EU ETS.

Interestingly in 2009 it was also found that 15 % of companies had a specific unit to handle the EU ETS, which could indicate that companies do not need a special unit to handle the EU ETS. However it is important to note that some of these companies because of their size do not have the resources to have a specific unit to handle the EU ETS and therefore put the responsibility to administration, the production unit manager or the owner. However this does not explain the high share of companies put the responsibility with the administration. Under half of the companies in this group are smaller companies and companies with a turnover in the billions, also put responsibility to the administration.

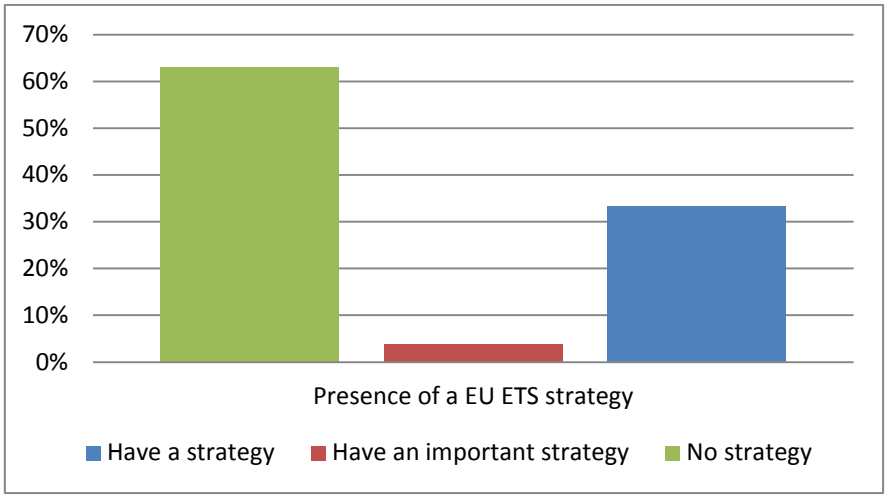


Figure 13 presence of a strategy towards the EU ETS in the companies.

In Figure 13 above the presence of an EU ETS strategy can be seen, where 60 % of the companies have no strategy for the EU ETS. A third of the companies have strategy and 4 % have an EU ETS strategy, which is important for the company's business model.

It is surprising such a share of the companies have not strategy for the EU ETS. In 2009 40 % of companies had no strategy for the EU ETS and in this light the result is even more surprising. It could be expect that after 7 years in the EU ETS all companies should need a strategy for EU ETS. Of course the 2012 survey does not cover the same companies, but you would still not expect such a huge shift in 3 years. The result would seem to indicate, that companies are downgrading the importance of the EU ETS, when they so many does not have a strategy for it (Zhang & Than Tran Thi, 2009, p. 62).

This can also be supported by the fact that only 1 company indicate that it's EU ETS strategy is important for the company. If the EU ETS had a huge impact more companies would integrate their strategy into their business plans.

5.6 Impact on company investment decisions

This section will look at the importance of the EU ETS in companies' investment decisions. If the EU ETS have a large effect on companies, factors related to the EU ETS should be important in decisions.

In Figure 14 below the importance of different uncertainties in company investment decision can be observed. The most important factors in the companies' business decisions are lowering production cost and the price of fuel or energy. This should be expected as these factors are directly connect to production cost and should therefore be

important in all businesses. Many companies have a focus on minimizing production cost to increase the monetary output of the company. These result falls in line with the study from 2009, where these two factors were also mentioned as the most important (Zhang & Than Tran Thi, 2009, p. 50).

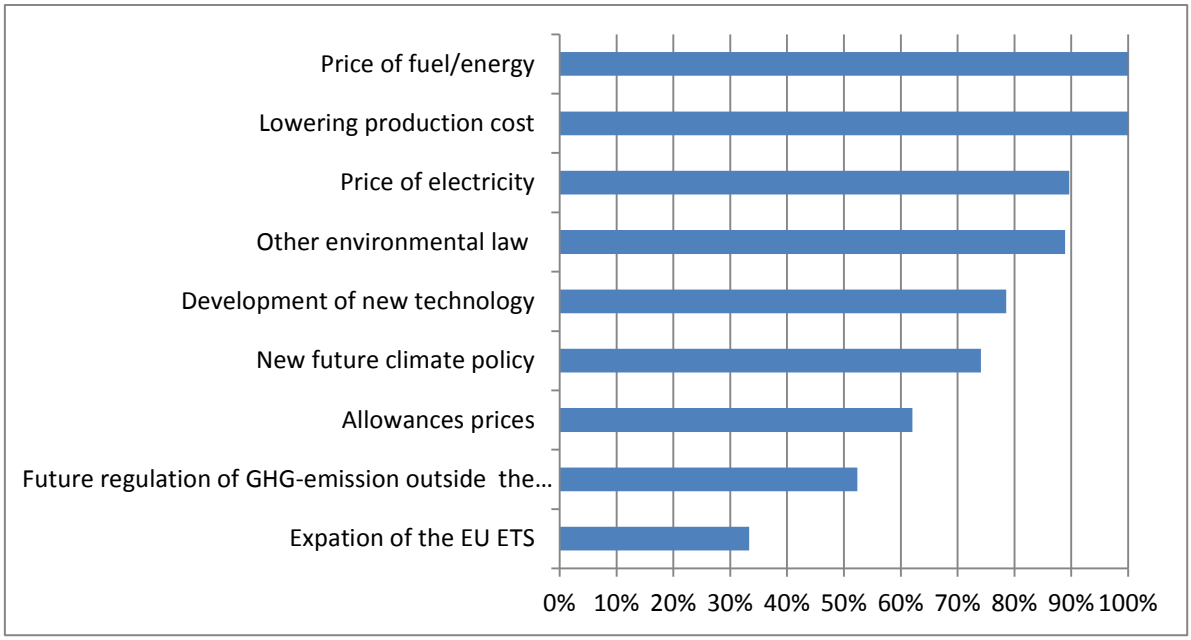


Figure 14 the importance of factors in investment decision as seen by the companies.

These factors are followed by the price of electricity, other environmental law, development of new technology and new future climate policy, which are all mentioned as important by more than 70 % of the companies. Allowances prices are mentioned as important by 60 % of the companies and future regulation of GHG-emission outside the EU is mentioned by 50 % of companies, which is very similar to the results from 2009 (Zhang & Than Tran Thi, 2009, p. 50). A future expansion of the EU ETS is mentioned by 33 % of companies and here a small shift has happened as a larger share of companies found this important in 2009.

These results indicate that no major changes have happened between 2009 and 2012 in what companies find important in when making investment decisions. The allowances price is important for a large share of companies, but other factors are more important.

5.7 Barriers for GHG-reduction

The focus of this section is to identify important barriers, which stop companies from reducing their GHG-emissions. The result can be seen in Figure 15 below.

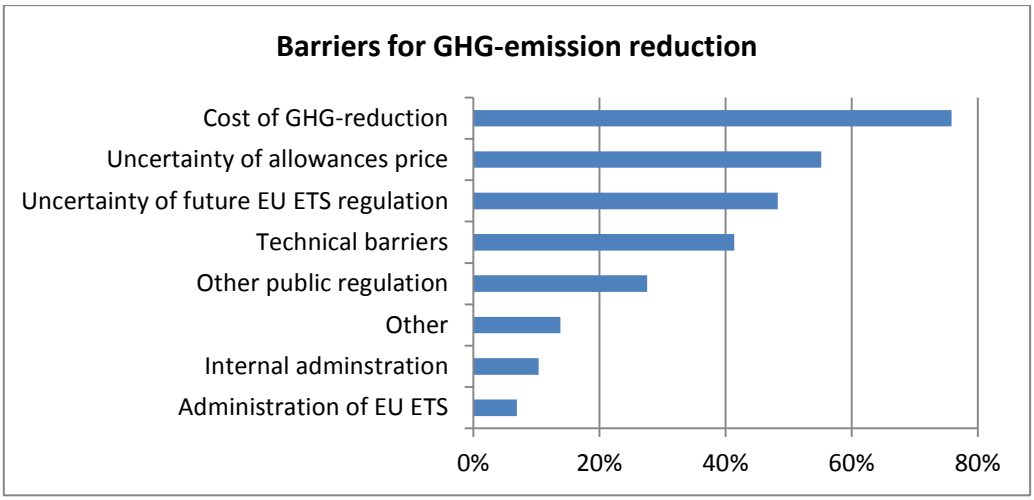


Figure 15 Barriers the company meet when trying to reduce GHG-emissions.

The largest barrier for companies is the cost of reduction, as seen in Figure 15, which is mentioned by more than 75 % of companies. This seems to indicate that the EU ETS does not generate a sufficient incentive for companies to reduce their investment. In 2009 only 60 % of companies mentioned this barrier, so a slight shift has occurred (Zhang & Than Tran Thi, 2009, p. 48).

This is followed by uncertainty connected to the allowance price in the carbon market with 55 % and uncertainty about future regulation of the EU ETS, which is mentioned by 50 % of companies. These results seem to indicate that there is still a high uncertainty connected to the EU ETS. These results are similar to the answers from 2009, where future uncertainty connected to EU ETS was mentioned by a comparable share of companies. Technical barrier is mentioned by 40 % of companies and this result is also similar to the answers from 2009 (Zhang & Than Tran Thi, 2009, p. 48). A few companies mentioned other barriers, which are related to specific environmental regulation and an accessibility of alternative fuels.

Overall, the result indicates that the EU ETS do not create sufficient incentive, as the cost of reduction is still seen as largest barrier for companies. There is also a high uncertainty connected to the EU ETS, as half of companies identify this as a barrier. The picture has changed a lot from 2009.

6. Part 2: The effect of the new benchmarking allocation method

This chapter will present the result from the survey covering the new allocation rules in the third period of the EU ETS. The chapter looks at the companies' perception of new the EU ETS post 2012, the companies' market strategies and non-market strategies in third period. The 29 companies covered in the survey will in this chapter be split into the two groups mentioned in the problem formulation.

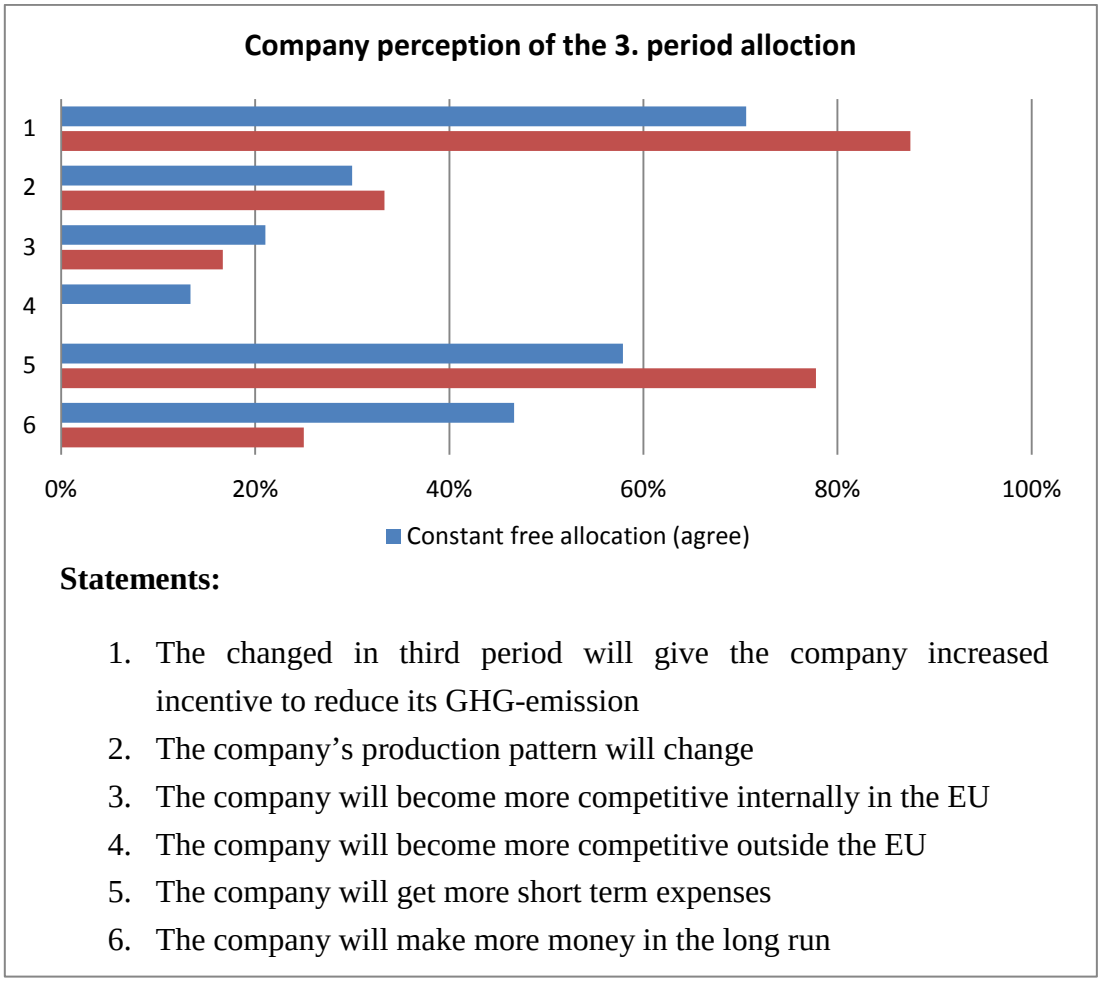
- Constant free allocation group or CFA, which include 20 of 29 companies.
- Reducing free allocation or RFA, which include 9 of 29 companies.

6.1 Perception of the third trading period

This section will investigate how the companies perceive the third period and how it will affect their company. This is investigated through 6 statements, which covers different effects of the EU ETS on companies. The result can be seen in Figure 16 below. The numbers on the left of the graph corresponds to the numbered statement below the graph.

In Figure 16 it can be seen that a large share (<70 %) of companies agree that the new allocation rules will create more incentive for companies than the current EU ETS. More companies in the RFA group (88 %), agree the system will give them more incentive. This result should be expected, as these companies will get their share of free allowances slowly reduced. Interestingly, these results are similar to the answers in 2009 (Zhang & Than Tran Thi, 2009, p. 41). It would seem that companies see the EU ETS as something that creates incentive, but the general perceptive have not changed with the introduction of a new more strict allocation method. A difference is seen between the groups and as expected, companies under the stricter rules expect the system to give them more incentive to reduce their emissions.

A small share (30 %) of the companies expects an impact of the new rules on production patterns and their competitiveness, but there is only a small difference between the two groups. A similar result was found in 2009, so the perspective has not changed, even though a new allocation method is being introduced (Zhang & Than Tran Thi, 2009, p. 41).



Statements:

1. The changed in third period will give the company increased incentive to reduce its GHG-emission
2. The company's production pattern will change
3. The company will become more competitive internally in the EU
4. The company will become more competitive outside the EU
5. The company will get more short term expenses
6. The company will make more money in the long run

Figure 16 Company that agree or completely agree in the listed statement related to changes in to the EU ETS in the third period.

In terms of competitiveness below 20 % of companies agree with these statements. This would seem to indicate that few companies expect a positive impact on competitiveness from the new allocation rules. There is a very small difference between the two groups, when look at competitiveness inside the EU. On competitiveness outside the EU no companies in the RFA group agree with the statement, which is 15 % below the CFA group. This indicates that the stricter allocation method used on the RFA group will give a higher impact on competitiveness outside the EU in this group. This should be expected, as it will cost more money for companies in this group to comply with the EU ETS post 2012. In 2009 between 15 and 20 % of companies expected the EU ETS to make their company more competitive both inside and outside the EU, so the companies view on this factor has not changed significantly over the last 3 years (Zhang & Than Tran Thi, 2009, p. 41). The introduction of the new allocation method does not seem to change the companies' perspective.

Over half of the companies expect that the new allocation method will create more short term expenses for the companies. As expected a higher share (78 %) of companies in the RFA group expect increased short term cost, when compared to the CFA group with 58 %. This result can be explained by the fact that companies in the RFA group should get a higher compliance cost post 2012. Again as above there has not been a large change between 2009 and 2012 (Zhang & Than Tran Thi, 2009, p. 41).

The largest shift between the 2009 and 2012 among the results are seen at the last statement, which covers if the company will become more profitable in the long run. In 2009 only 10 % of companies expected the EU ETS to make their company more profitable (Zhang & Than Tran Thi, 2009, p. 41). Today this result for the RFA group is 25 % and for the CFA group 45 %. There has been a shift indicating the companies expect the new allocation method will make their company more profitable. The difference between the two groups can be explained by the difference in allocation method used.

Overall, it does not seem that the introduction of a new allocation method has changed the companies' perception of the EU ETS. There has not been a shift between 2009 and 2012. The only difference is on the long term profitability impact of the EU ETS, as share of companies expecting this have increased.

6.2 Non-market strategies

In this section the focus will be on how companies expect to use non-market strategies in the third period of the EU ETS. It will look at different activities the companies can take in order to lower their emissions inside the EU either connected to reducing emission from production or by moving or reducing production. In Figure 17 below the likelihood of that the companies investing in new technology in the third trading period can be observed. There are five different activities covered in survey and the first is investment in R&D.

In general a low share (<30 %) of the companies expect to investment in R&D in the third period. The largest likelihood of investment R&D activities can be found in the CFA group with 25 %. In the RFA group only 12 % of companies expect to invest in R&D. It should be expect that the higher share of companies invested in the RFA group, as these companies run under a stricter allocation method. Instead it is the other way around, so it would seem that the new allocation method does not further incentivise the companies to invest in R&D. This is also support by the fact no increase in the willingness to invest in R&D between the second and third period (see 5.3). In fact a

slightly lower share of companies expects to invest in the third period, than the share of companies, who have invested up until today.

The next activity is direct investment in GHG-emission reduction, where 50 % of companies in the CFA expect to invest in reduction in GHG-emission. For the RFA group 45 % of companies expect to do the same in the third period. This repeats the pattern from the above, as there are more companies investing in the CFA group than in the RFA group. It should be the other way around, if the stricter allocation method should motivate companies more to reduce their emissions. Again a decrease in the share of companies, who wish to invest, is seen, when comparing to the share of companies that invested in the second period (see 5.3). It would seem that the companies' willingness to invest does not increase with the introduction of the new allocation method.

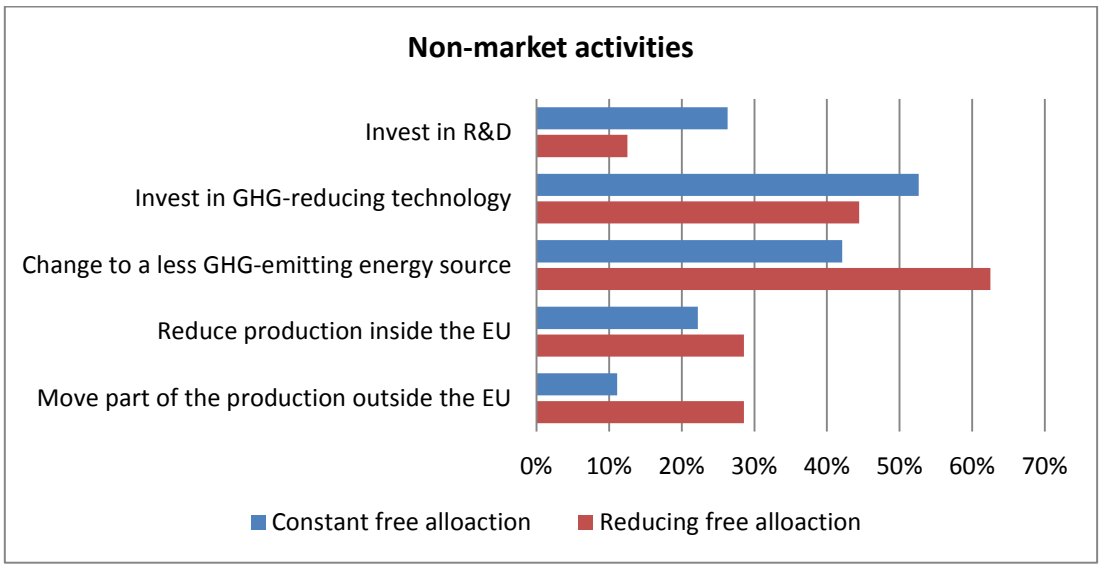


Figure 17 expected non-market strategies employed by companies in the third period.

The third activity investigated is the option to change to a less carbon intensive energy source. The CFA group is to least likely to change their energy source, but around 40 % of companies, find it likely they will use this option. For the RFA group around 60 % of companies see a high likelihood of changing fuel source. This result should be expected, as companies in the RFA group will be regulated under a stricter allocation method in the third period. Interestingly, companies expect to use this option even more in the third period than in the second period, as only 20 % of companies have used this option up until now. This indicates that this activity is the preferred option for companies, when they wish to reduce their GHG-emissions.

The last two activities are related to the options for companies to reduce or move their production, because of the EU ETS. In general a low share (<30 %) of companies expect to move or reduce production. In the RFA group around 30 % of companies find it likely that they will move or reduce their production in the third period. In the CFA group 10 % of companies find it likely to move production and 20 % find it likely that they will reduce their production. It should be expected that that a higher share of companies in RFA group than in the CFA group would use these options. However the difference is still small. There has also happened an increase in the use of the options between the second and third period, from 10 % to up to 30 %. However, it is still a relative low share of companies, which expect to either move or reduce production.

6.3 Market strategies

This section will focus on the market strategies the companies expect to employ under the new allocation methods in the third period. It will be investigated how companies expect to trade in the market, if they will participate in the market, if banking of allowances will continue and if companies will use the CDM/JI mechanisms. The results of the survey can be seen in Figure 18 and the first part to look at is market activities.

In the CFA group 45 % of companies will primarily sell allowances in the third period. Fewer than 10 % will buy and no companies expect to both sell and buy. Companies in this group continue to follow the pattern from second period, as could be expected. These companies will continue under an allocation method, which is similar to the current system. In the RFA group no companies expect to sell allowances. 20 % of companies expect to either buy allowances or have a balanced approach by both buying and selling allowances. These results are also in line with what could be expect. Companies in this group will receive a decreasing amount of free allowances, so they need to buy more allowances, if they are not going to decrease their GHG-emissions. It is however surprising that so few companies expect to buy allowances, but this might be connected to the fact that half of the companies in the survey have bank allowances, which they can use in the third period.

Another interesting result is the fact that in both groups around a third of the companies do not expect to participate in the market. There is a slight increase when comparing to the second period, which very surprising for the RFA group. You would expect companies in this group to be more likely to participate than before, as the new allocation method should give this group an added incentive to participate in the market.

It might be possible to again explain this result by the fact that companies some of these companies have banked allowances from second period and therefore do not need to participate in the market.

When looking at Figure 18 it becomes clear that around 20 % of companies in both groups are not sure if they will participate or how they will trade in the market, if they are participating. This might be connect to the earlier mentioned uncertainty (see 5.7) connected to the EU ETS.

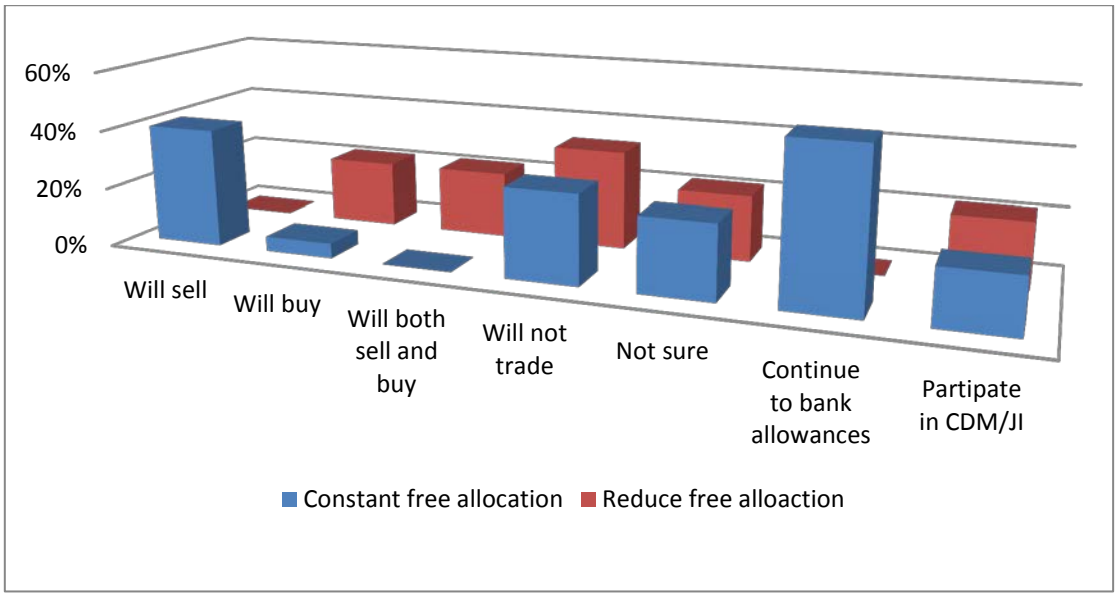


Figure 18 market strategies companies expect to employ in the third period.

When looking at the banking of allowances another clear pattern appears. As expected, will companies in the CFA group continue to bank allowances in the third period. Companies in the RFA group also follow this pattern as they do not expect to bank allowances. The companies behave as they should when look at the allocation method is used.

When look at the participating in CDM/JI around 20 % of companies expect to use this option in the third period. It should be expected that more companies from the RFA group would use this option, as they need to find more allowances or invest in reducing emissions. This result indicates that the new allocation methods do not force companies to get extra allowances from CDM/JI projects. However, companies seem to be more aware of the option, as more companies are expecting to use it, than have used it in the up until now (see 5.3).

7. Conclusion

This report investigates the effect of the EU ETS on Danish companies. More specific the impact a specific allocation method on the strategies used by companies towards the EU ETS. To investigate this, the following research question was created: *"How does the choice of allocation method influence the EU ETS's ability to incentives Danish companies to reduce GHG-emissions?"* The study is done on the basis of survey conducted among 68 companies, where 29 companies participated. The study is split into two parts, part 1 investigating the impact of grandfathering in the first and second period of the EU ETS. Part 2 investigates the expected effects of the introduction of benchmarking allocation method in the third period. Three hypotheses have been created to investigate the research question and we will now look at the first.

The first hypothesis states as following:

1. *As the number of free allowances allocation to the companies has not changed between 2009 and 2012, it should be expected that companies use the same strategies towards the EU ETS today, as they did in 2009.This behaviour results in a less effective EU ETS, which in itself does not create sufficient incentive for the companies to reduce their GHG-emissions.*

To investigate if the companies have kept the same behaviour six different topics have been covered and compare to results from the 2009 survey of the same companies. The first topic is the observed impact of the EU ETS on companies' business, where the largest impact is seen on production cost and the market price of a production. However the impact on these factors was smaller than what companies identified in 2009. On the other factors limited impact is being seen by the companies, as 20 % or less mentioned any effect of the EU ETS. These results are similar to the 2009 results. A slight decrease in the perceived impact on companies' business is observed and the overall impact is still low. This should indicate the use of grandfathering, as allocation method, does not create an effective EU ETS.

On non-market strategies similarities between 2009 and 2012 are seen in the investment in R&D. Around 30 % of companies have used this option and it is mainly large companies. A higher than expect share of companies have directly invested in emission reduction, but is not known how large the investments have been. A lower than expected share of companies have used fuel switching as strategy to lower their emissions. A slight increase in share of companies, which have reduced their production inside the EU, is seen between 2009 and 2012. When looking at the technology used in the companies, the main difference is an increased use of biomass, which might be

connect to the increased investment in emission reduction. The companies are still for a large part depending on fossil fuel energy sources, mainly natural gas and other than biomass no changes are seen. A larger than expect share of companies have invested and more companies are using biomass, as an energy source, so a small technology shift might have happened. However the EU ETS has not created the large technology shift needed to cut emission significantly so far.

In market behaviour companies follow have followed the same strategies, as they did in the first period of the EU ETS. A high share of companies sold allowances and only a small share have bought or both sold and bought allowances. This is interesting, as companies expected a need to buy more allowances in the second period, over allocation of allowances in this period meant companies did not need to do this. This also resulted in a nearly a third of companies did not participate in the market and that more than half of companies have saved up allowances for the third period. Companies have also seen little need to get more allowances from CDM/JI projects, as only one company in the sample have used this option. This behaviour point towards an imbalance in the market and it undermines the effectiveness of the EU ETS, as it can keep allowances prices down. One the reason for the low demand for allowances among the companies is connected to the economic recession, which have reduce production and thereby it has resulted in fewer emissions. It might still undermine the future effectiveness of the EU ETS.

On organisational impact a pattern has been identified, which show that the responsibility for the EU ETS have moved down from top management to administration. This can be seen as downgrading of the importance of the EU ETS, as main decisions about EU ETS are not made by top management. Also there been no change in the share of companies having a specific unit responsible for the EU ETS. The higher share of companies today, as in 2009, has no strategy towards the EU ETS, which seem to support the fact that companies see the EU ETS as less important.

In investment decisions the most important factors are still, as in 2009, production cost and price of fuel/energy. Factors related to EU ETS are the least important of the mentioned factors, but are still seen as important by half of the companies. There are no major changes the importance of the different factors between 2009 and 2012. These results indicate the companies take the EU ETS into account, but it is still not a deciding factor in when a company invest in new technology.

The main barriers for companies are still the cost of reduction and the uncertainty of the allowances prices. This has not changed from 2009. Half of companies still see

uncertainty about the future regulation of the EU ETS, which can indicate a lack of knowledge about the post-2012 regulation of the EU ETS. These results support that the EU ETS in its current design does not create sufficient incentive by itself for companies to reduce their emissions.

When look at the results miner shift have happened in company behaviour between 2009 and 2012, but it is limited. On one hand, companies are observing a slightly smaller and relative low impact on their business, many companies are selling and banking allowances even though they expect to need to buy, or they are not participating in the market. On the other hand, more companies have invested in emission reduction and the use of biomass as an energy source has increased. So in some areas the EU ETS have become less effective and in other it have become more effective. In most areas however the behaviour has not changed significantly.

The hypothesis is proven correct and the EU ETS does not create sufficient support for companies in itself today.

Second and third hypotheses states following:

2. *As the **constant free allocation group** will continue with constant level of free allowances throughout the third period, it should be expected that companies in this group will continue to behave as they did in the second period. This behaviour results in a less effective EU ETS, which in itself will not create sufficient incentive to companies to reduce their emissions.*
3. *As the **reducing free allocation group** get a reducing free number of allowances throughout the third period, it should be expect that companies in this group will have a more active approach and do more to reduce their GHG-emission. This behaviour should result in a more effective EU ETS, which should generate sufficient incentive for companies to reduce their emissions.*

Companies see the new benchmarking allocation methods, as something that will give them increased incentive. In the RFA group a higher share of companies see this, which fit with the stricter allocation method this group is under. The CFA companies have a similar view, but a lower share has the view, however their view is similar to the 2009 results.

Other differences between the two groups of companies are seen on short and long term cost of the EU ETS post-2012. The RFA group expect the EU ETS to cost them more money in the short term and they will make less money in the long run. This view is support by the fact that these companies in the third period will need to either buy more

allowances or invest in reducing their emissions. In the CFA group a similar share of companies, as in 2009 see the companies as something give them more short term expenses. However a shift has happen for companies in this group, when they look at long term cost. Three times as many companies see the EU ETS as something that will make them more money in the long run.

On competitiveness inside and outside the EU and changes in production patterns, there are no major differences between the two groups of companies and no major difference are seen when comparing to the results from 2009.

When looking at expected non-market activities a fall in the share of companies investing emissions reduction can be seen when comparing to what companies have done up until today. Only half of companies expect to invest and surprisingly the lowest share is seen in the RFA group.

Other differences between the two groups are seen in R&D, fuel switching and the moving of production outside the EU. In R&D the RFA group has the lowest share of companies investing, but this group should have the highest share if the stricter allocation method was effective. The CFA group follows the patterns seen in 2009 and 2012 with 30 % of companies investing in R&D. More companies in the RFA group expect to use the fuel switching than in the CFA group. Surprisingly more in companies RFA group expect to move production. These companies should be in low risk of carbon leakage, so it is strange that third of these companies are thinking about using this strategy.

In market strategies the CFA group follows the direction companies have so far, the largest share expect to mainly sell allowances and continue to bank allowances to a later time. For the RFA group companies expect to buy or both sell and buy. No companies expect to sell or bank allowances, so they are preparing to the decreasing number of free allowances with the new stricter allocation method. A very surprising result is the fact that a third companies in the RFA group expect not to participate in the market. You would expect every company in this group to need to buy allowances. The CFA group follow the pattern from earlier, as a similar share does not participate in the market. Finally a slight increase in the interest in using CDM/JI can be seen in both groups; however it is not above 20 %.

Overall, it does not seem the a more strict allocation method, as in the RFA group, gets makes the companies more active and get a higher share to reduce their emissions. On one hand, you see the companies in the RFA group react by stop banking and selling

allowances. They also perceive the new allocation method, as something which gives a higher incentive and that it cost them more money both short and long term, if they do not reduce emissions. On the other hand, they do not expect to invest more than the other group in reducing their emissions. It must be concluded that the third hypothesis is not valid, as a more strict allocation method does not increase the willingness with companies in the RFA group to invest in GHG emission reduction.

Companies in the CFA group follow the same strategy, as they have done so far. There minor differences, as a slight decrease in companies expecting to sell allowances and a small increase in companies expecting to reduce production. However the companies seem to be content to continue working within the system and no major technology shift is happening. The second hypothesis is proven correct; as the companies in this group continue to follow the same behaviour pattern and new allocation method does not bring about technology change.

These conclusions could be expect, as research focusing on the innovation effects of the EU ETS on the German power sector shows similar results (Rogge, Schneider, & Hoffmann, 2011). The German energy sector is interesting, as companies here will run under an allocation method based on a 100 % auction, which means no free allowances. Even under these strict rules the German Energy companies does not expect the EU ETS to generate sufficient incentive by itself. There will be a need to for more direct incentives or support policies, if significant head towards reducing GHG-emissions, is to be made. It is also concluded, that the market mechanisms in the EU ETS in principle, does work. However it will not be enough by itself if the 2020 goals are to be reached for the German power sector. (Rogge, Schneider, & Hoffmann, 2011)

The study embraces 29 companies, which is a little more than 40 % of all Danish production companies subjecting to EU ETS These are also relatively a small share of the overall Danish CO_2 allowance. With this in mind, the findings only uncover part of the overall situation. Also, the empirical data was collected through surveying one respondent from each company; thus, information was somehow irrational and bounded by the individuals' perceptions. If more people in each company ware surveyed a more complete picture could be created.

Another import limitation in this research is connected to the fact that it was conducted in a Danish context. There are differences between the regulative and economic business environment in the different EU countries. It is noted that some companies in some countries might be more ready to adapt to the use of a market based environmental regulation, than in other countries (Huth, 2010). One should be aware of

the differences in the business environment, if these results are applied to EU countries. This is also the case, if we look at the Danish energy sector, which also will run under the reducing free allocation model. It could be plausible to think that if similar survey was conducted for Danish energy companies, the same result would be found. The post-2012 EU ETS will not be enough to motivate large invest in bio energy in the Danish energy sector. This development is driven by other policies.

An underlay aspect for some problems, seen in the EU ETS, is the economic recession, which hit in 2008. This has lower production in many European countries, which have resulted in a lowering in GHG-emissions. This effect has been seen in the power sector and other industrial sectors (Declercq, Delarue, & D'haeseleer, 2011). This has resulted in lower than expected demand for allowances and as result over allocation and low carbon prices can be seen today. It will be interesting to see what will happen with the EU ETS, if and when the economy in Europe starts to recover. Will the carbon price start to go up again, when the demand for allowances goes up together with an increase industrial production? This is essential if the EU ETS is to work and keep emissions down while product goes up.

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Appendix A: Survey questioner

EU ETS og dets indflydelse på danske virksomheder

Dette spørgeskema indeholder 15 spørgsmål, der alle er multiple choice. I bunden af svarvinduet findes en navigationsbar, som også viser status i forhold til hvor langt man er med spørgeskemaet. Når spørgsmålene på hver side er besvaret går man videre til næste side ved at klikke på pilen placeret på højre side af navigationsbaren. Alle spørgsmålene skal udfyldes, da man ellers ikke kan gå videre til næste side i skemaet.

Som nævnt i mailen, vil de indsamlede data fra spørgeskemaet blive holdt anonyme, og vil kun blive benyttet i forbindelse med dette projekt.

Jeg takker dem for at ville deltage i min undersøgelse.

MVH Lars Rysgaard Madsen

Før de begynder gives lidt information omkring EU ETS.

Info om EU ETS

EU ETS er et marked for CO2-udledning, som dækker alle 27 EU lande. Formålet er at give virksomheder incitament til at reducere deres CO2-udledning. Dette gøres ved at virksomheden får defineret en øvre grænse for, hvor meget CO2 den må udlede. Virksomheden tildeles efter behov tilladelser til CO2-udledning. Disse tilladelser kan sælges i kvotemarkedet, hvis virksomheden har flere end den skal bruge. Dette vil være tilfældet, hvis virksomheden har reduceret dens CO2-udledning.

Ændringer af EU ETS

EU ETS blev implementeret i 2005 og har gennemgået ændringer undervejs. I 2008, med begyndelsen af den anden handelsperiode, blev mængden af tilladelser sænket, da der var tildelt for mange i den første periode. Dette havde betydet et kollaps af kvotemarkedet i 2007. Igen fra 2013 vil der med begyndelsen af den tredje handelsperiode komme nye regler. Dette betyder en yderligere sænkning i mængden af tildelte tilladelser og gradvis reducering af den øvre grænse for den tilladte CO2-udledning. Disse nye regler vil også være gældende til og med 2020.

1. Hvilken eller hvilke energikilde(r) benyttes primært i virksomhedens produktion?

Flere valgmuligheder kan markeres samtidig.

(1) ❑ Olie
(2) ❑ Naturgas
(3) ❑ Kul
(4) ❑ Elektricitet
(5) ❑ Vedvarende energi (F.eks. vind eller sol)
(6) ❑ Biomasse/biogas
(7) ❑ Andet, og i så fald hvad: _____

2. Hvem står for overvågning af virksomhedens CO_2-udledning?

Vælg en af følgende muligheder.

(1) ❑ Egne ansatte
(2) ❑ Ekstern virksomhed eller organisation
(3) ❑ Andre, og i så fald hvem: _____

3. Har virksomheden deltaget i Clean Development Mechanism (CDM) eller Joint Implementation (JI) projekter?

Vælg en af følgende muligheder.

(1) ❑ Ja, har deltaget i et af disse
(2) ❑ Nej, har ikke deltaget i et af disse
(3) ❑ Ved ikke

4. Hvem i virksomheden er ansvarlig for beslutninger i forhold til EU ETS?

Vælg en af følgende muligheder.

(1) ❑ Virksomhedens bestyrelse
(2) ❑ Den ansvarlige for hver produktionsenhed
(7) ❑ Virksomhedens administration
(4) ❑ En speciel EU ETS ansvarlig enhed/afdeling
(5) ❑ Ingen har det specifikke ansvar
(6) ❑ Andet, og i så fald hvad: _____
(8) ❑ Ved ikke

5. Har virksomheden en strategi til håndtering af EU ETS?

Vælg en af følgende muligheder.

(2) ❑ Ja, vi har en strategi for EU ETS, som er en vigtig del af virksomhedens forretningsmodel

(1) ❑ Ja, vi har en strategi for EU ETS, som hjælper virksomheden med håndtering

(3) ❑ Nej, vi har ikke udviklet nogen specifik strategi for EU ETS

(4) ❑ Ved ikke

6. Har virksomheden handlet med kvoter i den anden handelsperiode af EU ETS (2008 - 2012)?

Vælg en af følgende muligheder.

(1) ❑ Ja, vi har primært solgt kvoter

(2) ❑ Ja, vi har primært købt kvoter

(4) ❑ Ja, vi har både købt og solgt kvoter

(3) ❑ Nej, vi har ikke handlet med kvoter

(5) ❑ Ved ikke

7. Har virksomheden på grund af EU ETS foretaget en eller flere af følgende handlinger siden 2005?

Flere valgmuligheder kan markeres samtidig.

(13) ❑ Opsparet CO2-kvoter til den tredje handelsperiode

(7) ❑ Investeret i forskning og udvikling i sænkning af virksomhedens CO2-udledning

(10) ❑ Foretaget investeringer som mindsker virksomhedens CO2-udledning

(6) ❑ Skiftet til en mindre CO2-udledende energikilde

(4) ❑ Reduceret virksomhedens produktion inden for EU

(14) ❑ Oprettet en afdeling eller enhed, som er ansvarlig for EU ETS

(15) ❑ Udviklet en specifik strategi i forhold til EU ETS

8. Er følgende forretningsfaktorer i virksomheden blevet påvirket af EU ETS siden dets indførsel i 2005?

	Ja, er vokset	Ja, er mindsket	Nej, er ikke blevet påvirket	Ved ikke
Produktionsomkostninger	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Produktionsmængde	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Markedsandel i forhold til konkurrenter	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Efterspørgsel på virksomhedens produkter	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Produktionseffektivitet	(1) ❑	(2) ❑	(3) ❑	(4) ❑

9. Er følgende konkurrencefaktorer i virksomheden blevet påvirket af EU ETS siden dets indførsel i 2005?

	Ja, er blevet mere konkurrencedygtig	Ja, er blevet mindre konkurrencedygtig	Nej, er ikke blevet påvirket	Ved ikke
Markedspris på virksomhedens produkter	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Kvaliteten af virksomhedens produkter	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Virksomhedens varemærke	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Virksomhedens kundeservice	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Virksomhedens offentlige image	(1) ❑	(2) ❑	(3) ❑	(4) ❑

10. Der er forskellige usikkerheder forbundet med investering i ny teknologi. I hvor høj grad spiller følgende usikkerheder en rolle, når virksomheden skal investerer i ny teknologi?

	Slet ikke	I mindre grad	I nogen grad	I høj grad	Ved ikke
Prisen på CO2-kvoter	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Prisen på elektricitet	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Prisen på brændstof / energi	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Sænkning af produktionsomkostninger	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Udvikling af ny teknologi	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Anden miljøregulering	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Ny fremtidig klimapolitik (fx nye CO2-reduktionsmål)	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Udvidelse af EU ETS (f.eks. med stater i USA)	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Fremtidig regulering af CO2-udledning uden for EU	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑

11. Hvilke barrier møder virksomheden i forhold til reducering af dens CO_2-udledning?

Flere valgmuligheder kan markeres samtidig.

(2) ❑ Omkostning ved reduktion
(3) ❑ Usikkerhed i forhold til CO2-kvoteprisen
(9) ❑ Anden offentlig regulering
(4) ❑ Usikkerhed i forhold til fremtidig regulering af EU ETS
(5) ❑ Administration af EU ETS (optælling og rapportering af udledninger)
(6) ❑ Intern administration
(7) ❑ Tekniske barrierer
(8) ❑ Andet, og i så fald hvad: _____

12. Vil virksomheden handle med kvoter i den kommende handelsperiode af EU ETS (2013 - 2020)?

Vælg en af følgende muligheder.

(1) ❑ Ja, vi regner med primært at sælge kvoter
(2) ❑ Ja, vi regner med primært at købe kvoter
(3) ❑ Ja, vi regner med både at købe og sælge kvoter
(4) ❑ Nej, vi regner ikke med at handle med kvoter
(5) ❑ Ved ikke

13. I hvilken udstrækning er de enig med følgende udsagn i forhold til ændringerne af EU ETS, som træder i kraft med den tredje handelsperiode fra 2013?

	Helt uenig	Uenig	Enig	Helt enig	Ved ikke
Ændringerne for den tredje handelsperiode vil give virksomheden større incitament til at reducere CO2-udledning	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Virksomhedens produktionsmønster vil blive ændret	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Virksomheden vil blive mere konkurrencedygtig intern i EU	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Virksomheden vil blive mere konkurrencedygtig udenfor EU	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Virksomheden vil få yderlige omkostninger på kortsigt	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑
Virksomheden vil tjene flere penge i det lange løb	(4) ❑	(3) ❑	(2) ❑	(1) ❑	(5) ❑

14. På en skala fra 1 til 5, hvor sandsynligt er det at virksomheden på grund af EU ETS vil foretage følgende handlinger i den tredje handelsperiode (2013-2020)? (1 ikke sandsynligt, 5 meget sandsynligt)

	1	2	3	4	5	Ved ikke
Opsparer CO2-kvoter til de efterfølgende år	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Deltage i CDM/JI projekter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Investerer i forskning og udvikling i forhold til CO2-reduktion	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Investerer i ny CO2-besparende teknologi	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Skifte til en mindre CO2-udledende energikilde	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Reducere virksomhedens produktion indenfor EU	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Flytte dele af virksomhedens produktion udenfor EU	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

15. Betydning af kvoteprisen. Ved hvilket prisniveau vil EU ETS give jeres virksomhed incitament til at investere i CO_2 -reduktion?

Vælg en af følgende muligheder.

(1) ❑ €5 - €10
(2) ❑ €10 - €15
(3) ❑ €15 - €20
(4) ❑ €20 - €25
(5) ❑ €25 - €30
(6) ❑ €30 - €35
(7) ❑ Over €35
(8) ❑ Ved ikke

Appendix B: Company list

This appendix lists the companies, which have participated in the survey. Company size and main activity can also be seen. This company size is based information from Krakmarkedsdata (Krak, 2011) on turnover and number of employees. In the same database the main activity can be found, as the main NAC-code, which is used to sort out if an activity is in risk or carbon leakage or not.

Table 3 Surveyed companies in the judged in risk of carbon leakage.

Carbon leakage risk group		
Company name	**Company size**	**Company activity**
Ardagh Glass Holmegaard A/S	Large	Fremstilling af flasker, drikkeglas mv.
Cheminova A/S	Large	Fremstilling af pesticider og andre agrokemiske produkter
CP Kelco ApS	Large	Fremstilling af andre kemiske produkter i.a.n.
Danisco A/S	Large	Fremstilling af andre kemiske produkter i.a.n.
Novozymes A/S	Very large	Fremstilling af andre organiske basiskemikalier
TripleNine Fish Protein AMBA	Large	Fremstilling af fiskemel
Hanstholm Fiskemelsfabrik A/S	Large	Fremstilling af fiskemel
Sophus Fuglsang, Export-Maltfabrik A/S	medium	Fremstilling af malt
Danish Malting Group A/S	medium	Fremstilling af malt
Højslev Teglværk A/S (randers tegl)	Small	Fremstilling af mursten, teglsten og byggematerialer af brændt ler
Pipers Teglværker A/S (randers tegl)	Small	Fremstilling af mursten, teglsten og byggematerialer af brændt ler
Tychsens Teglværk A/S (randers tegl)	Small	Fremstilling af mursten, teglsten og byggematerialer af brændt ler
Monier A/S	medium	Fremstilling af mursten, teglsten og byggematerialer af brændt ler
A/S Carl Matzens Teglværker	Small	Fremstilling af mursten, teglsten og byggematerialer af brændt ler
A/S Gråsten Teglværk (ejer ovenover)	Small	Fremstilling af mursten, teglsten og byggematerialer af brændt ler

Saint-Gobain Weber A/S	Large	Fremstilling af mørtel
Aalborg Portland A/S	Large	Fremstilling af cement
Damolin A/S	medium	Anden råstofindvinding i.a.n.
Novopan Træindustri A-S	Large	Fremstilling af finerplader og træbaserede plader
Arla Foods Energy A/S	Very large	Mejerier samt ostefremstilling
Duferco Danish Steel A/S	Large	Fremstilling af jern
Dalum Papir A/S	Large	Fremstilling af papir og pap
Skjern Papirfabrik A/S	medium	Fremstilling af papir og pap

Table 4 Surveyed companies in the judged in no risk of carbon leakage.

No carbon leakage risk		
Company name	**Company size**	**Company activity**
A/S Knud Jepsen	Small	Dyrkning af andre etårige afgrøder
Alfred Pedersen & Søn Bellinge ApS	Small	dyrkning af grønsager og meloner, rødder, og rodknolde
Gartneriet Kronborg ApS	Small	Planteformering
Dangrønt Products A/S	medium	Fremstilling af færdig foder til landbrugsdyr
Carlsberg Danmark A/S	Very large	Fremstilling af øl
Daka a.m.b.a.	Large	Forarbejdning af svinekød
Danish Crown	Very large	Forarbejdning af svinekød
Arkil A/S	Large	Fremstilling af asfalt og tagpap
Brdr. Hartmann A/S, Tønder	Large	Fremstilling af andre papir- og papvarer

Table 5 Company size categories.

Very large	>500 M €
Large	50 - 500 M €
Medium company	10 - 50 M €
Small business	<10 M €