Strategic Early Options under an Emerging Emissions Trading Scheme
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Implications for US Nitric Acid Companies

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ABSTRACT

Within the next years, new greenhouse gas emission allowance trading systems will emerge in various countries, such as in the United States, Australia, Japan and New Zealand, opening different strategic early options for companies that will most likely receive a reduction cap under new national emissions reduction regulations. Strategic early options represent corporate actions that might pro-actively include emissions reductions or counter-actively exclude emissions reductions prior to the emerging obligatory cap-and-trade system. This work identifies as strategic early options:

- the participation in an early action program of any emerging national cap-and-trade system,
- emissions reductions under federal offset programs of exiting cap-and-trade systems,
- the realization of offset credits in the voluntary market and
- no early emissions reductions.

Risks and opportunities result from strategic early options themselves, as well as from their interaction with the emerging emissions cap-and-trade system. The work defines five key company, policy and market factors in order to best possibly analyze a company's exposure to policy and market developments:

1. the early emissions reduction portfolio,
2. allocation procedures,
3. design of an early action program,
4. emissions credit standards and regulations, as well as
5. prices of emission allowances and offset credits.

The five key factors will be combined to a framework for strategic early option analysis representing a comprehensive tool for risk and opportunity assessment.

According to the analysis in this thesis, business is able to combine the presented early options and choose between four basic environmental strategies for best positioning under an emerging emissions trading system. The strategic choice depends on the mentioned risks and opportunities that are assessed through the framework of strategic early option analyses.

If a company faces neither risks nor opportunities, it might choose the indifferent basic strategy of "wait and see" adopting a rather passive approach to save recourses. When only facing risks and no opportunities it might better follow a defensive strategy, under which it will not consider any early emissions reductions. The innovative basic strategy of only reducing part of its emissions will diversify early actions and may be best applicable, if a company faces risks and opportunities under a cap-and-trade scheme. In case of only having opportunities, the company might choose the offensive strategy of focusing on early reductions before trading starts.

It is assumed that the US nitric acid industry will be obligated to reduce the side product of its chemical processes nitrous oxide emissions under a future US federal emissions cap-and-trade system. The trading program will most likely start between 2012 and 2014. Nitric acid companies are able to realize advantages and reduce their exposure to risks before trading begins by adopting one of the four basic strategies. The assessment of risks and opportunities through the framework of early option analysis within the different emissions markets and in the context of the emerging US trading scheme reveals that nitric acid companies are best positioned by structuring their existing early emissions reductions portfolio into one group of nitric acid facilities in which emissions will be reduced early and into one group of facilities in which emissions will not be reduced, thus adopting the innovative basic environmental strategy.

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LIST OF ABBREVIATIONS AND ACRONYMS

BAT	Best available technology
BAU	Business as usual
°C	Celsius
CAAA	Clean Air Act Amendments
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CMEB	Carbon Market Efficiency Board
CO_2	Carbon dioxide
CO_2e	CO_2 equivalent
EC	European Commission
E.g.	Exempli gratia (for example)
EPA	US Environmental Climate Protection Agency
ETS	Emissions trading system
EU	European Union
EU-ETS	European Emissions Trading System
GDP	Gross Domestic Product
GHG	Greenhouse Gas
G8	Group of the eight
HNO_3	Nitric acid
H_2O	Water
Install.	Installation
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
JI	Joint Implementation
MGGA	Midwestern Greenhouse Gas Accord
Mil.	Million
NH_3	Ammonia
NO	Nitrogen oxide
NO_x	Generic term for mono-nitrogen oxides
NSCR	Non selective catalytic reduction
N_2	Nitrate
N_2O	Nitrous oxide
OTC	Over the counter market
O_2	Oxygen
Red.	Reduction
RGGI	Regional Greenhouse Gas Initiative
SO_2	Sulfur dioxide
t	Ton
UNEP	United Nations Environment Programme
USA	United States of America
USD	US Dollar
VCS	Voluntary credit standard
VER	Voluntary emissions reduction
VER+	Voluntary emissions reduction standard
WCI	Western Climate Initiative
WRI	World Resource Institute

1 INTRODUCTION

Over the next years, the world is going to face strong political enforcement towards more climate protection (see Hoffman & Woody 2008; Point Carbon 2008d). More and more countries are considering mandatory emissions trading systems as one of the main methods to address the reduction of anthropogenic greenhouse gases (GHG) (see Schüle & Sterk 2007, 1ff.). Canada announced the implementation of a domestic emissions scheme in 2007 with the intention to start trading in 2012 (see Schüle & Sterk 2007, 18). Japan has decided to move forward and finalize its emissions reduction system by the end of 2008 (see Rudolph 2008, 8). Australia aims to commence its emissions trading in 2010 (see Australian Government 2008b). New Zealand forces activities towards emissions reductions through trading by starting to implement a system by the end of 2008 (see New Zealand Government 2007).

The United States of America (USA) consider to introduce a federal mandatory greenhouse gas emissions trading system as one component in order to reduce greenhouse gases from 2012 onwards (see Conserve Energy 2008; Layke 2007; Paltsev et al. 2007). Already, US policy makers in the West[1], Midwest[2] and Northeast[3] are implementing regional cap-and-trade systems and are rapidly developing the future compliance requirements for their region (see ARB 2008; RGGI 2008; MGA 2007; WCI 2008a). Since the beginning of the year 2008, US Congress discussed several federal bills on cap-and-trade schemes including the favored Boxer-Lieberman-Warner Bill[4] and might pass a final version in 2009 (see PEW Center 2008d). New Carbon Finance (2007, 2) estimates the likelihood of a federal US trading scheme to be 80 percent.

The emerging emissions trading schemes mainly address large emitters in the industrial sector (see Schüle & Sterk 2007, 17ff.). The global industry is concerned about the legal and financial impact of the cap-and-trade systems on their company and business perspectives (see Enkvist et al. 2008, 35; Hoffman & Woody 2008). The increasing number of voluntary offset credits realized in the voluntary market indicates a pro-active attitude of an already large group of companies towards the inclusion of emissions reduction into their strategies (see New Carbon Finance 2008a). From a pure environmental perspective, the consideration of voluntary emissions reduction in their today's decisions can be viewed positively. However, companies, having to meet compliance obligations in the near future, must look very carefully at which impacts their present decisions will have on their position in the future cap-and-trade system. Some literatures automatically associate reducing emissions, in general and before regulation starts, with business opportunities (see Hoffman & Woody 2008; Schultz & Williamson 2007). The authors argue that companies are able to take advantages of a regulation vacuum (in pre-compliance time) by reducing emissions at its own pace rather than wait until an imposed timetable will force reductions (see Hoffman & Woody 2008, 38).

[1] Western Climate Initiative (see chapter 4.4.2)
[2] Midwestern Greenhouse Gas Accord (see chapter 4.4.3)
[3] Regional Greenhouse Gas Initiative (see chapter 4.4.1)
[4] Bill S. 3036 (see Boxer et al. 2008) (see chapter 4.3.3)

This work clearly demonstrates that this is only true to some extent. It is not a vacuum that exists but rather a tight and close interrelation between actions in the period prior to a trading scheme and options in the compliance period. Whether early emissions reductions that are realized before a cap-and-trade system is put in place lead to advantages or disadvantages strongly depends on the accompanied threats and opportunities of early options, on the final design of the trading system and on the company's strategic positioning. Thus, for companies that will most likely face a future reduction obligation, it has become indispensible to approach options prior to an emerging cap-and-trade system strategically.

1.1 Objectives of the thesis

Theoretical debate

This work will contribute to the theoretical debate on strategic early options prior to the implementation of a cap-and-trade system. It is surprising that, so far, such early options have not been approached strategically in a theoretical context. Considering the number of countries that will implement an emissions trading system soon, the topic is more important and actual than ever.

In the presented work, the following strategic early options are identified:

- The participation in an early action program of the future national emissions trading system.
- The participation in offset programs of already existing trading systems in other countries.
- The realization of offset credits that can be sold in the voluntary offset market.

These three options require that greenhouse gas emissions are reduced by the company on a voluntary basis even before an emerging compulsory cap-and-trade system is politically implemented. Another strategic early option prior to a trading program is not to reduce any emissions.

A company that will likely face obligations to reduce emissions under a future cap-and-trade system must understand how such early options influence the company's eventual position in the trading scheme. Risks and opportunities of early options depend on policy and market factors (see chapter 3.2) and create a complex interaction.

1. *The thesis identifies a company's early options and evaluates their risks and opportunities against the background of an emerging cap-and-trade system.*

Framework-building

Political developments are uncertain and often complex. E.g. the USA still face presidential elections. A congressional decision on a final emissions trading bill has not been made yet (see chapter 4.3). Only prognostic work can be done about the constraints, which must eventually be followed by companies with future reduction obligations. Next to political developments, other emissions markets have to be analyzed in order to assess risks and opportunities. Within this work, the creation of a framework with five strategic key factors shall help to generalize reality and reduce complexity originated in the interaction of the policy and market factors.

2. *A general framework for strategic early option analysis with five key factors is created in order to provide an overview on the risks and opportunities, as well as a tool for evaluating early options, in the context of political and market developments.*

The early options and the general key factors that influence early strategic decisions are similar in every emissions trading scheme. According to this work, these five factors lead to strategic positioning regardless of the company and its location. They indicate the opportunities and threats of early options in the context of an emerging trading system. Thus, the developed framework for strategic early option analysis aims to set a standard for identifying a company's position under any emerging emissions reduction scheme and other already existing emissions markets.

<u>Strategy formulation</u>

In order to realize the opportunities and to minimize the threats, a company might choose a basic environmental strategy. Basic strategies are originated in strategic environmental management, supporting a company in achieving advantages of environmental challenges, such as emissions reductions (see Schaltegger et al. 2003, 171).

3. *The early options of a company prior to an emerging trading scheme will be combined and formulated to basic environmental strategies.*

The work will clarify which key factor designs lead to pro-active strategies, such as early emissions reductions, and which key factor designs rather lead to counter-active strategies, such as wait and see.

<u>Analysis of US nitric acid companies under an emerging emissions trading system</u>

As stated above, the created framework and the developed basic environmental strategies aim to be suitable for any emissions trading scheme and company with future reduction obligations. To prove their applicability, this work exemplarily describes the US nitric acid industry in the context of the emerging emissions reduction cap-and-trade systems in the USA. By using the framework for early option analysis, the risks and opportunities of nitric acid entities will be assessed. Moreover, based on the results of the assessment a basic environmental strategy will be discussed that best possibly positions a nitric acid company under the emerging US federal emissions reduction scheme.

4. *This thesis will assess the strategic options available to US nitric acid companies that will most likely face future compliance obligations, in order to best possibly position them before a US federal emissions trading scheme.*

1.2 Scope of the thesis

This thesis is exclusively located in the theoretical context of strategic environmental management. The challenges of an emerging emissions trading scheme are presented from the business perspective of an affected company, considering the scheme as an external factor that constrains business. Advantages and disadvantages of such trading schemes are evaluated in opportunities and threats and will be addressed strategically.

Emissions trading schemes represent a flexible mechanism of environmental policy (see Pätzhold & Mussel 1996, 82ff.). Environmental policy is defined as

"(..)any actions deliberately taken – or not taken- by government that are aimed at managing human activities with a view to preventing harmful effects on nature and natural resources, (…)" (McCormick 2001, 21).

Many works have been accomplished on emissions trading schemes from the environmental policy perspective. However, this work does not evaluate environmental policies with the goal to effectively reduce emissions. Neither is the aim of this work to give a complete overview on international or US green policy regarding climate change. The analysis of US developments with respect to emissions reduction efforts focuses on the current emerging US federal and regional emissions trading schemes.

For more information on environmental politics see Bringezu (1997); Jänicke et al. (2000); Jänicke & Jörgens (2004); Pätzold & Mussel (1996). For references on environmental policy instruments see Knüppel (1989) and for the discussion on political climate protection see Bardt & Selke (2007); Heister et al. (1991).

Next to environmental policy, the theoretical field of environmental economics intensively studies the effects of emissions reduction trading schemes (see Perman et al. 2003, 202ff.). Central topics within the economic perspective are allocative efficiency, the role of markets and prices (see Perman et al. 2003, 11). This study does neither intend to give an analysis on effects of early reductions prior to an emerging emissions trading scheme on the economy, nor is its aim to give advice on how emissions trading schemes should be economically designed for efficient early reductions. Nevertheless, the scope is influenced by and benefits from research results in environmental policy and economics. For more information on environmental economics and early reductions see Carrao (2000); Eckermann (2004); Kennedy (2002); Tol (1999).

Finally, this study comprises implications for companies that likely face constraints in an emerging emissions trading scheme. Suggestions for business sectors that will most likely be excluded from mandatory emissions reduction compliance systems are only provided to some extent. However, the emerging emissions markets encompass promising opportunities but also risks for companies with and without a future cap. The framework for early option analysis comprises high potential for functioning as an important assessment tool for companies without a future cap. It underlines the importance of theoretical works on strategic positioning under emerging emissions markets. The development of the framework for being suitable for companies without future obligations must be subject of further research.

1.3 Structure

After the introduction in chapter one, the theoretical background for strategic options prior to a cap-and-trade system is described in chapter two. The emissions reduction trading scheme is briefly outlined as an environmental regulation to politically constrain operational emissions of a company. In order to truly understand the influence of an emerging cap-and-trade system on business, the interaction of a trading scheme and business environment is assessed by using Schaltegger et al.'s (2003, 42ff.) classification of business spheres. Then, each early option that is addressed in this work will be described revealing a company's alternatives. After that, an introduction in strategic theory and strategic environmental management will be given. The basic strategies of Steger (1988, 150ff.) are introduced as the best approach for positioning a company before a future emissions trading scheme is finally implemented. In the end of section two, the framework approach is presented as a model to reduce complexity and analyze business environment.

Chapter three is dedicated to building a framework for strategic early option analysis and to formulate basic strategies for early positioning. The core risks and opportunities of each early option are identified. The key factors that influence the risks and opportunities are combined to form a framework for strategic early option analysis. The framework establishes a clear structure for analyzing political and market developments in the context of an emerging emissions trading system and other emissions markets. After knowing the risks and opportunities, four basic strategies are formulated that integrate and combine early options for best positioning. In the end, the framework-building and basic strategy formulation is evaluated.

Part four focuses on the analysis of the US nitric acid industry under an emerging US federal cap-and-trade system. By using the framework for early option analysis, the current situation in the White House, in Congress, in the regional initiatives and the voluntary emissions market will be outlined. Risks and opportunities are assessed in order to identify a basic strategy for US nitric acid companies. To round up the thesis and to point out the individual aspect of basic strategies, a US nitric acid company is selected and described as one example.

Finally, the thesis provides an overall summary, a conclusion and an outlook of further research possibilities in section five.

2 THEORETICAL BACKGROUND FOR STRATEGIC EARLY OPTION ANALYSIS UNDER AN EMERGING EMISSIONS REDUCTIONS SCHEME

2.1 Cap-and-trade: An introduction on emissions reduction schemes

In 1990, the first trading of emissions certificates was introduced under the Clean Air Act Amendments (CAAA) in the USA (see Lile & Burtraw 1998). Its aim was to reduce sulfur dioxide (SO_2). In 1997, the first international agreement on stabilizing the emission of anthropogenic greenhouse gases, the Kyoto Protocol[5], included emissions trading as one of the mechanisms to help reducing the six climate gases carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride[6] (see bpb 2006; UNFCC 2008a).

Emissions trading schemes belong to the market based instruments of environmental policy (see Pätzhold & Mussel 1996, 82ff.). In contrast to command and control regulations, where directives are either strictly compulsory or prohibited, marked based tools set market incentives for business to accomplish compliance (see Jänicke et al. 1999, 101ff., Endres 1994; Knüppel 1989). Emissions trading schemes address emitting business sectors with emissions reduction targets.

It is necessary to distinguish between a cap-and-trade and a credit-and-baseline system (see PEW Center 2008b, 1f.). The cap-and-trade approach constitutes the foundation basis of an emissions reduction scheme. Within the program, government defines an emissions cap and gives out tradable allowances (the right to emit) to covered entities equivalent to their overall amount of emissions minus their mandatory reduction target. Within one trading period these entities have to comply with their target by either buying allowances from other companies or by reducing emissions themselves (see PEW Center 2008b, 1f.). Giving addressed entities the choice of investing in reduction potentials or in CO_2e allowances, provokes cost-efficient business activities. Individually, they are able to manage their compliance in relation to their marginal productions costs (see PEW Center 2008b, 2; Pätzhold & Mussel 82f.).

The credit-and-baseline system can be linked to a mandatory emissions trading system and is based on voluntary reductions from companies that have not received a cap. Tradable credits (the prove of having reduced emissions), so called offset credits[7], are created which then can be bought and used for compliance purposes by companies that are capped under a mandatory trading system (see PEW Center 2008b, 2). Usually the amount of credits from a credit-and-baseline approach is limited in an emissions trading system as it is seen as additional assistance for reaching national reduction goals (Pätzhold & Mussel 82f.).

[5] 164 countries developed emissions reduction targets they have to comply with between 2008 and 2012. The Protocol could finally be ratified after Russia agreed to its commitment in 2004 (see bpb 2006).

[6] Throughout his work, greenhouse gases always refer to these six gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

[7] Next to offsets, early action programs and the voluntary market are based on a credit-and-baseline system. The three approaches will be described in detail in chapters 2.3.1 to 2.3.3 and 3.2.2 to 3.2.4.

The political process of considering a trading scheme, from the final decision on its introduction to the actual implementation, usually takes several years[8] (see chapter four). As soon as the implementation of an emissions trading scheme is put on the political agenda, entities that will most likely receive a cap must assess the optimal emissions reduction adjustment process with minimized compliance costs (see Kennedy 2002, 21ff.). Two periods for actions can be generally distinguished, the period prior to compliance time (pre-compliance) and the compliance period itself (see Kennedy 2002, 18f.). The general time periods of an emissions trading scheme are displayed in figure one. Options prior to the start of the trading period are called early options (see figure one).

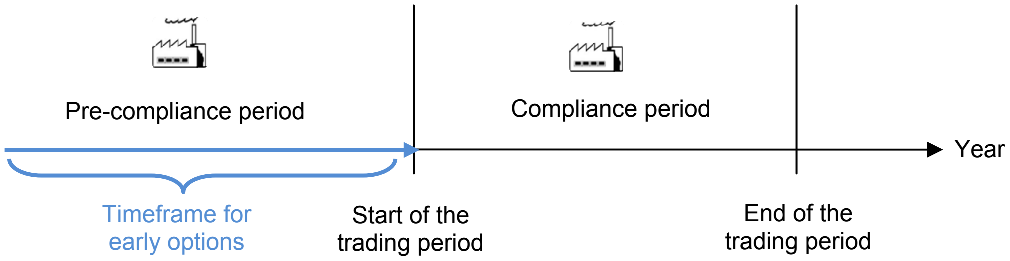

Figure 1: General time periods of an emissions trading system (own source)

Early options in the pre-compliance period (see chapter 2.3) are voluntary whereas actions in the compliance period are obligated (see Hoffman & Woody 2008, 38; PEW Center 2008b). A company's early options: the participation in an early action program of the future national emissions trading system; the participation in offset programs of already existing trading systems in other countries; the realization of offset credits that can be sold in the voluntary offset market and no early emissions reductions are described in detail in chapter 2.3.

In the following work, only actions in the pre-compliance period will be regarded. Nevertheless, the compliance period will be taken into account. Early options shall always be evaluated in the context of the real trading scheme.

2.2 Influence of an emerging cap-and-trade system on business environment

The introduction of an emissions trading system is accompanied by many variables affecting the complete business environment (see Hoffman & Woody 2008, 5). The aim of this chapter is to provide profound theoretical background information on how a company is influenced by such system. It represents the first step towards understanding the complex external structure and the interaction between business, policy and market factors under an emerging cap-and-trade scheme. Only thus, options in the pre-compliance period that are described in chapter 2.3 can be evaluated.

Rumelt (1980), as well as Porter (1980, xxvi), gave business environment a dual character. In its generic environment, business creates social value and constantly adapts to economic and social conditions. Within its competitive environment, business aims for capturing some

[8] E.g. the Kyoto Protocol was adopted on 11 December 1997 but was first entered into force on 16 February 2005 (see UNFCCC 2008).

of the social value as profit realizing an advantage against its competitors (see also Mintzberg et al. 2003, 82, Dess et al. 2008, 44ff.). Andrew (1980) states:

"The environment of an organization in business, like that of any other organic entity, is the pattern of all external conditions and influences that affect its life and development" (Andrew 1980, 48).

The external variables affecting a firm are political, legal, sociocultural, economic and technological in kind (see Schaltegger et al. 2003, 37ff.). The next chapter describes the impacts of a future trading scheme in these five different areas of business environment.

2.2.1 Political environment

The political environment is driven by the interaction of political, social and business interest groups in a political process and is characterized by the conflicts arising through non-conformable claims and the allocation of limited resources (such as emissions reduction certificates) (see Schaltegger et al. 2003, 149ff.; Schaltegger & Petersen 2004, 31f.). During the progress of establishing an emissions trading scheme, individual interests of political parties, the struggle for votes or political power and the arising conflicts[9] between the actors often make the final design of a law unpredictable and increases uncertainty in business action (see Schubert & Bandelow 2003, 4ff.).

However, the early confirmation of rules, transparent design discussions, as well as constant political long term goals, are essential for long term strategic business planning (see OECD & IEA 2007, 11). Thus, finding the most efficient strategy for achieving emissions reduction compliance is threatened when long term investment decisions for emissions reduction have to be evaluated with a risk discount rate (see also chapter 2.2.4) (see Sudsawasd & Moore 2006).

In the process of policy adoption, business itself can influence the political agenda in order to secure individual interests, values or resources (see Kleinfeld et al. 2007, 1ff.; Schaltegger & Petersen 2004, 9ff.). In this case, Wehrmann (2007, 38f.) refers to legislative lobbying[10]. For instance, between 2001 and 2003 the German energy industry was able to exert strong influence on the German allocation plan in the European Emissions Trading System (EU-ETS). They achieved a better allocation of emissions certificates for the energy sector than it had been politically planned (see Convery et al. 2008, 10; Zöckler 2004). Successful enforcement of business claims or policy interests depends on the degree of influence and resistance power and on the ability of conflict management each party has within the political arena (see Mintzberg et al. 2003, 76; Schaltegger & Petersen 2004, 15ff.).

All in all, politics taken place prior to the implementation of a trading scheme strongly influence how efficiently business is able to adapt to its new compliance situation before and in the trading scheme.

[9] Policy-analysis defines such conflictual interaction as politics. The policy-analysis will not be described further. For more information see Fuhse (2005); Schneider & Janning (2006) or in relation to green policy Jänicke et al. (1999).

[10] Schaltegger & Petersen (2004, 25) embrace all activities with the effort of maximizing own interests in allocation processes under rent seeking, such as lobbying.

2.2.2 Legal environment

The political environment includes the political process of policy making whereas the legal environment assesses the final legal results (see Schaltegger & Petersen 2002, 11f.). The legal environment represents one of the most direct spheres in which business is influenced by environmental political performance. When a mandatory emissions trading scheme is passed, business can either be in compliance or in non-compliance (see Schaltegger et al. 2003, 94f.). In some cases, business is not able to be in compliance with their mandatory emissions reduction target. Allowance prices might be too high or the needed technology might not be developed yet (see chapter three). In general unacceptable behavior is outlawed through penalties or fines (see Jänicke et al. 1999, 101f.).

If business shows good practices or even an enforcement of going beyond the requirements, it may be subject to fewer controls in present and future regulations (see Wall & Bong-gon 1980, 93f.; Schaltegger & Petersen 2004, 77ff.).

As soon as an emissions cap-and-trade system is put on the political agenda, companies have to follow the green policy discourse closely in order to know through which concrete requirements it will eventually be affected.

2.2.3 Sociocultural environment

Schaltegger et al. (2003) describe the sociocultural environment as a corporate area in which the social and local legitimacy of business is formed. Forces in society are values, beliefs and lifestyles (see Dess et al. 2008, 45). The social acceptance might decide over business success and is a powerful driver for changing business behavior (see Schaltegger et al. 2003, 45f.).

Over the last couple of years, climate change has risen to an intensive discussed topic in public, dramatically changing business' image exposure related to climate protection (see Weart 2008). In 2007 more than 740 US mayors (who represent more than 60 million US citizens) had signed the US Mayors Climate Protection Agreement asking US congress to pass GHG reduction legislation including an emissions trading scheme (see The United States Conference of Mayors 2007). Depending on the company's exposure, certain stakeholders[11], such as customers or the media, might watch the attitude towards binding environmental issues very carefully. Thus, business must be very sensitive with approaching a new trading scheme in the pre-compliance period. Being strongly reluctant to upcoming compulsory emissions reductions could lead to negative press or even to a customer's boycott (see Meffert & Kirchgeorg 1993, 12; WWF & BVI 2006, 37).

[11] Individuals and groups that have interests and claims in business activities are called stakeholder (see Schaltegger et al. 2003, 36).

2.2.4 Technological environment

The technological environment refers to technological adaptation, as well as to new discoveries and inventions (see Schaltegger et al. 2003, 42). The improvement of the production process, services or products is essential for success orientated business (see Schaltegger et al. 2003, 59). Cap-and-trade systems impose the reduction of emissions. Emissions reductions often require a reduction technology (see BMWI 2008, 17). If technology is too expensive or changes the quality of the produced products, a loss in profitability or in its competitive position might be the consequence.

The more time business has for developing or searching for the needed reduction technology, the more easily it is able to adapt. Thus, business must search for own technological possibilities in the pre-compliance period. It must know as early as possible whether its needed reduction technology already exists or if new, time intensive technological inventions are required for emissions reduction.

2.2.5 Economic environment

The substantial purpose of corporate entities is to maximize profitability and to survive in their market sector (see Wöhe & Döring 2008, 1ff.). Positioned in a highly dynamic and vulnerable interrelation between its competitors, suppliers and customers, external changes will eventually have an impact on a company's market position (see Dess et al. 2008, 52ff.; Henry 2008, 66ff.). An emissions trading scheme can influence business profitability through various aspects[12]. Enkvist et al. (2008) state that regulations will change business strategy, production economics, competitiveness, investment decisions and the value of different assets. Others refer to the impacts on output and employment through the increase of marginal production costs (see Rübbelke 2005; BMWi 2008 13ff.; Porter & van der Linde 1995).

Porter (1991a) in contrast, emphasized a win-win situation between environmental legislation and business performance. Regulations place a monetary value on carbon reduction, increasing the demand for low-carbon technology. Companies that develop technology early can increase profitability by selling their constructions (see Hoffman & Woody 2008, 13). Process-innovations might lead to less production costs due to more process efficiency. Investments that have seemed to be unprofitable in the beginning may even enhance profitability in the end (see Porter & van der Linde 1998; Porter & Reinhardt 2007). E.g., due to the ratification of the Kyoto Protocol, European and Asian companies are better prepared to deal with climate change than their American counterparts (see Hoffman & Woody 2008, 13). Porter explains this phenomenon through imperfect information and management resistance for changes (see Porter & van der Linde 1995; Porter & van der Linde 1998; Wagner 2003).

[12] The risks and opportunities in economic environment have been intensively discussed in business and political science, illustrating how sensitive this topic is (see BMWi 2008, 13ff.; Porter & van der Linde 1995; Porter & van der Linde 1998; Rübbelke 2005).

2.3 Early options prior to a cap-and-trade system

Chapter 2.2 provided the first fundamental information for understanding the influence of an emerging emissions trading scheme on business environment. Such system influences all five external areas, the political, legal, sociocultural, technological and economic environments, not only in the compliance period but also in the pre-compliance period. Thus, early options will interact with the company's eventual position under an emissions cap.

But what kind of early options do companies exactly have? As shown in figure one in chapter 2.1, "early options" are options prior to the start of an emerging emissions trading period. In general, pro-active and counteractive options can be distinguished. Pro-active options encompass early reductions. Chapters 2.3.1 to 2.3.3 show that such reductions create value in different emissions markets. Counter-active options do not consider reducing emissions before trading starts. In the following paragraphs, each early option of a company will be briefly described (see figure three for an overview).

2.3.1 The participation in an early action program

Until now, analysis of emissions reductions prior to the final implementation of a trading scheme were mainly concentrated on discussing advantages and disadvantages of early action programs. Such programs were first designed under the emissions trading approach of the Kyoto Protocol in the late nineties (see Burnett & McDermott 1998; Tol 1999) and are included in every legislative proposal on emissions trading in US Congress (see New Carbon Finance 2007, 13; PEW Center 2008a).

An "early action program" represents one part of an emissions trading bill (see Michaelowa & Rolfe 2000, 286f.; Stronzik et al. 2000, 11ff.), which purely focuses on acknowledging early emissions reductions of companies that have taken place before they are capped under a future emissions trading scheme (see Stronzik et al. 2000, 11ff.). By participating in an early action program, companies with future reduction obligations shall receive a similar amount of allowances in the compliance period for such emissions reductions that have been accomplished in the pre-compliance period (see Parry & Toman 2001, 2f.). That way, early emissions reductions can be integrated into the actual trading scheme (see IISD 2006, 4; Stronzik et al. 2000, 8). Allowances received for early reductions within an early action program are called "early action credits" and can either be used to compensate own future emissions in a compliance period or can be sold to other companies with compliance obligations under the cap-and-trade program (see Michaelowa & Stronzik 2000, 11). Their main aim is to protect companies with compliance obligations of being punished because of their early reduction efforts (see Stronzik et al. 2000, 36). The aspect of discrimination due to certain allocation procedures is discussed in detail in chapter 3.2.1.

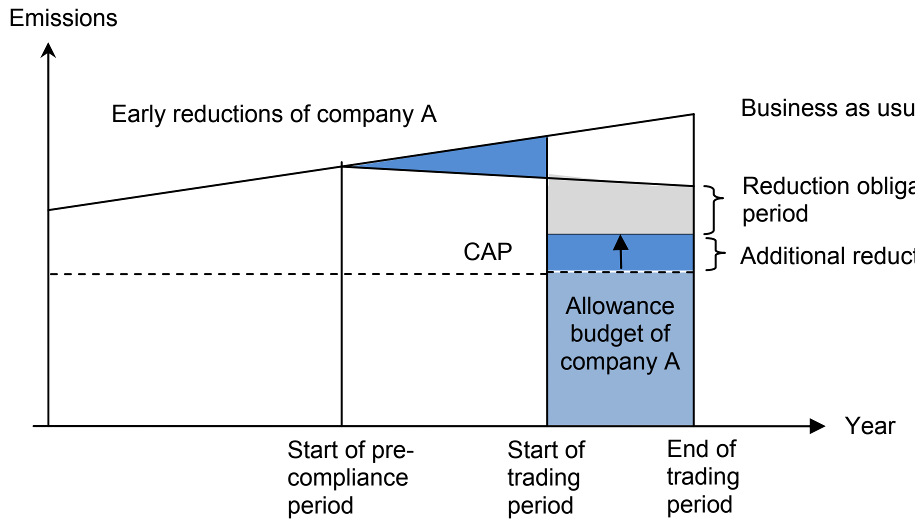

Figure 2: Participation in an early action program of company A (source: based on Michaelowa & Stronzik 2002, 190)

Figure two visualizes the mechanism of an early action program. Company A reduces emissions in the pre-compliance period presented by the dark blue triangle. The amount is converted into early produced credits that increase A's allowance budget in the trading period (dark blue rectangle). The initial allowance budget is shown by the light blue rectangle. The final company's reduction requirements are displayed by the grey area.

In order to generate early action credits, companies' reductions efforts have to follow certain requirements, such as the additionality aspect. The requirements are described in detail in chapter 3.2.2.

As stated above, early action programs have been intensively discussed in the time between establishing the Kyoto Protocol in 1997 and its ratification (see Michaelowa & Stronzik 2000; Kennedy 2002; Parry & Toman 2001). Not only in the European Union but also in the US[13], scientists and politicians started emphasizing early reductions before 2008[14] according to a number of parameters, such as minimizing compliance costs and time preference (see Kennedy 2002, 17ff.).

Looking back at the start of the European Emissions Trading System (EU-ETS), the threats of acting early, such as being disadvantaged in the compliance period, (see also chapter 3.2.1) were predominant to the opportunities[15] pointed out by scientists and politicians (see IISD 1998; Parry & Toman 2000; Parry & Toman 2001; Stronzik et al. 2000). Moreover, organizations were largely unaware of the likelihood of future emissions restrictions until just before the actual start of the first trading period in 2005 (see Michaelowa & Rolfe 2001, 283). Other incentives for reducing emissions early, such as generating image values, were very

[13]At that time, it was not clear yet that the US would not ratify the Kyoto Protocol. Many American scientists put a lot of effort in forming a US domestic trading system with a starting point in 2008. Early action programs as a possible US compliance support was intensively discussed by GAO (1998); IISD (1998) and Parry & Toman (2000; 2001).

[14] Start of the Kyoto period (see UNFCCC 2008).

[15] Among other opportunities, the faster reduction of a country's greenhouse gas business-as-usual path was discussed (see IISD 1998; Parry & Toman 2000; Parry & Toman 2001; Stronzik et al. 2000). The opportunities often focus on the macro-economic perspective.

small at that time, as climate change did not receive the attention of society as it has been receiving over the last couple of years (see Weart 2008).

Looking at today's worldwide emerging emissions trading schemes, companies face more perspectives than European companies at the beginning of the EU-ETS. The experiences being made in the European system, in the Joint Implementation (JI), Clean Development Mechanism (CDM) (see chapter 2.3.2) and in the fast growing voluntary emissions market (see chapter 2.3.3) help to better understand and to identify challenges and options of early positioning under future emissions trading schemes. The already existing trading systems also provide further possibilities in the pre-compliance period additional to generating early action credits. The options related to early emissions reductions in the context of other markets will be briefly introduced in the following chapters. More information is provided in chapters 3.2 and 3.3.

2.3.2 Generating credits under offset programs of existing mandatory cap-and-trade systems

Next to participating in an early action program, companies might have other options prior to an emerging emissions trading scheme. They might be able to generate tradable offset credits giving entities a whole new perspective on activities prior to an emerging cap-and-trade system as it represents a true alternative to generating early action credits under an early action program.

Carbon offsetting is defined as

> *"(…) the aim to compensate for or, in principle, "offset" their own emissions, by paying someone else to reduce them elsewhere" (Kollmuss et al. 2008, v).*

"Offsets" are generated by uncovered and unregulated facilities through qualified emissions reduction projects on a voluntary basis. The qualification of entities for realizing offset projects and the procedure of how to reduce the emissions are defined under different offset standards. The real reductions will be finally converted into tradable credits, if all requirements of the chosen offset standard are fulfilled.

In general, two types of offset projects must be distinguished. Depending on the eligibility of the respective entity and the chosen emission reduction standard, the credits can be effectively integrated into a mandatory cap-and-trade system or can be sold in the global voluntary offset market (see Offset Quality Initiative 2008, 1). The following section will describe offsets that can be integrated in already existing obligatory emissions trading schemes. Offsets realized for the voluntary market are described in chapter 2.3.3.

The majority of current compulsory trading schemes allow capped entities to buy a defined portion of certain offset credits in order to meet their compliance obligation (see Hoffman & Woody 2008, 66f.). Companies aiming to produce and sell such offset credits must follow the standard defined by the offset program of the respective cap-and-trade system by which the buying entity is covered. E.g. the EU-ETS refers to an external offset standard the JI and CDM standard developed under the Kyoto Protocol (see UNFCCC 2008). The obligatory emissions trading program of the US regional initiative RGGI is currently developing its own offset standard (see RGGI 2008).

Not every company sector is able to generate offset credits that can be sold into mandatory emissions trading systems. One of the most crucial aspects for the eligibility of an offset project is the additionality component and therefore its voluntary basis[16]. Obligatory emissions reductions due to economic or regulative reasons would have happened anyway and are thus not additional (see Kollmuss et al. 2008, 20ff.). The regulations and standards of offset programs that create credits for the compliance purpose under an emissions trading scheme are further discussed in chapters 3.2.3 and 3.3.1.

Companies that will most likely face a reduction obligation in the future must analyze very carefully the standards of offset programs under existing emissions trading schemes in order to find out whether or not they are eligible for generating offset credits under such programs. Since the voluntary basis of their effort to reduce emissions is a fundamental aspect, entities that will most likely face an obligatory emissions cap themselves sometime in the future are only able to realize voluntary and valuable emission reductions before any regulation is implemented. To give an example: Australia has signed the Kyoto Protocol giving Australian companies theoretically the opportunity to generate JI offsets, which could be sold to European entities that are covered under the already existing emissions trading system of the European Union, the EU-ETS[17] (see Australian Government 2008a). However, the Australian government intends to implement a mandatory emissions trading scheme itself in 2010 (see Australian Government 2008b). Australian companies that will most likely receive a cap under the Australian emissions trading system have thus a limited timeframe for realizing JI offset credits, which would end in 2010 since reductions after 2010 are obligatory and not additional.

2.3.3 Generating offset credits for the voluntary emissions market

Early options for companies with a future cap under an emissions trading scheme are also provided in the voluntary offset market. The procedure of generating credits is very similar to the offset model described in the previous chapter 2.3.2. Emissions are voluntarily reduced for creating valuable credits that can then be sold. Other than under offset programs of mandatory trading schemes, not only the entity supplying offset credits participates on a voluntary basis but also the entities that are demanding them. Thus, basically anyone can generate offset projects for the voluntary market, enabling those in unregulated sectors or countries that have e.g. not ratified the Kyoto Protocol (like the USA) to participate in such system (see Kollmuss et al. 2008, v). The market supports participating organizations in gaining experience with carbon inventories and carbon markets (see Kollmuss et al. 2008, vi).

The voluntary carbon market is mainly driven by companies that demand voluntary credits for image purposes and has emerged parallel to the compliance allowance and offset market.

[16] The voluntary and additional aspect is a fundamental requirement under all currently existing offset standards (see chapter 3.2.3)

[17] Companies are only able to generate offsets under the JI or CDM program if its country has signed the Kyoto Protocol (see UNFCCC 2008).

With a total of 65.1 million ton CO_2e (331 million USD) transaction volume in 2007, the voluntary carbon market has more than doubled compared to 24.6 million ton CO_2e in 2006 (see New Carbon Finance 2008a, 5f.).

Other than the compliance market and their offset programs, the voluntary model lacks regulatory drivers (see New Carbon Finance 2008a, 20). However, several standards have emerged over the last year that more and more structure the voluntary system. Their requirements are similar to regulations comprised in offset programs of emissions trading systems (see chapter 3.2.3). They will be described in detail in chapters 3.2.4 and 4.5.

Figure three provides an overview of the different options a company has when emissions are reduced prior to the start of the trading period. It visualizes the participation in an early action program as well as in offset programs of obligatory cap-and-trade systems and in the voluntary market.

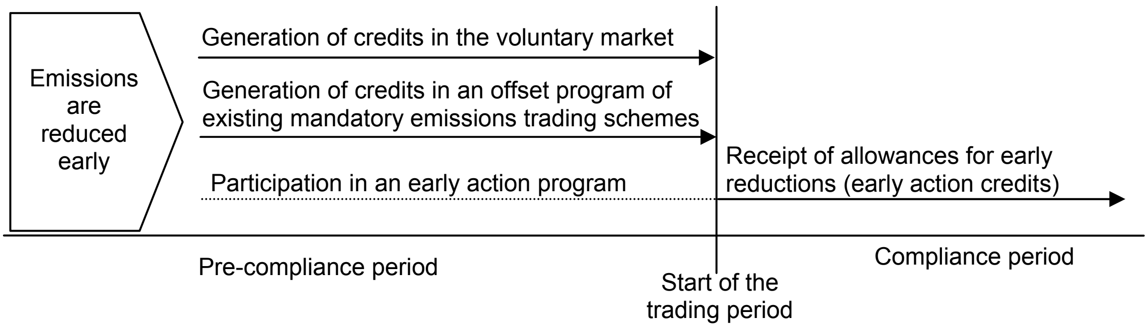

Figure 3: Different early options by participating in different markets and programs in case of early emissions reductions (own source)

2.3.4 *No emissions reductions prior to an emerging emissions trading scheme*

Next to pro-active options, which include the early reduction of emissions, counter-active or passive options might be taken into account in the pre-compliance period. Their fundamental approach is not to reduce any emissions early. Not to reduce before trading starts, represents an important alternative to pro-active reductions. If early reductions do not promise any corporate advantages, a company may not plan on accomplishing them.

The option of not to reduce emissions in the pre-compliance period will be regarded as the counterpart of early emissions reductions throughout the thesis.

2.4 Strategy as an approach for finding most suitable early options

Chapter 2.3 outlined a company's voluntary early options before a mandatory emissions trading system will be implemented. Business has to deal with complex interactions between actions prior and within a cap-and-trade system. The present context of having the choice upon several actions and their influence on business environment makes a strategic approach indispensable in order to find the optimal way forward. The best strategy resembles the company's most favorable option that lead to best positioning before the cap-and-trade system is implemented.

"The ultimate goal of developing a climate strategy is to have a measure of control over your future business environment" (Hoffman & Woody 2008, 3).

The interaction between the many variables of an emerging cap-and-trade system presented in chapter 2.2 and the early options presented in chapter 2.3 lead to opportunities and threats. "Threats" indicate the potential of possible disadvantages; "opportunities" the potential of possible advantages evolving through claims by society, political institutions or other market participants and factors (see Andrews 1980, 57ff.; Schaltegger et al. 2003, 37ff.).

If business aims for best possibly positioning itself and for minimizing negative effects, it must approach its early options and the challenge of an emerging cap-and-trade system strategically. Whether business realizes opportunities depends on the design of the trading system, business' ability of adaptation and its chosen strategy (see chapter 3.4).

2.4.1 Defining strategy

The term "strategy" has a military origin defining the skill of war-leading by not only concentrating on operational moves in a fighting situation. War strategy included the expected moves of enemies, as well as the expected future developments in its planning. About 40 years ago, business management theory has adopted strategic policies, as complexity of the business' external and internal environment increased and competition became more and more intense (see Henry 2008, 4; Mintzberg et al. 2003, 4).

Strategy in business management has been analyzed by many works and has become one of the key theories in management studies (see Andrews 1980; Ansoff 1966; Mintzberg et al. 2003; Porter 1996). Consequently, various definitions of strategy emerged through constantly shaping and developing the theoretical discussion. In one of the earlier works on strategy, Ansoff (1966, 9) defines it as a decision-making process for developing business policy. He approached strategy from the planning side of business. Later Andrews (1980) offered a broader definition.

"*Corporate strategy is the pattern of decisions in a company that determines and reveals its objectives, purposes and goals, produces the principal policies and plans for achieving those goals and defines the range of business the company is to pursue (…)*"
(Andrews 1980, 2).

His work is most commonly associated with the position that strategy ultimately has to accomplish to be successful between the external factors (opportunities and threats[18]) and the internal capabilities (strengths and weaknesses) (see Andrews 1980; Mintzberg et al. 2003, 72). "Strengths" are areas of a company where it exceeds its competitors through certain internal characteristics, such as knowledge or technology (see Henry 2008, 61).

[18] Opportunities and threats have already been defined in the introduction of chapter 2.4.

"Weaknesses" display the contrary and define areas where the company lacks the needed abilities (see Henry 2008, 61).

Porter (1980; 1996; 1998) concentrated on a slightly different approach on strategy and defined it as following:

"*Competitive strategy is about being different. It means deliberately choosing a different set of activities to deliver a unique mix of value*" *(Porter 1996, 64).*

He gave strategy a strong focus on competition. Rumelt (1980) as well as Porter (1980, xxvi) himself clarified the discussion by dividing business environment into a generic and a competitive area, giving it a dual character. They are described in chapter 2.3.

Today, both approaches (Andrews/Porter) still represent two of the most dominant theoretical foundations in the discourse on strategy, though they have been developed further by many studies. For a fundamental overview on the different developments on strategy see Mintzberg et al. (2003, 3ff.). For an appraisal of different theoretical approaches on strategy see Göbel (1997); Mintzberg et al. (2003) and Scherer (1995).

Strategic management process includes the strategic analysis, the strategy formulation as well as the strategy implementation (see Dess et al. 2008, 153ff.; Henry 2008, 8ff.). Strategy analysis assesses the company's situation in the external general and competitive environment as well as in the internal environment (see Henry 2008, 38ff.; Mintzberg et al. 2003, 92ff.). Within strategy formulation, a concrete strategy is elaborated that best possibly applies to the company's situation (see Henry 2008, 182ff.; Mintzberg et al. 2003, 70ff.). Mintzberg et al. (2003, 141) enhance the creative process that accompanies strategic formulation. Finally, the strategy must be implemented through communication and coordination (see Henry 2008, 10).

This work only concentrates on strategic analysis and formulation. The final implementation of the chosen strategy will have to be assessed in another detailed theoretical and practical context and gives options for further research.

2.4.2 Strategic environmental management

The relation between strategic management and environmental impacts has been observed by Meffert & Kirchgeorg (1993); Schaltegger et al. (2003) and Steger (1988). Schaltegger et al. (2003) define strategic environmental management as the following:

"Strategic environmental management is the positioning of a business to take advantage of environmental challenges" (Schaltegger et al. 2003, 171).

In the context of strategic environmental management, the word "environment" [19] means all living conditions, entailing nature in its pure existence and the habitat created by human beings (see Schaltegger et al. 2003, 18). Management issues are environmentally focused when they are related to the ecosystem, which includes living components, such as animals and plants, and non-living components, such as soil types and weather (see Schaltegger et

[19] Hence, the term environment is used in a different context than in chapter 2.2, where environment refers to external factors of business.

al. 2003, 18f.). Environmental challenges refer to the aim of improving business actions, which have a negative impact on the environment (see Schaltegger et al. 2003, 28f.). Such goals are often not integrated into the overall planned and realized business strategy. In fact, in many cases they enter strategic business goals as “add-ons” e.g. by answering legal requirements, through personal intentions of individual executives or because of image issues (see Schaltegger et al. 2003, 179).

Schaltegger et al. (2003, 178f.) base the strategic inclusion of environmental issues on Mintzberg’s theory of deliberate and emergent strategies[20] (see Mintzberg et al. 2003, 5). This is consequent as Mintzberg et al. (2003, 5) underline that the realized strategy does not only consist of an intended strategy. Only its deliberate part will eventually be realized together with later emerged strategies, such as the inclusion of environmental issues.

Schaltegger et al. (2003, 174) have identified three types of primary strategies that visualize how business copes with environmental issues. While competitive strategies indicate if ecological performance enhances competitive advantages, risks strategies secure business against strong environmental exposure. The general orientation of business towards environmental issues in its generic environment is indicated through basic strategies (see Schaltegger et al. 2003, 174ff.).

At this point, the focus of this thesis has to be underlined. Its aim is to identify early options prior to an emerging greenhouse gas emissions trading system and to evaluate them in a strategic context. Risk strategies are not suitable for giving a good overview and evaluation on strategic options as they only concentrate on threats, leaving the opportunities aside (see Meffert & Kirchgeorg 1993, 159ff.; Schaltegger et al. 2003, 195ff.). Competitive strategies are very important because of examining the competitive environment (see Porter 1980, 3ff.). However, not the impact of competitive actors shall be evaluated but the impact of political effects (see chapter 1.1).

Basic strategies seem to be most applicable giving business a fundamental frame for dealing with environmental challenges. Nevertheless, the competitive and the risk component cannot be ignored. As shown in figure four, all three strategies are directly linked to each other.

[20]The theory of deliberate and emergent strategies is associated with the learning school in strategic management. It is contrary to the design school theory influenced by Andrews (1980) and Ansoff (1966), which only concentrates on the rational approach to strategy (see Mintzberg et al. 2003, 5ff.).

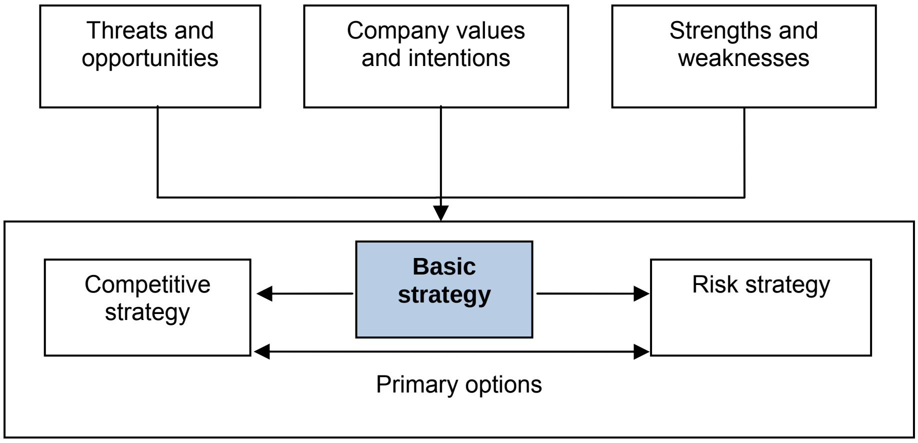

Figure 4: Components of strategic environmental management (source: Schaltegger et al. 2003, 174)

This work has to be integrated into the discourse of business strategic options in a carbon constrained world. Analysis on competitive strategies addressing climate change have been accomplished by Hoffman (2006); Hoffman & Woody (2008); Porter & Reinhardt (2007); Schultz & Williamson (2007). Risk strategies addressing climate change are provided by Singleton (2007); Yeoh (2007).

Next to external factors, internal capabilities (strengths and weakness), as well as business purposes and intentions, constitute further fundamental elements of strategic environmental management (see Schaltegger et al. 2003, 74ff.). Strategic alternatives result from matching external opportunities and internal strengths at an acceptable level of risk (see Andrews 1980; Henry 2008, 38ff.). It must be ascertained what a company *might* do in terms of threats and opportunities evolving through an emerging cap-and-trade system. Then a company must analyze what it *can* do in terms of individual capabilities and power (see Andrews 1980, 40).

In the following chapter, the basic strategies will be introduced as a strategic approach based on opportunities and threats of early options in the context of an emerging emissions trading scheme.

2.5 Basic environmental strategies

"Basic environmental strategies" are characterized through the systematical approach of environmental challenges in the generic business sphere (see Meffert & Kirchgeorg 1993, 146). If business is exposed to threats and opportunities related to environmental regulation, it might be able to react in different ways presented through four basic strategies. They are outlined by Meffert & Kirchgeorg (1993, 145ff.); Schaltegger et al. (2003, 182ff.) and Steger (1988, 150ff.).

Meffert & Kirchgeorg (1993, 147ff.) characterize environmental basic strategies related to the environment through the following aspects:

- Action level: Counter-active or pro-active approaches are distinguished through the level of adoption. Business with a pro-active approach tries to include the smallest movements in environmental regulation as early as possible and adapts. They look for advantages and consider time and action as an opportunity factor. So called “first movers” are not afraid of expanding into new fields where overall experiences are missing.
  Others try to minimize threats by being counter-active. Counter-active orientated business will be reluctant or indifferent towards adaptation and changes until the very end.
- Level of strategy realization: Strategy realization can either happen individually or in cooperation with the whole industry. Business with a cooperative approach will search for industry wide solutions seeking for an overall advantage instead of a small individual benefit. An overall advantage could represent a prevention of a mandatory environmental regulation through the admission of a self-regulated process. In contrast, an individual approach focuses on a solution on business level.
- Focus of strategy: The strategy chosen by business can either be restricted to internal business sectors or be open and include market participants as well as other stake-holders. If they include market aspects the chosen basic strategy might be directly linked to business competitive strategy.
- Strategy implementation: Business can integrate the strategy into the formulation of corporate strategy where it influences job descriptions, management control processes and operational control tasks. An isolated strategy approach only focuses on certain business sectors, ignoring the overall business strategy.

The four basic strategies are displayed in figure five. The above described characteristics are revealed in every strategy. Each strategy has a different focus depending on business exposure to potential threats and opportunities.

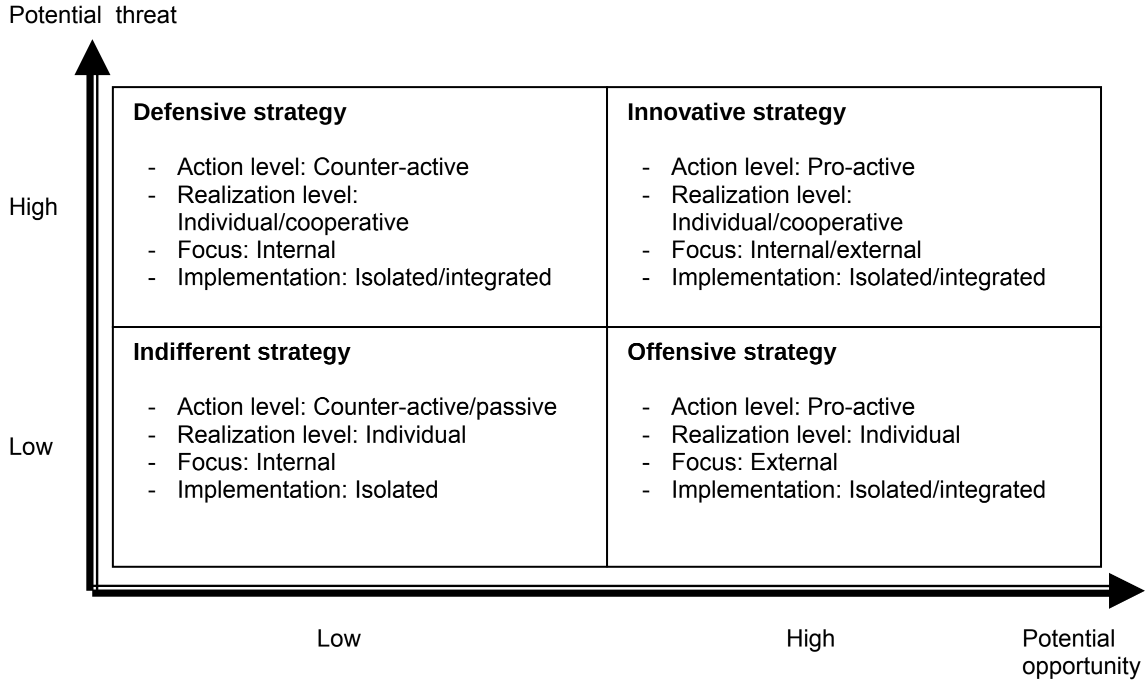

Figure 5: Basic environmental strategies (source: based on Schaltegger et al. 2003, 182)

2.5.1 Indifferent strategy

Business that is exposed to few threats and also few opportunities related to environmental issues does not have many incentives to become active. Long-term success potential through environmental protection cannot be identified (see Steger 1988, 174). Thus, environmental issues are not considered to be important and will not be integrated into the process of corporate strategy planning (see Meffert & Kirchgeorg 1993, 151f.). They rather ignore their environmental impact as public attention has not been aroused so far and environmental regulation are intended to be implemented sometime in the future and have not received definite outlines yet (see Schaltegger et al. 2003, 183). The passive or counter-active attitude will not deter business from reevaluating business-as-usual activities when legal requirements are eventually about to be implemented. Cost savings through environmental orientated optimization are considered when additional expenditures must not be taken into account. Being individual and internal orientated, business will not stand up for improvements the whole industry would benefit from (see Meffert & Kirchgeorg 1993, 151f.; Schaltegger et al. 2003, 183).

2.5.2 Defensive strategy

A defensive strategy is needed when business is exposed to high threats and almost no opportunities in an environmental orientated conflict (see Steger 1988, 151). In such situations, business often has not the flexibility needed to approach opportunities within the new situation. Then, it must counter-actively try to decrease the threats as much as possible (see Meffert & Kirchgeorg 1993, 152). In order to do that, various options can be considered. If image is threatened, case-specific public relations might be a suitable method to limit the danger. In case of upcoming unfavorable environmental regulations, legislative lobbying can help business to fight for better conditions under such regulations. Also, it is useful to prevent critical stakeholders from being incorporated in the process as they might aim for yielding own individual advantages (see Schaltegger et al. 2003, 183). Legislative lobbying is usually realized through a group representing the whole industry (see chapter 2.2.1). If threats become too high, a final option for business is to retreat and leave the region in order to look for a place with weaker regulation. This option is integrated on corporate level and might not be realizable for every business (see Meffert & Kirchgeorg 1993, 152f.; Schaltegger et al. 2003, 183).

2.5.3 Innovative strategy

High potential threats in combination with high potential opportunities display a challenging situation (see Steger 1988, 151). On the one hand, business must be careful not to injure profitability by not taking the threats into account well enough. On the other hand good strategic moves offer a lucrative position, sometimes a competitive advantage (see Schaltegger et al. 2003, 180ff.). The needed strategic options are highly dependent on the situation. Characteristic for an innovative strategy are the pro-active and external components of an early mover. In order to minimize the threats business uses a combination of an individual and cooperative strategy process, whereas the cooperative activities are shaped through legislative lobbying. The implementation of the strategy varies from being isolated to being integrated depending on the situation (see Meffert & Kirchgeorg 1993, 153).

2.5.4 Offensive strategy

When business identifies opportunities parallel to little potential threat it must look for the best way to take advantage of the situation (see Steger 1988, 151). This is done through a pro-active attitude. Time might play an important factor. Compliance with legal requirements are affordable and do not threaten products and production. Image can be improved to strengthen the external focus of business. In this case an integrated approach may even be considered where business includes its offensive strategy related to environmental aspects into its overall business strategy. Even though a cooperative policy is possible, the strategy is mostly realized individually due to the aim for competitive advantages. Thus, including market participants into the strategy, which reveals an external tactic, is done in many cases (see Meffert & Kirchgeorg 1993, 149ff.; Schaltegger et al. 2003, 183).

2.5.5 The dynamic of basic strategies

Basic strategies are business options to confront environmental regulation, such as an emerging cap-and-trade system. In chapters 2.5.1 to 2.5.4, they were differentiated in indifferent, defensive, offensive and innovative types. However, a very important factor, the dynamic of basic strategies, has not been considered yet. Once business has chosen a basic strategy it will realize it as efficiently as possible and one can observe a certain consistency to the strategy. But in the end, strategic processes are highly dynamic and cannot by seen as a static condition due to external and internal changes over time. Porter (1991b) states:

> *"The environment, as well as the firm's own capabilities, are subject to change. Thus, the task of strategy is to maintain a dynamic, not a static balance" (Porter 1991b, 97).*

Especially basic strategies are exposed to adjustments as they are to answer external influences that cannot be fully controlled through business. Figure six displays a possible development cycle of a basic business strategy. An indifferent strategy chosen by business might develop to a defensive strategy. The defensive strategy might emancipate to an innovative strategy over time, if business environment develops to obtaining new opportunities next to arisen threats. In the end, business may secure its position by minimizing the threats and confront environmental issues offensively.

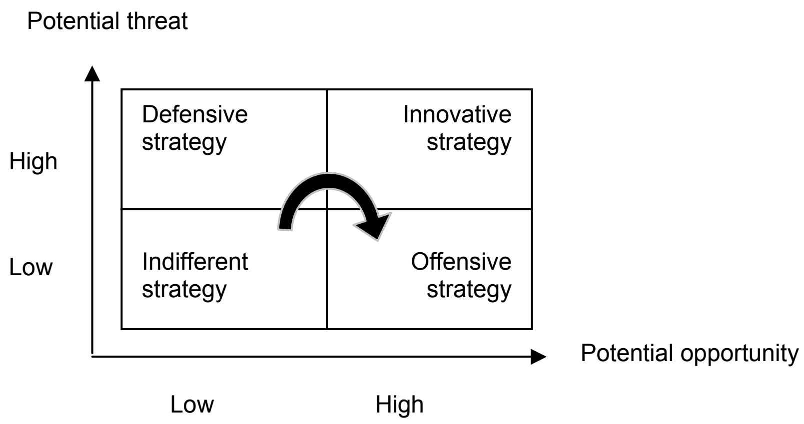

Figure 6: Dynamic of basic strategies (own source: based on Schaltegger & Petersen 2002; 38)

The dynamic of basic strategies constitutes a fundamental role in the analysis of strategic options prior to an emissions trading scheme (see chapter 3.4.5). As stated in chapter 2.2, business has to cope with uncertainty. Only prognostic work can be done, the constraints of which covered companies eventually must follow and what effects early options will have on its final position. Furthermore, policy and market developments of an emerging trading scheme are constantly changing in the pre-compliance period (see chapter four). Every basic strategy is only appropriate and effective at a certain time. They must be adjusted to always appeal to the company's exposure by frequently monitoring the external developments in business environment basic strategies. Thus, companies with an indifferent strategy might be able to ignore developments to a certain stage. To first reevaluate business-as-usual activities when legal requirements are already implemented, would lead to missed early options in the pre-compliance period (see chapter 3.4.5).

2.6 Strategic analysis with the framework approach

The determination of a suitable strategy for business starts with identifying the opportunities and threats in its specific environment and of its actions (see Mintzberg et al. 2003, 74). But how is business able to obtain a sophisticated understanding of its market and business environment? This fundamental question of systematic strategy analysis must be answered. And again, reducing complexity plays an important role. An applicable tool is needed that breaks down all information into manageable and understandable parts.

"The use of models is an attempt to try to represent what goes on in the real world and to predict or derive useful outcomes" (Henry 2008, 68).

Even though strategic and decision theories have offered various techniques for decision making and strategy formation (see O'Brain & Dyson 2007), complexity and the dynamic of developments pose a challenge to conventional approaches to strategy (see Porter 1991b, 97). To give one example: General quantitative studies of business decision have created a wide range of mathematical and statistical models for decision-making under uncertainty and risk, such as decision-trees, option theory, the Bernoulli principle or the Monte Carlo simulation (see Bitz et al. 2002; Klein 2008; Zarkos et al. 2007). Lately, several works have been accomplished on strategic investment decisions of electricity industry constrained by an emissions trading system, using the real option theory and the Monte Carlo Simulation to model carbon prices and uncertainty factors (see Fabra et al. 2008; Kalitzky & Mjia Pino 2007, OECD & IEA 2007). It is typical for quantitative models being restricted to small subgroups, such as the energy market, that fit to the model's assumptions. Thus, they are not appropriate to identify key factors that apply to any broader group of company sectors.

Another well known analytical strategic analysis approach is named SWOT analysis (see Dess et al. 2008, 77; Henry 2008, 61). It sets the internal strengths and weaknesses in relation to the external opportunities and threats (see Henry 2008, 61). SWOT analysis is applicable in a company specific environment (see Henry 2008, 70) but does not break down and generalize a company's environment to build a structure that can be used over and over again. It rather gives a one-shot view of a moving target (see Dess et al. 2008, 77).

This work aims to develop a comprehensive tool for decision-makers in order to analyze and better understand its position in the context of the complex and highly dynamic development of an emerging emissions trading system no matter which industry they belong to or from which starting position they come. The goal is to have a framework that allows capturing the full richness of its surrounding with a limited number of dimensions (see Henry 2008, 68).

The framework approach is mainly formed by Porter (1980; 1991b) who has designed the most popular and widely accepted framework, the five forces framework of industry competition. Framework building only uses the smallest number of key elements that still confines the diversity of interactions in a market (see Henry 2008, 69).

Chapter three develops a framework for strategic early option analysis. It identifies five key factors that must be continuously monitored by companies with possible future compliance obligations, longing for best positioning itself before a future emissions trading scheme is finally implemented.

By developing the framework this work aims to set a standard for strategic early option decisions related to any company with future compliance obligations under an emerging cap-and-trade system.

2.7 Discussion

An emerging cap-and-trade system incorporates two time periods, the pre-compliance and the compliance period (see chapter 2.1). All five sectors of business environment (political, legal, sociocultural, technological and economic) are influenced by an emerging cap-and-trade system (see chapter 2.2). Today’s companies have more options to position themselves prior to a trading scheme than companies had just a few years ago e.g. before the start of the EU-ETS (see chapter 2.3). Next to generating early action credits under an early action program, they might realize credits under offset programs of existing cap-and-trade systems or for the voluntary market. These pro-active options all include the reduction of emissions before trading starts. Counter-active options do not include the early reduction and are rather passive.

The variable influence of an emerging emissions trading scheme and the existence of different alternatives to act in the pre-compliance period premise a strategic approach (see chapter 2.4). Within strategic environmental management, basic strategies are regarded as a good method to address external risks and opportunities of environmental challenges. Thus, they are chosen to pursue best early positioning under an emerging cap-and-trade system (see chapter 2.5).

The framework approach is chosen to properly analyze the influences that have been described in theory chapter 2.2. The assessment encompasses risks and opportunities of the introduced early options (see chapter 2.3) in the context of the emerging emission trading scheme.

3 FRAMEWORK-BUILDING FOR STRATEGIC EARLY OPTION ANALYSIS AND BASIC STRATEGY FORMULATION

In the following chapters, early options, introduced in chapter 2.3, will be analyzed in the context of an emerging emissions trading scheme. The aim is:

1. To build a framework with selected key factors influencing the core opportunities and risks of early options. The framework tries to simplify reality (see Henry 2008, 68). By using the framework, a company shall be able to identify a basic strategy to realize opportunities and minimize threats.
2. To define four concrete basic strategies that will finally indicate which actions best possibly position a company in the context of an emerging emissions cap-and-trade system.

On the one hand, the framework will be determined by the strengths and weaknesses of a company's early reduction portfolio. The portfolio will be introduced and analyzed in chapter 3.1. On the other hand, the framework is developed by assessing the opportunities and threats of a company's early options that have already been outlined in chapter 3.2. Opportunities and threats as well as strengths and weaknesses evolve through the early options and their interrelation with a future compliance trading scheme.

The actual framework will be finalized in chapter 3.3. The information gained from the analysis in chapter 3.1 and 3.2 and from framework-building in chapter 3.3 is used to formulate four basic strategies in chapter 3.4. The process of strategic analysis and formulation throughout chapter three is shown in figure seven.

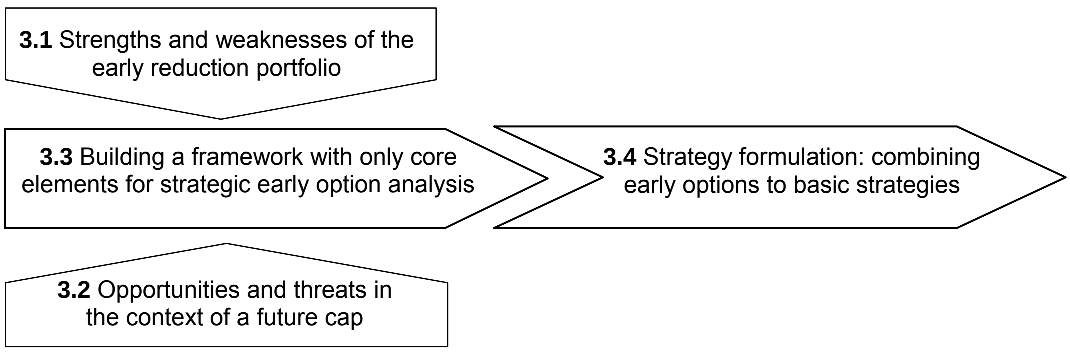

Figure 7: Framework-building for strategic early option analysis and basic strategy formulation (own source)

3.1 General analysis of early reduction potential – strength and weakness assessment

Best positioning does not only depend on opportunities and threats but also on the company's internal capability to deal with external challenges (see chapter 2.4.1). A company's early emissions reduction portfolio influences early options as it displays strengths and weaknesses regarding early reductions. The portfolio consists of a company's reduction potential and their location. The potential depends on the assessed reduction amount of any greenhouse gas, the early reduction timeframe and the reduction costs. The early emissions reduction portfolio of an organization constitutes the foundation of any strategic early action effort. As stated in chapter 2.4.3, strengths and weaknesses are company-specific and must be individually assessed by the company itself. In the following paragraphs, each aspect of the portfolio will be briefly described.

Assessed reduction amount of any greenhouse gas

The reduction amount is defined as the maximum amount of any greenhouse gas that can be reduced throughout the value-chain within one company (see Hoffman & Woody 2008, 27). Emissions are divided into different categories, such as direct emissions, emitted by the company itself, and its indirect emissions, emitted through energy use, or sources other than own ones (e.g. suppliers) (see Schultz & Williamson 2007, 124). In the EU-ETS, only direct emissions are capped (see Hoffman & Woody 2008, 75ff.; Schultz & Williamson 2007, 124). Two current drafts for a US federal emissions trading scheme also cover certain indirect sources (see Lieberman & Warner 2008, 350; Boxer et al. 2008, 140). A company should be aware of each category. The best way of tracking them is by establishing an inventory of greenhouse gas emissions followed by a monitoring process (see Hoffman & Woody 2008, 28ff.; Kolk & Pinkse 2005, 10).

In general, the existence of a high reduction potential widens the strategic range of actions before and in the trading period. However, takes a lot of effort and lead time to identify the overall emissions reduction potential (see Hoffman & Woody 2008, 24). Also, before reducing emissions, it must be evaluated how possible reductions effect products or production processes. Some emissions reduction might have to be excluded due to their negative impacts (see Hoffman 2006, 12f.).

Early reduction timeframe

The timeframe determines the maximum amount of valuable reductions prior to a cap-and-trade system. Time (window of opportunity) is narrowed by the company's possible reduction start (time for technology development and/or implementation have to be calculated) and the start of the trading system (see chapter 2.1).

A longer timeframe can positively affect early reduction efforts and the adjustment process towards compliance. Costs of innovation and adopting new technologies might be reduced, if being spread over a longer time period[21]. Time-intensive learning effects associated with technological innovations may become possible (see Kennedy 2002, 17; Nordhaus et al. 1998, 6f.). Also, a more gradual adjustment process eases the potential of adverse impacts on output and employment (see Kennedy 2002, 17f.).

[21] This aspect refers to the technological environment described in chapter 2.2.4.

Reduction costs

Reduction or abatement costs are defined as the costs a company must spend in order to reduce its greenhouse gases (see Hoffman & Woody 2008, 35). Costs can be evaluated through different measurements based on an absolute-cost basis (total costs of emissions reductions), a normalized basis (cost per ton of emissions reduced) or on a financial-return basis (costs minus revenues) (see Hoffman 2006, 31f.).

High reductions costs might reflect expensive reduction technologies or processes. It may change over time, as e.g. technology becomes more elaborated and available (see Michaelowa & Rolfe 2001, 281).

In general, emissions reductions might not only realize costs but could also lead to cost savings, e.g. through improvements in energy and operational efficiency (see Hoffman 2006, 21f.). Such savings must be subtracted from costs.

Local distribution of a company's early reduction

The local distribution of a company's early reduction potential refers to different geographical areas where reductions can take place. Companies may reduce emissions in several divisions located regionally, nationally or globally. Not only does this differentiation within one company help to identify the key reduction locations. Different political cap-and-trade programs also show considerable flexibility on a regional, national and global[22] level. Also, a company might decide to choose different early options in different divisions. As a result, each company faces an individual mix of political requirements related to their reduction locations.

The portfolio contains strengths and weaknesses. E.g. a company's high reduction potential (see below) can be considered as strength when early reduction opportunities exist (see chapter 3.2). The appraisal of the reduction potential and the local distribution enables firms to create the best available in-house early emissions reduction portfolio. Thus, strengths can be supported and weaknesses improved.

3.2 General analysis of early options – opportunity and risk assessment

Corporate strengths can only create a strategic advantage if they meet opportunities (see chapter 2.4.1). Next to estimating the early emissions reduction portfolio, the general possibilities and risks of each early option must be analyzed. Pro-active options are always accompanied by early emissions reductions whereas counter-active options do not consider reducing emissions early. Counter-active options will then be taken into account when early reductions resemble too many risks for entities in the context of the current and future position.

[22] The JI and CDM programs define the global emissions market, today. Within the next years the world will experience a trend towards intensifying global trades by linking the existing and emerging regional or national systems (see Flachsland et al. 2008; Schüle & Sterk 2007).

In the following, each pro-active option will be described in more detail. The first aim is to select key opportunities and threats of each early option. According to this thesis, only they need to be known for making a strategic choice. The opportunities and threats are influenced by certain policy and market factors, which are originated in existing offset and/or voluntary markets and in the emerging emissions trading scheme. By focusing on these core factors, one automatically concentrates on assessing the key opportunities and threats. Thus, the second aim is to assess the related policy and market core elements that are linked to the opportunities and threats. Finally, the identified policy and market factors[23] will create the framework for strategic early option analysis in chapter 3.3.

At the end of each description of one early option, the key opportunities and threats are summarized in order to assess the related policy and market factors. As each early option is analyzed in the context of an emerging trading system, it includes factors of the system itself when needed. The structure of the tabular summary displayed in table one will be used in every chapter from 3.2.1 to 3.2.4.

Table 1: Structure of the tabular summary of key opportunities and risks in the context of the interrelation of the pre-compliance and compliance period and the related policy and market factors (own source)

Selected key opportunities	**Selected key risks**	**Related policy and market factors**
This column will display the selected key opportunities in the following tables.	This column will display the selected key risks in the following tables.	This column will reveal the related policy and market factors that influence the opportunities and threats of the early option of the respective chapter. It will be also referred to the interrelation of the pre-compliance and compliance period.

3.2.1 Early reductions in general

One of the most fundamental pro-active options represents voluntary early reductions without combining them with the participation in any other markets or programs as described in chapter 2.3. Opportunities apply to cost efficiency, such as energy cost savings by improving production processes or working behavior, and image improvements (see Hoffman & Woody 2008, 50f.). New public attention on climate change (sociocultural business environment) enables business to market early reductions as an image issue by presenting a responsible business attitude (see chapter 2.2.3).

Early reductions might also lead to an advantaged position in a trading scheme. This aspect is strongly influenced by the allocation of emissions allowances to the companies (see Stronzik et al. 2000, 36ff.). Allocation procedures distribute benefits and burdens among entities and industry sectors in the trading scheme (see Hoffman & Woody 2008, 78). The interrelation between the allocation method and early reductions has been intensively discussed in theory and defined as the main challenge of early reduction decisions prior to

[23] Additional to the policy and market factors, the early emissions reduction portfolio is included in the framework.

an emissions trading (see IISD 1998, 8; Kennedy 2002; Michaelowa & Rolfe 2001; Stronzik et al. 2000, 36ff.).

Allowances can either be auctioned or given out for free to facilities (see PEW Center 2008b, 4ff.). Free allocation methods are called grandfathering and benchmarking. They are designed on identifying an individual emissions baseline from which the emission reduction obligation is subtracted (see PEW Center 2008b, 5). Allowance distributions through grandfathering are based on historic emissions, thus favoring facilities with high emissions in the past (see Kopp 2007, 4). If the company actually plans to reduce early, it evaluates the grandfathering method negatively due to the disadvantaged allocation in the trading period. The higher a company's reduction obligation is the higher would be its negative exposure (see Hoffman & Woody 2008, 27ff.). If the company does not plan to reduce early at all, it might welcome the grandfathering method when emissions trading starts. Grandfathering is considered as being the less rigorous allocation method (see Kopp 2007, 4).

A benchmark system relates output or input to emission intensity (see PEW Center 2008b, 5f.). A "best available technology" benchmark defines the emissions produced with the most efficient technology as the baseline for allocation allowances. All installations with the same output or input goods receive the same benchmark (see PEW Center 2008b, 6). While late movers need to reduce emissions in the trading period or buy credits to meet the benchmark, early movers generally have already achieved to meet the benchmark. Thus, they are better positioned compared to companies without early reductions.

The auction of allowances forces entities to buy the needed compliance amount in the beginning of a trading period. Auctioning rewards early reductions the strongest because it decreases the required amount of emission rights that ought to be bought (see PEW Center 2008b, 6).

A combination of free allocation and auctioning is also possible and is considered in many cap-and-trade drafts (see Kopp 2007, 3). The tabular summery of the key opportunities and threats of early reductions in the context of an emerging trading scheme together with the related policy and market factors is shown in table two.

Table 2: Key opportunities and risks of early reductions in the context of an emerging emissions trading scheme and the related policy and market factors (own source)

Pro-active option: early reductions in general		
Selected key opportunities	**Selected key risks**	**Related policy and market factors**
- Advantaged allocation in case of a benchmark based allocation or auctioning	- Disadvantaged allocation in case of a grandfathering based allocation	- Allocation method of the emerging trading scheme - Company's reduction cap

3.2.2 The participation in an early action program

Emissions may be reduced while aiming for participating in an upcoming early action program at the same time. The early action program, which has already been described in chapter 2.3.1, rewards reduction efforts prior to a cap-and-trade system. Its main aim is to protect companies with compliance obligations of being discriminated through an allocation that is based on historic emissions (see chapter 3.2.1). Thus, an early action program might provide opportunities. The design is politically set (see Stronzik et al. 2000, 13ff.). Several aspects are important to evaluate when considering a participation in such a program.

<u>Program's runtime:</u>

The program defines a time period in which early action is rewarded. The runtime determines the maximum timeframe in which a company can claim early action credits. Short early action programs might not be able to compensate a disadvantaged allocation in a trading period. The program's runtime must be compared to the company's reduction timeframe described above (see Stronzik et al. 2000, 13).
In some drafts, such as in the German National Allocation Plan (NAP) 2005-2007 (see AGE 2003, 43), it was possible to claim early action credits for reductions taken place prior to the early action program start. Rewarded past reductions are considered as "low hanging fruits" that a company should not miss (see Michaelowa & Rolfe 2001, 287).
In case of an allocation through grandfathering, it is especially important to look whether a well-designed early action program is provided. The possible amount of early action credits has to be compared to the missing deviation of allowances that is allocated to "late movers" in one trading period. This key aspect is shown in figure eight.

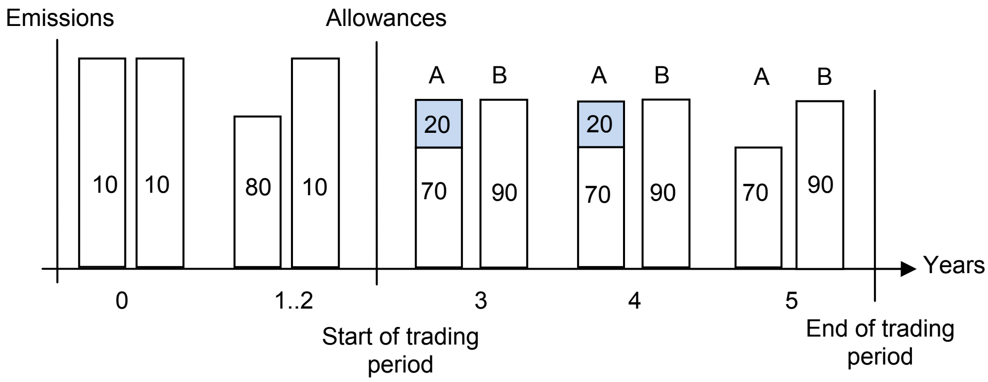

Figure 8 : Scenario of a grandfathering allocation and the receit of early action credits (own source)

Assuming two companies A and B that both emit 100 units and that have to reduce 10 units of their historic emissions of year one in the trading period. A has reduced 20 units early in year one and two. B does not reduce early. The trading period lasts 3 years. Company A, whose historic emissions are 80 units due to early reductions, receives 70 allowances each year of the trading period. It is able to generate 20 early action credits for only two years (they are displayed by the blue rectangles). Company B receives 90 allowances through grandfathering each year of the trading period. Thus, company A is disadvantaged as it can only compensate two trading years with early action credits.

Baseline

Early action credits are created if reductions take place below a set baseline (see Michaelowa & Rolfe 2001, 287). The baseline is defined by either absolute emissions or emissions per production unit in a base period (see Michaelowa & Rolfe 2001, 287). The baseline assessment can include discount and adjustment factors, such as an economic change factor or a GDP[24] adjustment factor (see Stronzik et al. 2000, 14). The deviation between the baseline and the assessed reduction amount constitutes the maximum of possible early action credits a company can receive. Baseline considerations have to be done especially under a grandfathering allocation in the cap-and-trade system. In order to create a baseline, total emissions must be known. Companies have to register emissions under a registry, which will be established along with the emissions trading (see Frauenhofer ISI 2005, 123ff; Rich 2008).

Early action standard

Early action credits must be applicable to a certain standard (see Nordhaus et al. 1998, 24ff.). Often, they are required to be additional e.g. to reductions created by already existing political requirements (see offset regulations below). Also, reductions have to be monitored correctly in order to prove their authenticity thus requiring a report to a registry (see Nordhaus et al. 1998, 26). As the emissions market has more and more matured over the past years (see Kollmuss et al. 2008, v), several credit standards have already been established. Either politicians decide on accepting an existing credit standard or they establish a new one (see chapter 4.3.3). However, when planning to generate early action credits it must be observed very carefully which standard the program will be likely to put in place and whether the company is able to follow the regulations. Usually the standards have not been elaborated very well in that early stage, making an analysis very challenging.

Budget limitation

The final state's allowance budget will eventually be set and static. The early action budget is part of it and must be subtracted from the state's allowance amount (see Michaelowa & Stronzik 2000, 192). No early action budget limitation could lead to an overall allowance reduction in the compliance period. In that case, the claim of too many early action credits indirectly shifts the allocation of a high allowance amount into the pre-compliance period (see Michaelowa & Stronzik 2000, 192f.; Nordhaus et al. 1998, 22). This matter may be irrelevant, if only a few organizations participate in an early action program. But in case of an active participation it can lead to a substantial burden on late movers and to a (competitive) advantage for early movers as shown in figure nine.

[24] GDP = Gross Domestic Product

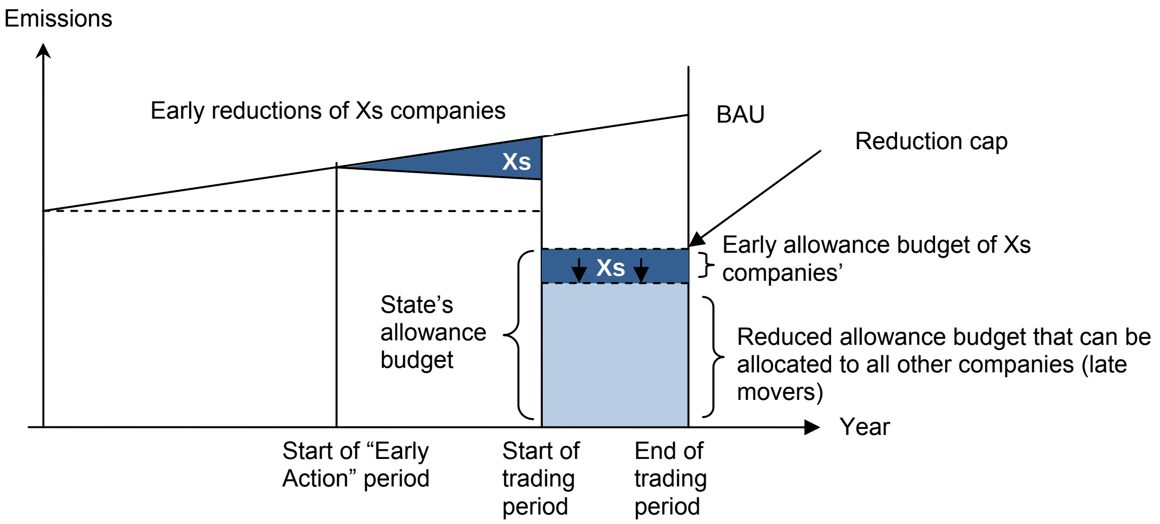

Figure 9: Allocation without early action budget (source: Michaelowa & Stronzik 2000, 193)

Figure nine visualizes the subtraction of early action credits, Xs companies accomplished, from the overall state's allowance budget in a trading period. Some drafts envisioned a limit on early action credits (see chapter 4.3.3). A proportional set-aside amount of federal allowances were to guarantee the final allocation of early action credits later on (see Michaelowa & Stronzik 2002, 190). This would solve the problem of early mover advantages to some extent but imposes other side effects. Either not all entities are able to claim early action credits or all credits have to be discounted by the exceeded credit amount. In the first case it might lead to a "first come – first served" attitude, forcing organizations to act quickly. In the second case, an additional uncertainty factor is added to early action credit evaluation (see Nordhaus et al. 1998, 22; Stronzik et al. 2000, 29f.). However, whereas government must estimate the early action credit demand as well as possible, companies must evaluate the risks originated in the uncertainty of the government's budget management.

Early credit value

Finally, the value of the early action credits needs to be assessed. In the trading period, the credits will be transferred into an equivalent amount of emission allowances (see Burnett & McDermott 1998). Thus, the future allowance price must be taken into account when evaluating early reduction and the participation in an early action program. The future allowance price is driven by the estimated future demand and supply of the credits and thus subject of volatility.

Table three visualizes the selected key opportunities and risks and the related policy and market factors influencing the participation in an early action program.

Table 3: Key opportunities and risks of participating in an early action program in the context of an emerging emissions trading scheme and the related policy and market factors (own source)

Pro-active option: Participation in an early action program		
Selected key opportunities	**Selected key risks**	**Related policy and market factors**
- Compensation of disadvantaged allocation - Claiming early action credits for low hanging fruits - Inclusion in the reserved early action budget	- No compensation of disadvantaged allocation through: short runtime, budget limitation, low baseline, discount factors - Volatile prices	- Allocation method and cap of the emerging trading scheme - Consideration of an early action program - Standards of the program - Regulatory framework of the program - Allowance price

3.2.3 Early reductions in offset programs that are linked to a mandatory trading system

In case the early action program entails too many risks for entities, the offset market might provide alternatives. As described in chapter 2.3.2 entities are able to reduce emissions and generate offset credits that are then sold to caped entities under already existing ca-and-trade systems in other countries. Compared to early action programs that are mostly not finalized in the pre-compliance period, offset programs of existing compliance markets provide more certainty since their regulatory framework has already been developed (see UNFCCC 2008). However, realizing emission reduction projects for claiming offset credits is constrained by various aspects.

In order to generate offset credits, an obligatory standard needs to be followed (see Offset Quality Initiative 2008, 5). Such reduction standard provides compulsory guidelines for credit generation on the basis of uniform applicability (see Offset Quality Initiative 2008, 6). The standards are defined in the mandatory emissions trading scheme into which the credits will be integrated (see Offset Quality Initiative 2008, 20ff.). The requirements, such as environmental integrity, the avoidance of double counting and additionality, limit the claim for offset credits (see Kollmuss et al. 2008, 14ff.; Offset Quality Initiative 2008, 10ff.). Standards also incur additional costs e.g. for third party validation and verification (see Offset Quality Initiative 2008, 20ff.).

A company must analyze, whether the generation of offsets through its reduction potential is possible, which costs need to be encompassed and how many credits can be created. Standard guidelines and additional costs might make a project unfeasible reducing opportunities to a minimum.

Prices are an important indicator for offset project consideration (see von Velsen-Zerweck 2008). By comparing them with reduction costs, profit can be estimated.

Offsets prices follow different patterns than allowance prices. Supply and demand of allowances are formed by the availability of offsets and allowances and the difference between actual emissions and reductions goals of a cap-and-trade system (see New Carbon Finance 2007, 20f.; Point Carbon 2008a, 2). Offset prices depend on project type; source, project maturity and offset demand (see Point Carbon 2008a, 12). Demand can be defined through the amount of offsets covered entities are allowed to use for compliance purpose (see New Carbon Finance 2007, 20ff.). Selling offset credits might compensate investment costs or even result in profit. However, prices could be too low compared to reduction costs or other credit prices.

Not only the offset program itself entails opportunities and risks but also the emerging mandatory emissions trading scheme when considering the creation of offset credits. As described in chapter 3.2.1, the allowance allocation of the emerging emissions trading scheme must be analyzed when early reductions are considered. If a benchmark or auctioning design is planned, early reductions will be rewarded anyway (see chapter 3.2.1). Thus, the participation in an offset program might represent an opportunity to generate additional value. However, in case of a grandfathering allocation, generated offset credits might not be able to compensate the risks through a disadvantaged allocation. Table four displays a summary of the selected key opportunities and threats and the related policy and market factors.

Table 4: Key opportunities and risks of early reductions in offset programs in the context of an emerging emissions trading scheme and the related policy and market factors (own source)

Pro-active option: Early reductions in offset programs		
Selected key opportunities	**Selected key risks**	**Related policy and market factors**
- Compensation of disadvantaged allocation - Creation of additional value in the pre-compliance period through selling offset credits	- No compensation of disadvantaged allocation because of low offset credit value - Offset standard claims difficult requirements and imposes high additional costs - Volatile credit prices	- Allocation method and cap - Standards and regulatory framework of offset programs - Additional standard costs - Offset credit prices

3.2.4 Early reductions in the voluntary market

Creating voluntary emissions reductions (see chapter 2.3.3) to be sold on the global voluntary market has emerged to an alternative option to generating early action credits under an early action program and to generating offset credits for compulsory trading systems. In the USA, the voluntary market is to some extent regarded as the pre-compliance market, giving firms the chance to learn how to act in a future cap-and-trade system (see New Carbon Finance 2008a, 36).

Even though the voluntary market is considered to be non-regulated (see chapter 2.3.3), applying a standard is necessary to cell credits to buyers (see New Carbon Finance 2008a, 47ff.). Especially in 2007, several standards have been developed by third parties, such as the Voluntary Carbon Standard (VCS), VER+ and the Gold Standard[25] (see New Carbon Finance 2008a, 47ff.). Not only their requirements but also their social and market acceptance vary strongly. The higher the quality of the standard the more expensive the generated credits can be sold (see New Carbon Finance 2008a, 54).

[25] The presented standards will be described in more detail in chapter 4.5.

Voluntary offset credit prices not only depend on the used standard but also on demand (see New Carbon Finance 2008a, 10ff.). Demand is driven by entities using the credits for image or pre-compliance purposes (see New Carbon Finance 2008a, 5ff.), creating different price ranges for every project type (see New Carbon Finance 2008a, 38). E.g. native and plantation reforestation/afforestation are regarded as “attractive” projects for image purpose and represent the most expensive offset type (see New Carbon Finance 2008a, 38). The lowest price for credits was paid for industrial gas projects and geological sequestration in 2007 as they are not as “charismatic” and more cost effective (see New Carbon Finance 2008a, 39).

Companies must compare available standards and their usability, additional standard costs, and prices to see whether the voluntary market entails opportunities. When participating in the voluntary market one must evaluate the consequences on the eventual position in the trading period. Next to creating additional value, voluntary credits might compensate the risks through a disadvantaged allocation in case of grandfathering allocation in a future emissions trading scheme (see chapter 3.2.1). However, when compensation is not possible, reducing emissions early might represent a risk. A summary of risks and opportunities in the voluntary market and the related policy and market factors is provided in table five.

Table 5: Key opportunities and risks of early reductions in the voluntary market in the context of an emerging emissions trading scheme and the related policy and market factors (own source)

Pro-active option: early reductions in the voluntary market		
Selected key opportunities	**Selected key risks**	**Related policy and market factors**
- Compensation of disadvantaged allocation - Creation of additional value in the pre-compliance period through selling offset credits - High credit value through attractive voluntary project type	- No compensation of disadvantaged allocation because of low voluntary credit value - Low voluntary credit value through available project type - Voluntary standard requests difficult requirements and high additional costs	- Allocation method and cap in the emerging trading system - Standards of the voluntary market - Additional standard costs - Voluntary credit prices

3.3 Building a framework for strategic early option analysis

Chapter 3.1 described the early emissions reduction portfolio and stated that related strengths and weaknesses have to be identified by the company on an individual base. Chapter 3.2 discussed the company’s options related to early reductions. Their opportunities and threats were identified in the context of an emerging emissions trading scheme.

3.3.1 Five core elements for strategic early option analysis

The aim of assessing the early emissions reduction portfolio, as well as the opportunities and threats of early options, is to develop a framework for strategic early option analysis. The framework shall only include the core elements influencing the opportunities and threats, as well as the strengths and weaknesses.

The early emissions reduction portfolio represents the company's central internal origin for any early emissions reductions and thus influences every early option. Being the core company factor, the "early emissions reduction portfolio" is introduced as the first key element. This aspect is displayed in table six.

Table 6: Selected key company factor that influence strengths and weaknesses in the context of early options (own source)

No.	Early option / Key company factor	Early reductions in general	Participation in an early action program	Early reductions in offset programs	Early reductions in the voluntary market
1	Early emissions reduction portfolio	√	√	√	√

The core factors influencing the opportunities and threats have been presented in table two to five in chapters 3.1 and 3.2 for each early option. Table seven presents an overview of the results.

Table 7: Selected key policy and market factors that influence opportunities and risks of early options (own source)

No.	Early option / Key policy and market factors	Early reductions in general	Participation in an early action program	Early reductions in offset programs	Early reductions in the voluntary market
2	Allocation method and cap	√	√	√	√
3	Consideration of an early action program		√		
4	Standards of crediting programs		√	√	√
	Regulations of crediting programs		√	√	
	Additional standard costs			√	√
5	Allowance prices		√		
	Offset prices (compliance)			√	
	Offset prices (voluntary)				√

As displayed in table seven, the allocation method and the company's cap are decisive for each early option and will be combined to the second key element "allocation procedures". The early action program represents a key policy factor itself as its purpose is to secure early acting companies from receiving a disadvantaged allocation in the trading period. Thus, the third key element is described through the "design of an early action program".

Several different standards in three different markets and programs (early action program, offset program and voluntary market) need to be assessed and will be combined to the fourth core element “emission credit standards”. Additional standard costs are included in credit standards. Due to some regulatory aspects in offset programs the element is extended to “emission credit standards and regulations”. Allowance prices as well as offset credit prices are combined to the fifth core element “prices of emission allowances and offset credits”.

Two of the key elements are policy factors of the future emissions trading scheme, the allocation procedure and the design of an early action program. Emission credit standards and regulations represent a mixed factor containing policy and market elements. Prices of emission allowances and offset credits are primarily a market factor but influenced by policy. The uncertainty of each element is different. The allocation procedures and the early action program are still uncertain in the pre-compliance period (see chapter four). The offset standards under the voluntary market and under the federal and regional offset programs as well as offset credit prices can be mainly analyzed as they already exist. The key factors will be described in detail in the following paragraphs.

Early emissions reduction portfolio

The early emissions reduction portfolio (see chapter 3.1) represents the internal framework. It is the origin of any company’s strengths and weaknesses related to early reductions. Every entity must analyze the external factors in the context of its early emissions reduction portfolio. If possible, it should be assessed even before pre-compliance starts. Otherwise precious time is lost for considering a basic strategy at right time. Hoffman & Woody (2008, 26) emphasize this aspect by saying a company must identify its carbon footprint as soon as possible.

The key questions that need to be answered within this key factor are:

How many direct and indirect emissions can be reduced? When can they be reduced? Where are they located and how much do reductions cost?

Allocation procedures

Before even considering a basic strategy to best position oneself under a future cap-and-trade system, a company should find out whether its industry sector will be capped and how high its own cap will be. Chapter 3.2.1 clearly concluded the allocation method as one of the core elements influencing early options. At every early option presented in chapter 3.2.2 to 3.2.4, a company has to take into account how it will receive the allowances in the trading period. The allocation method constitutes the basis for further early option analysis, such as participating in an early action program, in an offset program or in the voluntary market. The importance of allocation procedures is shown in table seven where it presents the most mentioned key factor.

To assess allocation procedures, a political decision process must already be at a more or less developed stage. If the allocation method has not even been politically discussed yet, it is very difficult up to almost impossible assessing any risks and opportunities of early options with respect to allocation. In such case, experiences and decisions over methods and procedures of already existing emissions trading schemes might lead to more clarification.

The key questions that need to be answered within the key factor allocation procedures are:

Is the company capped under the future emissions trading scheme? How high is its cap? Is the chosen allocation method in the eventual implemented cap-and-trade system going to discount or reward early reductions? How definite are the political statements about the regulation?

Design of an early action program

As stated in chapter 3.2.2, the policy key factor the design of an early action program represents one option to reduce the risks of a disadvantaged allocation method or to create additional value before emissions trading starts. The program design itself needs to be analyzed in order to make a strategic decision. The program's main elements, consisting of runtime, baseline, early action standard and budget limitation, reveal whether an early action program is well designed.

The evaluation of an early action program is challenging when still being politically discussed. Only tendencies can be taken into account making the plan of participating in such program very vulnerable. Experiences from already existing trading schemes might help to identify design likelihoods. Regarding the early credit standard, offset and voluntary standards might give orientation. Sometimes, existing offset standards might be accepted as an early action standard (see chapter 4.3.3).

The key questions that need to be answered within the key factor design of early action program are:

Does the government plan an early action program? If yes, how many credits can be generated and which criteria most likely would have to be followed under an early action program?

Emission credit standards and regulations

Offset credits can be generated is governmental offset programs of existing cap-and-trade systems or in the voluntary offset market depending on whether emissions reductions of a company are accepted under an applicable offset standard. The chosen standard does not only impose the procedures to be followed and constrain the amount of credits. They also create additional costs, which need to be encompassed next to pure emissions reduction costs (see chapters 3.2.3 and 3.2.4).

Several offset and voluntary standards are already developed and practiced (see New Carbon Finance 2008a, 47ff; Kollmuss et al. 2008, 14ff.). The assessment of the advantages and disadvantages can often be finalized with more certainty giving a good counterbalance to the uncertain key policy factors allocation procedure and early action program.

Certain requirements are needed in several standard types. Knowing about similarities regarding offset standards in the offset compliance and voluntary market, as well as in the early action program, increases flexibility. To give an example: If an early action program is considered but its design remains uncertain, entities might choose to follow an early action standard and an offset standard with similar aspects. Thus, the company is prepared to gain credits in the offset market and later on under the early action program (see Hoffman 2006, 49).

In the offset market, legislative regulations of the emissions trading scheme encompass an important role. E.g. for company to generate JI or CDM offset projects, its country must have ratified the Kyoto Protocol (see UNFCCC 2008). The regulations can be found in the mandatory emissions trading bills and must be analyzed.

The key questions that need to be answered within the key factor emissions credit standards and regulations are:

Is the company able to generate offset credits under the various governmental offset programs or in the voluntary market? How big is the possible amount of credits the company can generate? Which additional standard costs need to be calculated? Which standards are accepted in which markets and programs?

<u>Prices of emission allowances and offset credits</u>

Prices of offset credits and allowances serve as a market orientation factor and determine the market value of reductions in the present and in the future (see New Carbon Finance 2007, 15f.; Point Carbon 2008a, 2).

Price developments in all three markets (mandatory emissions trading scheme, offset market and voluntary market) need to be encompassed in the assessment of optimal positioning. Regarding emerging emissions markets, price analysis comprise political discussions on caps, safety valves, banking and/or borrowing and the allowance of using offsets for compliance purpose (see EPA 2008c; New Carbon Finance 2007 15ff.; Point Carbon 2008i, 12ff.). Thus, allowance prices can reflect the lightest political change (see Point Carbon 2008a, 2).

In the current emissions trading schemes, allowances are more valuable than offset credits. Voluntary offset credits are traded at the lowest price compared to the compliance market (see New Carbon Finance 2007; Point Carbon 2008b). Comparing different carbon prices with reduction costs offers a good overview on profits and opportunity costs in the different markets. Opportunity costs can be assessed, by matching prices of different credit forms, such as early action credits, offset credits or voluntary credits. E.g., allowance prices represent the opportunity costs of deciding against early action credits.

However, a certain price risk must be accepted and incorporated in calculations. Only offset credit prices in existing governmental programs and in the voluntary market can be presently observed (see New Carbon Finance 2007, 15f.). Allowance prices in any emerging emissions market can only be estimated (see Point Carbon 2008a, 2).

The key questions that need to be answered within the key factor prices of emission allowances and offset credits are:

What is the current and future market value of emissions reductions in the mandatory emissions trading and in the various offset markets?

3.3.2 Building the framework

In chapter 3.2, the five core elements for strategic early option analysis have been developed. In this chapter, they will be combined to a framework. The framework is shown in figure 10.

The early emissions reduction portfolio resembles the core internal factor of the company, the internal framework. It represents the strengths and weaknesses of a company regarding early emissions reductions. The allocation procedures, the design of an early action program, the emission credit standards and regulations; and the prices of emission allowances and offset credits represent the key external factors of business environment. They are combined to the external framework and decide whether business faces risks and/or opportunities regarding early options. The allocation procedures and the design of an early action program apply to the compliance emissions trading system. The emission credit standards and regulations, as well as the prices of emission allowances and offset credits, refer to the compliance and to the voluntary, as well as offset market.

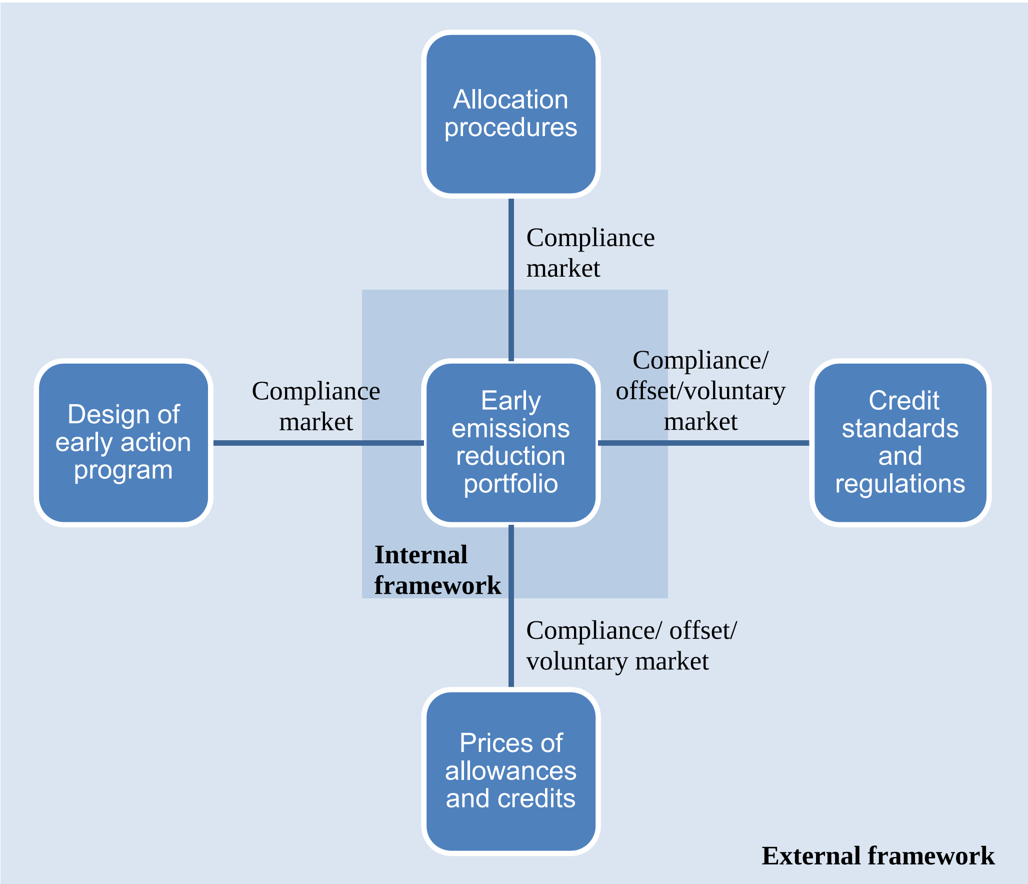

Figure 10: The framework for strategic early option analysis (own source)

The framework for strategic early option analysis is generalized and constitutes a tool for any company approaching options in the pre-compliance period of an emerging greenhouse gas emissions trading scheme strategically. It has combined three different emissions market forms, mandatory emissions trading schemes, governmental offset programs and the voluntary emissions market. Even though it approaches different markets, its aim is to reduce complexity to a minimum. Only five core elements need to by analyzed and monitored for assessing opportunities and threats of early options in all three markets without ignoring a company's future reduction obligation in an emerging emissions trading scheme.

As shown in figure seven, the analysis of the early emissions reduction portfolio and of the opportunities and threats has not only enabled a framework-building for strategic early option analysis. By knowing the information, four basic strategies can be formulated, which will be accomplished in the following chapter.

3.4 Basic strategy formulation for early options

Companies have to consider their strategic early options against the background of a diverse policy and market landscape presented in chapter 2.2. Chapter 2.5 introduced basic strategies as a useful model to realize opportunities and minimize threats. For being able to decide on a concrete basic strategy in the pre-compliance period, an analytic framework for early option analysis has been accomplished in chapter 3.3. As shown in figure 11, the basic strategies for early options will now be formulated based on the presented risks and opportunities in chapter 3.2. The early emissions reduction portfolio, described in chapter 3.1, represents the basis for any early reductions. Only the selected core elements (see figure 10) are considered for strategic formulation and positioning.

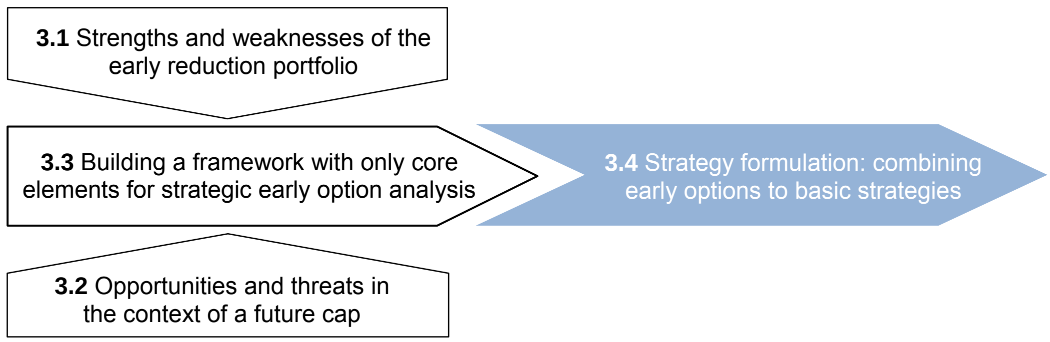

Figure 11: Basic strategic formulation for early options (own source)

3.4.1 Indifferent strategy: Wait and see

Strategic analysis of the company´s early options through the framework might display low threats and low opportunities in all three emissions markets[26] e.g. at a very early stage of political developments when the status of the emissions trading design is still too vague to name either opportunities or risks. They might have reached as far as announcing the intention of implementing a greenhouse gas emissions cap-and-trade system in the near future. Other than that, more details about allocation procedures or an early action program may not be available. Furthermore, the compliance-offset market or the voluntary market might not provide any opportunities to realize additional value. Reasons for that could be e.g. standard or project type problems due to an inappropriate early emissions reduction portfolio.

[26] Future emissions trading scheme, governmental offset programs, voluntary market

When risks and opportunities are low, a company might choose the indifferent strategy. In spite of a possible good early emissions reduction portfolio and image improvements through early reductions, it may be better to wait and see. It might be too early to evaluate necessary steps for starting to become active in either the one (counter-active) or the other way (pro-active). At that stage of developments, being passive would leave all doors open, without spending unnecessarily any resources (time, manpower, money). It might not be appropriate to participate in legislative lobbying or corporate interest groups. An individual realization level and a rather isolated approach would minimize costs and time to be spent at this stage. Nevertheless, it would be very important to continue monitoring the ongoing developments of the key policy and market elements. The situation of low risks and low opportunities might change, requiring the elaboration towards another strategy than the indifferent strategy (see chapter 3.4.5).

3.4.2 Defensive strategy: Do not reduce emissions early; exert influence

A company might assess only risks and no opportunities in the offset markets and in the context of future reduction obligations. E.g., the core policy factor, allocation procedures, could reveal a clear tendency towards a grandfathering allocation. An early action program might be still vague or poorly designed. The company might not face any opportunities by creating additional value in the compliance-offset or voluntary market.

In such situation the passive indifferent strategy would not be appropriate as risks must be confronted. If one does not have any flexibility to realize opportunities, a defensive strategy might be most suitable. The defensive strategy incurs a strong counter-active attitude towards early reductions. No matter whether a reasonable emissions reduction portfolio exits, emissions will not be reduced early. Instead, legislative lobbying might be applicable. A strong interest group could influence policy developments for the whole industry sector (see Hoffman & Woody 2008, 73ff.). The cooperative level of strategy realization could either support grandfathering and the tendency against early reductions, urging for a defensive strategy all the way until the emissions trading scheme is finally implemented. Or it could foster policy developments towards an improvement of the early action program, pushing towards an innovative or even offensive strategy[27]. Which tendency a company decides on, does not only depend on its early emissions reduction portfolio. Defensive companies tend to be reluctant to changes and adaptation, thus exercising the first option (lobbying against early reductions) more commonly, such as in the beginning of trading in Germany (see Zöckler 2004).

A defensive company might try to take an internal focus by staying as discrete as possible in enforcing their counter-active approach. They would only include selected social stakeholders that accept the company's attitude of being against early emissions reductions (see chapter 2.2.3). A defensive strategy is integrated in the corporate business strategy. Only thus, is it possible to reduce the risks for the whole company (see Schultz & Williamson 2007, 121) and to give protection against image-loss or to develop the strategy further.

[27] The dynamic of basic strategies for early options is described in chapter 3.4.5.

3.4.3 Innovative strategy: Reduce emissions early; diversify actions; exert influence

A company might face as many opportunities as it may confront threats regarding early options. The combination of high risks and high opportunities demands the most careful analysis and monitoring of political and market developments. Business must give risks enough credits to secure profitability (see Hoffman & Woody 2008, 85). At the same time, good strategic moves might offer market advantages. Innovative companies are often willing to take risks by acting as first movers despite of political uncertainty. To be too far ahead from competitors will make a company vulnerable to sudden political or market changes into unexpected directions (see Hoffman & Woody 2008, 25).

In such situation, a company would be best prepared by choosing an innovative strategy. The innovative strategy is characterized by pro-active approach and encompasses early reductions. It can only be realized by holding a reasonable early emissions reduction portfolio. The more diverse the portfolio is in terms of locations as well as direct and indirect potential, the more options and risk management the innovative strategy provides. To give an example: As stated in chapter 3.3.1, prices of allowance credits and therefore from early action credits, are more lucrative than voluntary credits. To wait until an early action program is finalized might be too risky as it reduces the possible time for reductions. To reduce and to bank the reductions in order to receive credits for the whole amount would be too insecure, as the uncertainty in design is high. Instead, one part of early reductions could be banked. The other part could be sold into the voluntary or offset market, securing profits.

Other companies with different early emissions reductions locations might reduce emissions early at only one location and sell these credits into the voluntary or the offset market. At other locations it might first reduce early when the early action program is finalized. Other than that, a company could just reduce indirect emissions for cost efficiency (e.g. from suppliers) and wait with direct emissions reductions until trading starts.

Being innovative and pro-active encompasses flexibility. E.g. a credit standard could be chosen whose requirements are applicable for generating compliance-offsets, voluntary credits and/or early action credits. Thus, a company might prepare reductions and credit realization but is still flexible enough to choose the optimal market at best time.

Taking influence on certain political developments would help to enhance the opportunities. Legislative lobbying could not only force political developments into a favored direction, such as a better allocation method but help to keep track of developments. However, one must be careful not to lose the early mover advantage. Therefore, the realization level could be a mix of an individual and cooperative approach. Whether an internal or external focus is chosen depends on the chosen innovative actions and the stakeholders. On the one hand, one must be careful with involving the sociocultural environment when only reducing part of the emissions. Company could easily become a target for negative press as they do not put all their effort in emissions reductions (see chapter 2.2.3). On the other hand, the company must best possibly exploit their existing reduction efforts for image improvements (see Hoffman & Woody 2008, 70). An innovative strategy would only be successful when it is integrated into the corporate strategy. It demands high flexibility and the support of the whole company (see Meffert & Kirchgeorg 1993, 149).

3.4.4 Offensive strategy: Reduce maximum emissions early; focus actions

It is possible that a company might only face opportunities and no threats e.g. through an advantaged design of the key policy factors regarding a future emissions trading scheme and through the ability to generate additional value in the offset markets. With a reasonable early emissions reduction portfolio emissions could be offensively reduced. At a benchmark or auctioning allocation, early reductions are politically not penalized but rewarded.

In case of only facing opportunities, actions would not have to be diversified in order to reduce risks. A company could focus its pro-active actions on reducing the maximum amount of direct and indirect emissions and choose its most profitable way to generate reduction credits in an early action program, in the offset market or in the voluntary market. In case of a not finalized early action program, reductions could be fully banked. A poorly designed program would not entail any risks with the above mentioned allocation methods. Legislative lobbying would not be needed to improve the individual or sectoral position. The offensive strategy could be realized at an individual level, which saves time and money. An external focus would market the early reductions to investors and customers and improves the company's image. The more offensive the basic strategy is, the more important is its integration in the corporate business strategy. Only thus, a company could benefit from all its strengths to realize the opportunities.

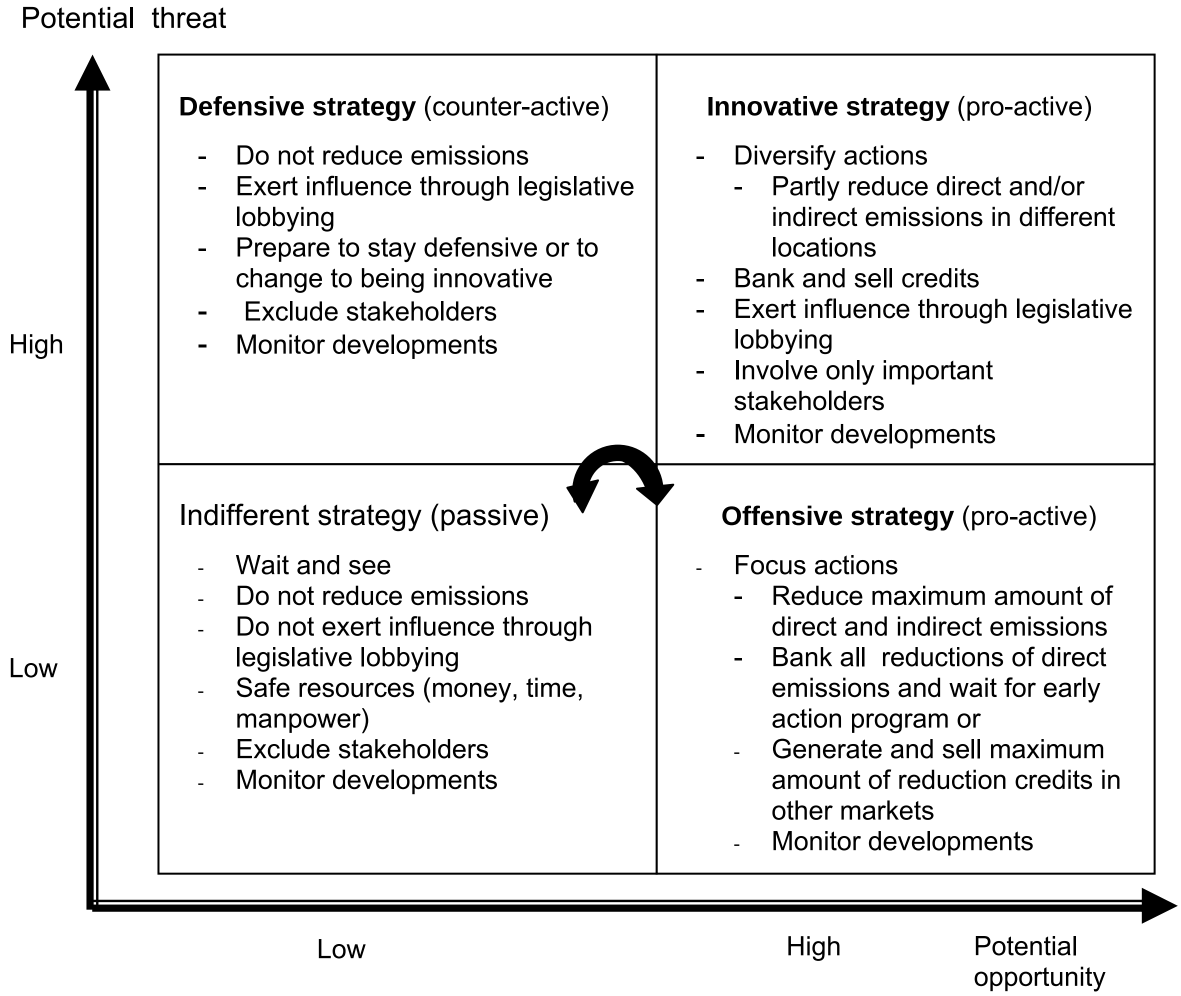

Figure 12: Overview of basic strategies for early options (own source: based on Schaltegger et al. 2003, 182)

3.4.5 Dynamic of basic strategies for early options

To meet the dynamic of basic strategies for early options, a consequent monitoring of the key policy and market factors is demanded. Choosing the indifferent strategy and being passive might only be appropriate at the very beginning of the pre-compliance period (see chapter 3.4.1). The timeframe in which companies might neither face risk nor opportunities is very limited as political developments will further elaborate at a considerable fast paste. As already stated in chapter 3.4.2, a defensive strategy can take two fundamental tendencies. A company could choose a defensive approach until the trading period starts. It could also choose begin with a defensive strategy while at the same time improve its early emissions reduction portfolio for adopting the innovative strategy later on. The innovative strategy might have to change into an offensive strategy when risks are completely dissolved. However, it political developments might force a company to postulate the change from an offensive strategy back to an innovative or even back to a defensive strategy.

The chosen strategy must be able to mature along with the internal development process of the company (improvement of the early emissions reduction portfolio) and the external development process in its business environment (e.g. political and sociocultural progress). A constant feedback and review of the chosen strategy is indispensable.

3.5 Discussion

A comprehensive framework, developed in chapter 3.3, defines four policy and market key factors and one business factor to be analyzed for deciding on a basic strategy. Four core elements, the allocation procedures, the design of an early action program, emission credit standards and regulations as well as prices of emission allowances and offset credits, were identified by assessing the opportunities and threats of each early option in the context of an emerging emissions trading scheme. Together with the early emissions reduction portfolio as the fifth core element the framework combines the internal and the external view on early options (see chapters 3.1 to 3.3).

Four concrete basic strategies have been introduced for best positioning until a future emissions trading scheme is finally implemented (see chapter 3.4). Next to one passive (indifferent) and one counter-active (defensive) strategy, two pro-active strategies have been developed (innovative and offensive). The basic strategies present a suitable approach to cope with threats and opportunities in different emissions markets and with facing an emerging emissions trading scheme at the same time. The dynamic of basic strategies enables a company to adjust to its individual exposure in these markets (see chapter 3.4.5).

According to this work, the framework represents an overall qualified methodology for analyzing and evaluating basic strategic early options. The assessment concentrates on the interrelation of actions in the pre-compliance period and the final position in the trading scheme. The framework includes three market forms (future emissions trading scheme, offset and voluntary market) and widens the strategic perspective of today's companies (see chapter 2.3.1) immensely while reducing complexity to a minimum at the same time. It enables a continuous monitoring of the company's exposure in the carbon constrained world. Additional to the five key factors, no other elements were considered as being decisive to be included in the framework due to two reasons:

1. Only the selected key factors presented in the framework influence the core opportunities and threats according to this thesis.
2. The assessment of the selected key factors will result in the choice of one basic strategy, which is capable to best position a company under current and future circumstances.

The two aspects need to be proved practically. Only thus, it can be concluded if other core elements are missing in order to be able to assess a company's exposure and to choose a basic strategy. This will be done in chapter four, by analyzing the US nitric acid industry under a future federal emissions trading scheme.

Nevertheless, certain boundaries reached by the framework and the basic strategies can be already stated at this point. Competitor's behavior and customer relationship, which hold a key role in a company's competitive environment (see Porter 1980, 1991b), cannot be analyzed by using the framework and are not addressed through the basic environmental strategies. As shown in chapter 3.4, the isolated use of a basic strategy for early positioning will not lead to successful strategic realization. Basic strategies can only be seen as one part of strategic environmental management next to competitive and risks strategies. Thus, the question of how aggressively should a company pursue climate strategies must reflect the overall business strategy and the competitor's environment (see Hoffman & Woody 2008, 24). Board-level engagement is the most critical component of any successful climate strategy (see Hoffman 2006, 37). This aspect refers to another issue that has not been addressed in this work so far, the implementation of a basic strategy (see chapter 2.4.1).

Furthermore, uncertainty will remain a risk that cannot be fully assessed with the framework. The framework helps to cope with uncertainty. Still, the key policy factors provide better assessments on risks and opportunities the more concrete and certain information on the trading scheme design is available.

Another important aspect applies to the early reduction portfolio. It outlines whether a company is weak or strong regarding early reductions. But it does not ascertain how to secure its internal strengths and improve its weaknesses, e.g. how to increase its early emissions reduction potential.

The just presented aspects of boundaries shall be seen as fields where further research and development is needed.

4 STRATEGIC ANALYSIS AND FORMULATION: THE US NITRIC ACID INDUSTRY UNDER AN EMERGING US FEDERAL EMISSIONS TRADING SYSTEM

The United States experiences a concentration of climate change related policies as never before (see chapter 4.3.3). Not only has the Congress intensively discussed the implementation of a cap-and-trade system (see PEW Center 2008f.). Regional initiatives have also independently emerged throughout the USA, aiming to develop regional emissions reduction trading schemes (see chapter 4.4). Such development is striking as US lawmakers have been strongly reluctant to debating any kind of compulsory emissions regulations in the US since refusing to sign the Kyoto Protocol in 1997 (see Deutsch 2008, 6).

The new movements towards more climate protection will have a strong impact on US companies. The US nitric acid industry will most likely receive a cap under the emerging federal emissions trading scheme (see chapter 4.3.3). Thus, the nitric acid sector might serve as a good paradigm for proving the theoretically developed approach of strategic early options in the context of a future cap-and-trade system, as discussed in chapter three.

The aim of the following chapter four is to assess strategic early options for US nitric acid industry in order to best possibly position them under the emerging US federal emissions trading scheme and in the context of the regional initiatives and the voluntary emissions market.

Chapter 4.2 shortly introduces the US nitric acid industry itself. Chapter 4.3 analyzes risks and opportunities of different US federal bills on a cap-and-trade system. The US regional initiatives will be analyzed in chapter 4.4. Chapter 4.5 evaluates risks and opportunities in the voluntary market. The assessments throughout chapters 4.3 to 4.5 are based on the framework for strategic early option analysis. In chapter 4.6, the basic environmental strategies will be discussed with the objective to identify the most suitable basic strategic approach for US nitric acid companies.

4.1 Methodology and analytical structure

Before starting the assessment, the chosen approach will be explained. Also, the analytical structure for analyzing US nitric acid companies and the US political developments on regional and federal trading schemes will be shortly described.

The nitric acid sector is chosen as paradigm for several reasons. Important information, such as emission reduction potential, costs and location, were available for this work.

Chapter 2.4 clearly stated that basic environmental strategies are company specific and not industry specific. Obviously, the constellation of strengths, weaknesses, opportunities and threats is different for every affected entity (see Andrews 1980; Mintzberg et al. 2003, 72). However, this work uses Porter's (1980) analytical approach of proving a structural framework by looking at whole industries first. Afterward results are broken down to corporate level. By using this approach, Porter was able to successfully verify his five forces for strategic competitiveness (see Porter 1980, 3ff.; Porter 1983).

Emissions trading bills treat companies of the same industry sector equally (see chapter 4.3.3). External opportunities and risks will therefore have strong similarities forcing companies of one industry in the same directions. Thus, generalizations for a whole industry sector, such as the nitric acid industry, can be justified to a certain extent. However, to enhance the individual aspect of basic strategies, an example will provide a detailed view of one exemplary nitric acid company in chapter 4.6.3.

As an analytical method, the empirical content analysis by Kromrey (2006, 319ff.) is used. The research technique incorporates a systematical and objective identification of results by evaluating every kind of meaningful source (e.g. literature, interviews). The sources themselves are not of interest but serve as information providers (see Kromrey 2006, 320). The structural hermeneutics of the empirical content analysis assesses which general aspects can be identified by looking at objective and subjective information (see Kromrey 2006, 321). The results can be conveyed to overall statements about reality (see Kromrey 2006, 319).

A systematical and objective identification is assured by using a system of categories (see Kromrey 2006, 333ff.). In case of this study, the framework for early option analysis developed in chapter three provides five categories of assessment. Qualified sources must be named, really existing and relevant (see Kromrey 2006, 337f.). The kinds of sources used for the following analysis apply to all three aspects.

Legislative proposals on federal and regional level serve as first literature for assessing the future emissions trading schemes in the US. At federal state level, only proposals that have reached reasonable subsidy are regarded. Research institutes provided comparisons of meaningful cap-and-trade drafts submitted to Congress (see PEW Center 2008f; WRI 2008). Moreover, the federal Environmental Protections Agency (EPA) provided appraisals on only the most powerful proposals (see EPA 2008b). Most of them have not been submitted to Congress before October 2007 and often present elaborated versions comprising applicable features from previous drafts. The elaboration of specific design aspects can be found repeatedly in several bills of different years without being changed or excluded. Since they must have been evaluated as feasible and convenient by Congress Members they are classified to have a high likelihood of being adopted in a final version approved by Congress. If the drafts give no implications to certain design factors, the experiences of advanced regional initiatives and of the already existing European Emissions Trading Scheme, the EU-ETS, are resorted in the following assessment (see Convery et al. 2008).

At regional level, the initiatives are developing one draft with certain overall directives to be followed by all members (see chapter 4.4). These drafts will be subject of research in chapter 4.4.

As secondary literature, press releases, analysis, position papers and other publications regarding political developments of the following institutions and persons were analyzed:

- Decisive independent US research institutes, such as the World Resource Institute (WRI), the PEW Center on Global Climate Change and the Resources for the Future Institute,

- US federal institutions, such as the EPA, and state intuitions such as the Western Climate Initiative Office,
- members of federal and state governments that have been involved in climate legislation, such as the democratic Senator Joe Lieberman,
- European Commission (EC),
- a leading provider of independent news, analysis and consulting services for carbon markets, Point Carbon,
- other climate emissions related news providers, such as New Carbon Finance, Carbon Finance and Reuters.

Due to fast moving developments, only literature not older than May 2007 is considered in chapters 5.2 to 5.4. Furthermore, professionals in the field of emissions markets and nitric acid have been interviewed for this thesis (see Roe 2008; von Velsen-Zerweck 2008)[28].

4.2 US nitric acid industry – an overview

The US nitric acid industry mainly produces the inorganic compound nitric acid (HNO_3) for manufacturing fertilizers (see EPA 1998, 1). Next to making synthetic commercial fertilizer, HNO_3 is needed for the production of adipic acid, nylon and explosives (see EPA 2005, 2). About 25 companies operate in the USA and run approximately altogether 65 nitric acid plants (see Roe 2008). The number of facilities belonging to one company varies between two and eight. In 2006, the annual average nitric acid production of one facility was about 0.120 million $tHNO_3$ (see EPA 2008a, 186).

Nitric acid is produced through a catalytic oxidation of ammonia at high temperatures. A detailed description of the production process is provided in annex one. The process creates a reactionary by-product: nitrous oxide (N_2O) (see Wiesenberger 2001, 37). N_2O is a greenhouse gas with a global warming potential 298[29] times as high as carbon dioxide (CO_2) (see IPCC 2007, 210ff.; Wiesenberger 2001, 37). Since 2001, the nitric acid production is seen as the largest industrial emitter of N_2O emissions in the USA (see EPA 2001, 2). However, the US government has not regulated N_2O emissions from nitric acid plants by any law (see EPA 2001; von Velsen-Zerweck 2008).

As stated in chapter 3.1, the early reduction portfolio must be assessed individually. Nevertheless, the portfolio of nitric acid plants is comparable, as operating procedures of running a plant are more or less similar[30] (see Roe 2008). Because of facing related strengths and weaknesses with respect to emitting greenhouse gas emissions, some overall aspects can be constituted. The assessment shall reveal which emissions are emitted and whether nitric acid companies generally have an early reduction potential. It is not the aim to

[28] As this is not an empirical but an analytical work, the interviews have not been included in the annex. Nevertheless, they can be demanded from the author if necessary.
[29] The second International Panel on Climate Change (IPCC) Assessment Report defined the GWP for N_2O to be 310, which is used under the Kyoto Protocol. The forth IPCC Assessment Report adjusted the GWP of N_2O to 298 (see IPCC 1995; IPCC 2007, 210ff.).
[30] See annex one.

calculate exact early emissions reductions portfolios but to show their exposure to a US greenhouse gas emissions trading scheme.

Assessed reduction amount of any greenhouse gas

According to the inventory of US greenhouse gas emissions and sinks, US nitric acid industry emitted direct N_2O emissions of 21.7 million tCO_2e in 2007 (see EPA 2008a, 181). The average business as usual emissions factor of a single nitric acid plant was estimated around 9.0kgN_2O/tHNO_3 (see EPA 2008a, 186). Thus, annual N_2O emissions from one nitric acid plant range around 0.33 million tCO_2e.

Currently, two major reduction technologies are used in order to reduce N_2O emissions in nitric acid plants, the secondary and the tertiary catalyst (see EPA 2008a; Yara 2006). Tertiary technology, such as the nonselective catalytic reduction (NSCR), has a N_2O abatement efficiency of about 95 percent (see EPA 2001, 7). They are installed in a separate reactor towards the end of the production process (see Connock 2008, 30). Due to high energy costs and the need of high temperatures[31] for good performances, they are not commonly installed (see EPA 2001, 7). Less than five percent of US nitric acid industry controls N_2O with a tertiary catalyst (see EPA 2008a, 197f.).

The secondary abatement technology for reducing N_2O emissions was first developed in the mid 1980s (see Yara 2006, 2). The catalyst, which achieves abatement efficiencies between 70 to 90 percent (see Yara 2006, 2), is placed in the ammonia oxidation reactor directly below the primary oxidation catalyst (see Connock 2008, 30).

The secondary and tertiary catalyst technologies are the most widely installed and state-of-the-art reduction technologies for reducing N_2O emissions in today's nitric acid plants (see Entec 2008). Other reduction technologies will not be considered due to possible negative impacts on the nitric acid production process (see EC 2007a, 113f.). However, a summary of all N_2O emissions reduction procedures in nitric acid plants is provided in annex two.

Regarding average emissions of 0.33 million tCO_2e per year and a general reduction efficiencies of 70 to 95 percent, a single US nitric acid facility is able to reduce up to 0.85 million tCO_2e per year (8.55 kg N_2O emissions per produced tHNO_3). The following assessment only includes N_2O emissions reductions. However, in some cases another greenhouse gas, Methane, is emitted during the N_2O reduction process. The actual sum of real direct and indirect emission reduction potential as demanded under the early reduction portfolio must be individually assessed.

Early reduction timeframe

As stated above, N_2O emissions reduction technologies already exist. The implementation of a tertiary catalyst demands major adjustments in existing plants. Up to twelve months must

[31] Tertiary technology needs considerable high temperatures in order to function well. In some cases, the tail gas must be reheated e.g. with gas for achieving such adequate temperatures (see EPA 2001, 7).

be taken into account for implementing the catalyst, due to installation issues and lead time for equipment (see EC 2007a, 131; Roe 2008).

For similar reasons, the process of purchasing and installing a secondary catalyst takes between three to six months (see Roe 2008).

Encompassing the installation issues and the current political developments of a possible US federal emissions trading start in 2012 (see chapter 4.3.3), the early reduction timeframe ranges between 2008 and 2012.

Reduction costs

Reduction costs vary depending on the chosen reduction procedure (see annex two). The costs of installing a secondary or a tertiary catalyst involve capital cost and direct operating costs. Direct operating costs for secondary technology include operating labor, maintenance labor, the replacement of the catalyst as well as the possible loss of nitric acid due to pressure drop[32] (see EC 2007a, 123ff.). Operating costs of tertiary technology include operating labor, maintenance labor, maintenance materials (including catalyst replacement), and in some cases natural gas as fuel and for achieving the needed gas temperature for operating the technology properly (see EPA 2001, 8).

The assumption of average costs for installing and operating the technology vary throughout literature (see EPA 2001, 9; Entec 2008, 23; EC 2007a 123ff.). However, in general it can be said that the installation of secondary technology is cheaper than the installation and operation of tertiary technology.

Cost savings through higher nitric acid production rates or reduced production costs do not exist when installing secondary or tertiary technology (see Roe 2008).

Location

The majority of nitric acid plants are located in agricultural regions in the South and Midwest (see EPA 1998, 1). Only very few can be found in the Northeast and Northwest (see Roe 2008).

Some US nitric acid companies also run plants in Canada or elsewhere (see Terra Industries 2008). To keep complexity of this thesis at a reasonable level, only nitric acid plants located in the US will be considered in the following chapters.

All in all, an average US nitric acid company emits a high amount of direct N_2O emissions (0.33 million tCO_2e/year). Even though reduction technologies exist, the majority of companies have not reduced emissions yet (see EPA 2008a, 197f.; von Velsen-Zerweck 2008). As technology is available they could start now. Thus, US nitric acid companies have a reasonable early reduction portfolio. Whether they are able to realize opportunities and minimize threats depend on the design of the other key factors for early option analysis which will be analyzed in the following chapters.

[32] Pressure drop is possible but not considered as normal when the catalyst is installed correctly.

4.3 Scenarios of emerging US federal bills on emissions trading

Over the last two years, a discussion on climate change has reached the legislative floor of US 110th Congress[33] as key members of Senate and House of Representatives have increased their activity towards a more compelling case for federal intervention on US wide emission reductions (see New Carbon Finance 2007, 2). The 110th Congress (2007-2008) has introduced legislation on emissions regulation at a faster pace than any other Congress. More than 235 climate bills, resolutions and amendments compared to 106 proposals of the 109th Congress have been submitted since 2007 (see PEW Center 2008f.).

Before concentrating on the Congressional developments, the position of the White House and the candidates of next presidential elections in November 2008 must be analyzed. Due to a US President's executive veto right (see Wright 2006), the White House must support any activity on establishing a US wide greenhouse gas cap-and-trade system.

4.3.1 The White House

While the attention of US public on climate change has widely increased (see Weart 2008) and US Congress has started to take action towards reducing US greenhouse gas emissions (see chapter 5.1.1), the current US president Mr. George W. Bush Junior remains opponent to regulating emissions reductions in US industry (see Bush 2008; New Carbon Finance 2007, 10). He emphasizes climate protection solutions through voluntary development of new energy technologies (see New Carbon Finance 2007, 10). Even though Bush has made concession towards more climate protection during the summit of the group of eight (G8) in Heiligendamm 2007 (see Federal Government of Germany 2008; Spiegel Online 2007) and in Tokyo in 2008 (see G8 Summit 2008), he vowed to veto the most successful emissions reduction bill, the Boxer-Lieberman-Warner Bill if it reached his desk (see Point Carbon 2008c). Senate voted on the legislation in June 2008 (see Lieberman & Warner 2008).

Considering the current position of the Bush administration, it is very unlikely that greenhouse gas emissions will be regulated under the current President Mr. Bush (see New Carbon Finance 2007, 11; Washington Post 2008).

4.3.2 Presidential Candidates

New US Presidential elections are scheduled for the 4th of November 2008 (see Congress 2008). The Democratic candidate, Senator Barack Obama (see Obama 2008), and the Republican candidate Senator John McCain (see McCain 2008) support a climate protection bill with specific emission targets and the introduction of an emissions trading scheme (see Point Carbon 2008d; Point Carbon 2008e).

McCain aims to reduce emissions 60 percent below 1990 level by 2050 (see McCain 2008) whereas Obama claims 80 percent reductions of US greenhouse gas emissions by 2050

[33] US Congress consists of the House of Representatives and the Senate (see Congress 2008). Currently, the House of Representatives of the 110th Congress is dominated by the Democrats. The seats in the Senate are evenly distributed to the Republicans and the Democrats. Next election of Congress will be January 2009 (see Congress 2008).

(see Obama 2008). McCain was not only the sponsor of the Climate Stewardship Act, which was rejected in 2003 (see New Carbon Finance 2007, 12), but also co-sponsored the Boxer-Lieberman-Warner Bill S.3036, which reached the Senate floor in June 2008 (see Point Carbon 2008e).

Also, Obama presented himself as a co-sponsor of climate bills. In the second part of 2007 he supported the aggressive Sanders-Boxer Bill (see New Carbon Finance 2007, 12). As the bill lost importance, Obama co-sponsored the Boxer-Lieberman-Warner Bill (see Carbon 2008e).

Moreover, both candidates mentioned to reintroduce the United States as a pro-active partner in the international negotiations on a climate protection treaty that will follow the Kyoto Protocol (see McCain 2008; Obama 2008).

The viewpoint of both presidential candidates certainly constitutes a very high likelihood of pushing a cap-and-trade system forward after presidential elections. As the President must give approval, it is Congress's obligation to elaborate and pass a bill on emissions trading (see Congress 2008).

4.3.3 Congress

A variety of comprehensive bills on emissions regulation have been proposed to the Senate, such as the Low Carbon Economy Act, the Clean Air/Climate Change Act or America's Climate Security Act (Lieberman-Warner Bill). Others were introduced in the House of Representatives, such as the Safe Climate Act or the Climate Stewardship Act (see New Carbon Finance 2007, 16f.; PEW Center 2008a)[34]. None of them have been successfully passed so far.

Previously, three bills, the Lieberman-Warner Bill (S.2191) introduced in the Senate on 18th of September 2007, the Bingaman-Specter Bill (S.1766) introduced on 11th of July 2007 and the Representative Dingell's forthcoming carbon tax and cap-and-trade bill, were considered to have the strongest chance of gaining Congressional approval (see New Carbon Finance 2007, 18; PEW Center 2008a; Point Carbon 2008i, 2). They apply to all sectors of the economy and cover all six GHGs. As in most other cap-and-trade systems, their first trading period will start in 2012 (see PEW Center 2008c).

The Lieberman-Warner Bill finally dominated political discussions and accomplished to reach the Senate floor on June sixth of 2008 in amended form and with an additional main sponsor, Barbara Boxer, chair of the Environment and Public Works Committee (see PEW Center 2008a). The Boxer-Lieberman-Warner Bill (S. 3036) was the first bill that has ever come that far. Even though the Senate has rejected the Boxer-Lieberman-Warner Bill in the end, it is seen as the raw model for any successful US federal bill on a cap-and-trade system (see Deutsch 2008, 15f.; Point Carbon 2008f; Point Carbon 2008i, 2).

As already stated in chapter 4.1, it is not the aim of the thesis to discuss every climate bill presented to Congress in detail but to assess how the key elements for early options (see

[34] The PEW Center provides a list of proposed bills, resolutions, and amendments on climate change in Congress, which is updated on a regular basis (see PEW Center 2008c).

chapter 4.3.2) will most likely be formed once a bill is ready to pass Congress. The Bingaman-Specter Bill S.1766, the Lieberman-Warner Bill S.2191 and the Boxer-Lieberman-Warner Bill S.3036 already display a fairly good framework of tendencies and directions (see Deutsch 2008, 11; Point Carbon 2008i, 3ff.). Thus, the following outline of the key factors concentrates on commenting these three bills. As the Dingell's carbon tax and cap-and-trade bill has not been introduced yet and is expected to be released by the end of this year 2008, it cannot be included in the assessment (see Deutsch 2008, 12; Point Carbon 2008f.).

Allocation procedures

As stated above, all three drafts apply to major industry sectors and include all six greenhouse gases. Bingaman & Specter (2007) directly mention nitric acid companies as covered facilities.

"The term "covered greenhouse gas emissions" means (…) for a facility in the United States that manufactures adipic acid or nitric acid, the quantity of nitrous oxide emitted by the facility; (…)" (Bingaman & Specter 2007, 8).

Definitions of covered entities within the Lieberman bills, S. 2191 and S. 3036, are slightly misleading. On the one hand they cover any entity that emits more than 10,000 tCO_2e/year and on the other hand they do not directly mention intentions to cap N_2O emissions from US nitric acid industry (see Boxer et al. 2008, 13f.; Lieberman & Warner 2008, 234f.). Indications in other mandatory systems reveal developments towards a future regulation for the nitric acid sector. The European Commission plans to include N_2O emissions from nitric acid companies in the EU-ETS after 2012[35] (see EC 2008b, 35) and so does the biggest US regional initiative on emissions trading, the Western Climate Initiative (see chapter 4.4.2).

As more facts speak for the inclusion of N_2O emissions in US trading, it is assumed that nitric acid companies are covered in the future US federal emissions reduction scheme.

Almost every bill on emissions trading proposed in Congress suggests a mixture of auctioning and free allowances allocation (see Bingaman & Specter 2007, 24; Boxer et al. 2008, 24; Lieberman & Warner 2008, 343; PEW Center 2008c; PEW Center 2008d). So far, the drafts do not provide indications of whether free allocations will be based on grandfathering or on a benchmark for the nitric acid industry sector. Thus, allocation procedures used for nitric acid companies in the EU-ETS after 2012 will serve as a reference scenario (see chapter 4.1). Due to possible windfall profits[36] for nitric acid companies in case of a grandfathered allocation, EU-member states will most likely allocate allowances by using a benchmark on the base of best available technology (BAT) (see EC 2007b). The Integrated Pollution Prevention and Control directive (IPPC recommends a BAT level of 1.85 kg N_2O emissions per produced $tHNO_3$ for existing plants (see EC 2007b, 168). The European

[35] The EU-ETS only caps CO_2 emissions until 2012 (see EC 2008a).

[36] Windfall profits describe the ability of passing allowances costs on to customers, despite of receiving them for free. Windfall profits are also created through free allocation in combination with unreasonably high reduction potentials (see EC 2008a). The N_2O global warming potential of 310 and the ability to reduce emissions by 70-90% at once when installing the right technology would free a very high amount of allowances that were allocated for free to the industry, if the allocation was based on historic emissions.

commission has stated to take into account the IPPC recommendations (see EC 2008b, 36f.).

Since Congress tries to prevent windfall profits in any current US draft (see EPA 2008b, 99), it is assumed that a benchmark approach will be applied.

Figure 13 visualizes possible windfall profits of the nitric acid industry if the allocation would be based on historic emissions.

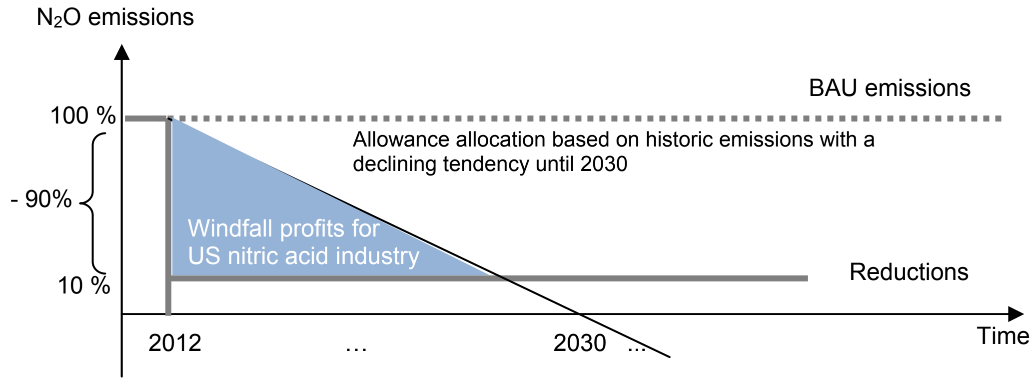

Figure 14: Windfall profit example for US nitric acid industry if allocation was based on historic emissions (own source: based on von Velsen-Zerweck & Gutknecht-Stöhr 2008)

The expected European BAT level of 1.85 kg N_2O emissions per produced $tHNO_3$ serves as a minimum case benchmark for US nitric acid plants in this work.

As stated in chapter 3.2.1, an auctioned and benchmark allocation rewards early reductions in emissions trading schemes and positions a company better in the trading period compared to a company without early reductions (see chapter 3.2.1). As both procedures are assumed to be used for allocating allowances to nitric acid companies, the entities could realize opportunities in the future trading scheme by reducing N_2O emissions early (see chapter 3.2.1).

However, the allocation method has not been clearly defined in any of the drafts. The assumption of receiving a benchmark is based on EU allocation procedures in the EU-ETS after 2012. Thus, the possibility of receiving free allocations based on historic emissions (grandfathering model) does exit and is considered as a risk regarding early N_2O emissions reductions (see chapter 3.2.1). The risk of being disadvantaged through a lower allocation compared to plants that have not reduced early could be compensated through a well designed early action program.

<u>Design of an early action program</u>

It is not only the bills S.2191, S.3036 and S.1766 that yield an early action program within a future cap-and-trade system (see Bingaman & Specter 2007, 45ff.; Boxer et al. 2008, 97ff.; Lieberman & Warner 2008, 308ff.). Nearly every other introduced bill in Congress considers early reductions as supportable and gives future covered entities a clear signal to reduce before enactment (see New Carbon Finance 2007, 13).

The early action program of the Bingaman-Specter Bill S. 1766 is not as elaborated as in the Lieberman-Warner and the Boxer-Lieberman-Warner Bill. Runtime and baseline are not defined (see Bingaman & Specter 2007, 45).

The amended Boxer-Lieberman-Warner Bill just as its previous version, the Lieberman-Warner Bill, sets the runtime for its early action program between January first of 1994 until the date of enactment (see Boxer et al. 2008, 97; Lieberman & Warner 2008, 308ff.; PEW Center 2008e, 10f.). Date of enactment will be between 2009 and the start of the trading scheme in 2012. Since runtime settings have not been changed in the amended Boxer-Lieberman-Warner Bill before reaching the Senate floor, a runtime starting in 1994 and ending between 2009 and 2012 is assumed. Reductions from 1994 until today are regarded as low hanging fruits because they are already accomplished and should be in any case used for claiming early action credits (see chapter 3.2.2). The runtime of the early action program (1994-(2009)2012) mainly equals the period of free allocation (2012-2030) (see above). Thus, it is assumed that an early action program would be able to compensate the amount of allowances that is missed through a grandfathering allocation (see chapter 3.2.2).

The amount of early action credits does not only depend on program's runtime but also on the standard applicable for transferring early reductions into valuable credits. The Lieberman-Warner, Boxer-Lieberman-Warner and Bingaman-Specter have already started to define certain requirements to be followed when emissions shall be eligible for receiving early action credits. The Climate Leaders Program represents an early credit standard that is developed by the EPA and is mentioned as being a suitable standard in all three bills (see Bingaman & Specter 2007, 45f.; Boxer et al. 2008, 98; Lieberman & Warner 2008, 309). Other applicable standards had been developed by the Energy Information Administration, regional programs (see chapter 5.2) and private registries (see Bingaman & Specter 2007, 45f.; Boxer et al. 2008, 98f.). Similarities among these standards are high. According to all of them, early emissions must be verified, credible and registered (see Bingaman & Specter 2007, 45f.; Boxer et al. 2008, 98; Lieberman & Warner 2008, 309).

It is expected that N_2O reductions of nitric acid companies must be registered under one of the above mentioned standards for generating early action credits before enactment. The Climate Leaders Program is not only a standard developed by US government but is also one of the most elaborated (see EPA 2008d). Thus, at current status of developments it might be most applicable to nitric acid companies to concentrate on the Climate Leaders Program for standard procedures.

So far, none of the bills provide information of how the final amount of emissions of one project will be calculated (see Bingaman & Specter 2007, 45ff.; Boxer et al. 2008, 97ff.; Lieberman & Warner 2008, 308ff.). However, the standards itself, such as the Climate Leaders Program, generally calculate the baseline from historic emissions or from data sets that are similar to recently undertaken or planned practices, activities, or facilities in the same geographic region (see EPA 2008d, 3f.). Looking at the reduction potential (see chapter 4.2), nitric acid companies have a fairly good opportunity to claim many early action credits. However, the exact amount can be first calculated when the early action program is finalized in a final approved US federal climate bill.

S.3036 and S. 2191 contain a budget limitation for early reduction credits. Five percent of state's allowances (5,775 million tCO_2e) are reserved for early actions in 2012 (288.75 million tCO_2e). The budget decreases by one percent every year until 2016 (see Boxer et al. 2008, 97ff.; PEW Center 2008d). S.1766 sets a one percent budget limit per year until 2020 (see Bingaman & Specter 2008, 23f.). Bingaman and Specter (2008, 23f.), that limit the state's 2012 budget at 6,652 million tCO_2e, would allocate 66.52 million tCO_2e to early actors in 2012. All three bills include a budget limitation for early actions. Looking at the declining annual amount, starting between 66.52 million tCO_2e and 288.75 million tCO_2e, credits could be discounted if many facilities participated (see figure nine in chapter 3.2.2).

All in all, the planned early action program provides opportunities but also risks. It is assumed that nitric acid companies are able to claim early action credits for a high amount of their early reduction potential. Together with the considerable runtime, the program might secure a missed amount of allowances when allocation is based on historic emissions. Nevertheless, the early action program is still under development. Moreover, a credit discount could be possible. Thus, it might not be the best strategy to only concentrate on an early action program.

Emissions credit standards and regulations

As it is assumed that nitric acid companies will be covered under the future US federal emissions trading scheme, they will not be able to generate offsets under the US federal cap-and-trade system.

However, nitric acid companies might have opportunities under already exsisting offset programs of other emissions trading systems. As stated in chapter 2.3.2, the most popular offset program is represented through JI and CDM projects within the Kyoto Protocol. Since the USA has not signed the Kyoto Protocol, US companies are not able to generate CDM or JI offset credits (see UNFCCC 2008). In the Kyoto market no opportunities can be currently realized. However, offset opportunities might be identified within the US regional cap-and-trade systems. They will be analyzed in chapter 4.4. Other offset programs next to CDM and JI offsets and the programs of US regional initiatives do not exist at the moment.

Prices of emission allowances and offset credits

The US greenhouse gas reduction market is expected to start at four to five billion tons of traded CO_2e, growing to seven to eight billion tons within only a few years (see Point Carbon 2008i, 13). Estimated allowance prices vary throughout literature. At the end of 2007, New Carbon Finance (2007, 21) suggested a price below 20 USD in the first trading years. However, the price could reach 40 USD if no abatement occurred in the short run. The EPA (2008c, 25) estimated a price range of 29 USD to 40 USD until 2015, 61 USD to 83 USD in 2030 and 159 USD to 220 USD in 2050, if the Lieberman-Warner Bill was approved. Looking at the Bingaman-Specter Bill, the EPA (2008b, 32) forecasted prices around 30 USD in 2015, 57 USD to 61 USD in 2030 and 149 USD to 162 USD in 2050. According to New Carbon

Finance (2008b, 1), the approval of the Boxer-Lieberman-Warner Bill would ensure that US carbon prices remain below 25 USD/ton CO_2e until at least 2020 whereas Deutsche Bank foresees prices in the range of 22 USD to 30 USD for the first years (see Deutsch 2008, 17). Depending on key design issues, such as the of CO_2e allowances under a future US emissions trading scheme eventually decided cap and the role of financial players, the price could turn out to be substantially higher or lower than these assumptions (see Deutsch 2008, 17; New Carbon Finance 2007, 13).

However, when incorporating the above mentioned estimates, it can be assumed that prices of CO_2e allowances will most likely range between 20 and 30 USD for the first years under a future US emissions trading scheme.

4.4 Scenarios of the emerging US regional initiatives

Multi-state programs have formed the emissions reduction discussion over the last years in the USA. Three initiatives have started to set up own emissions trading legislation in different regions (see Point Carbon 2008l; RGGI 2007; WCI 2008a). Figure 14 displays where they are located and which states belong to which initiative. Some states only hold observer status and will decide on their participation later on (see figure 14).

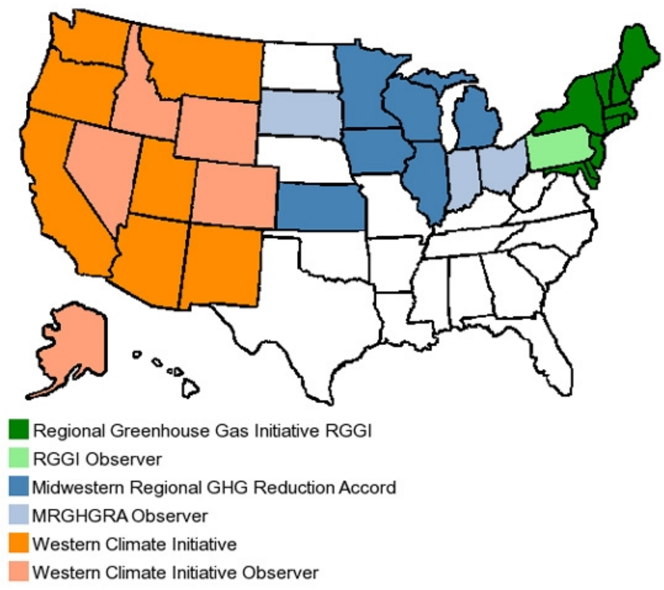

Figure 15: US regional initiatives (source: PEW Center 2008g)

Multi-state programs do not only add complexity to the strategic analysis because of evolving parallel to a federal state emissions trading scheme. They also contain risks and opportunities for US industry, such as nitric acid companies, when assessing strategic early options. It is important to know which of the opportunities or risks must be considered additional to those of a federal state program. In the following chapters, each initiative will be briefly presented and analyzed by using the framework of early option analysis.

4.4.1 Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) of only north eastern states will start its cap-and-trade program as one of the earliest in January 1st 2009 and runs until 2018 (see RGGI 2007, 2ff.). Reduction obligations are limited to fossil fuel-fired electric generating entities with greater capacity than 25 Megawatt and to the greenhouse gas CO_2 (see RGGI 2007, 2f.). So far, other US industry sectors and greenhouse gases are not included in the cap-and-trade system. Therefore, nitric acid companies do not have to consider future reduction obligations under RGGI into their strategic evaluation.

However, nitric acid entities might be able to generate offset credits under the offset program, which will be established by RGGI.

In the following paragraphs, only the key factors emissions credit standards and regulations and prices of emission allowances and offset credits will be outlined. Allocation procedures and design of an early action program are irrelevant, as nitric acid companies will not receive a cap under RGGI.

<u>Emission credit standards and regulations</u>

Presently, only five offset project types are considered under RGGI (see RGGI 2007, 9f.). Landfill methane capture and destruction; reduction in emissions of sulfur hexafluoride (SF_6), sequestration of carbon due to afforestation, reduction or avoidance of CO_2 emissions from natural gas, oil, or propane end-use combustion due to end-use energy efficiency in the building sector and avoided methane emissions from agricultural manure management operations (see RGGI 2007, 9). So far, the reduction of N_2O emissions in nitric acid companies is not recognized as an offsets project. Though, other project types will soon be observed by the RGGI board (see RGGI 2007, 9) and N_2O projects might become applicable in the future. In order to entail future offset opportunities under RGGI, nitric acid companies would have to continuously observe the ongoing political developments of the initiative.

However, the early action timeframe for generating offsets is limited for nitric acid companies. Such as under other offset programs, reductions, eligible for RGGI offset credits, must meet the regulatory and financial additionality criteria (see RGGI 2007, 10ff.). Since it is assumed the nitric acid companies will be covered under a federal trading system after 2012, they would only realize true additional reductions until the start of their compliance obligation.

<u>Prices of emission allowances and offset credits</u>

Currently, only offset credit prices are interesting for the nitric acid industry under RGGI, which will be briefly outlined. Offset credit prices under RGGI have not been estimated through political authorities yet. New Carbon Finance (2007, 33) does not expect them to be higher than 10 USD.

4.4.2 Western Climate Initiative

Two years after RGGI, the Western Climate Initiative (WCI), a partnership between western US states and several Canadian provinces[37], announced to establish an emissions trading system (see WCI 2008a). Trading shall start in 2012. WCI is considered to be half the size of the EU's emission trading system EU-ETS (see Point Carbon 2008g, 2). The partnership regulates all six GHGs and sources that emit more than 25,000 metric tons of CO_2e per year (see WCI 2008a, 3). Next to the energy and transportation sector WCI requires compliance obligations of industrial and commercial facilities with combustion emissions, as well as from entities with industrial process emission sources, including oil and gas process (see WCI 2008a, 1f.).

N_2O emissions from nitric acid companies are defined as industrial process emissions. An average plant emits 0.28 million tCO_2e per year (see chapter 4.2), exceeding the allowed emission amount. Thus, plants located in WCI states will receive a reduction cap.

<u>Allocation procedures</u>

Member states organize the distribution of allowances within their own jurisdiction (see WCI 2008a, 6). WCI seeks to establish harmonized approaches, where allocations to a particular sector should be treated uniformly throughout all states (see WCI 2008b, 5f.). The draft recommends auctioning between 25 percent and 75 percent of each state's allowance budget (see WCI 2008b, 6). The percentage of auctioning is planned to increase over time until it eventually reaches 100 percent (see WCI 2008b, 6).

The final allocation design is still under discussion (see Point Carbon 2008g, 2). There are no indications on allocation procedures regarding nitric acid companies, as none of the member states have outlined their allocation plan yet. Thus, the same assumptions will be taken, such as under a federal state program (see chapter 4.3.3). It is assumed that nitric acid companies will receive free allocation through a benchmark. The BAT level of 1.85 kg N_2O per tHNO_3 will serve as the minimum benchmark scenario. Other than that, it is assumed that nitric acid companies need to buy a portion of their allowances in an auction.

<u>Design of an early action program</u>

Each WCI partner has the opportunity to support early reductions by establishing an early action program (see WCI 2008c, 41f.). Runtime is defined considerably short compared to the federal state program (see chapter 4.3.3). It will start January first, 2008 and ends before the start of the first compliance period in 2012 (see WCI 2008c, 41).

The credits must not be taken off the state's allowance budget, counteracting the discount effect if early reductions exceeded the states early action budget (see WCI 2008c, 41f.). More specifications about early action budgets, standards and baseline information have not been provided yet. They are expected to be released by the end of 2009 (see WCI 2008c, 41).

[37] Manitoba, Quebec, Saskatchewan, British Columbia and Ontario (see WCI 2008a)

Considering the missing information, the current early action program of WCI is not elaborated enough in order to evaluate risks or opportunities for nitric acid companies. Developments must be monitored continuously.

Emissions credit standards and regulations

Nitric acid plants that are located in a WCI member state are not able to generate offset credits as they already have reduction obligations. Neither are companies able to participate in the offset program that have no plants in a WCI member state. The regional system will start in 2012, at the same time as the federal trading scheme. Thus, in 2012 all nitric acid plants are obligated to reduce emissions under federal State law.

Prices of emission allowances and offset credits

All allowance price estimations for the Western Climate Initiative still remain vague. Cost containments are included. Covered entities will be allowed to use unlimited banking. Borrowing of allowance will not be allowed (see WCI 2008a, 7). The maximum price will also be controlled through the amount of allowable offsets (see section above). Prices are estimated to be around 10 USD in 2015 and rise above 20 USD towards 2020 (see New Carbon Finance 2007, 33).

All in all, only nitric acid companies that have plants located in WCI member states must include the regional initiative developments into their strategic evaluation. Other than the federal state scheme, the regional cap-and-trade scheme is already politically passed and will certainly cap N_2O emissions. How regional and state level interact will be described in chapter 4.4.4. Nitric acid plants that are not located in WCI states (the majority) cannot encompass WCI into their strategic assessment as they are not able to generate offsets. However, the monitoring of developments will be important since changes might happen in the future.

4.4.3 Midwestern Greenhouse Gas Accord

Six Midwestern states have united to form the Midwestern Greenhouse Gas Accord (MGGA), the newest of the three initiatives (see Point Carbon 2007, 1). Their aim is to reduce emissions by 60 to 80 percent below current levels by 2050 through a cap-and-trade system (see Point Carbon 2008l). Their cap-and-trade system is supposed to be developed until the end of 2008 and shall be implemented in May 2010. Nevertheless, very little information on design issues is provided so far. It is undisclosed which entities are going to be covered, whether an early action program will be established and how it will be dealt with offset credits. Without these details it is not possible to estimate a price. At current status of developments, MGGA do not provide strategic actions for nitric acid companies. However, it can change quickly, making monitoring indispensible.

4.4.4 The interaction of a federal and the regional cap-and-trade systems

It is not clear yet, how the three initiatives and a future federal cap-and-trade system will be harmonized (see PEW Center 2008h). Some federal bills have adhered to the states' position and reserved a percentage of the overall allowance budget for states with more stringent caps (see Boxer et al. 2008, 101f.; Lieberman & Warner 2008, 312f.). Even though some bills reward regional effort, their focus lies predominantly on the role of the federal government. Furthermore, regulated entities will most likely argue that multiple cap-and-trade systems are too complex and a threat to competitiveness as the same sectors do not have to follow the same requirements throughout the whole country (see Point Carbon 2008h, 6). As a consequence some regional action might survive while others might not. In order to avoid any problems regarding the interaction between initiatives and federal government, the nitric acid industry would have to follow the developments on both levels to be able to adjust activities accordingly.

4.5 The international voluntary emissions reduction market

The voluntary emissions reduction market has already been explained in chapter 2.3.3. Nitric acid companies have to assess whether or not the market provides any opportunities to create profit by realizing N_2O abatement projects.

In the voluntary market, the origin of an offset project incorporates a decisive role for potential buyers of the credits. Companies that buy offset credits for image reasons prefer "good looking project types" that are easy to market to their customers. It is challenging to provide such projects for industrial entities. Their reduction effort is usually accompanied with installing a new technology in their production process in order to reduce industrial gases. This project type does not seem to be as attractive as e.g. afforestation projects (see New Carbon Finance 2008a, 32ff.). Nevertheless, a demand for industrial projects could be observed in 2006 and 2007 (see New Carbon Finance 2008a, 36).

The key factors emissions credit standards and regulations, as well as prices of emission allowances and offset credits, display whether the voluntary emissions market represent a true early option for nitric acid companies.

<u>Emission credit standards and regulations</u>

The offset standard represents a key point in the voluntary market. As stated in chapter 2.3.3, standards aim to provide reliable quality for both buyer and supplier. In 2007, many third party standards have emerged creating a huge and confusing mix of different packages of requirements (see New Carbon Finance 2008a, 47ff.). In the following section, only the most important standards will be briefly analyzed.

The Chicago Climate Exchange (CCX), the only exchange for voluntary offset credits, has developed its own offset standards for various project types. Standardized procedures are available for agricultural methane, landfill methane, agricultural soil carbon, forestry, renewable energy, coal mine methane, and rangeland soil carbon management projects (see CCX 2008). They have not developed standards for reducing N_2O emissions. Furthermore, the CCX had to cope with criticism lately according to which its standard would not follow minimum requirements and would thus not secure quality (see Point Carbon 2008m).

The Gold Standard, founded by World Wildlife Fund (WWF), was developed as a high-end quality standard for carbon credits from renewable energy and energy efficiency projects. In order to use the Gold Standard, the project must significantly contribute to sustainable development (see WWF 2008). Even though it has amplified its scope to, only a few industry sectors, other than the renewable energy sector, are able to satisfy the strict requirements (see WWF 2008). Process gases, such as N_2O emissions, are not considered under the gold standard.

The VER+ standard, developed by TÜV SÜD, is based on CDM and JI methodologies and does not exclude the reduction of industrial process gases (see New Carbon Finance 2008a, 50). Neither does the Voluntary Carbon Standard (VCS), which was developed by the Climate Group, the International Emissions Trading Association, and the World Economic Forum in November 2007. Nitric acid companies are able to generate projects under these two standards.

Emissions reductions from projects that follow the VER+ or the VCS standard have to be real, additional, permanent and verifiable (see EPA 2008d; Tüv Süd 2008; VCS 2007, 7ff.) and have thus a similar approach as the offset standards under the regional programs and the early action standards proposed by the latest federal climate bills. Such similarities enable a nitric acid company to be in compliance not only with VER+ or VCS but also with an early action standard, such as the Climate Leaders Program providing higher flexibility.

Prices of emission allowances and offset credits

According to a survey of New Carbon Finance (2008a), prices for voluntary credits ranged between 1.80 USD/CO_2e and 300 USD/CO_2e displaying a huge range (see New Carbon Finance 2008a, 8). One reason for such price difference is the demand for different project types described in chapter 3.2.3. Attractive forestry projects would achieve higher prices than other project types. However, average prices for a voluntary carbon credit (VER) transacted in 2007 ranged between 4.20 USD/tCO_2e and 6.10 USD/tCO_2e (see New Carbon Finance 2008a, 24). Prices for industrial gas project types have moved towards 3.70 USD/tCO_2e in 2007 (see New Carbon Finance 2008a, 8) being a little under the average prices. The slightly lower price can be explained through demand on the one hand and through lower average project costs on the other hand (see New Carbon Finance 2008a, 32ff.).

All voluntary credit prices have experienced a strong increase from 2006 to 2007. Forecasts have announced a continuous price increase throughout 2008 (see New Carbon Finance 2008a; Hamilton et al. 2008). Hence, a nitric acid company could expect to receive prices above 3.70 USD/tCO_2e when having finalized an industrial gas N_2O abatement project.

4.6 Discussion and formulation: A basic strategic approach for US nitric acid industry

Chapters 4.2 to 4.3 have outlined the position of US nitric acid companies in the context of their early emissions reduction portfolio and an emerging US federal emissions cap-and-trade system. Chapters 4.4 and 4.5 analyzed opportunities in the US regional greenhouse gas initiatives and in the voluntary emissions reduction market. The final goal is to formulate and assess the most suitable basic strategy for US nitric acid companies based on the framework of early option analysis, this will be accomplished in chapters 4.6.1 and 4.6.2. Chapter 4.6.3 will visualize the result by presenting an exemplary US nitric acid company.

4.6.1 Strategic discussion: US nitric acid industry in the pre-compliance period

A single US nitric acid plant has an average early reduction potential of approximately 0.85 million tCO_2e per year of direct N_2O emissions (see chapter 4.2), which can be realized by either using secondary or tertiary reduction catalysts. The ability of reducing emissions today and the current starting date of a US federal emissions trading scheme defines the early reduction time frame between 2008 and 2012. Plants are mainly located in the South and Midwest. All in all, an average nitric acid plant has a reasonable early emissions reduction portfolio and might be able to realize value by reducing emissions.

It is assumed that a final US federal emissions trading bill will cap N_2O emissions of nitric acid companies. Allowances might be partly auctioned and allocated for free. The US government might use a similar approach such as the European Union by applying a benchmark when allocating free allowances to individual nitric acid companies (see EPA 2008b, 99). As described in the previous chapters, a benchmark entails profitable opportunities for early actors. However, since the outcome of a final bill is not definite yet, entities could still receive free allowances based on the grandfathering method. The possible risks of a disadvantaged position of early actors compared to entities that have not reduced emissions early in case of a grandfathered allocation might be compensated by an additional US early action program. Design factors of a program, such as runtime, standards and baseline have already been elaborated to some extent in all proposed bills but still contain uncertain aspects (see chapter 4.3).

The already prevailing risks and opportunities would be ignored when entailing a passive attitude of “wait and see”, thus the indifferent basic strategy would not be suitable for nitric acid companies (see chapter 3.4.1).

How decisive are risks and opportunities for US nitric acid companies? With the ability to reduce emissions 70-90% (early reduction potential), an average US nitric acid company would be able to stay under an assumed minimum benchmark scenario of 1.85 kg $N_2O/tHNO_3$ and would thus be best prepared to realize a strategic advantage. The higher the final benchmark, the higher the amount of free allowances in the compliance period (see chapter 4.6.2). But not only does the allocation procedure reveal opportunities. The appraisal of voluntary offset standards and prices compared to reduction costs constitutes a positive engagement in the voluntary market by generating N_2O abatement projects (see chapter 4.5).

Choosing the counter-active defensive strategy of not considering early actions would not be suitable as potentials are assessed by reducing emissions early.

However, next to opportunities, risks, such as uncertain allocation procedures and early action programs, do exist and have to be taken into account when formulating a concrete basic strategy. WCI requires additional reduction obligations next to a federal system and the offset markets of the regional initiatives offer surprisingly few opportunities to become engaged (see chapter 4.4). This is mainly due to missing information on important design factors and to poorly elaborated offset standards. The offensive basic strategy of focusing and reducing the maximum of emissions would lead to a high exposure to the mentioned risks and could threaten their market position. Hence, the offensive strategy would not lead to best positioning in the pre-compliance period.

Nitric acid companies would be best prepared by choosing an innovative strategy prior to the emerging trading scheme because they not only face opportunities but also considerable risks. The innovative strategy will be elaborated in the following chapter 4.6.2.

4.6.2 Strategic formulation: An innovative strategy for US nitric acid companies

The innovative basic strategy provides a number of possibilities to combine early options. The pro-active approach demands high flexibility and a constant monitoring of the key factors displayed in the framework of strategic early option analysis (see figure 10).

It could be suitable to diversify actions in order to approach opportunities and risks. Hence, a nitric acid company could structure its early emissions reduction portfolio. As stated in chapter 4.2, an average US nitric acid company runs between two to eight plants in different locations. They could be divided into one group that reduces emissions early and into one group that would not reduce emissions. Its individual allowance costs, individual amount of maximum reductions and their geographical location, will serve as decision factors.

By dividing the company's plants into two groups, risks are not related to the whole company and are thus better manageable. If free allowances were allocated through the grandfathering method in the final trading scheme, a nitric acid company would be able to cope with the loss of credits because emissions were reduced in only some of its plants. It would still have a fairly good amount of historic emissions due to the group of plants, in which reductions would have not been pursued.

Plants that are located in a WCI member state would be considered for reducing emissions before other plants. WCI has announced to cap N_2O emissions. It is not certain yet how WCI will be continued after a federal system starts (see chapter 4.5). However, at current status of developments, plants under WCI are assumed to be exposed to reduction obligations twice (regional and federal level).

Between 2008 and 2012, nitric acid companies are able to generate additional value in the voluntary market. Demand for industrial gas projects is lower than for other more charismatic projects but does exist (see chapter 4.5). Voluntary N_2O emissions reductions projects are accepted under the VER+ and VCS standards. The VER+ and VCS standards comprise many similarities to the early action standard of the Climate Leaders Program. Since the

Climate Leaders Program is run by the US federal EPA it is assumed that the early credit standard will be adopted under a final climate bill (see EPA 2008d). If nitric acid companies followed VER+ or VCS requirements, as well as the standard of the Climate Leaders Program, the company would be best prepared for generating voluntary credits that could most likely be transferred into early action credits later on.

With a price between 10 and 20 USD[38], early action credits are more lucrative than voluntary credits of industrial gas facilities. Due to the fact that an US emissions trading bill has not been passed yet, it is not possible to currently claim early action credits. In order to secure parts of the expected profit and to reduce risk exposure, one part of the credits could be sold into the voluntary market until 2012. The other part could be banked. The banked amount of credits would be quickly available when early action credits can be claimed. If the early action program ends up being poorly designed or if not all banked reductions can be transferred into early action credits, the remaining credits could also be sold into the voluntary market.

Figure 15 displays the innovative strategy for best positioning in the pre-compliance period.

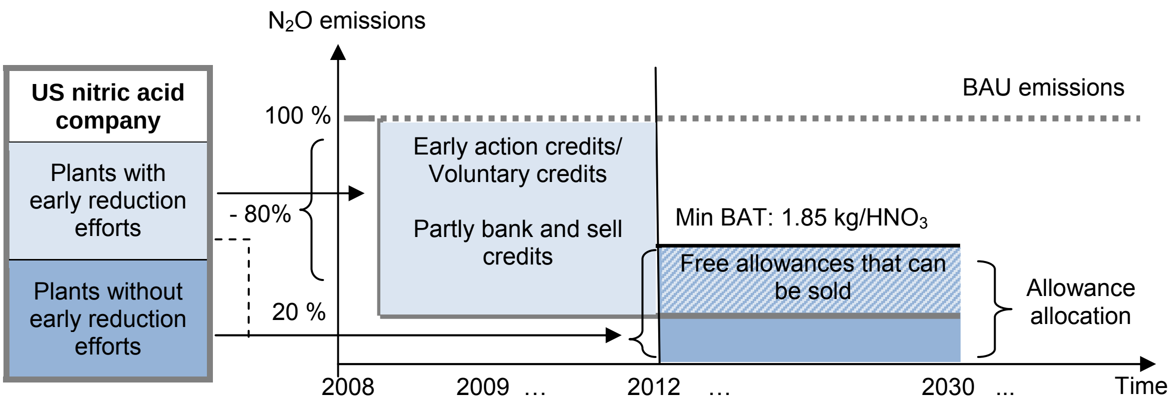

Figure 16: Possible innovative strategy for nitric acid companies between 2008 and 2012 (own source: based on von Velsen-Zerweck & Gutknecht-Stöhr 2008)

Next to reducing emissions pro-actively, legislative lobbying would be essential. The participation in interest groups would provide important information about current political developments and tendencies. At policy level, nitric acid companies might be able to secure the maximum of early reduction profit by lobbying for benchmark allocation. As well, they could try to achieve a higher benchmark than an minimum assumption of 1.85 kg $N_2O/tHNO_3$, which would free more allowances in the trading period (see figure 15). By becoming engaged in the EPA's Climate Leaders Program, they may be able to participate in developing the early action standard for nitric acid plants, reduce uncertainties and fight for high early action baselines (see EPA 2008d).

To secure the first mover position, a nitric acid company might not reveal its innovative strategy in detail. It could use its early reduction activities for image issues. By emphasizing the pro-active and voluntary part, a company fosters its social responsibility (see Schaltegger & Petersen 2002, 21). However, the use of early emissions reductions for image aspects can

[38] Early action credits are converted into allowances at trading start. Thus, the allowance price is calculated (see chapter 2.3.1).

be dangerous when being active in interest groups for maximum advantages in a trading system at the same time. Image activities need to be fostered very carefully (see chapter 2.2.3).

As time moves forward, developments and design aspects will become more certain in the federal system and in the regional initiatives. A constant monitoring at each plant (no matter if emissions will be reduced or not) through the framework of early option analysis and the activities in lobby groups is essential for a strategic evaluation on a continuous basis.

4.6.3 The innovative basic strategy of an exemplary nitric acid company "X"

To underline the individual aspect of basic strategies in the pre-compliance period, the innovative approach of an exemplary US nitric acid company X[39] will be described in this chapter.

Company X runs altogether three nitric acid plants in the states of Oklahoma, Arizona and Mississippi in the USA. Table eight displays the company's early emissions reduction portfolio.

Table 8: The early emissions reduction portfolio of Simply Company (own source)

Plant facts	A	B	C	Total	Unit
Annual nitric acid production	66,000	120,000	170,000	356,000	$tHNO_3$ /year
Project emissions	180,000	322,000	460,000	962,000	tCO_2e/ year
Reductions					
With secondary catalyst in tCO2e	141,000	257,600	398,000	769,600	tCO_2e/ year
Share of reduction portfolio	19%	33%	48%	100%	%
Reduction Costs (secondary technology) [40]					
Initial costs	<1,000,000	<1,000,000	<1,000,000		USD
Operating costs (0,87USD/tCO2e)	125,280	224,112	320,160	669,552	USD/year
Early reduction time frame					
With secondary catalyst	3 ½	3 ½	3 ½		Year
Location					
	Oklahoma	Arizona (WCI)	Mississippi		State

For the simplicity of this example it is assumed that the secondary technology is the best economic and technical option in all three plants.

Plant A has the lowest early reduction potential of 141,000 tCO_2e/year. Plant B is able to reduce 257,600 tCO_2e/year. Plant C has the highest early emissions reduction potential of 398,000 tCO_2e/year. The early reduction timeframe mainly depends on the installation and lead time of the reduction technology and the beginning of the trading scheme (see chapter

[39] Due to sensible information the name of the company and all company dates presented in chapter 4.6.3 have been modified. Nevertheless, it was tried to present the case as realistic as possible.

[40] Please note, that the costs displayed in table 8 are average cost figures presented in the reference document of the European Union (EC, 2007a). However, individual reduction costs vary depending on the technical set up of the respective plant (see Roe 2008; von Velsen-Zerweck 2008).

4.2). The federal trading scheme is expected to start in 2012 (see chapter 4.3). Since it takes a maximum of six months to acquire the secondary catalyst equipment (see Roe 2008), the reduction timeframe for plants A to C is calculated to be 3 ½ years.

According to the innovative strategy, elaborated in chapter 4.6.2, company X would be best positioned by diversifying its early actions. In order to realize the opportunities in the emissions market and to minimize the risks of unforeseen political decisions not all but only would be considered for emissions reductions before a federal emissions trading system is passed.

Plant B is the only plant that is located in a state which is a member of one of the US regional initiatives (Arizona; WCI) and thus would be prioritized for early reductions (see chapter 4.6.2). Company X would then have to evaluate whether additional reductions in plant A or C are reasonable. As the opportunities of receiving a benchmark are assumed to be higher than the risks of receiving allowances through grandfathering, it could be applicable for company X to reduce emissions early in more than one plant. However, in order to be prepared for receiving allocations through grandfathering, company X may reduce emissions in plant A and would thus abate only about 52 percent of its whole annual reduction potential (see table 8). Company X would still have an unused reduction potential of 46 percent (plant C) and would thus be flexible enough to cope with possible downsides of early reductions such as a grandfathering system for allocation allowances to the plant under a federal trading system.

The highest revenues of approximately eight million USD/year[41] for plants A and B would be achieved if the entire amount of early reductions were transferred into early action credits with an allowance price of 20 USD/tCO_2e. However, due to price uncertainties, a possible discount and credit standard aspects, it is assumed that only part of the revenues could be realized.

It may be too risky to focus on unsure early action credits (see chapters 4.6.1 and 4.6.2) which can only be secured in the future. In order to secure the return on reduction costs and part of the profit, a portion of company X reductions could be sold up front in the voluntary market. However, the expected voluntary credit price of 3.70 USD/tCO_2e for N_2O abatement projects in nitric acid plants (see chapter 4.5) is a lot lower compared to allowance prices.

Company X might realize voluntary credits at plant A by following the VER+ or VCS standard. Plant B may follow the early action standard of the Climate Leaders Program as well as the standard VER+ or VCS and bank its credits until early action credits can be generated. By additionally following voluntary standards, credits could be sold to the voluntary market at any time in case of a poorly finalized early action program.

[41] Before enactment of emissions trading bill (see chapter 4.3).

4.7 Discussion

This work has analyzed the situation of US nitric acid industry in the pre-compliance period of an emerging US federal emissions trading scheme. After assessing the general early emissions reduction portfolio of an average single US nitric acid plant, risks and opportunities of the different emissions markets were ascertained. The aim was to choose a basic strategy that combined a US nitric acid company's early options for best positioning in the context of the future emissions trading scheme. The assessment in chapter 4.6 revealed that an innovative basic strategy would be best suitable for realizing the opportunities and minimizing the threats.

The example of US nitric acid companies proved the applicability of the framework for strategic early option analysis as a comprehensive and compact tool to successfully analyze risks and opportunities of strategic early options. The assessment resulted in a discussion on the suitability of the different basic strategies in chapter 4.6.1 and displayed the decisiveness of the selected key factors developed throughout chapter three. The early reduction portfolio, the allocation procedures, the design of an early action program, the emission credit standards and regulations, as well as the emission allowances and offset credit prices within the different markets, has lead to the identification of one basic environmental strategy, the innovative approach, to US nitric acid companies in chapter 4.6.2. Thus, as claimed in chapter three, the selected key factors truly show the individual exposure of a company within different emissions markets and in the context of an emerging emissions trading scheme. This conclusion could be emphasized by displaying the strategy simplified for one exemplarily nitric acid company X in chapter 4.6.3.

The analysis did not reveal any dissonances between the framework of strategic early options analysis and the four basic strategies for early positioning. Nevertheless, further research with more company and industry case studies within different emerging cap-and-trade systems is needed to test the steadfastness of the framework and the strategies developed in this work.

5 FINAL CONCLUSION

5.1 Summary

Emissions reduction cap-and-trade systems are more and more used to constrain greenhouse gases of companies (see chapter 2.1). When this flexible mechanism of environmental policy is anticipated, companies are influenced in their political, legal, sociocultural, technological and economic business environment in the pre-compliance and compliance period (see chapter 2.2).

Entities with future emissions reduction obligations have several alternatives prior to an emerging emissions trading scheme to best possibly position themselves until a cap-and-trade system is finally implemented. This work identified pro-active and counter-active early options: The early reduction of emissions without participating in any program or market and the early reduction of emissions while participating in an early action program, in offset programs of already existing cap-and-trade schemes or in the voluntary market were described as pro-active alternatives. Counter-active options did not include the early reduction of emissions prior to the trading start (see chapter 2.3).

In the context of an emerging emissions trading scheme, early options comprise opportunities and threats in business environment. In order to cope with all relevant internal and external factors and to find a company's best early option combination, a strategic approach is anticipated. The indifferent, defensive, innovative and offensive strategies have been introduced as basic strategies of environmental management that help facing environmental challenges, such as emissions reductions in the pre-compliance period (see chapters 2.4 and 2.5).

Before formulating the strategy, the internal strengths and weaknesses and the external opportunities and threats must be analyzed. Complexity is reduced by focusing only on the most decisive and influential factors. This work has assessed four key policy and market factors, as well as one business factor, and combined them to a compact framework for strategic early option analysis. The external framework comprises the allocation procedures, the design of an early action program, emission credit standards and regulations as well as prices of emission allowances and offset credits. The internal framework encompasses the company's early emissions reduction portfolio, which resembles the early reduction potential and reduction locations (see chapters 3.1 to 3.3).

The framework analysis in the pre-compliance period clarifies whether a company is best positioned by choosing:

- The indifferent strategy of wait and see,
- the defensive strategy of not reducing emissions early and of exerting influence,
- the innovative strategy of partly reducing emissions early, of diversifying actions and exerting influence or
- the offensive strategy of reducing the maximum amount of emissions and of focusing on only certain actions (see chapter 3.4).

To prove the applicability of the framework and the basic strategies, the strategic analysis and formulation has been accomplished for the US nitric acid industry under an emerging US federal emissions trading scheme. It is assumed that they will face a future N_2O emissions reduction obligation under the federal scheme. For the strategic appraisal the developments in the White House, in the 110th Congress, in the regional initiatives and in the voluntary market needed to be ascertained (see chapters 4.1 to 4.5).

According to the assessment of the internal framework, US nitric acid companies have a reasonable early emissions reduction portfolio, which is considered as a strength. The design of the external key factors resembles opportunities, as well as threats for US nitric acid companies. Thus, the persuasion of an innovative strategy might be most suitable. It is assumed that they could realize advantages by fostering their opportunities in the voluntary market through generating voluntary credits. The use of the VCS or VER+ standard on the one hand and the adherence of the early action standard of the Climate Leader Program on the other, enables the creation of a portfolio with credits that could be sold in the voluntary market and with credits that could be banked for a possible yield of early action credits in the future. To minimize the risks of uncertainty, only some of their plants would reduce emissions early. To underline the individual viewpoint of a basic strategy, the innovative strategy has been shown for one nitric acid plant in the end (see chapters 4.5 and 4.6).

5.2 Conclusion

The world's companies will increasingly face greenhouse gas regulations (see Hoffman & Woody 2008, 4). At first glance, pre-compliance period is mainly characterized through complex political developments and uncertainty. At second glance, early options display a widespread field that is not only restricted to the emerging political emissions system. Alternatives range from activities in the mandatory system, over other already existing offset markets to activities in the voluntary market.

Before the start of the EU-ETS, companies have revealed a counter-active attitude towards early reductions (see Zöckler 2004). E.g. they mainly favored the allocation method grandfathering as it supports high emissions prior to a trading period.

This work has shown that another pro-active perspective on emissions emitted prior to a trading scheme is possible and in many cases even more applicable. It has been focused on assessing and evaluating early options in the compliance, offset and voluntary markets in the context of an emerging emissions trading scheme. Best timing of emissions reductions then becomes a critical aspect. As risks and opportunities emerge, companies must start to position themselves as early as possible. Otherwise, opportunities of creating additional value in the fast growing carbon-constrained world could be missed and left to competitors. Therefore, companies need to open themselves to their new alternatives in the different markets and really assess their strategic options.

Strategic preparation fosters the constant interaction in and monitoring of an entity's individual situation in its highly dynamic and uncertain surrounding (see Porter 1996). The framework-approach can be considered as a very helpful model for analyzing a complex system with many variables. However, the examination of the interaction between different emissions markets all over the world will stay difficult and challenging. Especially the fast changes can put a company in a total different business environment within only a few years (see Hoffman 2006). As stated in chapter 2.3, European companies could not choose between different emission markets in their pre-compliance period because they simply did not exist.

This work has discussed early options with a new strategic approach. Its aim was not only to present a comprehensive outline of strategic early options but to develop a framework for strategic early option analysis, as well as basic strategies to approach best positioning. Even though an attempt was made to cover every important aspect, the study has left many options for further research. To only name some of them:

- The work has not included recommendations on how to implement the developed basic strategies effectively into the corporate strategy. As this is an important aspect, it should be considered for further research.
- The boundary of approaching competitive aspects through basic strategies was mentioned in chapter 2.7 and gives room for developing a method on including the competitive environment.
- So far the framework has only been used once for US nitric acid companies. More empirical research is needed on the framework and the basic strategies.

The framework and the basic strategies only display solutions for one part of the challenges in a carbon-regulated world. The costs of climate change to companies will not only have its origin in regulation of greenhouse gas emissions or image effects. The impacts are by far more complex and diverse. It will change the infrastructure, insurance exposure, energy prices and many other important areas for business (see Enkvist et al. 2008, 45; Schultz & Williamson 2007, 120f.).

So far, little attention has been given to the physical improvement of emissions reduction on climate change and the responsibility of politics in this work. In order to stabilize the world's climate, a drastic greenhouse gas reduction is necessary (see IPCC 2007). Voluntary pre-compliance emissions reductions represent emissions reductions in the present. As stated in the well known Stern report, today's climate protection will cost the world economy not as much as the world's adaptation to climate change in the future. That makes present emissions reductions more valuable (see Nordhaus et al. 1998, ii; Stern 2006). Moreover, it enables future generations to accomplish greater levels of climate protection (see Michaelowa & Rolfe 2001, 281). With this knowledge and the findings of this work, politics should realize the importance of early reductions and know how to design allocation procedures, the early action program and credit standards and regulations for creating as many early opportunities as possible. However, political uncertainty will stay most likely one of the biggest constraints for early reductions (see Hoffman & Woody 2008).

All in all, this work has shown that the theme climate change and business is still a field where theoretical developments are essential in order to support companies in finding the best way forward in the new carbon-constrained world.

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7 ANNEX

The following description of nitric acid production and abatement processes represent a close summary of the documents EC (2007a, 123ff.) and Wiesenberger (2001).

7.1 Annex one: The production process of nitric acid

Ammonia (NH_3) is oxidized with air to form nitric monoxide (NO). NO is further oxidized to form nitrogen dioxide (NO_2), which finally is absorbed in water to produce nitric acid (HNO_3).

A simplified schematic representation of nitric acid production is shown in figure 16.

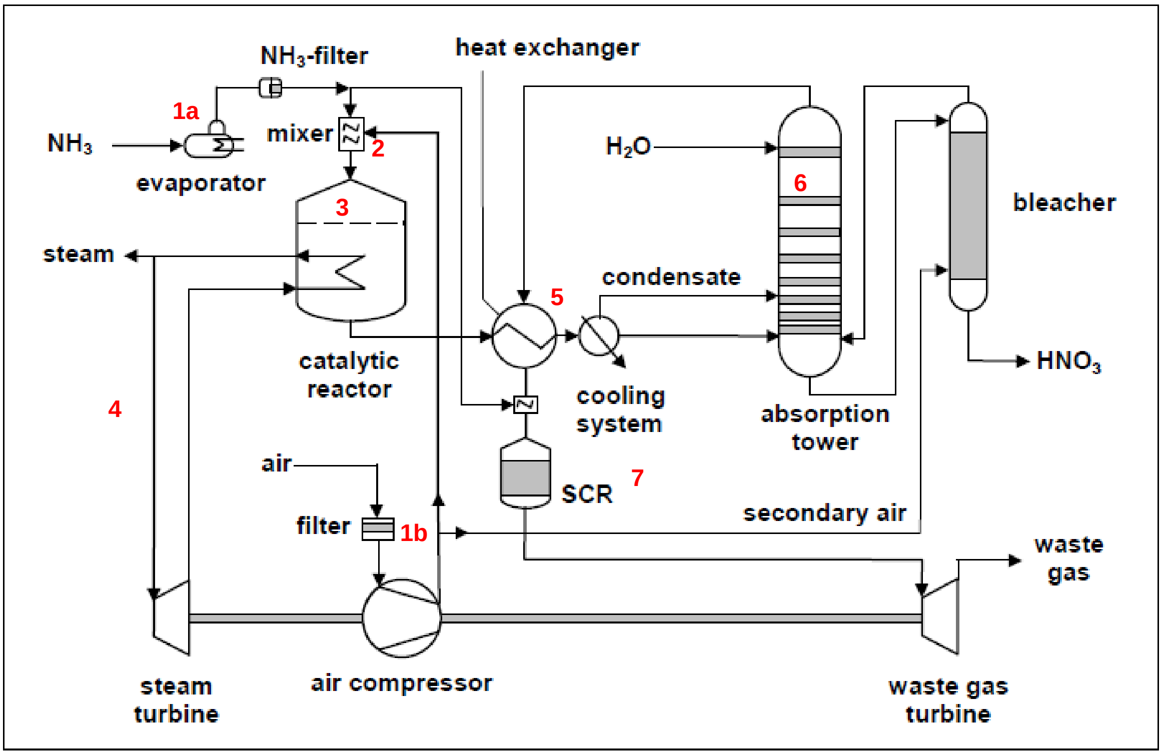

Figure 17: A simplified schematic representation of nitric acid production

1. Evaporated ammonia is superheated with waste heat of secondary air compression and filtered in order to remove any rust from carbon steel equipment. Then the air is compressed to the working pressure of NH_3 combustion.
2. Ammonia and primary air are mixed in a multistage static mixer, the NH_3/air-mixture is filtered in order to get a homogenous gas flow.
3. Air/ammonia oxidation over catalytic gauze: $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$.

   The yield of ammonia oxidation is declining with pressure and depends on flow rate and combustion temperature of the gas compound. Consumption of ammonia and emissions of N_2O depend on the yield, as secondary reactions of ammonia burning are the conversion of NH_3 into N_2O or nitrogen.

4. Energy recovery by steam generation and/or gas re-heating: Heat arising from ammonia combustion is recovered in a waste heat boiler, located below the burner of the catalytic reactor.

5. Gas cooling: A set of gas/heat exchangers transfers energy from the gas leaving the waste heat boiler to the absorption column. In a cooling and condensing system following the heat exchangers, process gas is cooled to 20 °C.

6. The production of nitric acid in the absorption tower: The oxidation of NO and the absorption of NO_2 is favored by high pressures and low temperatures. Nitric acid is generated by absorption of NO_2 and dinitrogen tetroxide in water.

   Oxidation of residual NO into NO_2: $2\ NO + O_2 \rightarrow NO_2$,

   Absorption: $3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$

   Altogether, absorption efficiency depends on

   - Absorption pressure: High absorption efficiencies are achieved in particular with high absorption pressures (e.g.15 bar),
   - cooling efficiency at the absorption column and
   - on the design of the absorption column (absorption volume and number of sieve plates).

7. Heating of waste gas leaving absorption: In most of the nitric acid plants, waste gas is subjected to processes for reduction of NO_X emissions in a SCR process.

Due to different thermodynamic conditions for ammonia combustion and absorption, process technologies differ with regard to working pressure levels. Pressures are classified as following:

- N: normal (atmospheric) pressure oxidation and absorption (< 3 bar)

  Normal pressure at oxidation and absorption refers to atmospheric pressure absorption. They are not state of the art.

- M: medium pressure oxidation and absorption (3–6 bar)

  The oxidation of ammonia occurs at a more favorable pressure, whereas absorption efficiency is rather low due to an unfavorable (low) absorption pressure level.

  Medium pressure show lower N_2O emissions than high pressure. Consumption of ammonia is high, due to absorption losses resulting in high NO_X concentrations in the waste gas leaving the absorption column. NO_X reduction of the waste gas with a SCR reactor requires a considerable amount of ammonia as reducing agent.

- H: high pressure oxidation and absorption (> 8 bar).

  Oxidation of ammonia occurs at a rather unfavorable (high) pressure level with regard to ammonia oxidation yield, whereas the absorption efficiency is at a favorable level due to high absorption pressures and show rather high N_2O emission levels.

N_2O emissions in nitric acid plants

N_2O is produced at the catalytic oxidation of ammonia in the burner. Ammonia reacts into NO. The conversion efficiency of ammonia to nitric oxide is a function of temperature, pressure, velocity of gas stream, volume of catalyst, and purity of the ammonia and air streams. Ammonia can react in secondary reactions into nitrogen (N_2) and partly into N_2O. N_2O formation depends of the efficiency of the catalytic ammonia oxidation, pressure level, gas velocity and the reaction temperature and in the catalyst.

$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$

$4\ NH_3 + 4\ O_2 \rightarrow 2\ N_2O + 6\ H_2O$

7.2 Annex two: N_2O emissions reduction possibilities in nitric acid plants

Abatement technology	**Description**	**Costs**	**N_2O reduction**	**Comments**
Oxidation catalyst performance and campaign length	Due to catalyst loss, the catalyst gauze must be periodically exchanged. Campaign lengths range between 1.5 and 12 months. Fresh gauzes have less N_2O emissions in a medium burner. Changing a gauze more frequently results in less N_2O emissions.	• Additional monitoring costs • Additional costs for a more frequent catalyst exchange	500 ppm / gauze exchange	Is not considered due to impacts on production rates and product quality.
Optimization of the oxidation step	The optimization of NO yield results in lower N_2O emissions. The NO yield is influenced through changes of NH_3/air ratio, temperature and pressure.	• No specific information provided	Approximately 5%	Is not considered due to considerable low reduction efficiency.
Alternative oxidation catalysts	Modifications in composition and geometry of a platinum catalysts can reduce N_2O emissions. Next to platinum catalysts, CO_3O_4 based catalysts have a lower N_2O yield.	• Catalyst improvements or alternative: USD 1.5 – 2 mil. (from 2001)	Improved platinum catalyst: 30 % reductions CO_3O_4 based: catalyst 80-90 % reduction.	Is not considered due to negative impacts on productions rates (lower NO yields).
N_2O decomposition by extension of the reactor chamber	N_2O can be reduced by increasing the residence time in the reactor at high temperature (850 – 950°C). An empty reaction chamber of 3.5 m is installed between the platinum catalyst and the first heat chamber. N_2O is decomposed to N_2 and O_2.	• Low additional investment costs for new plants • Low additional operational costs	70-80% reductions	Only applicable to new plants with a reactor diameter of four meters. Not applicable to low pressure plants. Is still under development.
Catalytic N_2O decomposition in the oxidation reactor	A selective De-N_2O catalysts installed just after the platinum gauze in the burner reduces N_2O emissions.	• Additional cost for the catalyst	80-95 % reductions	
Non-selective catalytic reduction of N_2O	Non-selective catalytic reduction of N_2O takes place in the tail gases through the reduction of nitrogen oxides with a reduction agent (fuel). The fuel depletes the free oxygen in the tail gas and then removes N_2O and NO_x emissions.	• Technology costs: USD 106,000 to 143,000/m^3 • Fuel operating costs: USD 1.95/tone 100% HNO_3 • Installation maintenance and depreciation	80-95% reduction	