Tradable permits:
a successful policy instrument?

Designing an ex ante evaluation framework to assess the implementation of tradable permits

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PREFACE

This thesis has been written during my internship at Berenschot Procesmanagement and is the last stage of my MSc education in Systems Engineering, Policy Analysis and Management at Delft University of Technology. Writing this thesis has been a very valuable experience for me. I learnt how to apply the knowledge that I have learned during my studies in Delft and I experienced working individually on an intensive project. This made this research both an intellectual and a personal challenge.

Within the six months that I was graduating at Berenschot I did not only work on my thesis, but I was involved in consulting work in various fields as well. Especially in the beginning it was quite a challenge to find the balance between consulting work and working on my thesis, but after a couple of weeks I found out how to balance all my work and I found my way in the organisation. The combination of working experience and working on my thesis has made my time at Berenschot a real good experience. My colleagues were very inspiring and willing to share their experience and knowledge with me and, also very important, they were fun to work with.

I would like to thank my graduation committee Ellen van Bueren (first supervisor, section Policy, Organisation, Law and Gaming), Hans de Bruijn (chairperson, professor Organisation and Management), Aad Correljé (second supervisor, section Economics of Infrastructures) and Marijke van Roost and Marinka van Vliet (Berenschot) for their advices, feedback, guidance and great discussions. You really inspired me and challenged me to accomplish the best I could.

SUMMARY

Tradable permits can help the government achieving their goals in the field of sustainable development by coping with the problem of the tragedy of the commons, without strict regulation. The interest in the application of tradable permits in new cases is growing, but not every attempt to implement tradable permits has been successful (which means ecological effective, economic efficient and social justified), because the characteristics of the product and the market must make it possible that a market comes into existence. In this research a policy instrument will be considered successful if it contributes to sustainable development, thus if it contributes to economic efficiency, ecological effectiveness and social justice.

It would thus be interesting to asses ex ante whether tradable permits have potential to be a successful policy instrument in a specific case or not. To do so an ex ante evaluation framework is designed, which can support the decision-making process about whether or not implementing tradable permits in a specific case, by investigating if tradable permits have a high chance of being a successful policy instrument in that case or not.

The main objective of this research is to design a framework for the ex ante assessment of the potential contribution to sustainable development (and thus successfulness) of tradable permits. Based on this the research question which was answered in this thesis, is the following:

What does an ex ante evaluation framework to assess the potential contribution to sustainable development of the implementation of tradable permits in a new case look like?

The first step of the analysis was to investigate which basic conditions should be present for the implementation of tradable permits, in order to make it possible to develop a market: there should be buyers and sellers, a scarcity of permits, possibilities for innovation, the permits should be tradable and a tradable unit should be defined.

Then, based on the analysis of economic efficiency, ecological effectiveness and social justice, several characteristics for the market and the product, which positively influence the potential successfulness of tradable permits in a new case, have been defined. The characteristics of the market and the product give a description of the sector where tradable permits are considered to be implemented. The characteristics that should be considered before implementing tradable permits are: buyers and sellers, technical ability to monitor, transparency, entry and exit rules and homogeneity. Empirical analyses showed that it is possible to make adjustments to the product or the market to deal with imperfections of characteristics. This means that for a successful tradable permit system it is not necessary that all characteristics are perfectly fulfilled.

Empirical analyses also showed that when the government would like to implement tradable permits in a new case, not only the characteristics of the market and the product should be taken into account, but that also the implementation process crucial for a suc-

cessful implementation of tradable permits. Several risks and opportunities, which influence implementation process and thus the potential successfulness of a tradable permit system, can be distinguished: current policy, role of other countries, role of local and regional governments and the decision-making process.

Then is analysed which design choices exist when implementing tradable permits. The different design choices are: trading system (tradable reductions or cap and trade), level of permits (strict or loose cap/baseline), initial allocation (auctioning or grandfathering), lifetime of the permits (stock or flow permits, for a finite or infinite period), banking and borrowing (to allow banking and/or borrowing or not), monitoring (to monitor participants only or third parties), sanctioning (collective or individual sanctioning and the level of sanctions) and the institutional structure (to allow third parties to enter or not, how many parties join the trade and which authorities need to be appointed). An analysis of the three pillars of sustainable development (economic efficiency, ecological effectiveness and social justice) showed how these design choices contribute to each pillar, which could be used as input for the decision-making process about the design of a system of tradable permits.

It has been found that the best design of a tradable permit system does not exist, because trade-offs have to be made within and between the three pillars of sustainable development. So, the design choices are not part of the evaluation framework. What matters is the decision-making process about the design. The government cannot decide on her own about whether tradable permits will be implemented or not and what the best design of the tradable permits system will look like, for several reasons: First of all the relevant parties would not accept and support the outcome, if they were not involved in the decision-making process, while the government is dependent on the willingness and support of the participants and other actors. Secondly, it is not possible to design the optimal system of tradable permits based on complete and objective information, because the information is conflicting, contested or sometimes not available at all. Instead the participants should be involved in the analysis phase and the decision-making process. Involving the relevant parties increases their support, but also brings some risks. The decision-making process can take long, be hardly manageable and the outcome might be not effective or efficient. Therefore a process design should be developed, to structure the decision-making process about tradable permits. This will provide the participants an incentive to cooperate in implementing tradable permits, which will increase the chance on a successful implementation.

Based on these analyses the ex ante evaluation framework can be constructed, which consists of the factors that influence the potential contribution to sustainable development of a tradable permit system: the basic conditions, the characteristics and the risks and opportunities influencing the implementation process. This framework is used to assess two new applications of tradable permits: business areas permits and water quality permits. Based on this analysis can be concluded that tradable water permits have a low chance of becoming a successful policy instrument. Also tradable business area permits have not a high

chance of becoming successful, because it might be difficult to fulfil the (necessary) basic conditions.

The evaluation framework can be very useful when the government considers to implement tradable permits in a new case. The framework helps to structure the way of thinking, supports the researcher to adopt a critical point of view and helps to increase the transparency of the decision-making process about tradable permits.

INDEX

1. INTRODUCTION

1.1 SUSTAINABLE DEVELOPMENT

"Sustainable development (developing sustainable or achieving sustainability) is development that meets the need for the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Sustainability can be seen as the final goal: a balance of social and economic activities and the environment. Sustainable development is a means of reaching total sustainability (Hofman and Li, 2007). Sustainability is a dynamic goal, because the focus on social and economic activities and the environment changes during the time and thus the balance point also changes. Sustainable development can be approached by the "three pillar" approach, also known as the triple bottom line (TBL), which is the most common model since its adoption by the World Bank. The three pillar model distinguishes three domains within sustainable development: the social domain (justice), the economic domain (efficiency) and the ecological domain (resilience) (Serageldin, 1996).

1.2 COMMON POOL RESOURCES

One of the issues in sustainable development is how to deal with common pool resources. Common pool resources, alternatively named common property resources, are goods that are non-excludable and subtractive (see figure 1 below). This means that it is not possible to exclude a person from using that particular good and that there is competition involved in obtaining the goods; if a certain person or company uses that resource, there will be less available for others. Examples of common pool resources are irrigation systems, clean air or fishing grounds.

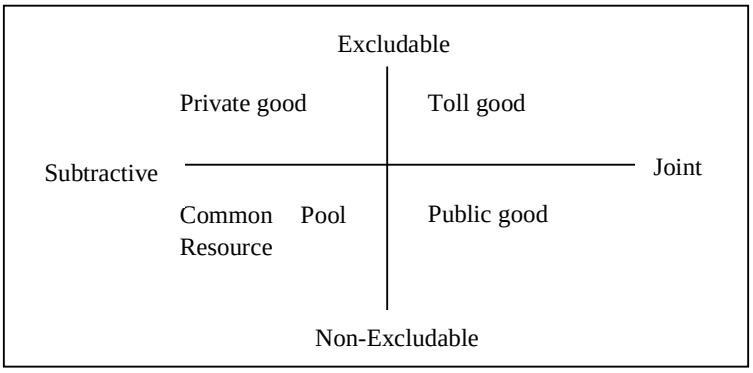

Figure 1: Common pool resources

Because of the fact that common pool resources are subtractive and non-excludable they often face problems of congestion or overuse, called the tragedy of the commons. This term derives originally from a comparison noticed by William Foster Loyed in 1833 and was then popularized and extended by Hardin (1968) with his essay "The Tragedy of the Commons". The tragedy of the commons predicts that free access and unrestricted demand

for a finite common-pool resource would eventually face destruction in the long run, due to collective action problems leading to the over-exploitation of the resource. This occurs because the benefits of exploitation go to individuals or small groups, each of whom is motivated to maximize its use of the resource. The costs of the exploitation are distributed among all those to whom the resource is available, which may be a wider class of individuals than that which is exploiting it (Tietenberg, 2003). For instance, a sea with fish allows for a certain amount of fish to be caught each year without the average fish population being decreased. If no person can be excluded from fishing in the sea, every person will try to maximize his profit, by catching as much fish as possible. This excessive catch causes that the amount of fish in the sea decreases quickly, because there are too little fish left to reproduce themselves till the original level.

1.3 POLICY INSTRUMENTS

The government has the opportunity of using many different policy instruments to achieve their goals, for example in the field of sustainable development by protecting the commons. Van der Doelen and Klok (1989), Bressers et. al., (1990) and de Bruijn and ten Heuvelhof (1991) distinguish three basic types of policy instruments: regulatory, communicative and economic instruments.

Regulatory (or judicial) instruments are based on regulation, which force the parties to act in a certain way. They have been widely used, because the government can set certain goals, which are likely to be achieved. Currently regulatory instruments are losing popularity. The Dutch government would like to stimulate developments without strict regulation, because it can cause a lot of resistance and strategic behaviour. The policy is set by the government and the affected party has no or limited influence, so regulatory instruments are hierarchic instruments. According to de Bruijn and ten Heuvelhof (1991) hierarchic policy instruments are less applicable in networks, where actors are pluriform, closed, interdependent and act in a dynamic environment (de Bruijn et. al., 1995). Hierarchic policy instruments do not contribute to the fact that actors are pluriform, because the regulation is the same for all actors. They might cause resistance of the affected parties, which is not a good development for the government, because the government is dependent on these parties too. Hierarchic policy instruments are not very flexible, so they cannot deal well with dynamic environments and they do not provide incentives for closed actors to cooperate.

Communicative agreements are instruments that focus on communicate information about decision possibilities in order to achieve the desired goal. Communicative agreements make actors voluntarily agree to take action. Examples of voluntary agreements are marketing and informing. They are becoming more popular, because the government would like to influence actors without strict regulation. On the other hand, many scientists have their doubts about the effectiveness of these instruments. According to Bressers et. al. (1990), Tampier (2003) and Rivers and Jaccard (2005) marketing is not an effective policy, because the impact of voluntary programs is very limited. Karimi (2005) agrees, he

states that complete reliance on voluntary programs will not be effective and that voluntary programs must be complemented by regulations.

Economic (also known as market-based or price-based policy instruments) **instruments** are based on economic incentives, although implementing economic instruments also commonly requires some form of regulation. Economic instruments become more popular, because it can be an effective policy instrument that uses price or other economic variables to provide the right incentives. Economic instruments are so called second generation policy instruments, which means that they can deal well with complex situations (de Bruijn et. al., 1991), because they provide incentives, instead of obliging actors to act in a certain way. On the other hand, economic instruments are sometimes not very effective, because it is not sure if and how actors will respond to the incentives. Examples of economic instruments are subsidies and taxes.

Which type of policy instrument is used depends on what and who the government wants to influence, but also on the political conjuncture. A trend worth noting is the fact that for the last two decades 'the market' is the source of inspiration for Dutch governmental policy (Plug et. al., 2003). This so called "new public management" also became more popular in other European countries. Due to the disappointing results of the hierarchic regulating government, the trust in the market mechanism has grown. The force of the market and the 'invisible hand' of price mechanism are seen as the replacement of the visible hand of a hierarchic government policy. This means that the Dutch government is less focussing on regulation, but lets developments be stimulated by the market, so market-based instruments are becoming a popular policy instrument. "More market, less government" was the slogan for cabinet Lubbers in the late eighties that summarises this development (Plug et. al., 2003).

1.4 TRADABLE PERMITS

The principle of tradable permits (also known as marketable or transferable permits) can help the government achieving their goals in the field of sustainable development by coping with the problem of the tragedy of the commons, without strict regulation. Strict regulation is not necessary, because firms can decide themselves how they will comply with the target set by the government. Tradable permits can contribute to sustainable development, because it has a positive influence on the three pillars for sustainable development: economic efficiency, ecological resilience and social justice. Ecological effectiveness is achieved, because every firm will not produce more than allowed according to its amount of permits, so the target set on macro-level will be exactly achieved. Every firm will decide if it complies with the target by choosing the cheapest or most attractive of the following options: buying extra permits or taking reduction measures (contribution to economic efficiency). The goal of social justice is achieved because the polluter-pays-principle is implemented. Polluters are going to pay for the right to produce or emit, instead of having the free benefits of exploitation, while the society as a whole suffers from the negative effects of the exploitation. This means that tradable permits internalize the negative environmental externalities.

The idea of using tradable permits (a market-based instrument) to allocate the rights to produce pollution among firms or individuals was developed by Crocker (1966), Dales (1968) and Montgomery (1972). An important characteristic of tradable permits is the fact that it is an indirect policy instrument. The government does not control directly, but uses the market mechanism to do so (MDW, 2001). The system of tradable permits has two main elements: there is a limit set on the total produced or emitted quantity of a certain product (CO_2, milk, manure) that is to be allowed (the cap) and there is the possibility to trade these rights to produce or emit. The organiser of the trade does not attempt to determine how that total allowed quantity is allocated among individual firms. The only rule is that no firm is allowed to produce or emit beyond that quantity of permits it possesses, which means that any increase in production or emission by a certain producer must be offset by an equivalent decrease elsewhere (Perman et. al., 2003).

The lower the limit, the higher the scarcity of permits, the higher will be the price of the permits. There are three types of limits. A limit can be a natural limit, like the amount of fish in the sea. It can be a technical limit, like the amount of radio-frequencies. Or there could be an established maximum, which is a limit set by the organiser of the trade (the government in most cases) in order to achieve certain policy goals, like a limitation of the emission of carbon dioxide. The total limit is divided into several smaller permits. These permits to use or produce a certain quantity are distributed over the users. Once allocated, the participants can trade these rights amongst themselves.

A tradable permit system is based on two principles. The first principle is that the price to reduce differs between measures, companies and sectors, so every reduction differs in cost-effectiveness. Secondly, the government is not able to know which one of the reduction measures is the most cost-effective, so she cannot force the companies to use the cheapest measure (Bunte, 2007). Within certain boundaries, it is the participants' own responsibility how they comply with the limit. If they need more rights, they can choose between buying extra rights and implementing innovative measures to reduce their production or emission. The supply and the demand of the permits are determined by the difference between the price of the permits plus the costs of the transaction and the marginal abatement costs (the marginal costs to reduce). If the price of a permit minus the costs of the transaction is higher than the costs to reduce, the participant will reduce and sell the rights to produce or emit. The difference between the price of the permit minus the transaction costs and the costs to reduce is the profit for the participant. If the price of a permit minus the transaction costs is lower than the costs to reduce, it will be cheaper for the participant to buy extra permits instead of taking reduction measures.

The 'invisible hand' is thus used to solve the issue of not knowing which reduction measure is most costs effective, because assuming that the participants act fully rational, every individual firm will always choose the cheapest of these two options, which means that reduction measures will be taken at the firms which can implement the cheapest (most cost-effective) reduction measures (contribution to economic efficiency). Where traditional regulations simply require compliance, tradable permits provide an ongoing incentive for technological development and innovation, because a profit can be made from the

sale of the surplus permits, so innovations are rewarded financially. Assuming that every firm will not produce more than it is allowed according to its amount of permits, the target set on macro-level will be exactly achieved (contribution to ecological effectiveness) (Klooster et. al., 2007). In order to make sure that the producers don't produce more than they are allowed, monitoring is essential. Other advantages are that tradable permits will cause less resistance then regulation, because producers can decide themselves how they comply with the limit and that tradable permits might have (relatively) lower costs then direct regulation or price policy (MDW, 2001).

Implementing the system of tradable permits has also some disadvantages. Monitoring the production is necessary, otherwise the system will not be effective. Monitoring can in some case be very difficult, because it will not be easy to measure every individual producer. The total target must be set very precise, if not, the ecological goal will not be achieved. Tradable permits can only achieve an average compliance (macro level) instead of goals on individual level (individual compliance), because the government does not attempt to determine how that total allowed quantity is allocated among the individual firms. If individual compliance is necessary, tradable permits will not be an effective policy instrument (MDW, 2000). This makes tradable permits less suitable for paternalistic policy. Paternalistic policy means that the government has a better insight (or thinks she has a better insight) about the desirability about certain activities than firms or individuals. In that case the government wants to have a direct influence on the undesired activities. Tradable permits are not suitable in that case, because it gives the responsibility to the market, while the government would like to have control. Also, paternalistic policy tries to influence on the individual level, which makes tradable permits not a suitable policy instrument (MDW, 2000). Another disadvantage is that tradable permits might not be successful in every case. The characteristics of the market and the product must make it possible to develop a market.

1.5 Applications of tradable permits

Applications of tradable permits have spread to many different types of resources and many different countries. In the eighties in the European Union the system of tradable milk quota was implemented in order to limit the amount of milk produced. Later on the manure quota and fish-quota were implemented, which decreased the production of manure and the amount of caught fish. These three systems still exist in the European Union. Recently, the European Union has also started an emissions trading system in order to reduce CO_2 emissions, to meet the targets in the Kyoto protocol. The Netherlands have also implemented a system of tradable permits for NO_x-emissions, which started at June 1st, 2005 (Ministerie van VROM, 2008). In the Unites States permit trading systems have been introduced for different types of air pollutants. Possible situations in which the system of tradable permits is or can be applied can be found in appendix A.

The interest in the application of tradable permits in new cases is growing. The government is considering to implement tradable permits to solve common pool problems and other issues, like the limitation of the number of new business areas build (Wesselink,

2007), to limit the number of new buildings build in rural areas, by implementing tradable development rights in the province of Limburg, the Netherlands (Bruil et. al, 2004) and improving the water quality (Klooster, et. al., 2007). Also the introduction of the carbon dioxide trade in the agricultural (Brouwer et. al., 2001) and transportation sector (Volkskrant, 2008d) is considered.

Because of the growing interest, it is important to know under which conditions tradable permits would be a successful policy instrument, because in some cases other policy instruments (like subsidies, fines or regulations) might be even more applicable. Some attempts to introduce tradable permits have been very successful, for example the introduction of the European fish quota and milk quota. On the other hand, historical record performed by Tietenberg (2003) shows that not every attempt to introduce tradable permits has been successful. In air-pollution control attempts to establish a tradable-permits approach have failed in Poland (Zylicz, 1999) and Germany (Scharer, 1999). The initial attempts to introduce a sulphur-dioxide (SO_2) trading system also failed in the United Kingdom (Sorrell, 1999). Programmes in water-pollution control have generally not been very successful (Hahn and Hester, 1989).

1.6 RESEARCH PROBLEM

The previous paragraph has showed that not every attempt to implement tradable permits has been successful: the characteristics of the product and the market must make it possible that a market comes into existence. These characteristics are general, design-independent aspects of permit trading systems and are thus relevant for any trading system to be introduced.

It would thus be interesting if policy-makers are able to assess if tradable permits have a high or a low potential of being successful in a specific case before the implementation starts. This analysis can support the decision-making process about whether or not implementing tradable permits in that case. There are different criteria to judge whether a policy instrument is successful or not. For example Bressers et. al. (1990) distinguish attainability, feasibility and effectiveness. In this research a policy instrument will be considered successful if it contributes to sustainable development, thus if it contributes to economic efficiency, ecological effectiveness and social justice.

An analytical framework to explore ex ante which characteristics have to be considered, can support the decision-making process when the government considers to implement a system of tradable permits in a specific case, by investigating if tradable permits have potential to contribute to ecological effectiveness, economic efficiency and social justice in that case or not.

Not only the characteristics of the market and the product influence the potential economic efficiency, ecological effectiveness and social justice of a tradable permit system, but also the design of the system of tradable permits (the design choices) does. There are many different possibilities to design a system of tradable permits, each contributing differently to

economic efficiency, ecological effectiveness and social justice. Therefore, the consequences of each design choice should be investigated, which can support the decision-making about the design of the system of tradable permits.

1.7 RESEARCH GOAL AND RESEARCH QUESTIONS

The main objective of this research is to design a framework for the ex ante assessment of the potential contribution to sustainable development (and thus successfulness) of tradable permits. This framework can support the decision-making process about whether or not implementing tradable permits in a specific case. The evaluation framework is based on the characteristics of the market and the product, which give a description of the sector where tradable permits are considered to be implemented. An analysis of economic efficiency, ecological effectiveness and social justice will help to distinguish these characteristics. Also the different possibilities to design a system of tradable permits will be analysed to investigate how each design choice contributes to economic efficiency, ecological effectiveness and social justice.

Based on this the research question which will be answered in this thesis, is the following:

What does an ex ante evaluation framework to assess the potential contribution to sustainable development of the implementation of tradable permits in a new case look like?

In order to answer this question, a couple of sub-questions should be answered first:

- Which design choices exist when implementing tradable permits and how do these design choices contribute to economic efficiency, ecological effectiveness and social justice?
- Which characteristics of the market and the product have a positive impact on economic efficiency, ecological effectiveness and social justice?
- What does empirical analysis tell about which factors are important for the implementation of tradable permits?
- What does a framework for ex ante evaluation of tradable permits look like?
- What does the framework tell about the potential contribution to sustainable development of tradable permits for business area permits and water quality permits?

1.8 METHODOLOGY AND SCOPE

Various research methods are used to investigate which conditions and choices influence the contribution to sustainable development (and thus to a successful implementation) of tradable permits in new cases. This report can be divided into two sections. The first section focuses on theory. A conceptual analysis of tradable permits is performed, which finishes with an overview of the characteristics that influence the contribution to sustainable development of a tradable permit system and an overview of the consequences of the various design choices. The second section focuses on practice. First an empirical analysis of

two cases is performed, which might provide new insights for the framework. Then the framework is designed and used to assess the potential contribution to sustainable development of tradable permits in two new cases. The last steps are the conclusions and recommendations.

Section one: Theory
A literature study is the basis for the conceptual analysis of this thesis. For this literature study books and journals of various authors are studied. The literature is selected as follows: first an overview has been made of the most dominant authors in the field of tradable permits during the last 15 years. Then various works of these authors have been studied. The next step was to search for interesting references in their works, which have been studies as well. This step has been repeated several times, to make sure that the literature study has been as complete as possible. In order to find some relevant examples, which are useful to further explain the described theory, some ex post evaluation reports of tradable permits have been studied. Finally, the conceptual analysis is discussed with various experts (see for an overview Appendix B) to collect extra information and new insights.

The first step of the conceptual analysis is the investigation of the basic conditions, which are conditions that are necessary to develop a market. The next step is a literature study about the possible design of a tradable permit system (the design choices).

Then each of the criteria for successful policy (economic efficiency, ecological effectiveness and social justice) are analysed to see which characteristics of the market and the product positively influence these criteria. These characteristics are the basis for the evaluation framework. Also the impact of the different design choices on the criteria is investigated, which is the basis for the decision-making about the design of the tradable permits system. Each criterion is analysed in a separate chapter, so the analysis has a single-dimensional point of view.

Section two: Practice
In the second part some current experiences with implementation of tradable permits are investigated (empirical analysis). This analysis provides probably new insights for the framework, like other factors that also influence the successfulness of a tradable permit system. The empirical analysis is performed by a literature analysis of ex-ante and ex-post evaluation reports and interviews with experts (see for an overview Appendix B). The cases that are analysed are milk quota and carbon dioxide emission trading. Carbon dioxide emission trading is chosen, because this trading system is recently implemented. This makes it easier to find experts to be interviewed and a lot of information about the implementation process is available. A disadvantage of the analysis of carbon dioxide emission trading is that the effects of the trade are not visible yet. Therefore the system of milk quota will be analysed; this system was implemented 25 years ago, so the consequences of the implementation are clear. On the other hand it will be more difficult to find information about the implementation process, so this information will not be complete. The following questions are answered to analyse these cases:

- *How are the basic conditions (buyers and sellers, an incentive to trade and a tradable product) fulfilled?*
- *What are the characteristics of the market and the product and how is dealt with the imperfections?*
- *What did the decision-making process look like?*
- *Which design choices have been made and why?*
- *What were the consequences of the implementation of tradable permits: was the implementation a success or not?*
- *What are the lessons for further analyses or for future cases?*

The next step is to construct the ex ante evaluation framework, based on the characteristics found in section one and the insights of the empirical analyses. This framework provides a guideline to assess the potential successfulness of a new case where tradable permits are considered to be implemented and it can support the government to decide about whether or not implementing tradable permits in a specific case.

The evaluation framework is used to assess the potential successfulness of tradable permits in two new cases. First is chosen to apply the framework on tradable business area permits. This case is chosen, because the Dutch Minister of Environment has already shown her interest in the possibilities of tradable business area permits, while there is no experience with this application of tradable permits in any other country. So, the government has no idea if tradable business area permits have potential to become successful. Secondly is chosen to apply the framework on tradable water quality permits. This case is chosen, because the Dutch Ministry of Transportation and Water-management has also shown her interest. There are some studies which are positive about the implementation of tradable water quality permits in the Netherlands, while tradable permits to control the water-pollution have generally not been very successful in other countries (Hahn and Hester, 1989).

Finally some conclusions and recommendations for the government and for further research are formulated.

Previous research

Many studies about tradable permits have been performed and also ex ante evaluation methods exist. Sorrel and Skea (1999) and MDW (2001) come up with a list of criteria when emission trading is most likely to be successful ('when choosing to implement tradable permits') and a list of key choices for policy design ('what are the building blocks for creating tradable permits'). MDW's study is relevant for any trading system to be introduced, while Sorrel and Skea's list is relevant for emission trading only. Van Der Kolk Advies et. al. (2006) have performed an ex ante evaluation of the NO_x emission trade, where they focus on juridical aspects, possible effects, costs and benefits. However, this ex ante evaluation is very product specific and is not usable for other applications. The study does not consider the design choices and the fact if the market and the product of NO_x would be suitable for the implementation of tradable permits.

What makes this research different is the fact that those researches focus mostly on feasibility and efficiency, while this research will also consider the other two pillars of sustainable development (ecological effectiveness and social justice) as well. Another difference is that Sorrel and Skea (1999) and MDW (2001) do hardly consider the consequences of the possible ways to implement tradable permits (the design choices), while this study will.

Scope
The framework, which will be developed to assess whether tradable permits are a suitable instrument to apply on a certain case or not, will be based on the insights from the three perspectives of sustainable development: economic efficiency, ecological effectiveness and social justice. The attainability and feasibility of the implementation of tradable permits will not be taken into account in this research. Also very little attention is paid to the juridical implications of the implementation of tradable permits in a new case.

1.9 OUTLINE OF THIS THESIS

This thesis consists of eight chapters. In chapter two some practical issues are discussed and the design choices of tradable permits are discussed in detail (question one). Then each of the chapters three, four and five deals with one of the criteria for successful policy: economic efficiency, ecological effectiveness and social justice. In these chapters both the impact of the design choices on the successfulness (question one) and the characteristics that positively influence the successfulness (question two) are discussed. In chapter six the practical side of tradable permits is analysed, by performing an empirical study to analyse the success and fail factors of attempts to implement tradable permits. This analysis might provide new insights for the design of the framework for answering question number four (chapter seven). In the same chapter the framework is used to analyse whether tradable permits can be applied successfully in two new cases, tradable business area permits and water permits (question five). Finally chapter eight provides conclusions and recommendations. This structure is shown in figure 2 on the next page.

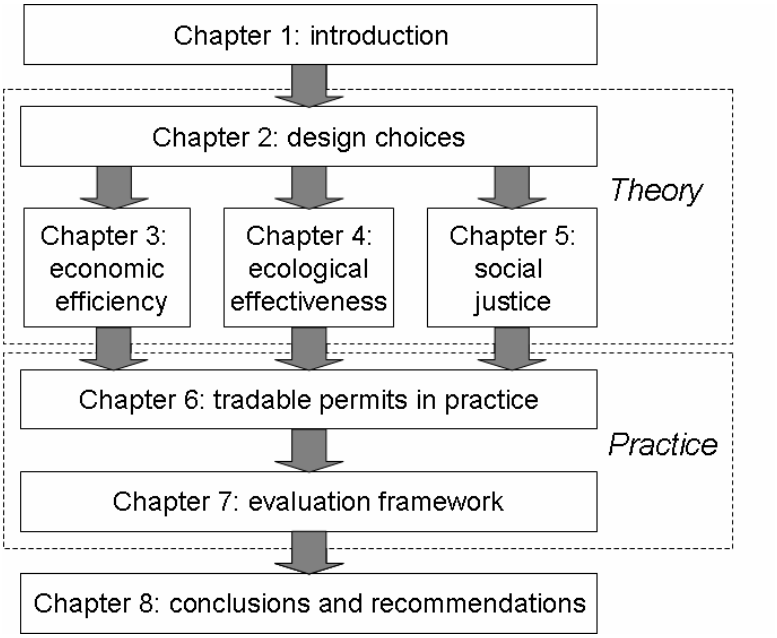

Figure 2: Thesis structure

2. DESIGN CHOICES

When implementing tradable permits the first step before the trade can start is to make sure that several practical conditions (the basic conditions), in order to develop a market, will be met. These issues are relevant for all types of permit trading systems, so they are design-independent. The basic conditions are discussed in paragraph one.

The next step before the trade can start is to design the system of tradable permits, because there are different options for implementing a system of tradable permits (the design choices). This chapter investigates, in a descriptive way, all design choices: the different options for the trading system, the level of permits, the allocation of permits, the possibility to bank or borrow, the monitoring and sanctioning system, the lifetime and the institutional structure (paragraph two till eight). Paragraph nine provides conclusions for further analyses.

2.1 BASIC CONDITIONS

The first step before the trade can start is to make sure that the basic conditions for a trading market are fulfilled, which are necessary conditions in order to develop a market. This means there should be buyers and sellers, a tradable product and an incentive for the buyers and sellers to trade that product.

The first condition is met when there are potential buyers and sellers, which will be the firms that currently produce or emit. In some cases not all producing or emitting companies will join the trade, when some companies will receive a dispensation. The fact that there should be buyers and sellers is a basic condition, but how many and which companies will join the trade is a design choice and will be discussed later on.

Secondly, the tradability of the product should be written down in regulation. To do so, the current policy should be taken into account and if necessary adjusted. In order to develop a market the permits should be suitable for transfer to others (the permit should be tradable). For example in the Netherlands, according to article 3:83(3) BW tradability of 'other rights' than ownership, limited rights and claim rights' is excluded, unless the legislation does allow tradability (MDW, 2000). Also permits which are associated to a person (like certificates) are not transferable to other persons and permits which are associated to a case, (like a building permit) can in the Netherlands not be transferred without the case (MDW, 2001). If the permits are not tradable according to the Dutch legislation, this should be adjusted. Also essential for a tradable product is that a tradable unit is defined to make the emission or production measurable and unambiguous, which is not always easy to do. Examples of current tradable units are kg of milk, kg of fish, tons of carbon dioxide or grams of NO_x per tons of production.

Thirdly, the incentive to trade should be provided by a scarcity of permits, because a market does not function without a price and a price does not function without a scarcity.

Therefore, the total number of allocated permits should be smaller than the expected emission level or production level (DHV et. al., 2007). Without a scarcity of permits no price for the permits will come into existence and then the participants will not have an incentive to trade (Commissie CO_2-handel, 2002). The fact that there should be a scarcity of permits is a basic condition, but the definition of the exact level of permits is a design choice and will be discussed later on. Also sufficient technological measures should be available for the participants in the near future to reduce their production or emissions (Commissie CO_2-handel, 2002; Klooster, et. al., 2007), because without innovation hardly any trading will take place. A market might be very static, because the participants might have taken reduction measures recently. If there are little possibilities for innovation measures available, the government can try to stimulate research and development by extra subsidies.

2.2 TRADING SYSTEM

Before the trading can start the trading system must be defined. There are two different systems for trading the permits: cap-and-trade and tradable reductions.

The cap and trade approach is, also internationally, the most common approach for tradable permits. For example, it is used for milk quota, manure quota and CO_2-emissions trading. This approach means that an aggregate target (the cap) for the total amount of production or emission, which is allowed by all producers, is set by the government. This cap is then divided to all individual producers, where the total amount of these individual limits is equal to the target level. The producers are allowed to trade amongst themselves to determine which producer actually emits the total pollution load. If the individual production is above the individual limit, reduction or buying extra credits is necessary. If every producer does not produce more than he is allowed to, the total produced or emitted amount will never exceed the cap.

The tradable reduction approach is based on a baseline for companies. The baseline can be set collectively ('Performance standard based trading') or individually ('Baseline-and-credit trading') (Eco-consult, 2001). The system for NO_x-emission is an example of tradable reduction. The baseline gives a maximum for the emission or production per unit activity (like production volume, added value or the amount of energy used). For example the NO_x-emission rate is expressed in grams NO_x-emission per gigajoule (GJ) or per tons product. Thus, the total amount of production or emission depends on the baseline and the level of activity, which implies that it has a relative cap. If a participant has a NO_x-emission rate lower than the performance rate (or reduces the rate by taking innovation measures), the participant can sell those permits. In a tradable reductions market an active initial allocation of permits is not necessary, because the initial allocation is determined by the performance standard rate in relation to the current performances of the companies.

The choice for a tradable reductions or a cap and trade approach depends on the goal to be achieved by tradable permits. It is not the case that one of the methods is more applicable in case of a certain product or method.

2.3 LEVEL OF PERMITS

After the choice of a trading system, the government must set the baseline or the aggregate target. Setting the optimal target can be very difficult, but also very important for the successfulness of the trade. The level of permits can be a necessary (technical or natural) or a desired (established) target. In case of a necessary technical target (for example the amount of radio-frequencies), the definition of the target is very unambiguous, because the limit simply cannot be exceeded. The definition of a necessary natural target (for example the amount of fish which is allowed to be caught) and the definition of an established target (like the limitation of the emission of carbon dioxide) is often more difficult and ambiguous. The definition can be based on ecological resilience or on neoclassical economics, but measurement and information problems make it complex to define the optimal level of permits. Often the actors do not agree about the information provided as the basis for setting the target (the information is contested, see paragraph 6.4) or several researches (for example about the current level of fish in the sea) contradict. Therefore the definition of the level of permits is often a political choice.

2.4 INITIAL ALLOCATION

In case of a tradable reductions market with a collective target (performance standard based trading) an active initial allocation of permits is not necessary, because the initial allocation is determined by the performance standard rate and is equal for all participants. In case of a cap and trade approach or a tradable reductions market with an individual target (baseline-and-credit trading) the permits must be allocated to the participating companies, which is perhaps the most controversial aspect of a tradable-permits system. There are four possible methods for allocating initial entitlements. The first two, random access (lotteries) and first come - first served are social justified, but they will not be taken into account: they are not common for allocating tradable permits and they do not contribute to ecological effectiveness and economic efficiency, because they do not provide in immediate incentive to innovate and the government has no control over the distribution. The other two methods are the most common for allocating tradable permits, auctioning and allocation based upon eligibility criteria (Tietenberg, 2003). Auctioning (also known as the primary market) means that the permits are sold to the actor with the highest bid. Allocation based on several criteria is known as ‘grandfathering’. The government could allocate permits on the basis of past usage, some measure of output, existing regulatory requirements or to politically favoured groups. Especially allocation based on historic use is very common, for example milk-quota and the carbon dioxide are allocated with this method.

2.5 TYPE OF PERMITS

Either stock or flow permits can be allocated. A flow permit refers to a rate measure, where the time is explicit (e.g. tons/year) or to a concentration measure where the time dimension is incorporated in the averaging period (e.g. hourly average). These permits may be valid for a finite period of time, where the right of use expires at the end of a cer-

tain period, or indefinite, where no termination date is defined (Sorrel and Skea, 1999). If a participant sells some of his permits, the buyer will receive the right to produce or emit that certain amount per year during the lifetime of the permits. If a participant has a surplus of permits, but thinks he needs all his permits next year, he can offer his permits for lease to other participants.

Alternatively, a stock permits refers to total quantities (e.g. tons of production or emission). The participant could be allocated a certain amount of permits each time period, with each permit worth a certain amount of production or emission. Every time period, the participants will receive new permits. The key difference between the two types is that stock permits are used up as they are applied to a certain quantity of production or emissions, while flow permits are not. Stock permits will deplete unless they are renewed periodically, while flow permits will not (Sorrel and Skea, 1999).

2.6 BANKING AND BORROWING

Also a decision must be made about allowing the participants to bank and/or borrow or not. Banking means allowing participants to save permits for use or sale in subsequent years. In case of banking the flexibility of the system will be higher and participants can implement a long-term strategy. For the participants a risk of banking might be the fact that the government will lower the amount of permits. For example under the Acid Rain Program (US program to control sulphur dioxide emissions from power station), unused permits may be banked for use in subsequent years, thereby giving an extra dimension of flexibility (Sorrel and Skea, 1999).

The allowance to borrow means that the actors can borrow permits from subsequent usage. If a participant knows that he will use less permits than his cap next year, he can use borrowing to use those permits this year (Sorrel and Skea, 1999). If borrowing is allowed, a maximum level of borrowed permits or a maximal duration can be set.

2.7 MONITORING AND SANCTIONING

In order to make sure that the producers don't produce more than they are allowed, monitoring and sanctioning is essential. Only effective compliance rules can guarantee the effectiveness and efficiency of the system. However, a trade-off may be necessary between the effectiveness of enforcement and its costs. There are many different design choices to be made when implementing a monitoring and sanctioning system. How to monitor will often depend on the product or emission. The first design choice to be made is if only the participants of the trade will be monitored, or if non-participating companies will be monitored as well. Secondly, the level of sanctions for non-compliance must be defined. Lastly, the sanctions can be given to individual participants or to a bigger group.

2.8 INSTITUTIONAL STRUCTURE

Complex systems, like tradable permits, need an institutional structure that coordinates the positions, relations and behaviour of the parties who operate within the system and are owner of it (Koppenjan and Groenewegen J., 2005). About the definition of institutionalisation is little consensus within the scientific community. Goodin (1996) defines it as the process through which organisations and procedures acquire value and stability. Institutions can be defined as structures and mechanisms of a social order which steer behaviour within a society.

Before the permit trading can start, first the parties who join the trading program must be defined (definition of the boundaries). Ostrom (1990) mentions that 'individuals or households who have the right to withdraw resource units from the common pool resource must be clearly defined, as must the boundaries of the common pool resource itself'. The European carbon dioxide trading system covers only the heavy industry and not all emitting parties.

Also there should be decided if third parties are allowed to step into the market. In principle, emission trading can operate on the basis of bilateral agreements between individual participants. However, if third parties are allowed to enter the market this will result in a much richer set of institutional arrangements and actors. Other parties might step into the tradable permit market, because they see a possibility to make profit by buying and selling permits. These include: brokers (identifying and arrange possible trades), auction houses (dealing with both publicly distributed permits and those offered for sale privately), future markets (lowering risks by creating stability over time) private equity companies, intermediates, speculators, re-bundling companies and lease companies. Also environmental groups might purchase permits (Sorrel and Skea, 1999). In the Dutch CO_2 trade, third parties are allowed to buy permits, while in the NO_x trade, only the emitting participants are allowed to buy permits (Ministerie van VROM, 2008).

The third institutional issue to be defined is which authorities will be appointed to organise the trade. According to MDW (2001) and Brouwer et. al. (2001) a registration and controlling organisation (central administration) should be appointed, which will be responsible for distribution, registration in case of trade, control and recall of permits. In practise this means that this organisation will register many transactions. This supervising authority can be a ministry, agency or independent policy institute. An example of a new authority in the field of tradable permits is the NEA, the Netherlands Emission Authority, which regulates and controls the Dutch carbon dioxide and NO_x trade (NEA, 2008). Secondly, Ostrom (1990) suggests that trading partners and their officials should have rapid access to low costs arenas to resolve conflicts. An independent conflict authority can be appointed in order to deal with the parties' conflicts.

If the government appoints many parties who join the trading program, allows third parties to enter the trade and appoints and independent authority, the government should be aware that the institutional structure of the tradable permit market will change. It will result in a much richer set of institutional arrangements and actors, so the government will probably

have less overview and thus less influence on the market and the participants (according to Mark van Twist, Berenschot).

2.9 CONCLUSIONS FOR FURTHER ANALYSES

Before starting the trade the following basic conditions need to be taken care of: there should be buyers and sellers, a scarcity of permits, sufficient innovation measures, the permits should be tradable and a tradable unit should be defined.

The next step before the trade can start is to make the following design choices:

- Trading system: tradable reductions or cap and trade;
- Level of permits: definition of aggregate cap or standard performance rate;
- Initial allocation: auctioning or grandfathering;
- Lifetime of the permits: stock or flow (for a finite or infinite period) permits;
- Banking and borrowing: to allow or not allow banking and/or borrowing;
- Monitoring: to monitor participants only or third parties too;
- Sanctioning: collective or individual sanctioning and what will be the level of sanctions;
- Institutional structure: to allow third parties to enter or not, how many parties join the trade (define boundaries) and define which authorities need to be appointed.

If the basic conditions are fulfilled, all trading rules are defined, the institutions are appointed and every participant has received the initial permits, the trade can start.

Each choice has its advantages and disadvantages and contributes differently to ecological effectiveness, social justice and/or the economic efficiency and thus to the chance of a successful implementation of tradable permits. This will be explained in the coming three chapters, from a single-dimensional and theoretical point of view. This analysis can support the decision-making about the design choices.

3. ECONOMIC EFFICIENCY

This chapter will discuss the first criterion to determine whether a policy instrument will have potential to be successful or not: economic efficiency. The assumption of an efficient market is known from the **Neoclassical Economics** school of thought, which assumes that actors are substantive rational and able to calculate ex ante optimal positions. Neoclassical economics assumes potentially efficient markets and, consequently, a role for government to intervene only in cases of market failures and market imperfections (public goods, natural monopolies and externalities). Neoclassical economics assumes that markets function perfectly; the signalling function of prices is not disturbed and no transaction costs exist (Groenewegen, 2001; Groenewegen and Correljé, 2007).

However, in the world of **New Institutional Economics** (the second economic school of thought) actors are considered to be bounded in their rationality, because the environment prevents them from doing so. New institutional economics attempts to extend economics by focusing on the social and legal norms and rules that underlie economic activity. In the world of new institutional economics, Transaction Cost Economics can be considered the core, because transaction costs can prevent actors to internalize the externalities, which calls for government intervention. The government should only act when the social benefits of intervention are higher than social costs (Groenewegen and Correljé, 2007). Important new institutional economists are Williamson and Ostrom.

Neoclassical and new institutional economics can be labelled as “mainstream economics”. Both approaches are based on an individualistic, utilitarian conceptualization of the actors (Groenewegen, 2001; Groenewegen and Correljé, 2007). Neoclassical economics and new institutional economics are the basis for this and the next two chapters.

In the first four paragraphs several theories help to distinguish the characteristics that influence the economic efficiency. According to neoclassical economics a market will be more efficient in case of a perfect competition, which is discussed in paragraph one. In order to judge the economic efficiency the following economic criteria can be distinguished: cost-effectiveness, dynamic incentives and the level of transaction costs (Keudel, 2007). These aspects are discussed in paragraphs two, three, and four. The effects of the design choices on economic efficiency are discussed in paragraph five. Finally paragraph six provides the conclusions for further analyses.

3.1 PERFECT COMPETITION

It is important for the efficiency of tradable permits that the market suffices the characteristics of a perfect competition. Perfect competition is a market in which no producer or consumer has the power to influence prices and would lead to a completely efficient outcome. The theoretical model of perfect competition has the following assumptions (Plug, et. al., 2003):

In order to start the trading between the different participants there should be sufficient participants (Klooster, 2007). The market should be an atomistic market, which is a market in which there are a large number of small producers and consumers on a given market, each so small that its actions have no significant impact on others. In case of an atomistic market, firms are price takers, meaning that the market sets the price that they must choose (each individual producer or client has no deciding influence on the price of the product). Many buyers and sellers will prevent that one party has market power. If one firm has market power, it can prevent the trading system from coming to the least-cost solution (Hahn, 1984). Concentrations of permits at one source and/or price fixing agreements between sources will lower the efficiency of the market because it lowers the number of potential trading partners for some sources. Individual buyers and sellers must act independently, in order to prevent groups of buyers and/or sellers coming together with a view to changing the market price (collusion or cartels). European competition law forbids this, but monitoring and sanctioning on this point is necessary.

The second assumption is that every company should have free and immediate entry- and exit possibilities, without high costs. These rules make sure that every company who wishes to enter or exit the tradable permit market, can do so. High barriers for firms to enter a market are for example investment costs and advertising costs. High barriers for firms to exit a market include high asset specific investments, which are investments (like factories, fishing boats) that are very specific to a particular situation and cannot be redeployed for another situation. For instance, permits for radio-frequencies are tradable (Ministerie van Economische Zaken, 2005), but trading of the permits hardly takes place, because it is very difficult to enter and exit the market for radio making, which hampers the trade. The investment costs are very high and specific for radio making. The investment costs are not only the costs for a radio studio, but more important are all costs of building the name of the radio channel, by previous marketing campaigns.

Thirdly, each producer or client should have perfect and complete information: all relevant information about the market and the product, like price, availability and quality of a product or service must be immediately and easily accessible for everyone, without high costs. This is necessary information for the participants of the trade, when they are deciding if they will buy or sell their permits.

In practice not every assumption will be fulfilled. The ideal situation of perfect competition will barely or never be reality. Often the power between sellers is divided unequally and a small group of producers has market power and at most markets there is information-asymmetry between buyers and sellers. These factors block the ideal situation of the perfect market (Plug, et. al., 2003). The government must try to achieve these principles as much as possible. Sometimes, she can influence them by taking extra measures or by choosing a certain allocation or trading method.

3.2 COST-EFFECTIVENESS

The next criterion to judge the economic efficiency of a tradable permit market is the cost-effectiveness. Cost-effectiveness requires that a predetermined ecological objective will be achieved at least cost.

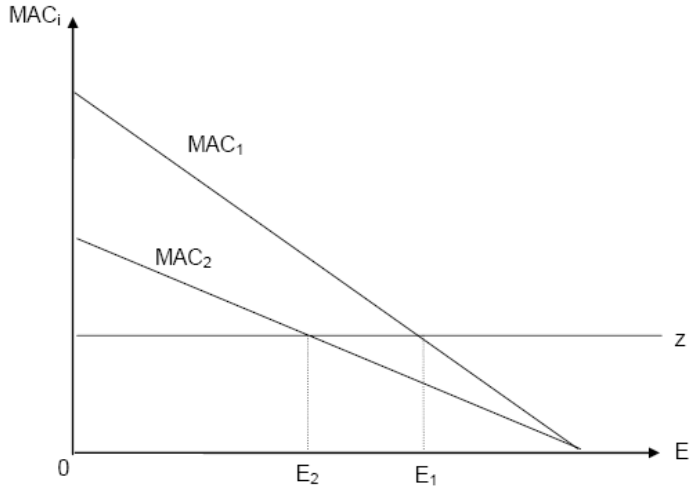

Figure 3: Cost-effectiveness (Keudel, 2007)

Figure 3 shows that in theory a permit trading system automatically guarantees cost-effectiveness, in case of a scarcity of permits. Each participant compares his marginal abatement costs ($MAC_{1,2}$) and the permit price (z). In order to make sure that the firms know the current permit price, a transparent market (perfect and complete information for everyone) is necessary. As long as the permit price exceeds the marginal abatement costs, the emitter would abate emissions. If the marginal abatement costs exceed the permit price, the emitter would cover his emissions with permits which he will purchase on the market. The emitter thus produces quantity E at the point where MAC = z. This is true for all emitters, thus all emitters will produce with MAC = z. The reduction measures will differ in cost-efficiency so the marginal abatement costs will differ for each participant. Each participant makes an individual decision about whether to purchase permits, or to abate and sell permits, so the absolute levels of emissions are different for all participants. The achievement of the predetermined objectives is obligatory, so each source compares the individual abatement costs and the available price for permits and makes an autonomous decision regarding implemented measures (Keudel, 2007).

Tradable permits can be more cost-effective than other policy instruments, if there are differences in the cost-effectiveness between the reduction measures of the participants of the trade. If the differences of the marginal abatement costs are small, no advantage will be achieved compared with other policy instruments (Commissie CO_2-handel, 2002).

3.3 DYNAMIC EFFICIENCY

A crucial economic concern is whether tradable permits provide an incentive for participants to install newer and better (meaning less polluting) technologies (dynamic efficiency). The incentive to invest in new technologies can be characterised by the cost savings resulting for innovative participants. Reductions lead to a surplus of permits; these can be sold on the market and thus overcompensate the expenses for the abatement technology. But this will only work in case of a growing scarcity of permits on the market, because otherwise there is no necessity for the firms to invest in innovation. In case of a very static market (for example because the participants might have taken reduction measures recently) the only option to achieve the target would be to decrease the production, which can be very undesirable. Another influencing factor is the number of buyers and sellers joining the trade. If more firms join the trade, more firms have the possibility to innovate, so the higher will be the dynamic efficiency.

The advantage of innovation is illustrated in figure 4 below. The new technology reduces the marginal abatement costs of the concerned source (shift from MAC_0 to MAC_1). Again, the emitter compares the permit price Z_0 with the *MAC* and produces at the point where M*AC* = Z_0. Before the technical innovation, the emitter holds permits for the emissions from 0 to *E* ' (point *B*). The innovation results in lower MAC_1. The same emission level *E* ' is achieved at lower abatement costs (cost savings = *ABC*). And the participant has an incentive to abate more, because the equivalent of the permit price Z_0 and the MAC_1 is realised at point *D*. The surplus of permits (*E* '' to *E* ') can be sold on the market. The financial benefit gained by selling surplus permits (*E* ''*DBE* ') is higher than the additional abatement costs (*E* ''*DCE* ') by *DBC*. The total incentive to abate is thus indicated by *ABC* + *DBC* = *DBA* (Keudel, 2007).

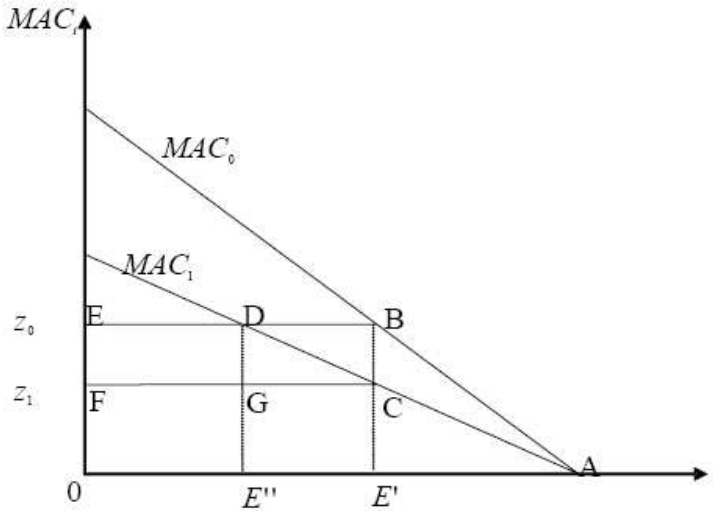

Figure 4: Dynamic efficiency (Keudel, 2007)

If all participants adopt new technologies, the demand for additional permits and thus the price Z_0 may decrease (Z_1) as the supply increases. This would result in a lower, but still

positive, incentive to invest in new technologies. If the number of emitters is high, the innovation of a 'small' emitter would not influence the price noticeable. Additionally, this effect might be lowered or even overcompensated by the effects of economic growth or of an increasing number in emitters. Finally, the total amount of permits and thus the amount of discharges may be decreasing over time as a result of political or ecological reasons. In the long term, this would also create the incentive to innovate as a result of higher prices (Keudel, 2007).

The Dutch dairy market is an example of a dynamic efficient market, because many reduction measures have been taken since the introduction of milk quota in the Netherlands in the 1980's. The target level of 10 percent lower than the previous year was achieved and a lot of trading took place between the milk producers. The number of dairy farms has more than halved, the average production per cow has doubled from 4000 kg to 8000 kg per year and the average production has doubled to an average of 398600 litres of milk per farm per year (Agricultural Economics Research Institute, 2002; Centraal Bureau voor de Statistiek, 2000).

3.4 TRANSACTION COSTS

Transaction costs, as initially explained by Coase (1937), are the margin between the buying and selling price of a commodity in a given market, for both the participants of the trade and the government. So, transaction costs include the costs for the trading, but also the costs for the installation and the maintaining of the trading system (Commissie CO_2-handel, 2002). Three potential sources of transaction costs can be identified in the tradable permit markets. First there are costs for search and information, because potential buyers and sellers need to find each other. Secondly there are costs for bargaining and decision-making, which are made during the negotiations, like broker- or insurance costs. Thirdly there will be costs for monitoring and enforcement, which will be paid by the government instead of the negotiators (Stavins, 1995).

The level of transaction costs depends on the size of the market. If the market is small and the trade is limited, the transaction costs can be large. If the market is large and a lot of trading takes place, the transaction costs will be relatively small (Commissie CO_2-handel, 2002).

Thus the specific design of the trading system, influences the level and structure of transaction costs (Keudel, 2007), while the level and structure of transaction costs, in turn, influence the general functioning and the efficiency of a permit trading system. Stavins (1995) investigated the effects of transaction costs on the performance of markets. He concludes that that low or even zero trading activities in permit trading systems are, in most cases caused by too high transaction costs, so the level of transaction costs hampers permit trading activities and thus the efficiency of a tradable permit market. The lower the transaction costs, the more efficient will be the market.

3.5 DESIGN CHOICES

In this paragraph the influence of the design choices on the economic efficiency will be analysed. Only the influence on economic efficiency will be analysed: ecological effectiveness and social justice will not be taken into account.

Choice of a trading system
If the government chooses for a tradable reductions approach everyone can operate on the market, as long as a participant does not exceed the performance standard rate. A system of tradable reductions can deal well with a growing market; companies who perform according to the performance standard rate can expand their production, without buying extra permits.

Entering a tradable reduction market is easier then entering a cap and trade market, because in the last case the entering party is dependent on buying new rights from other parties. Another difference is that the government can easily make the performance standard rate stricter if necessary, so there is no necessity for the government to buy the permits (Brouwer et. al., 2001).

Level of permits
A scarcity of permits does positively influence the cost-effectiveness and the dynamic efficiency of a sector, because it stimulates innovation. One of the reasons why sulphur trading failed in the UK was that the target defined by the government was set too low. It would be met without extra measures anyway, so the participants had no incentive to innovate (Skea, 1999). However, a very strict target might hamper the economic development of a sector, so is not very desirable either.

According to neoclassical economics the optimal level of permits should be defined as follows: the optimal level of emission or production is attained when the marginal environmental damages (*MD*) of the pollution equal the marginal abatement costs (*MAC*), both depending on the emission or production level *E*. At this point, the sum of damage costs and abatement costs is at the minimum (*E* *). The total amount of permits issued should be equal to the target level, in order to achieve the ecological target, which is shown in figure 5 on the next page (Keudel, 2007).

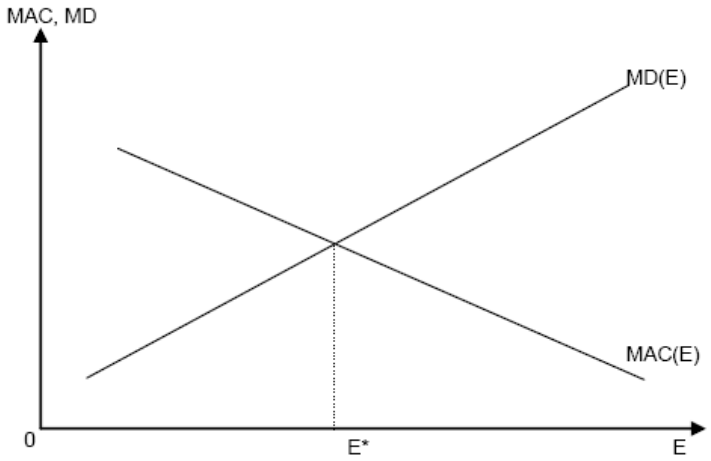

Figure 5: Optimal level of permits (Keudel, 2007)

However, in reality it is very complex to determine the optimal level of targets using this method. It is very complex to determine exactly the marginal damages and the marginal abatement costs curve, due to measurement and information problems. The theory also assumes these optima to be static, while in reality they are dynamic. Technological progress, for example, can change the conditions and the marginal cost curves (Keudel, 2007).

Initial allocation

Auctioning contributes to cost-effectiveness, because the firms, who have the highest reduction costs, are willing to pay the highest prices for the rights to produce (Cramtona et. al., 2002; MDW, 2001; Tietenberg, 2003). On the other hand, in case of auctioning big and rich firms might buy all the permits. This will lower the number of buyers and sellers, which makes the market less efficient (see paragraph 3.1).

A problem of grandfathering based on historic usage is that it may penalize participants that have taken reduction measures in the past. Therefore grandfathering based on historic usage may promote inefficient behaviour. When the initial allocation is based upon historic use and users are aware of this aspect in advance, an incentive to inflate historic use (to qualify for a larger initial allocation) is created (Berland et. al., 2001), so firms can show strategic behaviour. On the other hand is expected that the administrative costs for grandfathering method will be lower.

Type of permits

Stock permits are allocated for each time period, so the lifetime of stock permits is often short. The lifetime of flow permits can be finite, where the right of use expires at the end of a certain (short or long) period, or indefinite, where no termination date is defined. A stable policy environment is necessary for the participants' support in order to guarantee planning reliability for all participants. It is essential that the participants have confidence in the stability for a reasonable period of time. Uncertainty about the future cap or the future costs of reduction measures will influence the willingness to buy or sell permits and

to take reduction measures and thus the efficiency of the trade, because the participants are not sure about the value of the permits. This will hamper the trade. The longer the lifetime of the permits, the less uncertainty, the more efficient will be the participants decisions (Bunte, 2007). The participants will only support a trading system, which allows them to plan without uncertainties caused by the design. Therefore participants should be informed about all relevant elements of the trading system, regulations should be consistent over time and market interference by the government must be as predictable as possible, in order to prevent disturbing the market and damaging the producers.

Banking and borrowing

Banking will make the market for tradable permits more flexible, because it provides the participants the opportunity to follow a long-term strategy. Borrowing will also provide flexibility for the participants, because the permits which are expected to not be used in the following years can be used by the participants already.

Banking and borrowing also provides companies the opportunity to speculate on the permit price. When price increases or decreases are expected, permits can be sold or bought to increase the company's profit.

Monitoring and sanctioning

Monitoring and sanctioning is necessary, otherwise the predetermined objective will not be achieved. If a policy instrument is not effective, it will not be efficient either. A monitoring and sanctioning system is efficient if the costs of monitoring and sanctioning are as low as possible. The government can lower the monitoring costs due to self check by the participants. The government can provide an incentive for the participants to monitor each other by sanctioning a group instead of individual participants. A similar, well functioning, monitoring and enforcement system is implemented in the Dutch fisheries nowadays. This system is based on the allocation of rights to a group of fishermen. In case of exceeding by a member of the group a sanction (like take away permits plus a fine) is given to the whole group. That is why it is important for the collective to check each other (Brouwer et. al., 2001).

Institutional structure

The more parties joining the trade, the higher will be the number of buyers and sellers. In that case the possibilities for reduction measures will be higher, so the bigger will be the chance for cheap reduction possibilities (Bunte, 2007), so the more efficient will be the market of tradable permits.

Transaction costs can be reduced if third parties, like brokers, are allowed to step into the market (Stavins, 1995; Brouwer et. al., 2001). Brokers can reduce the transaction costs of search and information. They will produce information about firms' pollution-control options and potential trading partners, and thus reducing transaction costs, while absorbing some as fees. For example in the established sulphur dioxide (SO_2) trading program in the United States of America under the Clean Air Act amendments of 1990, there is a substantial role for brokers for consulting with electrical utilities to help them understand their

options. Brokerage firms maintain computer models used to predict the supply and demand for permits to provide forecasting for utilities (Stavins, 1995). If third parties will step into the market this will influence the trading system, because a total different market with total different parties will come into existence. This may cause a certain resilience to deal with uncertain situations.

3.6 CONCLUSIONS FOR FURTHER ANALYSES

Based on an analysis of the economic efficiency of tradable permits, the following conditions which influence the economic efficiency and thus the potential contribution to sustainable development in a new case, can been defined:

- Buyers and sellers;
- Transparency;
- Entry and exit rules.

These characteristics will be used in the framework.

Also is discussed how the design choices contribute to economic efficiency. This information can be used as input to support the decision-making process about the design-choices. However, the decision about the design of a tradable permit system cannot be based on economic efficiency only, because in order to make sure that the design of a tradable permit system contributes to sustainable development, ecological effectiveness and social justice should be taken into account as well.

4. ECOLOGICAL EFFECTIVENESS

Policy is to aspire the realisation of a certain goal with certain instruments in a given limited time. A policy instrument can be used by an actor to achieve that specific goal (Hoogerwerf, 1984). Effectiveness means whether a policy instrument is able to achieve a predetermined objective and is the second criterion to determine whether a policy instrument might be successful or not. As mentioned in the introduction of this thesis, tradable permits are a very effective policy instrument: the target set on macro-level is fixed by the total number of allocated permits and cannot be exceeded (Keudel, 2007). However, generally spoken the ecological effectiveness can be limited if:

- The traded product is not homogeneous. In that case it cannot be guaranteed that an increase in production or emission by a purchasing source is equal to the decrease of production or emission through the reduction of the selling source;
- The total amount of allocated permits is higher than the optimal level of permits (from an ecological resilience point of view). In that case the ecological target will not be achieved. If there is hardly a scarcity of permits the prices of the permits will be low, which will give the companies no incentive to innovate;
- Firms can produce more than they are allowed to according to their amount of permits. In order to prevent this monitoring is essential.

Paragraph one deals with the homogeneity of the traded product. The level of permits and monitoring are design choices, so these, and the other design choices, are discussed in paragraph two. Paragraph three provides conclusions.

4.1 HOMOGENEITY

The ecological target will only be achieved if the traded product is homogeneous. Homogeneity means that goods are perfect substitutes: there is no product differentiation for all users (in time and space), so all firms produce or emit an identical product: every unit of emission or production has the same ecological impact. CO_2 is an example of a homogeneous product, because neither the source (place) of emissions nor their timing is important from an environmental standpoint (Cramtona, et. al., 2002). Only if the traded units are homogeneous, the system can guarantee that the increase in production or emission by a purchasing source is equal to the decrease of production or emission through the reduction of the selling source (Keudel, 2007). If the product is not homogeneous and the time or location of the emission or production does matter, there is a risk that individual trade will lead to negative consequences at a certain time or a certain location, so the system will not be effective. For example, a plant close to a sensitive ecosystem may buy many emission permits and disturb the ecosystem (Sorrel and Skea, 1999).

4.2 DESIGN CHOICES

The following design choices influence the ecological effectiveness:

Choice of the trading system
The system of tradable reductions has a relative cap, opposite to the fixed cap on macro-level of the cap and trade approach. In case of a cap and trade approach the total produced or emitted amount will never exceed the cap (assuming that every producer does not produce more than he is allowed to). In case of tradable reductions the total amount of production or emission depends on the performance standard rate and the level of activity, thus the level of production or emission can vary and the ecological target might not be achieved. In case of a desired established target this is not desirable, but not a big issue. In case of a necessary target based on a natural limit, an exceeding of the target will negatively influence the ecosystem. In case of a necessary target based on a technical limit, it is not even possible to exceed the limit, so that should be taken into account when choosing a trading system.

Level of permits
As mentioned in the introduction of this chapter, the main challenge of ecological effectiveness is not whether the target set on macro-level will be achieved or not, but to define the optimal ecological target. The optimal ecological level of production or emission (*E*) should be determined based on the ecological resilience of an ecosystem. Ecological resilience of an ecosystem can be defined "the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes" (Resilience Alliance, 2008). A resilient ecosystem can withstand shocks and rebuild itself when necessary (Jansen, et. al., 2007).

An ecosystem is in a dynamic equilibrium if the input is equal to the output. For instance, the optimal level of production or emission in a year should be equal to the capacity that the ecosystem can handle (for example produce or absorb) each year. Defining the optimal target based on this dynamic equilibrium can in some cases be calculable, for example based on the multiplication rate of fish. In other cases this can be very complex, because it is hard to calculate the 'assimilative capacity' of an ecosystem, which is the ability of an ecosystem to absorb various materials without degradation of the ecosystem (Cairns, 1999).

The dynamic equilibrium can be disturbed by a large production or emission. As long as the disturbance stays within the limiting value of the ecosystem, the ecosystem can preserve or restore the dynamic equilibrium and remain stable, due to an internal feedback system. When the disturbance is too intense and lasts too long, the ecosystem might become instable and the equilibrium cannot be restored. It is therefore important that the production or emission stays within the limiting value of the ecosystem. Again, this limiting value can be very difficult to calculate, because the information that is available is theoretical instead of practical.

Initial allocation
Grandfathering provides greater political control over the distributional effects of regulation (Stavins, 1997), which can be positive for the ecological effectiveness. Grandfather-

ing also causes the least resistance of the existing sources, because they do not have to pay for their permits (Brouwer et. al., 2001; Tietenberg, 2003). If the initial allocation causes less resistance, the participants will support the system of tradable permits, so they will be more willing to comply with the target.

Auctioning provides an incentive for innovation, because the firms who can take reduction-measures will immediately start doing so, because then they do not have to buy any (expensive) permits. This might cause radical steps (system change) in the innovation process. In case of grandfathering every company should reduce for example 10 percent, which is possible by taking incremental steps only. In the short time this does not affect the ecological system, because the ecological target (level of permits) is fixed. However, these radical innovations make it possible for the government to lower the ecological target even more in the future, because they know that the possibilities to innovate exist.

Type of permits

If the permits are allocated for a short period, this will give the government the flexibility to influence their policy or the cap to take account of new information about environmental damage, public expectations or radical innovation (Sorrel and Skea, 1999). If the government has no possibility to decrease the environmental target in case of new insights, the ecological system would not benefit at all.

On the other hand, the participants might not be willing to invest in reduction measures and might rather wait for a couple of years, because they are not sure about the government's future plans. Current reduction measures might influence their future allocation of permits.

Banking and borrowing

Banking and borrowing do influence the effectiveness of a tradable permits system. If the government allows banking the total level of emissions or production over the whole period does not change. If the emissions are lower than the target in a certain year, this creates the possibility that subsequent annual production or emission exceeds the annual target. This is why banking is not allowed in the RECLAIM initiative, which is the Californian program to control the sulphur dioxide and nitrogen oxides emissions (Sorrel and Skea, 1999). In case of a desired established target this is not desirable, but not a big issue. In case of a necessary target based on a natural limit, an exceeding of the target will negatively influence the ecosystem. In case of a necessary target based on a technical limit, it is not even possible to exceed the limit, so that should be taken into account when deciding about whether to allow banking or borrowing or not.

The same is the case with borrowing. In case the government allows borrowing, the policy goal for that certain year will not be achieved. But in subsequent years the emissions or production will be below the target level. The US proposed borrowing, on discounted bases, in its draft Framework Convention on Climate Control, but it was rejected at Kyoto for the reason that it brings no environmental gains and risks deferring non-compliance with the environmental obligations (Sorrel and Skea, 1999). If the government allows bor-

rowing she should define a maximum level of borrowed permits or a maximal duration. If she does not, participants might borrow unlimited permits during many years, causing the annual target to be exceeded.

Monitoring and sanctioning

As mentioned in the introduction of this chapter, regardless of how well any tradable-permit system is designed, non-compliance can prevent the system from achieving the ecological objective, as defined in the paragraph one. The absence of an effective and well-defined monitoring and enforcement system raises incentives for non-compliance. Monitoring and sanctioning is thus necessary, otherwise the predetermined objective will not be achieved. For example, in 1988, the expected positive effects of individual transferable quotas in the fishery in the Netherlands did not materialize due to inadequate enforcement (NRCC, 1999).

Enforcement depends also on the technical ability to detect violations (Tietenberg, 2006), because technology has played an important role in checking whether the actual productions or emission of a firm are within the limits. The technological attainability will differ per case. Especially in case of non-point sources, which are sources that do not discharge pollutants at a precise point, it is hardly possible to assign individual accountability for the resulting pollution, which results in a significant monitoring problem (Keudel, 2007).

Carbon dioxide emissions are easier to measure than methane emissions, because the carbon dioxide emission are directly related to the usage of fossil fuels, while methane emissions in the agricultural sector are related to many factors, like animal type, food, housing and the storage of the manure (Brouwer et. al., 2001). A method should be developed to monitor both the owners of the permits and the similar firms who do not have any permits. If the parties can still produce or emit without buying extra permits and without any sanctioning, this will cause that the ecological objective will not be achieved.

A successful enforcement programme also requires a carefully constructed set of sanctions for non-compliance. The sanctions need to be set high enough to create the incentive for compliance. Penalties need to be higher than the financial benefit from non-compliance to create the incentive to fulfil the reduction requirements (Keudel, 2007). However, it is not true that the steepest penalties are the best penalties. They are not credible and penalties that are unrealistically high may not be imposed. In the sulphur dioxide (SO2) trading program in the United States of America, generally considered a successful tradable permit programme, those found in non-compliance must not only pay a substantial financial penalty, they also must forfeit a sufficient number of future allowances to compensate for the overuse. It is also possible to allow only those in compliance to transfer permits (Tietenberg, 2003).

Institutional structure

The ecological target will only be achieved if the boundaries of the system of tradable permits are equal to boundaries of the ecosystem, which means that all polluters or producers in a certain ecosystem should join the trade. If a community in Africa makes

agreements about the amount of fish they are going to catch from a certain pool, the agreements will have no effect if another community, living also close to that pool, does not comply with those agreements and catches as much fish as possible from the pool. If tradable permits are implemented in the Netherlands to increase the water quality of a river (or decrease the pollution) cooperation of all upstream countries is necessary, because the water quality of the Netherlands is highly dependent on the environmental activities in upstream countries. Therefore environmental effectiveness can only be guaranteed if all upstream countries will join the trade too, otherwise the achievement of the ecological objectives could be hampered (Keudel, 2007). Leakage and substitution processes should be avoided, by preventing that the firms have the possibility to move their facilities to countries without any regulation in that field, because that would disturb the effectiveness of tradable permits (Tietenberg, 2006). Another advantage of large boundaries of a trading system is that the number of buyers and seller joining the trade will be large too. This will increase the economic efficiency.

Appointing a registration and controlling authority will provide the government more knowledge about all the transfers of permits, for example about the price, which parties buy and sell and the number of permits transferred. The knowledge about who can be very useful if the government is considering to make adjustments to the trading system, for example when defining a new cap. This may increase the effectiveness of the system.

4.3 Conclusions for further analyses

Based on an analysis of the ecological effectiveness of tradable permits, the following characteristics that positively influence the ecological effectiveness and thus the potential contribution to sustainable development in a new case, can been defined:

- Homogeneous product;
- Technical ability to monitor.

These characteristics will be used in the framework.

Also is discussed how the design choices contribute to ecological effectiveness. This information can be used as input to support the decision-making process about the design-choices. However, the decision about the design of a tradable permit system cannot be based on ecological effectiveness only, because in order to make sure that the design of a tradable permit system contributes to sustainable development, economic efficiency and social justice should be taken into account as well.

5. SOCIAL JUSTICE

The third criterion to determine whether a policy instrument will be successful or not is social justice. The principle of tradable permits does contribute to social justice anyhow, because the polluter-pays-principle is implemented. Polluters are going to pay for the right to produce or emit, instead of having the free benefits of exploitation, while the society as a whole suffers from the negative effects of the exploitation. Implementing tradable permits will make sure that the costs of the negative environmental externalities are incorporated (internalised) into the price. The level of social justice is influenced by some design choices: the trading system, the initial allocation and monitoring and sanctioning (paragraph one). Paragraph two provides conclusions for further analyses.

5.1 DESIGN CHOICES

The following design choices influence the social justice:

Trading system
In case of a tradable reductions system the polluter-pays-principle will not be fully implemented. If a company expands its level of activity, it can increase its total amount of emission for free, so the emissions will not be completely incorporated in the price. In case of a cap and trade system every emission has a price, even if the permits were allocated for free. By using the permits to cover emissions, the company will lose the opportunity to sell the permit and these opportunity costs will be incorporated in the price (Nentjes, 2000).

Initial allocation
Auctioning of the permits internalizes the negative environmental externalities and contributes to the polluter-pays-principle, while grandfathering does not. In case of auctioning, the participants are going to pay for the right to produce or emit, instead of having the free benefits of exploitation, while the society as a whole suffers from the negative effects of the exploitation. The bonus of this system is that the revenue from the auctions could be refunded through tax cuts to citizens. This means that polluters are effectively buying the right to pollute from the public.

In case of grandfathering the existing parties on the market often have an advantage, because they will receive all their permits free of charge. New entrants have to buy permits from the existing parties. In some cases the government has some permits left for new entrants, but often there are many parties interested in those permits, while there are only some permits left.

Monitoring and sanctioning
Monitoring and sanctioning is necessary, because it would not be fair for others who do comply with their individual limit, because these participants would still suffer from the negative effects. Both the owners of the permits and the parties who do not have any per-

mits must be monitored. Otherwise, some parties can have the same activities outside the market, without any sanctioning, which is not fair for the participants of the trade who did buy the permits. Individual sanctioning contributes more to social justice, because it is not fair to sanction participants who did not exceed their target.

5.2 Conclusions for further analyses

No characteristics that influence the social justice can be identified, because the principle of tradable permits does contribute to social justice anyhow.

In this chapter is discussed how the design choices contribute to social justice. This information can be used as input to support the decision-making process about the design-choices. However, the decision about the design of a tradable permit system cannot be based on social justice only, because in order to make sure that the design of a tradable permit system contributes to sustainable development, economic efficiency and ecological effectiveness should be taken into account as well.

6. TRADABLE PERMITS IN PRACTICE

In chapter three, four and five a conceptual analysis of tradable permits is performed, to investigate the important characteristics of the market and the product and the contribution of the various design choices to economic efficiency, ecological effectiveness and social justice. The influence of the design choices and the characteristics on economic efficiency, ecological effectiveness and social justice are analyzed from a theoretical, isolated and static point of view.

However, when implementing tradable permits the reality will be much more complex. From a system view the three elements of sustainability are not considered as static and isolated factors, but rather as related components of social, economical, and ecological systems (Jansen, 2007). According to a third economic school of thought, **original institutional economics**, economics is an open and evolving system, situated in a natural environment, affected by technological changes and embedded in a broader set of social, cultural, political and power relations (Hodgson, 2000).

Thus, when the governments would like to implement a new policy in a certain sector, she cannot base her decision on one of the pillars of sustainable development only. Instead, a balance between the three pillars should be found. The potential successfulness of a tradable permit system does not depend on the characteristics of the market and the product only, but also on the implementation process.These insights have consequences for further analyses, so therefore this chapter will focus on how it works in practice, instead of how it works in theory.

First, the conceptual analyses are enriched by performing empirical analyses, by investigating two previous experiences with the introduction of tradable permits. These analyses help to find out what makes a system of tradable permits a success or not. In the first paragraph milk quota and in the second paragraph carbon dioxide quota are analysed, by answering the following questions:

- *How are the basic conditions (buyers and sellers, an incentive to trade and a tradable product) fulfilled?*
- *What are the characteristics of the market and the product, as investigated in chapter three, four and five and how is dealt with the imperfections?*
- *What did the decision-making process look like?*
- *Which design choices have been made and why?*
- *What were the consequences of the implementation of tradable permits: was the implementation a success or not?*
- *What are the lessons for further analyses or for future cases?*

Paragraph three provides preliminary conclusions of the empirical analyses and provides an overview of the risks and opportunities influencing the implementation process and thus the potential successfulness of a tradable permit system. Also the decision-making

process about the design of a tradable permit system is important for a successful implementation, which is discussed in paragraph four. In order to structure the decision-making process about tradable permits, a process design should be developed, which is discussed in paragraph five. Paragraph six provides conclusions.

6.1 MILK QUOTA

Milk quotas were introduced in European Union on the 1st of April 1984. They were introduced to balance the production and demand of milk, in order to overcome the problem of growing milk surpluses in Europe.

6.1.1 Basic conditions

In paragraph 2.1 some basic conditions have been formulated, which are necessary conditions to develop a market. In case of milk quota the conditions are fulfilled as follows:

All milk producing farmers in the European Union were forced (by European legislation) to join the milk quota system and to decrease their milk production. All producers received a certain amount of permits, which allowed them to produce a certain amount of milk.

The incentive to trade was provided by a scarcity of these milk quota permits, which was 10 percent lower than the milk production of 1983. In the Dutch milk production market many innovation measures were available, by the automation of the production process and economies of scale. It was possible to increase the milk production per cow, while decreasing the amount of labour.

The tradability of the milk quota was written down in the European legislation (856/84/EEG). Milk is measured by kilogram of milk per year, which is an easy to measure and unambiguous unit.

6.1.2 Characteristics of the market and the product

The market and the product of milk quota can be characterised as follows:

Buyers and sellers
In the eighties around 45,000 dairy farms existed in the Netherlands, but this number has decreased to the current number of 21,000 and is still decreasing (Berkum et. al, 2006). These farms differ in size, but the differences are small and the number of buyers and sellers is very large, so additional measures to prevent certain parties from having market power were not implemented by the Dutch government.

Transparency
The more sellers in a market, the more difficult it will be for the buyers to find all the relevant information (like the price and the amount of permits available) of all the sellers.

In case of milk quota the number of buyers and sellers is large, which has a negative influence on the transparency of the milk quota market. However, the government has not taken extra measures (like organising an exchange market) to increase the transparency, but literature study does not provide reasons for that. In order to increase the transparency of the market and decrease the transaction costs for searching and information many broker firms became active in the market for milk quota (search for "melkquotum" at the internet and you will find lots of them), because these brokers know all the current prices and quantities. This decreases the transaction costs for the farmers and for the brokers it is an easy way to make a good profit.

Entry and exit barriers
The barriers to enter the dairy market are not easy, because before a farmer can enter the dairy market, the farmer must do a lot of specific investments, like buying land and cows. He also needs a lot of specific knowledge about how to take care of cows. The barriers the exit the market can be large too, because often the farmer does not have the qualification to find another job. However, since the introduction of milk quota many milk farmers have quitted, so obviously the barriers to exit the market were not too large, because good prices were paid for the land and the quota.

Homogeneous product
Milk is not a homogeneous product, because every cow produces milk with a different butterfat percentage. The higher the percentage of butterfat the more dairy products can be made out of that milk. Therefore a butterfat base is attached to milk quota. This means that for every percentage above/below the base the farmers' production rises/falls by a couple of percentages.

Technical ability to monitor
Monitoring takes place by monitoring the amount of milk that farmers sell to dairy factories. Therefore the farmers are only allowed to sell their milk to qualified dairy factories. This is easy to monitor, because only official dairy factories can sell their products to the shops.

6.1.3Decision-making process

In the beginning of the eighties the member states of the European Union agreed on the fact that measures to decrease the European milk production were necessary. The European Ministers of Agriculture have decided together to implement a certain cap per country. Every country could decide themselves how they would implement the cap, because it only matters if the cap would be achieved and not how. Most countries decided to implement a tradable cap (to increase the efficiency of the market), but in France the farmers receive their quota directly from the government and if the farmers decided to quit the quota should be returned to the government (Vogelzang et. al, 2003). New member states of the European Union had to accept European regulation when entering the European Union, so they had to limit their milk production too.

The implementation process was not very difficult. Of course the farmers were not happy with the implementation of milk quota, but most of them understood that this was the only way to increase the efficiency of the milk market, which could guarantee an acceptable milk price for them and thus an acceptable income. The member states were given a lot of freedom to decide about the design of the system of milk quota. In the Netherlands, the interests of the farmers were taken into account, in order to put as less pressure as possible on the farmers and protect the Dutch milk market. Therefore is decided to grandfather the permits and implement a flexible transfer system, by allowing to lease quota and to allow transfer of quota without a transfer of land.

6.1.4 Design of the tradable permit system

When implementing milk quota, the European Union has decided about most of the design of the system, but the member states were allowed to decide about some issues, too. The European Union has allocated a certain amount flow permits to each member state (valid to produce a certain amount of milk for a certain amount of years). It is not allowed to exceed this amount in a certain year, so banking and borrowing was not allowed and cap and trade was chosen as the trading system. Every member state has given a certain flexibility to decide herself about the initial allocation and the trading rules. The design of the system of tradable permits for milk quota in the Netherlands is as follows:

Trading system
A cap and trade approach has been chosen by the European Union in order to guarantee that the absolute cap will be achieved, because there was already a large stock of dairy products (Vogelzang et. al, 2003). Every country has received a certain cap they must achieve, so trading does only take place between farmers from the same country and not between countries. The argument that the cap would be guaranteed was more important than all other arguments in favour of a tradable reduction system.

Level of permits
The European Union allocated a certain amount of quota (the cap) quota to the EU member states, which was based on the demand of milk in the EU, which was around the production of 1983 minus 10% (Vogelzang et. al, 2003). There have been further reductions in quota later on in the eighties, but during the last years the cap has been increased several times, due to the increased demand of milk in the EU.

Initial allocation
Part of the deal was that every member state had a certain freedom to allocate these quotas. The Dutch government has decided to allocate the quota to the milk producers free of charge, based on the production of 1983. The allocation has been taken special situations at individual farms into account, like recent investments and cattle-diseases (Vogelzang, et. al., 2003). Even though an auction of the permits might be more efficient, grandfathering was chosen to protect the income of the farmers and to increase their commitment.

Banking or borrowing
Banking and borrowing of the milk quota would provide the farmers certain flexibility, but it was not allowed by the European Union, in order to guarantee that the absolute cap will be achieved. Banking and borrowing will cause that the target will be exceeded in a certain year, which was not desirable. Raw milk cannot be stored, so in case of overproduction the milk must be processed to certain dairy products like butter and cheese.

Monitoring and sanctioning system
The milk production is monitored by the sales level to the dairy factories. Farmers are only allowed to sell their milk to a qualified factory. Each year depending on how much the country as a whole has exceeded its quota, a super levy rate is set. This basically means that every producer is given a grace on his quota. For anything that a milk producer produces above its individual quota (plus the grace) the farmer will be fined with an individual super levy. This is a fine that is set at a certain percentage above the price of milk, so the fine is bigger than the revenues of producing extra milk. The farmers pay the super level to their national government, who pays the levy to the European Union (Vogelzang et. al, 2003).

Type of permits
Milk quota permits are flow permits (unit: kilogram of milk per year) and they are valid for the duration of the system of tradable milk quota. When milk quota were implemented the duration of the system was five year (856/84/EEG). Later on the system has been expanded several times (3950/92/EEG, 1256/1999/EG) and since 2003 (1788/2003/EG) the system is legitimate till 2015. The permits are valid for the whole period. Even though the lifetime of the permits is long, policy interventions were possible. The number of allocated permits have been increased and decreased several times, by increasing or decreasing the amount of milk which is allowed to be produced when having a permit. Also the level of the fine has been adjusted several times.

Institutional structure
The parties that should join the trade are all milk producing farms, so no farms were excluded from the milk quota system. The government allowed brokers to step into the milk quota market, in order to decrease the transaction costs.

The Netherlands have chosen for direct transfer of quota from one company to another (no authority is involved) in order to decrease the administration costs. This causes that no policy intervention is possible when the quota are transferred (Vogelzang et. al, 2003). Direct transfer means that the government does not regulate the trade and does not organise an exchange market, however often brokers mediate the transaction. The Productschap Zuivel (Dutch Dairy Board) registers and monitors all milk quota transactions.

Trading rules
In the Netherlands, a farmer can lease or buy quota, in order to increase quota. The possibility to allow leasing was introduced by the European Union in 1989/90 on request of several member states. Leasing provides extra flexibility, because it gives farmers the op-

portunity to adjust the amount of quota to the expected higher or lower production amount during the year, without any long-term obligations. The milk quota transfer back to the original owner at the end of the year (Vogelzang et. al, 2003). In the Netherlands until 2006 a farm could lease a maximum of 30 percent of its quota to other firms, but in order to increase flexibility and decrease the regulation, this rule has been abolished (Ministerie van LNV, 2006b). In the Netherlands the transfer of milk quota was only allowed if also a transfer of land took place. But, since 2006 firms are allowed, under certain conditions, to buy quota without a transfer of land, in order to lower the administrative costs (Ministerie van LNV, 2006b) and increase the flexibility for the farmers.

6.1.5 Consequences of tradable permits

The most important consequence of implementing tradable permits was that the milk production did decrease and there became a balance between production and consumption. Farms work a lot more efficient and the labour productivity is much higher than in the eighties, due to innovations and economics of scale. Also a high price for milk could be guaranteed, without any government subsidies (Vogelzang et. al., 2003). A lot of trading took place between the milk producers: average around eight percent of the national quota is transferred every year and around 5 percent of the total amount of quota is leased every year (around 600 million kg). In 1998/1999 about 1/3 of the dairy farms did buy quota and about the same percentage did lease quota (Brouwer et. al., 2001), which is more than expected.

However, the introduction of milk quota in the Dutch dairy market had also major consequences for the farmers, because only the most efficient farmers were able to stay in business. Many other farmers have sold their permits and quitted. The number of dairy farms has more than halved and is still decreasing, while the average farm size is increasing. Because of the fact that only the most efficient farms stayed in business, the average production per cow and per farm has been doubled, since the introduction of the milk quota in the Netherlands (Agricultural Economics Research Institute, 2002; Centraal Bureau voor de Statistiek, 2000).

Of course the introduction of milk quota had some disadvantages too. Many companies are keeping less cows then they could do potentially and within several years the price of a quota increased with 400 percent, causing a certain pressure on the income of the farmers and on the position of the Dutch milk farms in the European Union (Vogelzang et. al., 2003).

6.1.6 Lessons for further analyses

The market for milk quota in the Netherlands has been effective (the milk production decreased and there became a balance between production and consumption), efficient (farms work a lot more efficient than 25 years ago) and justified (firms of the whole EU are joining the trade), so the milk quota have contributed to a sustainable development of the milk sector and can thus be considered quite successful.

Several reasons have contributed to a successful implementation of milk quota:

- The basic conditions for a trading market are fulfilled;
- Not every characteristic of the market and the product of milk are fulfilled, but additional measures were taken, to prevent them from hampering the successfulness of the tradable milk quota. The fact that milk is not homogeneous is adjusted by adding a butterfat-base and the transparency is increased by allowing brokers to enter the market;
- Every couple of years the system of milk quota was evaluated and if necessary adjusted (for example implementing the possibility to lease, adjust the level of permits to the current demand of milk). This provided the European Union and the Dutch government the flexibility to deal with new insights.
- The implementation process was not very difficult, because the farmers accepted the implementation of milk quota. The first reason for the acceptance was that they had a sense of urgency; they knew that milk quota would guarantee them a certain income. Secondly, when designing the system of milk quota, the Dutch government has taken the interests of the farmers into account and has designed a system with sufficient flexibility for the farmers.

6.2 CARBON DIOXIDE TRADE

At January first 2005, the European Union has started an emissions trading system (ETS) in order to reduce the CO_2 emissions, to meet the targets as agreed on in the Kyoto protocol.

6.2.1 Basic conditions

The basic conditions of the carbon dioxide permit market are fulfilled as follows:

The buyers and sellers of the carbon dioxide permits are the energy intensive companies in the European Union. They were forced (by European legislation) to join the emission trading system and to decrease their carbon dioxide emissions.

All producers received a certain amount of permits, which allowed them to emit a certain amount of carbon dioxide. The incentive to reduce emissions and to trade was very low, due to the fact that there was not a scarcity of permits, which causes a very low permit price (DHV et. al., 2007).

If a company or a country emits more carbon dioxide than it is allowed to and does not want to buy extra permits, there are many possibilities for a company to decrease its emission. First, it can decrease its fossil fuel use (by using less fuel or a higher percentage of sustainable energy). Secondly, the carbon dioxide emissions can be reduced in developing countries, by investing in CO_2-reduction projects there as an alternative to more expensive emission reductions in its own country. This system is called the Clean Development Mechanism (Rammeloo, 2008). Thirdly, can be invested in emission reduction projects in developed countries as an alternative to reducing emissions domestically, so reduction

measures can be transferred from one developed country to another. This system is called Joint Implementation (Algemene Rekenkamer, 2007).

The emissions are measured by tons of carbon dioxide (equivalent), which is a measurable and unambiguous unit. The tradability of the carbon dioxide is written down in the European legislation (2003/87/EG).

6.2.2 Characteristics of the market and the product

The market and the product of the carbon dioxide permit market can be characterised as follows:

Homogeneous product
Carbon dioxide is a homogeneous product in time and in space, because neither the source (place) of emissions nor their timing is important from an environmental standpoint (Cramtona et.al, 2002), so additional measures by the government to create submarkets or set a maximum are not necessary.

Buyers and sellers
Every company and even every individual using fossil fuel is emitting carbon dioxide. This makes the possible number of buyers and sellers joining the trade very large. If all emitting parties will join the trade, the differences between the emitters (for example the difference between an individual person and a power plant) will also be very large. This might cause market power, because some emitters are much bigger and richer than others. Therefore, the European Commission has decided (2003/87/EG) that only the energy intensive companies should join the carbon dioxide trading system, so market power is less an issue anymore. Permits can be traded between all European companies joining the trade. This makes the market so large that even the largest players do not have a dominant position and are able to use their market power (DHV et. al., 2007).

The heavy industries are companies with burning installations, with a total thermal capacity of minimal 20 megawatt, such as power plants or chemical companies. Also carbon intensive factories like oil refineries, cokes ovens, metal producing companies, mineral processing companies and paper producing companies must join the trade (European Union, 2003: Annex 1). In the Netherlands 331 firms in total are joining the emission trade, which emit around 45% of total amount of the Dutch carbon dioxide.

Transparency
In order to increase the transparency of the trading system, the Dutch government has appointed the Netherlands Emission Authority (NEA) as an independent authority for emission trading in the Netherlands. The NEA hosts a website with all relevant information for the firms (NEA, 2008), like the current permit price.

There are also permits exchange markets: the largest is the European Climate exchange, where around 80 percent of the trading takes place (DHV et. al., 2007).

Entry and exit barriers
Currently, the European carbon dioxide trading market is open for energy intensive companies only. For these kind of companies entering and exit the market is very difficult, due to the high investment costs. The government has not taken extra measures to deal with this issue.

Technical ability to monitor
The emission of carbon dioxide emissions can be monitored directly, but expensive equipment is necessary to do so. Therefore monitoring the emission of carbon dioxide is done by measuring the usage of fossil fuels, because the carbon dioxide emission are directly related to the usage of fossil fuels and the energy consumption by a company is much easier to monitor.

6.2.3Decision-making process

The decision-making process about the emission trade can be divided into two phases. First the European Commission has decided about the fact that emission trade was going to be implemented, which trading system would be implemented, which firms should join the trade, the type of permits, the sanctioning, the institutional structure and the allowance to bank or borrow.

Then the national governments have decided about the cap, the initial allocation and the monitoring. These decisions are stated in the national allocation plans (European Union, 2003: Annex 3). These plans are handed in for every new allocation period by every EU member. The plans state the total number of CO_2-permits that they allocate for a certain period and the number of allowances the government intends to allocate to each company. The allocation plans are based on the Kyoto objectives.

In January 2003 the European Commission has consulted various companies from various industries about tradable permits. These consultations were meant to provide information for the European Commission about the development of the guidelines for the national allocation plans. The guidelines are used to approve the allocation plans as proposed by the national governments according to a certain list of criteria (PricewaterhouseCoopers and Energieonderzoek Centrum Nederland, 2003).

The Dutch allocation plan for the first allocation period has been established after a comment period in which members of the public were able to express their opinion. Due to these comments, the allocation outcome for a large number of installations has been adjusted, in particular as a result of improved data. The European Commission has also reviewed the allocation plan. As a result a number of changes have been made: a reduction in the total number of allowances and changes to the allocation of allowances held in reserve (Ministerie van VROM and Senternovem, 2004). In September 2006 the Dutch cabinet has proposed the Dutch allocation plan for the second allocation period to the European Commission, but in the beginning of 2007 the European Commission reacted that several member states, including the Netherlands, should lower their total amount of allocated permits with five percent during the second allocation period (Algemene

Rekenkamer, 2007). The Dutch government agreed with this (because they understood that it was a necessary step to achieve the Kyoto objective), so this means that the Dutch companies who join the trade receive less emission permits than the initial plan.

When defining the cap and the allocation method the Dutch government has focussed too much on the financial interests and the competitive position of the participants of the trade (Algemene Rekenkamer, 2007). The Dutch government thought that a loose cap and permits allocated for free would protect the companies and would provide an incentive for the polluters to accept the trading program and cooperate with the implementation, by providing necessary information about the historic emission levels (according to Chris Dekkers, Ministry of Environment). The Dutch government considers the first two allocation periods as start-up periods to make sure that the companies will accept the emission trade, in order to decrease the number of allocated permits during later allocation periods.

This approach is necessary, because the boundaries of the ecosystem cover the whole world, but only member states of the European Union are forced to join the emission program (Volkskrant, 2008a). This places the government in a difficult position. A loose cap and free allocation prevent the participants of the trade from moving to another country, which has not implemented an emission trading system (which some of the participants have threatened to do, if the cap would be too strict) (Volkskrant, 2008b) or moving to another EU-country, which allocates them more permits (Algemene Rekenkamer, 2007). The system of tradable permits will only function optimally if there is one level playing field worldwide, because in that case leakage is not possible anymore. Until a worldwide trading system is implemented the government has to take the companies' opinions into account, while keeping the ecological objective in mind also.

6.2.4 Design of the tradable permit system

The design of the system of tradable permits for tradable carbon dioxide quota is as follows:

Trading system
When choosing the trading system, a trade-off between efficiency and effectiveness was made. Even though the Netherlands had a positive experience with a tradable reduction market for NO_x (according to Chris Dekkers, Ministry of Environment), the European Commission has decided to implement a cap and trade approach, in order to make sure that the trade would contribute to ecological effectiveness and the Kyoto targets would be achieved. It was not desirable that an increase of the production level caused a further increase of the amount of carbon dioxide emitted.

Level of permits
A strict level of permits is desirable from an ecological point of view and would contribute to the targets of the Kyoto protocol, but the participants of the trade prefer a loose cap. A loose cap saves them money, because in that case they have to make fewer investments in reduction measures or buy fewer permits.

Every EU-member state can decide herself about the number of permits allocated to the participants of the emission trade, but the European Commission should approve this proposal (Algemene Rekenkamer, 2007). The European Commission did not agree with the Dutch proposal of 115 megatons per annum, because that cap would contribute too little to the Kyoto targets. Under pressure of the European Commission the Dutch government has decided that the total CO_2 quota for industry during the first allocation period is 112 megatons per annum. Of the 112 megatons, 95.5 megatons is available for participants of trading system (Ministerie van VROM and Senternovem, 2004).

Initial allocation
The allocation was based on the participants' emissions of 2001-2002, with a bonus/malus system for reduction measures that were previously taken. Also a compensation for closed coal centrals was incorporated in the allocation, which made the system not transparent (Algemene Rekenkamer, 2007).

The allocation was free of charge, in order to protect the Dutch industry (other countries also did not auction their permits, so auctioning in the Netherlands would have caused a competitive disadvantage) and because the government thought that this would be an incentive for the polluters to accept the trading program and cooperate with the implementation (according to Chris Dekkers, Ministry of Environment). Therefore no use is being made of the option to immediately auction some of the permits.

The European Commission is considering to let companies joining the ETS pay for their permits from 2013. The European Commission is planning to auction 20 percent of the permits and to grandfather (free of charge) 80 percent of the permits in 2013 and in 2020 all permits will be auctioned (Volkskrant, 2008a), because this will increase the efficiency of the emission trade market and it provides an immediate incentive for innovation.

Banking or borrowing
Borrowing of permits might be efficient, because it provides flexibility, but it also brings the risk that the cap will not be achieved in a certain year. The European Commission has decided that borrowing is allowed, but only within an allocation period. So it is not allowed to use permits of the second allocation period during the first allocation period.

During the first allocation period the permits were valid for that allocation period only, so it was only allowed to bank the permits within the allocation period. When that allocation period ended the permits could not be used anymore and they lost their value. Since 2008 banking of permits for the following allocation period is allowed, too. This might increase the price of the permits, because when participants expect a higher permits price in the future, they are willing to buy extra permits now.

Monitoring and sanctioning system
The Netherlands Emission Authority (NEA) is also responsible for monitoring, in order to make sure that the participants do not emit more than they are allowed to. Every year the participants of the trade hand in an emission-report about the carbon dioxide emissions of

that year to the NEA, with attached a declaration of an independent verification company about the reliability of the report (accredited by the "Raad voor Accreditatie") and a sufficient amount of permits to cover their emissions.

If a company does emit more than he is allowed to according to its permits the company has to pay a fine of 100 Euro per ton CO_2. The company is also obliged to compensate its shortage of permits in the next year (NEA, 2008).

Type of permits
Carbon dioxide permits are stock permits (unit: tons of carbon dioxide), which means that they are used up as they are applied to a certain quantity of emissions. They permits are allocated for one allocation period. The first allocation period had a duration of three years and started January 1st 2005. The second (which started at January 1st 2008) and the following allocation periods will all have a five year duration. After every allocation period a new cap is set, the permits are allocated again (the transactions of the previous allocation period do not influence that allocation) and the trading rules might be adjusted.

Institutional structure
The Dutch government has appointed the Netherlands Emission Authority (NEA) as an independent authority for emission trading in the Netherlands. The NEA has allocated the permits to the participants, supervises, monitors and registers the trade and hosts a website with all relevant information for the firms (NEA, 2008), like the current permit price.

Not only participants, but also third parties are allowed to trade CO_2-permits. However, in order to really emit CO_2 also an environmental permit is necessary. The environmental permit gives firms the allowance to emit CO_2, while the CO_2-emission permits gives firms the right to emit a certain amount. Permits can be sold bilateral, via exchanges or via intermediates. The trade in CO_2-emmission permits is international: Dutch companies can buy permits from other companies within the EU (Algemene Rekenkamer, 2007).

6.2.5 Consequences of tradable permits

In the beginning of 2005 the prices for the permits increased fast, but when the emission-levels of 2005 were presented the permits' prices decreased back to the original level in a very short time (in May 2006). The reason was that the participating companies had emitted less CO_2 than was allocated to them, due to the loose allocation of permits within the EU-member states. The permits price has been decreasing since May 2006 even more. Figure 6 on the next page shows the price of the futures-contracts (in euro's per ton CO_2 equivalent) in 2005, 2006 and the beginning of 2007 as registered at the European Climate Exchange (Algemene Rekenkamer, 2007).

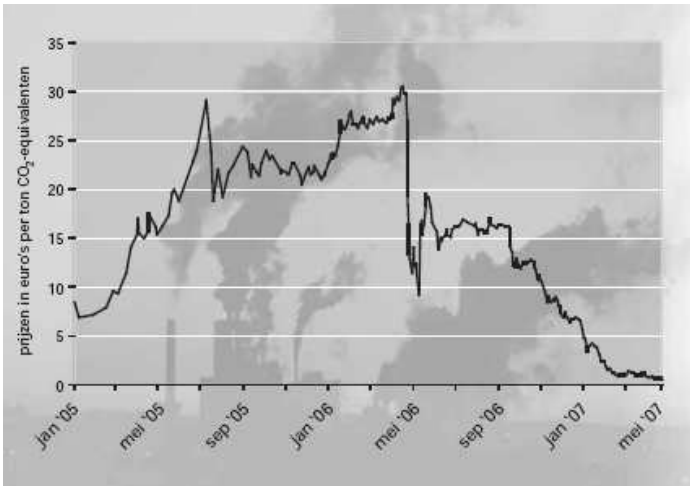

Figure 6: price in Euros per ton CO_2-equivalent (Cozijnsen, 2007)

Even though there is reduction potential in this sector hardly any reduction measures are taken. Due to the fact that there is no scarcity of permits, the market does not function, because a market does not function without a price and a price does not function without a scarcity. The very low permit price does not provide any incentive for the participants to take reduction measures, because they are not rewarded financially. According to the Dutch minister of Environment the target levels should be stricter (Volkskrant, 2008c). This makes the ETS not very successful yet. Under pressure of the EU the number of allowances for the second allocation period was decreased with another five percent, but these allowances are still not strict enough (according to Chris Dekkers, Ministry of Environment).

According to a research of DHV 42 percent of the responding participants has not taken any measures to reduce the emission of carbon dioxide, 56 percent has taken measures which can partly be counted to the implementation of emission trade and only 2 percent of the respondents has taken measures due to the implementation of the emission trade. Thus the main part of the reduction measures would have been taken without the implementation of emission trade anyway (DHV et. al., 2007).

6.2.6 Lessons for further analyses

The ETS has definitely potential to become a successful system of tradable permits, due to several reasons:

- Not every characteristic of the market and the product of carbon dioxide are fulfilled, but additional measures were taken, to prevent them from hampering the successfulness of the emission trade. The transparency is increased by a website hosted by the NEA and an indirect manner to monitor has been found;
- Every five years the emission permits will be allocated again, which provides the European Union and the Dutch government the flexibility to deal with new insights. This also provides them the opportunity to make the system stricter, step by step;

- The opinions of the future participants of the trade were taken into account in the decision-making process in order to make sure that they would accept and cooperate with the implementation of tradable permits.

However, ETS does not currently contribute to sustainable development, so it is not very successful, because the implementation process has been very difficult. The boundaries of the trade do not cover the boundaries of the ecosystem, which provides companies the opportunity for leakage. In order to prevent that the government has focussed too much on the financial interest of the companies when defining the level of permits:

- From an ecological point of view the target is too loose. The target set by the government is achieved, but there is a high chance that the ecological goal as agreed on in the Kyoto protocol will not be achieved.
- Also from an economic efficiency point of view the target is too loose. Due to the fact that there is no scarcity of permits and grandfathering of permits is used as initial allocation method, there is no incentive for the participants to reduce emissions and start trading.

If the number of allocation permits will decrease and the allocation takes place by an auction, the ETS have a higher chance of becoming successful.

6.3 IMPLEMENTATION PROCESS

The empirical analyses have shown that theory and practice differ. In the previous three chapters tradable permits were analysed from an isolated point of view, but this is not how it works in reality. A policy instrument does not operate in isolation, but in an open system, having an environment of various other factors. The empirical analysis of the carbon dioxide trade showed that the fulfilment of the characteristics of the product and the market is not a guarantee for successful implementation of tradable permits. Due to the fact that non-EU countries have not implemented an emission trading system, companies have threatened to move their firms if the cap would be too strict and if they have to pay for their permits. This gave them a strong vote in the decision-making process, so decisions were taken that hampered tradable permits from being successful, because a crucial boundary condition (scarcity of permits) was not fulfilled.

Thus, the potential successfulness of a tradable permit system does not depend on the characteristics of the market and the product only, but also on the implementation process. A proposed policy regime cannot perform its function if it cannot be implemented, causes a lot of resistance or if its main mechanisms are so weakened by the implementation process that it is rendered ineffective. What matters to policy-makers is not how a policy regime works in theory, but how it works in practice (Tietenberg, 2003).

This implies that when the government would like to implement tradable permits in a new case, not only the characteristics of the market and the product should be taken into account, but also the risks and opportunities of the implementation process should be sur-

veyed. If the government recognises the risks and opportunities and knows how to deal with them, it will increase the chance on a successful implementation of tradable permits. The following risks and opportunities might influence the implementation process and thus the successfulness of a tradable permit system:

- *Current policy*

When implementing a new policy instrument the current policy in that sector should be taken into account, because a permit trading is not compatible with all types of instruments. In the case of the introduction of a permit trading system in a sector with a certain current policy, existing instruments need to be identified and eventually adjusted or abolished. This might be difficult, because if the regulations are already quite dense, it is not necessarily reasonable to introduce a new instrument with all its consequences. In a world without any regulations, where decisions are about completely new introduction of instruments, discussions are open for all kinds of instruments. In that case the implementation of a permit trading might thus be easier (Keudel, 2007). For example the design of the emission trading system could be build from scratch, because no policy existed to limit the emission of carbon dioxide.

On the other hand, the less flexible the current policy and regulation in a sector, the more people would support the system of tradable permits. According to Goodstein (1996) and Berman and Bui (2001) in both the sectors of water and air pollution in the United States the transition following the introduction of transferable permits was not from an open-access resource to tradable permits, but from a less flexible control regime to a more flexible one (Tietenberg, 2003). The introduction of carbon dioxide emission trade caused a lot of resistance of the emitting parties, because they were suddenly going to be limited in their emissions.

- *Role of other countries*

Like the analysis of carbon dioxide trading showed, the policy of other countries if very important for the successfulness of a trading system. The more countries joining the trade, the less resistance of the relevant parties and the fewer opportunities the parties have to move to other countries. If only the Netherlands implement a tradable permits system, Dutch companies might have a cost-disadvantage compared with their competitors in other countries. For the ecological effectiveness it is important that boundaries of the trade cover the boundaries of the ecosystem. The experience of other countries with tradable permits in a certain sector might also be used as input for the decision about whether or not implementing tradable permits in that sector in the Netherlands and the decision about the design of a tradable permit system in the Netherlands.

- *Role of local and regional governments*

Also the role of the provincial (regional) and municipal (local) governments is important for the implementation process. These parties often have a lot of power and they might be difficult to control, because they have a formal relationship with the national government. If their interests conflict with the interests of the national government, this might make the implementation of tradable permits much more difficult.

- *Decision-making process*

Not only the local and regional governments, but also the relevant parties play an important role in the implementation process. Their cooperation and commitment to the implementation process is crucial for a successful implementation of tradable permits. If the participants have a certain sense of urgency, they will be committed to the implementation process (which was the case during the implementation of milk quota). Their support can also be increased, by involving them at an early stage when preparing the trading system, in order to develop support and knowledge (which has happened in case of carbon dioxide permits). This makes the decision-making process an important part of the implementation process, because the government cannot decide on her own about whether tradable permits will be implemented or not and what the design of the tradable permits system will look like. Thus, for a successful implementation of tradable permits the decision-making process should be well performed.

In the next two paragraphs first the importance of a well-designed decision-making process are discussed and then the key issues for a decision-making process are analysed. Involving the relevant parties in the decision-making process is definitely an added-value, but it also might bring a risk that it will negatively influence the result of the decision-making process. For example, in case of carbon dioxide permits not an optimal level of permits was chosen, which hampered the ecological effectiveness of the trade. Therefore, the government has to make a trade-off between support and outcome.

6.4 IMPORTANCE OF THE DECISION-MAKING PROCESS

The government cannot decide on her own about whether tradable permits will be implemented or not and what the best design of the tradable permits system will look like. First of all the optimal system of tradable permits does not exist: the complete and objective information, that is necessary to decide about the optimal design, is not available, because the information is conflicting, contested or sometimes not available at all (subparagraph one). On the other hand, due to the 'not invented here' principle, even if all objective information is available, the relevant parties would not accept and support this, because they were not involved in the decision-making process. So, in order to increase the support and cooperation of the relevant parties during the implementation process, they should be involved in the decision-making process (subparagraph two).

6.4.1 Information

An important issue for good decision-making is information, because no proper decision-making can take place without the right information. The information of chapter three, four and five will be the basis for the decision-making process about tradable permits. But in reality the information of these chapters cannot be considered from a theoretical, isolated and static point of view, which makes the decision-making process a lot more difficult. In reality, information is conflicting, contested or sometimes not available at all, which makes it very complex to define the optimal design for tradable permits.

The information is often conflicting, which means that dilemmas will exist. In some cases trade-offs between economic efficiency, ecological effectiveness and social justice, must be made. For example, banking and borrowing of carbon dioxide permits provides the participants extra flexibility, so it is economic efficient, but the consequence will be that the ecological target might not be achieved in a certain year, so it is not ecological effective. In other cases trade-offs within the pillars must be made: grandfathering as initial allocation method provides greater political control over the distributional effects of regulation (which positively influences the effectiveness), but auctioning provides an incentive for innovation (which also increase effectiveness). Often the government's and the participants' opinion about the design choices differ. The participants will prefer permits with a long lifetime, because that will guarantee planning reliability for them. The government will prefer permits with a short lifetime, because that will provide them the flexibility to influence their policy or the cap to take account of new information about environmental damage, public expectations or radical innovations.

Measurement and information problems cause that sometimes the right information is not available at all. For example, when determining the optimal level of carbon dioxide permits based on economic efficiency or ecological resilience, it is very complex to determine the amount of carbon dioxide that nature can handle or to determine the marginal damage curve and the marginal abatement costs curve. The theory also assumes these optima to be static, while in reality they are dynamic. Technological progress, for example, can change the conditions and the marginal cost curves. Therefore the definition of the design choices will often be a political one, made by the government and the participants, based on the information provided in chapter three, four and five.

Another difficulty will be that sometimes there is either hardly any objective information or there is none at all, because the information is 'contested'. Contested knowledge means that both the underlying facts and the underlying values or normative standards are controversial. Creating sufficient objective information is impossible, because there might be no consensus about data, methods, system boundaries, optimization or the normative standards (de Bruijn and Leijten, 2007). Parties might disagree about the definition of effectiveness or efficiency or about the impact of the design choices on economic efficiency, ecological effectiveness or social justice. If the input for the decision-making process is contested, this will probably lead to a very difficult process, because the parties will not agree on the outcome either. In order to deal with contested knowledge attention should be paid not only to the substance of analyses and information that are used, but also to the process of generating these analyses and this information (process management). The participants should not only be involved in the decision-making process, but also in the process of generating the analyses and the information; 'joint fact finding' (which means that they should have been involved in the conceptual analysis of chapter three, four and five). If the rules of the game are fair and allow all players to participate in forming the knowledge, their commitment to this knowledge will be stronger or it will at least be less easy for players to distance themselves from it, which will have a positive impact on the decision-making process. The result of a process of interaction is called 'negotiated knowledge': findings about which the participating actors agree (de Bruijn and Leijten, 2007).

The government should understand that it is not possible to design the optimal system of tradable permits based on complete and objective information, because the information is conflicting, contested or sometimes not available at all. So, the information of chapter three, four and five does not provide the optimal system of tradable permits, because the optimal design does not exist.

6.4.2 Increase support and commitment

Actors do not always behave fully rational, but sometimes they act appropriate. Chapter three, four and five assume that actors always behave rational. But, March and Olsen (2004) contradict the rational decision making process by generating alternatives and choosing the best alternative based on comparison of all alternatives by some criteria (neoclassical economics) with the view of decision making based on appropriateness of a certain decision by a particular actor within a social and institutional context (original institutional economics). This insight provided by the authors can be of significant value in the implementation process. When the government considers to implement tradable permits, it can be of great importance to see that these actors not only consider the consequences of their actions but that they also behave in a way they feel appropriate. When the government succeeds at creating conditions to show the participants their social and societal responsibilities towards the whole country and that there is no alternative available, they can be stimulated to act appropriate. This approach can increase the chance for successful implementation of tradable permits in a certain case.

Sometimes actors behave not like the government would like to, by taking advantage of the information-asymmetry with the government. In economics, the principal agent problem arises when a principal hires an agent in a situation of asymmetric information (Douma and Schreuder, 2002). The principal (government) wants the agent to act according to the interests of the principal. The agent wants to maximize his profit, so it will probably show strategic behaviour. Therefore, the principal must create incentives for controlling the agent. But, the principal and the agent do not have the same information, which is called information asymmetry. Both actors have their own, specific information, which they do not want to share with the other actor, because that might work against their own interest. In the relation between principal and agent is a lot of uncertainty, as a consequence of the asymmetric information between the actors (Jensen, 1997). Also in policy analysis the principal agent theory is commonly applied, when the relation between the government and the executers is discussed. In the case of tradable permits, the government can be seen as the principal and the participating firms can be seen as the agents. There is information asymmetry when tradable permits will be implemented. The government needs information (for example about current production level) from the participants in order to set the optimal target level. The agents might show strategic behaviour and provide the government with false or no information, in order to take care of their own interests. Without the agents' (correct) information, it will be very difficult for the government to set the optimal target. Information asymmetry was a major issue when defining the target level for the carbon dioxide trade, because the policy makers had not a good idea about the current CO_2 emission levels (Rammeloo, 2008). After implementation, the agents need to be monitored in order to control whether they stick to the rules. Information from the

agents is essential for monitoring. But, without knowing if the agents' information is correct and complete, monitoring them will be another challenge for the principal.

It is thus important that the government provides the participants an incentive for stimulating them to cooperate instead of showing strategic behaviour. According to de Bruijn et. al. (2002) and Ostrom (1990) the participants will be more likely to show appropriate behaviour instead of strategic behaviour, when they will be involved in the decision-making process:

When implementing tradable permits, the government is dependent on other actors, because the decision-making tends to take place in a network. In a network hierarchical decision-making has a little chance of success; involving the relevant parties in the decision-making process seems to be a better method, because then they will be more likely to show appropriate behaviour instead of strategic behaviour (de Bruijn et. al., 2002).

According to Ostrom (1990) the individuals that are affected by tradable permits should participate in the decision-making process, for example in defining the trading rules, because then they are willing to cooperate and comply with the agreements. Probably, the participants would feel more involved (and thus cooperate better) if they are not only involved in defining the trading rules, but also in the choice about whether or not implementing tradable permits and about the design of the system of tradable permits.

6.5 A PROCESS DESIGN

The previous paragraph showed the importance of a decision-making process, in which all relevant parties should be involved in an early stage. In order to structure that decision-making process a process design should be developed. A process design is the rules of the game for a decision-making process; managing such a process is called process management (de Bruijn et al., 2002). A process design consists of a set of agreements between parties about how they are going to decide about the design of a system of tradable permits in a certain sector.

An attractive process design can only come into being if all parties can participate in shaping it, so the process design is also the outcome of a process (de Bruijn, et. al., 2002). The main aim of the process design will be the commitment of all participating actors to the implementation of tradable permits, so none of the actors should have the feeling that they had no opportunity to influence the process and the outcome. For all affected actors it is important to be part of the process design, because it is their possibility to influence the possible outcomes of the process. In order to persuade all relevant actors to participate in the process, a possibility of gain must be built into the process. Adding more subjects to the agenda, where other parties than the initiators can benefit from, could do this. This increases the possibility to conclude the process with a win-win situation, represented by a package deal. The implementation of this policy will therefore be a process of giving and taking, wheeling and dealing (de Bruijn et. al., 2002).

Using a process design for decision-making also brings some risks. The more parties will be involved, the longer the process might take and the less manageable the process will be for the government. There is a substantial risk that no decisions will be taken, even though consultations and negotiations take place. The process must have sufficient speed and progress, because a process without any progress is frustrating for all participants. The speed and progress should also meet the requirement of substantive quality. Forced by the sharp conflicts of interests, the parties may take decisions that are poor from a substantive point of view or even incorrect ('negotiated nonsense') or impossible (de Bruijn et. al., 2002). The government must also realize that she cannot decide on her own about the outcome of the process, so the outcome of the process might be different than the favoured outcome.

To design the process, the government should contact an independent process architect. When the process architect develops the process design the risks as mentioned above should be kept in mind, for example by designing some rules for the decision-making process that guarantee substance or a certain progress. To make sure that the process as designed by the process architect will be followed, also a process manager should be appointed.

The process architect should design a process that is attractive to each of the parties involved: they should be convinced that the design offers them a fair chance of influencing the decision-making and that it will not harm their core values. The process design should consist of the following elements at least:

- Which parties will be involved and what are their roles?
- Which rules will be applied during the decision-making?
- What is the role of the process manager?
- Which subjects will be discussed?

A well-designed process design increases the chance of a well-performed implementation process and thus a successful implementation of tradable permits. The goal of the process design will be a design of the system of tradable permits contributing to sustainable development, which is supported by the relevant parties.

6.6 CONCLUSIONS

Based on the empirical analyses of milk quota and carbon dioxide permits several conclusions for further analyses have been found:

When designing a system for tradable permits the three pillars of sustainable development sometimes conflict with each other. Often trade-offs have to be made within, but also between the three pillars of sustainable development. This will make the decision-making process about the design of the system of tradable permits much more complex, because the optimal design of a tradable permits system does not exist.

It is possible to make adjustments to the product or the market to deal with imperfections of the characteristics. Additional measures can for example be taken to increase the trans-

parency of the market or to adjust the product, to make it homogeneous. This is an important conclusion for designing the evaluation framework, because it means that for a successful tradable permit system it is not necessary that all characteristics are perfectly fulfilled.

A system of tradable permits should have the opportunity for adjustments. This provides the government to opportunity to deal with new insights coming up during the trade.

When the government would like to implement tradable permits in a new case, not only the characteristics of the market and the product should be taken into account, but that also the implementation process is crucial for a successful implementation of tradable permits. Several risks and opportunities, which influence the implementation process, can be distinguished: current policy, policy of other countries, role of local and regional government and the decision-making process.

The decision-making process is an important influencing factor of the implementation process, because the government cannot decide on her own about whether tradable permits will be implemented or not and what the best design of the tradable permits system will look like. First of all the relevant parties would not accept and support the outcome, if they were not involved in the decision-making process. Secondly, it is not possible to design the optimal system of tradable permits based on complete and objective information, because the information is conflicting, contested or sometimes not available at all.

Therefore a process design should be developed, to structure the decision-making process about tradable permits. This will provide the participants an incentive to cooperate in implementing tradable permits, which will increase the chance on a successful implementation.

7. EX ANTE EVALUATION FRAMEWORK

Tradable permits are not economic efficient, ecological effective and social justified in every case, so in some cases another policy instrument might be a better option. This leads to the following goal of this chapter:

To design an ex ante evaluation framework to assess the potential contribution to sustainable development of tradable permits, which can help the government to decide whether or not implementing tradable permits in a certain case.

If the government considers implementing tradable permits in a new case, the first step is to investigate if it is possible to fulfil all basic conditions for trading (as distinguished in chapter two), in order to develop a market, which is described in paragraph one.

The second step would be to analyse if the market and the product are suitable for implementing tradable permits. The theoretical analysis from chapter three, four and five has provided several characteristics for the market and the product, which can influence the chance for a successful implementation of tradable permits in that case. The characterisation of the market and the product give a description of the sector where tradable permits are considered to be implemented. In order to structure this analysis, some assignments are formulated. In order to increase the support of the relevant parties, they should also be involved in the analysis phase, otherwise the problem of contested knowledge (as mentioned in the previous chapter) may rise. So, the government and the relevant parties should analyse together whether the market and the product are suitable for implementing tradable permits. If the characteristics seem suitable, it can be concluded that tradable permits have a high chance of becoming a successful policy instrument. Then the parties can decide to implement tradable permits in that case. The empirical analysis from the previous chapter showed that it is not necessary for a successful implementation that all these characteristics are fulfilled, but that there are various possibilities to deal with the imperfections. If the characteristics do not seem suitable for the implementation of tradable permits, there are often possibilities to make adjustments to the product and market in order to influence the characteristics. However, these adjustments may influence the market in such a way, that an effective and efficient market cannot be guaranteed. So, if too many characteristics seem not suitable for implementing tradable permits and too many adjustments to the market and the product must be made, the government can better not implement tradable permits in that case. The characteristics and the possibilities to adjust them are described in paragraph two.

The framework is not complete with an overview of the important characteristics, because the empirical analysis from the previous chapter also showed that the implementation process is also very important for success. Thus, the next step is to analyse the risks and opportunities of the implementation process, based on the assignments formulated in paragraph three. This analysis should also be performed together with the relevant parties. If there are some risks that might hamper the successfulness of implementing tradable

permits, the government should find a way to deal with them. The risks and opportunities that influence the implementation process are discussed in paragraph three.

In paragraph four the framework is used to assess to possible new applications of tradable permits (tradable business area permits and tradable water quality permits) in order to assess the potential contribution to sustainable development of tradable permits in those sectors. Paragraph five provides a reflection on the framework.

If the analyses of the basic conditions, characteristics of the market and the product and the external factors are performed, the next step will be the decision-making about whether or not implementing tradable permits (based in the information collected while using this framework) and the decision-making about the design choices (based on the information of chapter three, four and five), in which the relevant parties should be involved as well. A process design (see the previous chapter) should support structuring this decision-making process.

7.1 BASIC CONDITIONS

The first step is to investigate if it is possible to fulfil all basic conditions for a trading, in order to develop a market. This means that should be investigated if the following conditions are possible to fulfil:

- buyers and sellers (investigate the current producers or emitters);
- a tradable product (investigate if it is legally allowed to trade the right to produce or emit, of not investigate the possibilities to adjust this);
- a scarcity of permits (make sure a scarcity of permits is allocated);
- sufficient possibilities for innovation measures (investigate the possible measures to reduce the production or emission);
- a measurable and unambiguous unit (investigate if a measurable and unambiguous unit can be defined).

7.2 CHARACTERISTICS OF MARKET AND PRODUCT

Theoretical analyses from the previous chapters have provided several characteristics of the market and the product that influence the potential successfulness of a system of tradable permits. The characteristics cannot be described by a simple checklist, which states that if a certain number of characteristics is present, tradable permits will be successful. Instead of that, some assignments are formulated, which will be a guideline to make a good and complete description of the characteristics of the market and the product.

The government can try to influence some conditions by taking extra measures, which might have a positive effect on the contribution to sustainable development of tradable permits. However, influencing these characteristics might prevent the system from being cost-effective. The characteristics can sometimes also be influenced by the design choices.

Buyers and sellers
In order to start the trading between the different participants there should be sufficient participants. More participants of the trade will also increase the dynamic efficiency. Not only the number of buyers and sellers matters, but also the type and the size of the buyers and sellers, because that might influence if certain participants have market power.

Research how the market currently looks like: how many possible buyers and sellers are in the sector where tradable permits are considered to be implemented. Also analyse if that number is increasing or decreasing and what the expectations for the future are, based on the current trends in that sector and based on the expected consequences of the implementation of tradable permits. Secondly, investigate whether there are buyers and / or sellers that might have market power, because they are bigger or richer than others. If there might be buyers and sellers with market power, investigate how many and what the differences are. Next, analyse the type of buyers and sellers, for example they can be government organisations, multinationals, individuals etcetera. Based on these analyses can be concluded if additional measures to increase the number of buyers and sellers or to protect certain buyers and sellers are necessary for a successful trading system.

The government can try to expand the number of buyers and sellers in a certain sector, by defining easy entry rules (see below). In some cases the government can also oblige more parties to join the tradable permit program. For example in case of the CO_2 emission trading program, only the big CO_2 emitters are joining the trade, so in this case the government can expend the trading program to smaller emitters. In other cases (milk, manure, fish) all producing parties are involved, so the number of buyers and sellers cannot be expanded.

Transparency
Each producer or client should have perfect and complete information: all relevant information about the market and the product, like price, availability and quality of a product or service must be immediately and easily accessible for everyone, without high costs. This is necessary information for the participants of the trade, when they are deciding if they will buy or sell their permits.

Investigate which information is necessary for an efficient trade (examples: price, availability, quality) and whether that is immediately accessible for everyone: are the companies willing to share their information? Analyse the transaction costs for search and information. Based on these analyses can be concluded if additional measures to increase the transparency are necessary for a successful trading system.

In case of many buyers and sellers, it will not be possible for all consumers to have perfect information, but the government can take extra measures. The permits can be sold monthly or weekly at a central permit exchange or public auction. For example, milk quotas in Ireland (Ministerie van LNV, 2006a), Germany and Denmark (Vogelzang, et. al., 2003) are traded at a central exchange. And the sulphur dioxide (SO2) trading program in the United States of America under the Clean Air Act amendments of 1990, has shown

that a public auction increases the transparency of the market and has also a stabilising influence on the market (Brouwer et. al., 2001). The government can also arrange that a supervising company will take care of a website with all information about transactions and prices. For example, the Netherlands Emission Authority (NEA), which is the supervisor for the carbon dioxide trading in the Netherlands, hosts a website with all relevant information for the firms (NEA, 2008).

Entry and exit rules

Every company should have free and immediate entry- and exit possibilities, without high costs. This makes sure that every company who wishes to enter or exit the tradable permit market can do so.

Analyse what the barriers are to enter the market look like and if they would prevent potential buyers and sellers from stepping into the market. Analyse what the barriers are to exit the market look like and if they would prevent buyers and sellers from stepping out of the market. Investigate which investments have to be made when stepping into the market, how much these investments cost and if they are asset specific or not. Based on these analyses can be concluded if additional measures for an easier entrance of exit are necessary for a successful trading system.

Easy entering is influenced by the chosen trading system and initial allocation. Entering a tradable reduction market is easier then entering a market for tradable permits, because in the last case the entering party is dependent on buying new rights from other parties. In a tradable reduction market the entering party just needs to comply with the performance standard rate. Entering a market, which is allocated using auctioning is easier then entering a market allocated using grandfathering based on historic rights. In the last case new participants cannot enter the market directly, but they have to wait until they can buy permits. In case of auctioning they can buy permits at the auction and immediately start producing. A free initial allocation imposes also a bias against new users, because new firms have to purchase all permits, while existing firms get an initial allocation for free.

If the government plans to implement tradable permits in a market with mixed or idiosyncratic investment characteristics, the barriers to enter or exit a market will be very high. Additional measures should be taken before implementing, because otherwise no transactions might take place, which prevents tradable permits from being successful. Additional measures might be to increase the transparency, provide additional financial incentives and to promote how to reduce emission or reduction.

Homogeneous product

The ecological target will only be achieved if the traded product is homogeneous, which means that goods are perfect substitutes: there is no product differentiation for all users (in time and space), so all firms produce or emit an identical product. Only if the traded units are homogeneous, the system can guarantee that the increase in production or emission by a purchasing source is equal to the decrease of production or emission through the reduction of the selling source (Keudel, 2007).

Investigate what the tradable product looks like: analyse whether the product homogeneous in time (if it matters from an environmental point of view when the product is produced or emitted) and whether the product homogeneous in space if it matters from an environmental point of view where the product is produced or emitted). It is also important to investigate if the value of the product is the same for everyone. Based on these analyses can be concluded if additional measures to make the tradable product more homogeneous are necessary for a successful trading system.

If the product is not homogeneous, additional measures can be taken to ensure the ecological effectiveness. Absolute emission or production ceiling can be implemented, or trading could be allowed only within designated zones (creating submarkets). In the Regional Clean Air Incentive Market (RECLAIM) initiative, which is the Californian program to control the sulphur dioxide (SO_2) and nitrogen oxides (NO_x) emissions, the risk of trading leading to high pollutant concentrations is minimised by dividing the region into two zones. Plants in the upwind zone cannot purchase downwind permits. Whatever restrictions are made, there will be a trade-off between environmental protection and maximising the potential economic gains. The creation of submarkets lowers the number of buyers and sellers in a certain market and a ceiling can prevent the market from being cost-effective (Sorrel and Skea, 1999).

Technical ability to monitor

The absence of an effective and well-defined monitoring and enforcement system raises incentives for non-compliance. Monitoring and sanctioning is thus necessary, otherwise the predetermined ecological objective will not be achieved. Enforcement depends on the technical ability to detect violations (Tietenberg, 2006).

Investigate whether it is possible to directly monitor the production or emission without high costs. They sources must be known and it must be possible to measure them. If that is not possible, investigate if it is possible to monitor the production or emission indirectly without high costs. Based on these analyses can be concluded if additional monitoring measures are necessary for a successful trading system.

In some cases monitoring is easy. For example, it is quite easy to monitor how much milk a farmer has produced, by checking how much milk that farmer has sold to a milk-factory. In other cases, the government must find other (indirect) methods to monitor. For example, carbon dioxide emissions are monitored by the amount of fossil fuels used, because that is directly related to the carbon dioxide emissions. If that is also not possible, the participants can be asked to monitor themselves, but therefore the participants have to cooperate.

7.3 IMPLEMENTATION PROCESS

The empirical analyses in chapter six have provided risks and opportunities that influence the implementation and thus the successfulness of a system of tradable permits. It is important that the government recognises them and knows how to deal with them. Again

some assignments are formulated, which will help to describe possible risks and opportunities of the implementation process.

Current policy
Analyse what the current policy in that sector looks like and which adjustments to that policy are necessary before implementing tradable permits. Analyse if the new policy will have support or not, based on the fact if it will be less or more flexible than the current policy.

Policy of other countries
Investigate the boundaries of the ecosystem and if it is possible to develop a market covering the whole ecosystem: which countries will join the trading system and which countries might be convinced to do so? Secondly, analyse the risk that companies move to other countries with fewer regulation, by investigating what the current policy in other countries in that sector looks like: is it less or more flexible than tradable permits? Companies do not base their decision on regulation only, so the tax system, possibility to find good employees, the salaries and other costs (like land price, costs to move and other investments) should be investigated too. Investigate if countries have experience with tradable permits in that sector and if these experiences are positive or negative. Also investigate what can be learned from these experiences.

Role of local and regional governments
Investigate whether the local and regional governments will support the implementation of tradable permits and if they will cooperate with the implementation. Investigate the possible power of the local and regional governments to obstruct the implementation of tradable permits.

Decision-making process
Investigate which parties might be affected by the new policy and investigate their interests. Secondly, should be analysed if the relevant parties recognise the sense of urgency of implementing a new policy (which was the case when milk quota were implemented), for example because that could guarantee them a better income. Investigate which parties will have the most and the least resistance and if there are possibilities for a phased implementation. Investigate the major issues in the sector, which might help to create a sense of urgency, by linking these issues to create a win/win situation.

7.4 Application of framework on new cases

As mentioned in the introduction (chapter one) the Dutch government considers to implement tradable permits in several new cases. Therefore the evaluation framework will be used to assess two possible new applications of tradable permits, in order to investigate whether tradable permits can be successful in these cases and to test the applicability of the framework. The cases used for application are business area permits (subparagraph one) and water quality permits (subparagraph two). The main goal of this paragraph is:

To assess the potential contribution to sustainable development of tradable permits in a specific new case, based on the characteristics of the market and the product, the external factors and the fulfilment of the basic conditions.

7.4.1 Business area permits

"Increase distribution of business areas persists"
Ministerie van VROM (2007)

Many municipalities would like to attract firms to their municipality, because this has a positive influence on the employability in that area and it will give them financial profits from the sale of land. Therefore the municipalities have low prices for their land, in order to attract companies to move to their municipality. For this reason there is no incentive to be sparing with space, causing a low density of firms in business parks. Because of the fact that it is cheap for firms to move to a new place, firms are not willing to invest in renovation of their old buildings. Many commercial properties at older business parks are unused and have high renovation costs. More than 21,000 hectare of business parks need to be renovated, which is around 20 percent of the total surface of business areas (Ministerie van EZ, 2004).

In order to start the redevelopment of these business areas and to limit the municipalities selling their land to the project developers or the firms, Jan-Willem Wesselink and prof. Erik Verhoef developed the idea to introduce business area permits, which is based on the idea of tradable development rights in the US. The national government can allocate these permits to the local government (municipalities), giving them the right to develop a certain surface of business areas. The local government needs a certain amount of quota, before selling the land to companies, which, in theory, can help the national government to achieve both goals. Assuming that there is a certain demand for business area properties and the permits are scarce, the price for the permits will raise. For the municipalities having the lowest restructuring costs, it will be more attractive to restructure old business areas instead of developing new areas. They will do so and sell their permits. Municipalities having high restructuring costs will buy those permits and develop new business areas with a high density of firms, otherwise it would be too expensive for them (Wesselink, 2007). The Dutch Minister of Environment has already shown her interest in the possibilities of tradable business area permits. Since there is no experience with tradable business area permits in other countries, the evaluation framework will be used to assess the potential contribution to sustainable development of tradable business area permits.

Basic conditions
The first step is to investigate if it is possible to fulfil all basic conditions as defined in paragraph 2.1 in order to develop a market.

The first boundary condition is that there should be buyers and sellers of the permits, which will be the Dutch municipalities according to the plan of Jan-Willem Wesselink and prof. Erik Verhoef.

Secondly an incentive to trade should be provided by the scarcity of permits and sufficient possibilities for innovation measures. Currently there are many possibilities for innovation available in the business area sector. The first possibility for innovation is to restructure current business areas. Many commercial properties at older business areas are unused and the density in those areas is low, so restructuring would provide space for new companies. When the municipality decides to develop a new business area, she can make sure that the density of buildings in that is much higher, because then the municipality needs to buy less permits. These measures will differ in cost-effectiveness, because all new-build buildings and older business areas will have different characteristics and thus different costs. Other innovation possibilities can be: underground building or combined building (multiple function, for example living and business area).

Thirdly, there should be a tradable product, which will be the right to develop a m^2 of land into a new business area, which will have the unit m^2 of developed business area. This is not a measurable and unambiguous unit, for several reasons:

- Currently the classification of business area does not exist in the Dutch legislation, so it is not defined if a certain development is a business area or not. This should be adjusted before tradable permits can be implemented (according to professor Korthals Altes), which can take a long time.
- Also the classification new business area and restructuring an old business area does not exist. It should be exactly defined when land is developed into a new business area and when it is restructuring, because for restructuring no permits are required.
- Also should be defined what a m^2 of developed business area is: does that mean m^2 build or m^2 developed?

Buyers and sellers

The number of participants joining the trade of business area permits is equal to the number of municipalities in the Netherlands, 443 at this moment. Some of the municipalities are bigger, more attractive or richer than others, so some individual might have an influence on the price (market power), which can hamper the efficiency of tradable permits. A trend worth noting is that the number of municipalities has been decreasing since 1992, due to municipal merges (in Dutch: gemeentelijke herindeling). Probably, the number of municipalities in the Netherlands will decrease even more in the next couple of years (but not as much as the previous years), because some merges are scheduled. This trend might be a risk.

The government can take extra measures to prevent municipalities using their market power. The government can for example set a maximum of permits that a municipality is allowed to buy. The number of buyers and sellers can be increased by expanding the boundaries of the trading system to other countries. But this might be a risk when municipalities from other countries are richer then Dutch municipalities and buy many Dutch permits. In that case hardly any business area will be developed in the Netherlands, which is not good for the employment rate. On the other hand, probably the Dutch fiscal system

and the availability of employees will have more impact on the location choice than the price of land.

Also the role of the land owner should be taken into account. Often a farmer owns the land which is scheduled to be developed, instead of the municipality. Farmers might wait with selling their land to the municipality, due to expected increases of land price. This might influence the land market.

Entry and exit rules
Free entry rules is not an issue, because it can be expected that no new municipalities come into existence, so no new parties will enter the market. It is possible that the number of municipalities decreases, because of merges. In that case, the government should allow the merged municipalities to combine the permits that they have. The investment characteristics are not specific, because the land which was scheduled to be used for the business areas can be used for many other purposes also, like recreational or living purposes. Even if the land will not be developed at all and stays empty, the surface will still have a certain value, because people appreciate surface without any buildings.

Transparency
The number of municipalities is not very large, but too large to know all other municipalities' development plans (other than close neighbours), but due to digitalisation this information will be easier accessible. For an effective market, the municipalities should know how many permits are for sale and the price of the permit, in order to choose if they are going to buy permits and develop a new business area or renovate an older business area. The government can organise a central exchange, a public auction or maintain a website with all relevant information, to make sure that all relevant information is easy accessible for everyone.

Homogeneous product
Land is not a homogeneous product in space, because the price of land differs per location. The price of land depends for example on the accessibility, other businesses and availability of employees. Also the surface of land differs in space, which makes it less or more attractive (or expensive) to build on. The average price of a squared metre of land varies currently between €34 (provinces of Groningen and Friesland) to €205 (province of Zuid-Holland; Ministerie van VROM, 2007).

Due to the differences in land price, the willingness to pay for the permits will differ too. Some municipalities have high prices of land (for example in the bigger cities or in the Randstad area), for these municipalities the permits will be relatively cheaper, so these municipalities will buy the permits. For other municipalities (country side) the price of land might be even lower than the price of the permits, so these municipalities will sell their permits. This difference in the willingness to pay has nothing to do with differences in efficiency, but only with location. Thus, in case of tradable business permits, not the municipalities that can build at the most efficient way will buy the permits, but the municipalities with the highest prices of land.

This will cause that only municipalities with high prices of land will buy permits and that firms only settle in or move to these municipalities. In that case the employment in the country side will decrease and the cities will get denser and busier, which is not contributing to sustainable development. This might cause congestion, a lower quality of life and health problems. If the government supports the force of the market, this will give no problem, but probably the government would like to have sufficient employment in the rural areas too.

The government can influence the homogeneity by dividing the municipalities into several categories, each having similar characteristics (like prices of land, density, employment rate). Municipalities would be allowed to trade within their category only. However, in order to make a good distinction between the municipalities, a large number of categories is necessary, but in that case the number of buyers and sellers in each category will be much lower, which might hamper the economic efficiency.

The homogeneity of land also causes that tradable business area permits will have a limited influence on the location choice of a company (and thus limited effectiveness), because the accessibility and the availability of employees will be much more important for the location choice than the price of land. The older business areas are often in cities instead of close to the highway, causing high transport costs. The prices of land will be marginal compared with all other costs (salaries, transportation, building etcetera), so business permits will be an inelastic good. This means that an increase of the price will cause a slight decrease of the demand. According to prof. Korthals Altes even a double land price (due to the price of permits) will not affect the location choice of the companies, because the profits of moving (better accessibility) will be higher than the costs.

Technical ability to monitor
Even if a municipality has a permit to develop a certain surface into a new business area, still a building permit is necessary and the development must be stated in the municipalities' development plan. The building permit and the development plan must be published in public. The government can check all building permits for business areas for the fact if the municipality has sufficient permits for that surface. Even if the system of building permits does not exist, it is easy to monitor, because it is visible where new business areas are build. Extra monitoring measures to increase the effectiveness of tradable business area permits are not necessary.

Implementation process
Also the following risks and opportunities that influence the implementation process have been identified:

Current policy
Currently, the national government cannot limit the number and size of business areas being developed. The municipalities make a development plan, in which they state how much land they plan to develop for business parks. According to this plan they will sell

that amount of land to the project developers or the firms. This makes it easier to build up new policy from scratch, but it might cause a lot of resistance of the relevant parties.

Role of other countries
Surrounding countries of the Netherlands do not have any policy to limit the number of new business areas build, because they do not have a scarcity of land. Tradable business area permits might cause higher prices of land (because the municipalities recharge the costs of the permits in the price). This might be a risk, because if the prices of land will increase a lot, companies might consider moving to another country, because that might be a lot cheaper for them. On the other hand, the fiscal system and the accessibility will be much more important for the location choice than the price of land.

Role of local and regional governments
The municipalities will probably not be in favour of this initiative, because they are going to pay for the right to develop a business area, which used to be free. Of course they have the possibility to recharge the costs of the permits to the project developers, but due to the limited amount of permits they will probably sell less land, so they will have fewer benefits.

Decision-making process
Many parties play an important role in the land market: the farmers (selling their land), the municipalities, the project developers and the firms. Probably all parties would not agree with this initiative, because there is no current policy to limit the amount of business areas build and that these parties do not have a sense of urgency (they do not see the direct consequences of their excessive land use). Thus, a lot of resistance can be expected, which will make the decision-making process more difficult. In order to create a win/win situation certain issues might be linked to the decision-making, for example: accessibility of business areas by public transport and subsidies for sustainable building and renovating older business areas.

Conclusions
According to the characteristics of the product and the market can be concluded that it will be difficult to make tradable business area permits contributing to economic efficiency, ecological effectiveness and social justice and thus a successful policy instrument.

Although the product is not perfectly homogeneous, possibilities exist to adjust the market (dividing into subcategories) in order to deal with that, but this will make the trade less efficient. If no measures will be taken to adjust the homogeneity, this will have negative consequences for the equal distribution of the firms in Netherlands. Also extra measures to increase the transparency are necessary. One of the basic conditions, a measurable and unambiguous tradable product, will be very difficult to fulfil, which might be a problem.

This might hamper the trade, therefore tradable business area permits on a local level (where every municipality receives a certain amount of permits, she can sell to the interested project developers) or a non-tradable quota might be a better option to solve the

tragedy of the business areas. Another alternative is to develop a similar system for business areas as the 'office for office' initiative developed by Janssen-Jansen (2007). This initiative states that a company can build a new office, as long as they renovate an old office. This initiative can be applied to business areas too, which would mean that a new business area can only be developed if an old business area is restructured. Also a joint initiative of the firms to invest together in the restructuring of a business area (Business Improvement District) might be a solution (Regioplan, 2006).

7.4.2 Water quality permits

Water rights trading could be implemented with regard to water quality for eutrophication (discharge of nutrients) and discharge of cooling water. There are currently many discussions in the Netherlands about tradable water quality permits, but there are no concrete plans yet. Industrial sources and agriculture are parties for water quality rights trading. (Urban) wastewater treatment plants also discharge some pollution into the water, but they have the legal instruction to clean the water, so they will not be taken into account. The instrument is less suitable for toxic and bio accumulating substances, because the government tries to limit the emission of these substances as much as possible, so in these cases stricter regulations seem more suitable (Klooster et. al., 2007).

In the Netherlands there is no experience with water quality permits so far, but in the United States, different types of tradable water quality permits have been introduced, but all at a local (instead of a national) level (Keudel, 2007). The cost savings with regard to direct regulations can be considerable (tens of percentage points, Klooster et. al., 2007), but water quality permits have generally not been very successful (Hahn and Hester, 1989) due to the fact that an emission cap has not yet been determined in many places (Klooster et. al., 2007).

Basic conditions
The first step is to investigate if it is possible to fulfil all basic conditions as defined in paragraph 2.1.

The first boundary condition is that there should be buyers and sellers of the permits, which will be the firms that currently pollute the water: farmers and industrial sources.

Secondly an incentive to trade should be provided by the scarcity of permits (by allocating less permits than the current pollution) and by sufficient technological measures that are available in the near future (Klooster, et. al., 2007), because without innovation hardly any trading will take place. A market might be very static, because the participants might have taken reduction measures recently. If there are little possibilities for innovation measures available, the government can try to stimulate research and development by extra subsidies. Farmers can lower their water pollution by using other or less insecticides. The industrial sources can lower their water pollution by using better filters or by innovating their treatment method. The cost-effectiveness of these innovation measures will differ: the marginal abatement costs for the farmers are much lower than those for the industrial

sources (Keudel, 2007; Klooster, 2007), which will be an incentive for the farmers to innovate and sell their permits to the industrial sources.

Thirdly, there should be a tradable product, which will be the right to pollute the water. This can be the right to pollute a certain amount of a specific matter (phosphor, nitrate) or the right to pollute a certain amount of equivalent of a certain matter (for example if the types of pollution are comparable and has the same ecological impact or if a certain conversion factor can be used, which is the case with greenhouse gasses). The polluters currently have the right to pollute, so regulation should be adjusted in order to make the right to pollute tradable.

There are several possible units to express this right, each having advantages and bringing certain risks:

- kg of pollution/year, which means that every pollutant can discharge a certain amount of pollution every year. This is an efficient unit for the pollutant, because the pollutant can easily know how much pollution he is allowed to discharge and schedule their production according to this knowledge. However, this does not guarantee a certain water quality (less ecological effective), because the pollution does not disperse uniformly within the water, so local concentrations are possible (this is not the case with CO_2, because CO_2 disperses quickly in the air and a higher concentration at a certain moment does not harm the environment). The pollution level does also depend on the water quantity, which will differ during the seasons. This unit should be monitored at the pollutant itself, for which their cooperation is necessary.

- grams of pollution/m^3 (maximum at a certain point), this unit guarantees a certain water quality (ecological efficient) and can easily be monitored, by checking the water quality several times. This unit brings some difficulties for the pollutant, because they should adjust their production level to the current water quantity and the current pollution level, which provides less flexibility. Probably, this unit will provide very little opportunities for trading, because in order to guarantee a certain ecological target everywhere, the target will be strict.

- grams of pollution/m^3 (average at a certain point), this unit guarantees an average water quality (more effective than the first unit), but high concentrations at a certain moment are still possible, which can be very undesirable. This unit provides more flexibility to the pollutant than the second unit, because their production level does not have to match the current water quantity and the current pollution level all the time, as long as the average is alright. The disadvantage is that constant monitoring is necessary, which might bring extra costs.

Buyers and sellers

The possible buyers and sellers are farmers and industrial sources. The group of farmers is very large, but decreases fast: within the last 25 years the number of farms in the Nether-

lands decreased from 145,000 till 84,000. The marginal abatement costs for the farmers are much lower than those for the other sources (Keudel, 2007; Klooster, 2007; Kieser and Fang, 2005), so in general the industrial sources will be buying permits and the farmers will sell permits. The number of industrial sources is much smaller than the number of farmers, so the industrial sources will therefore have the market power to influence the price, creating an equity issue (Kieser and Fang, 2005).

Entry and exit rules
The investment costs for entering the market will be high (land, equipment, plant), so new entrants will have a barrier to enter the market. The main investment characteristics of the farmers are non-specific, because their main investment is land, which can be used for other purposes as well. For the industrial sources the main investment characteristics are their plant with the equipment. This is a very specific investment, because their plants are build specifically for them, so they cannot be used for other purposes. The government cannot adjust the investment characteristics, but she can take extra measures, like provide extra incentives for innovation. These measures can increase the efficiency, but the efficiency will still be less than in case of non-specific investment characteristics.

Transparency
The group of buyers and sellers will be very large, so extra measures are necessary. For an efficient market, the participants should know how many permits are for sale and the price of the permits, in order to choose if they are going to buy permits or reduce their pollution load. The government can organize a central exchange, a public auction or maintain a website with all relevant information, to make sure that all relevant information is easy accessible for everyone.

Homogeneous product
Water pollution is not a homogeneous product, because the location of discharges is more important with water rights trading than with emissions to air (Klooster, 2007). Pollution does not disperse uniformly within the water, thus local concentrations are possible, which are called hot spots (Keudel, 2007). This might cause problems if a plant close to a sensitive ecosystem buys many emission permits and disturbs the ecosystem. Within the whole system of during a whole period the water quality goal might be achieved, but locally or at a certain moment the limits might be exceeded (Klooster, 2007). So when designing the water rights trading system, attention must be paid to preventing quantities that are too great on a local level or at a certain moment.

To do so extra regulation is necessary, although this might hamper the efficiency. Absolute emission or production ceiling can be implemented. For example a condition for vulnerable areas can be admitted, saying that the rights can only be used as long as the quality standards at a certain point are not exceeded. In the US the Total Maximum Daily Loads (TMDLs) is developed, which is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards (Kieser and Fang, 2005). Another solution would be to allow trading only within designated zones (creating submarkets). It is also possible for the government to verify and approve every individual

transaction (Klooster, et. al., 2007), but that will increase the transaction costs, which is not desirable.

Technical ability to monitor
Two different sources of water pollution can be identified. Point sources (industrial sources) discharge their pollutants at a fixed and well identifiable point into the river. The discharges made by point sources can therefore be precisely monitored: this makes it possible to assign individual accountability for the pollution. Non-point sources, for example farmers, do not discharge pollutants at a precise point. It is not possible to assign individual accountability for the resulting pollution. This results in a significant monitoring problem (Keudel, 2007). The non-point sources can be excluded from the trade, but that would make tradable permits less efficient. The number of buyers and sellers will be significantly lower and the marginal abatement costs for some non-point pollutants are much lower than those for point sources (Keudel, 2007).

Implementation process
Also the following risks and opportunities that influence the implementation process have been identified:

Current policy
The current policy instrument for water quality is regulation, which is an inflexible policy instrument. Tradable permits are more flexible, so the support of the participants for tradable permits will be high. On the other hand, due to the fact that current regulation that works well, there is no sense of urgency for a new policy instrument.

Role of other countries
Due to the many rivers that flow into the Netherlands, the pollution that is discharged upstream into those rivers will end in the Dutch ecosystem of water. So, the boundaries of the Dutch ecosystem of water are larger than the border of the Netherlands. Thus agreements with neighbour countries, like Belgium and Germany are necessary. Currently the policy instrument for water quality in these countries is regulation. When tradable permits are introduced in those countries as well, agreements must be made about the level of permits, which can be quite a challenge. There will be no risks that the non-point sources will move to other countries due to the introduction of tradable water quality permit, because they will be sellers of permits (and thus make their reduction measures profitable). The point sources will not move either, because for them the costs to move (plant, equipment, employees) will be very high.

Role of local and regional governments
The implementation of tradable water quality permits does not affect the local and regional governments at all, so they will probably have no resistance to the implementation.

Decision-making process
Tradable water quality permits will provide the pollutants more flexibility than the current regulation, so they will probably support this new policy instrument. This makes the deci-

sion-making process not so difficult. In order to increase the relevant parties' support certain issues might be linked to the decision-making to create a win/win situation, for example: subsidies for innovation measures and tax advantages.

Conclusions
Based on the characteristics of the ex ante evaluation framework can be concluded that tradable water quality permits have a low chance of being a successful policy instrument. Tradable permits seem very applicable to point sources only, while point sources can easily be regulated with regulating policy instruments. Applying tradable permits on only the point sources will rescind all the economic and social advantages of tradable permits.

If the government chooses for a unit kg of pollution/year or average grams of pollution/m^3, high concentrations at a certain point and/or at a certain moment are possible, because water pollution is not homogeneous in time and in space. In that case the ecological target might not be achieved. It will also be difficult to monitor in case of non-point sources. If the government chooses for the unit maximum grams of pollution/m^3, a certain ecological level will be guaranteed, but this will influence the flexibility of the pollutant (less efficient). Other issues that might come up are that there might be market power and that the high asset specific investments cause a high barrier to enter or exit the market, which will also hamper the economic efficiency of the tradable permits market.

Even though there are possibilities to make adjustments to the market in order to influence the characteristics, these adjustments will influence the market in such a way, that an effective and efficient market cannot be guaranteed. Tradable water permits might in theory be more efficient than strictly regulated policy, but with all the adjustments that are necessary to deal with the imperfections of the market and the product, the advantages of a tradable permit market will be little. If there are hardly any efficiency advantages and the ecological effectiveness cannot be guaranteed either (because water pollution is not homogeneous and difficult to monitor), it might be a better idea to choose for a different policy instrument, like strict regulation to make sure that the ecological effectiveness is guaranteed.

7.5 Reflection on the framework

The ex ante evaluation framework is applied on two cases where tradable permits are considered to be implemented to assess whether tradable permits have a potential to be a successful policy instrument in that case or not. While using this framework to assess the cases, the following critical issues raised:

- Following the framework does not provide a complete overview of a sector, but only deals with the most important issues. Every sector has its own characteristics influencing the potential successfulness of a tradable permit system, while only the general characteristics are in the framework. Therefore the framework should be used with an open and critical vision, while keeping the limitations in mind every time using this framework.

- After a description of the sector is made, based on the formulated assignments, the researcher should conclude about the potential successfulness of tradable permits in that sector, but the framework does not provide a good guidance to conclude based on the descriptions. Often the analyses are interpretable in multiple ways and the conclusions might depend on the person using the framework. To increase the transparency of the conclusions and thus the commitment of the relevant parties with the conclusions, they should be involved not only in the analysis phase, but also when interpreting the analysis. A second-opinion of an independent researcher will increase the chance that the right conclusions are drawn.
- Some characteristics are more important to be fulfilled than others, but this is not described in the framework. It is up to the parties to decide which characteristics are considered more important. In further research weight factors might be formulated, which will be helpful during the conclusion phase.

While using this framework to assess the cases, the following positive issues raised:

- The framework provides a good guidance to describe the factors influencing the successfulness of tradable permits. The framework also helps to structure the way of thinking.
- The framework supports the researcher to adopt a critical point of view, instead of only a focus on the advantages of tradable permits.
- The framework helps to increase the transparency of the decision-making process about tradable permits. Especially when the government and the relevant parties analyse together whether the market, the product and the external factors are suitable for implementing tradable permits. This decreases the chance of contested knowledge and increases the support and commitment of the relevant parties.

While constructing the framework the following issues raised:

- The single-dimensional and theoretical analyses of ecological effectiveness, social justice and/or the economic efficiency were very useful to come to the core of tradable permits. This approach forces to make a complete and detailed description of the contribution of tradable permits to that certain pillar of sustainable development. But, as the empirical analyses showed, tradable permits cannot be considered from a single-dimensional point of view, so all the insights had to be combined later on, which was not always easy to do so.
- The framework is constructed from a sustainable development point of view, but contribution to sustainable development is not the only criterion to assess the successfulness of a tradable permit system. Therefore all the time a certain balance had to be found between extending the framework in order to make it as complete as possible and making sure that this research deals with the core issues of a successful policy instrument only.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

The interest in the application of tradable permits in new cases is growing, but not every attempt to implement tradable permits has been successful. In this research a policy instrument is considered successful if it contributes to sustainable development, thus if it contributes to economic efficiency, ecological effectiveness and social justice. It would thus be interesting to asses ex ante whether tradable permits have potential to contribute to sustainable development in a specific case or not. Based on this, the research question, which is answered in this thesis, is the following:

What does an ex ante evaluation framework to assess the potential contribution to sustainable development of the implementation of tradable permits in a new case look like?

Based on a theoretical analysis of economic efficiency, ecological effectiveness and an empirical analysis it was found that the following issues influence the successfulness of a tradable permit system:

- The following basic conditions: there should be buyers and sellers, a scarcity of permits, possibilities for innovation, the permits should be tradable and a tradable unit should be defined.
- The following characteristics for the market and the product: buyers and sellers, technical ability to monitor, transparency, entry and exit rules and a homogeneous product. Empirical analysis showed that it is not necessary for a successful implementation that all characteristics must be completely fulfilled, but the better they will, the higher will be the chance for a successful implementation of tradable permits. If some of the characteristics seem not suitable for implementing tradable permits, there are often possibilities to make adjustments to the product and market in order to influence the characteristics.
- Also the implementation process is important for a successful implementation of tradable permits. The following risks and opportunities that influence the implementation process can be distinguished: current policy, role of other countries, role of local and regional governments and the decision-making process.

These three issues are the basis for the framework for ex ante evaluation of tradable permits. The framework supports the decision-making process about whether or not implementing tradable permits in a specific case, by investigating if tradable permits have a high chance of becoming a successful policy instrument in that case or not. The evaluation framework can be very useful when the government considers to implement tradable permits in a new case. The framework helps to structure the way of thinking, supports the researcher to adopt a critical point of view and helps to increase the transparency of the decision-making process about tradable permits.

The evaluation framework is used to assess two new applications of tradable permits: business areas permits and water quality permits. Based on this analysis can be concluded that, based on the characteristics of the market and the product, tradable water permits have a low chance of becoming a successful policy instrument. Also tradable business area permits have not a high chance of becoming successful, because it might be difficult to fulfil the (necessary) basic conditions. If the framework provides a negative advice, the government should be careful when considering implementing tradable permits in that case.

Furthermore it has been found that the design of a tradable permit system does not influence the successfulness, because trade-offs have to be made within and between the three pillars of sustainable development, thus the best design does not exists. So, the design choices are not part of the evaluation framework. What matters is the decision-making process about the design. The decision-making process is an important part of the implementation process, because the government cannot decide on her own about whether tradable permits will be implemented or not and what the best design of the tradable permits system will look like. First of all the relevant parties would not accept and support the outcome, if they were not involved in the decision-making process, while the government is dependent on the willingness and support of the participants and other actors. To increase their cooperation, the participants should be involved in the analysis phase and the decision-making process. Secondly, it is not possible to design the optimal system of tradable permits based on complete and objective information, because the information is conflicting, contested or sometimes not available at all. Involving the relevant parties increases their support, but also brings some risks. The decision-making process can take long, be hardly manageable and the outcome might be not effective or efficient. Therefore a process design should be developed, to structure the decision-making process about tradable permits to make sure that the outcome of the process is an optimal design of a system of tradable permits that is supported by all actors. This will provide the participants an incentive to cooperate in implementing tradable permits, which will increase the chance on a successful implementation.

Coming back to the introduction of this research, this framework has definitely an added-value compared with the frameworks as designed by Sorrel and Skea (1999), MDW (2001) and Van Der Kolk Advies et. al. (2006), because it provides a good overview of all issues that influence potential successfulness of a tradable permit system. The framework provides not only an overview of the characteristics of the market and the product, but also an overview of the external factors and the basic conditions. Also the importance of the implementation process for a successful implementation has been discussed, which has not been discussed in the other three researches.

8.2 RECOMMENDATIONS

These analyses result in the following main recommendations for the government. Additionally, some recommendations for further research are formulated.

Use evaluation framework to test new case
When the government is considering to implement tradable permits in a new case, the ex ante evaluation framework should be used to find out if tradable permits have a high chance of becoming a successful policy instrument in that specific case or not. The relevant parties should be involved in this early stage already, to develop support and knowledge. The government should handle according to the outcome of the framework.

Work out a process management strategy for decision-making
When the government and the relevant parties come to the conclusion that tradable permits have a high chance of becoming a successful policy instrument in a specific case, the government should appoint a process architect to design a process management strategy for the decision-making process about the design choices. The design of the process management strategy is a process itself, so the participants should be able to give their opinion too. The use of a process management strategy for decision-making instead of hierarchical decision-making increases the chance for a successful implementation of tradable permits.

Before the framework is ready to be used by the government, a couple of issues need further research.

Empirical analysis
In this research a short empirical analysis of two cases is performed, which should be extended in further research with insights provided by other historic attempts of implementing tradable permits, within and outside the Netherlands. The framework and the process management strategy should be compared with the characteristics and implementation strategy of successful and non-successful historic attempts of implementing tradable permits, to see if their success or failure could be predicted.

Application by others
In this research, the same person designed and applied the framework. Before the government starts applying the framework, the evaluation framework should be applied by others, in order to find out if it is useful, easy to use and really supports the decision-making process about whether or not implementing tradable permits in a new case. This application can be performed by other researchers or experts.

Extend framework
This framework has been constructed based on an analysis of economic efficiency, ecological effectiveness and social justice. In order to design a complete evaluation framework, the framework should be complemented with insights provided by other criteria for successful policy instruments too, like feasibility and attainability.

Weight factors
Some characteristics are more important to be fulfilled than others, but this is not described in the framework. It is up to the parties to decide which characteristics are considered more important. In further research weight factors should be formulated, which will be helpful for the government and the relevant parties during the conclusion phase.

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APPENDICES

APPENDIX A: CASES

Possible applications of tradable permits are:

Milk quota
Milk quotas were introduced in Europe on the 1st of April 1984. They were introduced to balance production and demand of milk and dairy, so to stop the European over-production. Every EU member state receives a certain amount of quota. The initial quota levels were based on the production of the previous year minus a certain percentage and there have been further reductions as well. The quotas are divided along the milk producers. Each year depending on how much the country as a whole is over quota, a super levy rate is set. This basically means that the producer is given a certain grace on his quota. Anything that a milk producer produced above its individual quota (+ the grace) will incur a super levy. This is a fine which is higher than the price of milk. In order to increase quota a farmer can lease or buy quota. The consequences of the implementation of milk quota have been an increased economies of scale, a higher productivity per cow and a decrease in milk production (MDW, 2000).

Manure quota
The intensive agricultural sector resulted in a manure surplus: on one hand the production of manure has increased on the other hand the possibilities to drop off the manure in a responsible way have decreased. In order to reduce the consequences for the environment a limit for the production of manure is set. In the Netherlands the manure production quota are introduced by the implementation of the Meststoffenwet and the Wet verplaatsing mestproductierechten. Also some restrictions for the use of manure have been implemented (MDW, 2000).

Sugar quota
Before the introduction of the sugar quota the demand of sugar has been stable, while the production of sugar has been increasing. The national governments of sugar producing countries in the EU have been protecting and regulating the sugar industry, which caused larges differences in the price of sugar within the EU. That is the main reason why the system of sugar quota is introduced. This system covers its own costs on EU level, which means that the financial support is paid with the levies. Sugar producers always had a lot of power in the EU: they have been making agreements with the farmers about the price and the delivering of sugar. That is the reason why the system of sugar quota gives the farmers and producers the opportunity to make agreements, which will be checked by the government (MDW, 2000).

Fish quota
The EU member states have since 1976 limitation in the amount of fish they are allowed to catch. Since 1983 the EU has a common fish policy Gemeenschappelijk Visserij Beleid (GVB). Every year the Total Allowable Catches (TAC) is determined with advice of a couple of national and international research organisations. The TAC gives a certain amount of a certain fish which is allowed to be caught in a certain period. These quotas are divided among all member states using quota. The Netherlands have divided the total amount of fish which is allowed to be caught to the individual fishing companies (individual contingencies). The quotas are expressed in ton of a certain fish type, but a conversion factor can be applied, in order to exchange quota between member states (MDW, 2000).

Varkensrechten
The Netherlands have, according to the Nitraatrichtlijn (91/676/EEG), the obligation to reduce to amount of manure. Pig-farms contribute to the lion share of this surplus, so the pigs sector is restructured. In order to reduce the amount of manure produced by pigs, every farm has a quota for the amount of pigs they are allowed to keep (MDW, 2000).

Development rights
In Limburg (a province in the south of the Netherlands) a pilot has started with tradable development rights. In some states in the United States of America the ownership of land and the right to build are separated juridical. Building-permits can be traded separately, which is called 'transferable development rights'. The Dutch legal system does not know this separation. So the pilot in Limburg is based in the 'this for that' principle. If the landowner considers to develop, the municipality has the condition that the landowner should add extra quality anywhere else, for example by renovating old business areas into recreational areas (Bruil, 2004).

Business area permits
The offer of business areas is extreme larger than the demand, which causes low prices, so new area are developed on a very low quality. Tradable business area permits are permits divided by the national government to local governments and gives them the right to develop a certain surface of business areas. Hence, the local government needs a certain amount of quota, before selling the land to companies. Only necessary business areas will be developed, because otherwise it will be to expensive (Wesselink, 2007).

Water permits
Water rights trading could, in particular, be deployed with regard to water quality for eutrophication (discharge of nutrients) and discharge of cooling water. (Urban) wastewater treatment plants and agriculture are, in particular, obvious parties for water rights trading. The instrument is deemed less suitable for toxic and bio accumulating substances. Furthermore, water retention obligations with regard to water quantity can be considered: a land owner must achieve storage facilities for certain quantities but may also pay someone else to do this. There is already broad experience in the United States with water quality trading, in particular, eutrophication (Klooster et. al., 2007).

CO_2 emission trade
Carbon emission trading is emission trading specifically for carbon dioxide (calculated in tons of carbon dioxide equivalent) and currently makes up the bulk of emissions trading. It is one of the ways countries can meet their obligations under the Kyoto Protocol to reduce carbon emissions and thereby mitigate global warming. In Europe the CO_2 emission trade system started at January first 2005, with companies in the heavy industry sector. Other sectors, like the green house greenery, will probably follow soon. The CO_2 emission trade is based on a cap and trade approach, in which an aggregate cap on all producers is established and these producers are then allowed to trade amongst themselves to determine which sources actually emit the total pollution load. Hence, the amount of produced CO_2 will never be higher than the cap.

NO_x emission trade
In the Netherlands (as the first country within the EU) the NO_x emission trade system started at July first 2005, with companies in the heavy industry sector (Ministerie van VROM, 2008). Companies receive a relative performance standard rate, which is not a fixed rate, but depends on a company's performance. The performance standard rate is expressed in grams NO_x-emission per gigajoule (GJ) or per tons product. So, the NO_x-emission does not have a fixed cap, but depends on the production of the companies.

Frequency permits
Frequency permits, which are in the Netherlands distributed by the Ministry of Economic Affairs, provide an efficient use of (mobile) telephone, radio and television frequencies. Distribution can be done by: first come – first serve, examination or by an auction. In general permits for commercial use are distributed by an auction (MDW, 2000; Ministerie van Economische Zaken, 2005).

APPENDIX B: EXPERT INTERVIEWS

Name	**Function**	**Date**
Jan Willem Wesselink	Editor-in-chief of the journal Bedrijventerreinen (Business Areas)	September 28, 2007
Mark van Twist	Development director Berenschot Procesmanagement, dean NSOB, professor public private partnership at Radboudt University Nijmegen	October 5, 2007
Marinka van Vliet Erik Verhoef	Consultant at Berenschot Procesmanagement Professor Spatial Economics VU University of Amsterdam	October 11, 2007: workshop about tradable business area permits during conference business areas
Roel in 't Veld	Chairman RMNO, Professor Public Administration at Open University, professor Good Governance at the University of the Dutch Antilles, associate at Berenschot Procesmanagement	February 28, 2008
Chris Dekkers	Coordinator compliance issues emission trade, Ministry of VROM	March 4, 2008
Willem Korthals Altes Menno van der Veen	Professor of land development and board of director OTB Researcher geo information and land development at OTB	March 6, 2008
Jos Cozijnsen	Independent consultant emission trade	March 7, 2008
Erik Verhoef	Professor Spatial Economics VU University of Amsterdam	March 11, 2008