Optimisation of the Corporate Emissions Trading Strategy for the Projected GHG Market in Lithuania

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Abstract

The aim of this thesis is to investigate and develop a three step path for considering an optimal strategy for companies wanting to trade on the projected GHG emission market in Lithuania. An optimal strategy here is defined by two factors: financial gains by the trading company and real GHG emission reductions. The investigation included a review of the literature on the theoretical prerequisites for an efficient emission trading scheme design and the uncertainties associated with emergent GHG markets. A generic model of strategy under uncertainty was used to develop a framework for an optimal corporate emission trading (ET) strategy under a high level of uncertainty. This theoretical strategy construction constituted the first step. Further, the specific conditions related to the development and administration of a greenhouse gas (GHG) market in Lithuania were examined, including an analysis of the potential GHG market size. This was the second step in the path. As step three, a hypothetical case of trade between two major energy companies, one in Lithuania and one in Sweden, was then used to interrogate the framework for strategy under uncertainty. Finally, an optimal strategy was suggested for these two trading partners in this hypothetical scenario, taking into consideration issues of risks and profitability as well as environmental benefits. The suggested strategy in the scenario is intended to serve as a hypothesis that can be tested with further case studies and empirical analysis under different assumptions (e.g., market, policy, legislation, availability of fuels and their prices, technology development etc.) in the context of Lithuanian emissions trading developments.

Executive Summary

Emissions trading is one of the economic instruments used to reduce environmental compliance costs. The use of emissions trading (ET) began in the US in the early 70's in order to achieve reductions in Pb, SO_x and NO_x emissions. The Kyoto agreement reached in 1997 also included the use of emission trading for greenhouse gases (GHG). Since then, several domestic GHG trading schemes have been created. The EU GHG trading scheme (EUETS) currently under development will be the largest emission ET scheme implemented so far.

What will be the implications of the EUETS scheme for the companies involved in the scheme? What opportunities, challenges and pitfalls are they facing under the new emission allowances market? What would be the optimal corporate ET strategy for companies involved in the scheme? These are the questions being investigated in this thesis project under the conditions of the emerging GHG market in Lithuania, one of the EU accession countries.

The main aim stated for this thesis is to define and investigate factors that would lead to the optimisation of strategy for companies that will be involved in emission permit trading on the projected Lithuanian GHG emission market. An optimal strategy here is defined by two indicators: financial gains by the trading company and real GHG emission reductions.

Tradable emission permits is a type of commodity that can be traded on the market. Following that, general economic and management rules that are applicable for any other type of commodity - are also applicable to trading of emission permits. The ET market is characterised by high uncertainty, especially at the beginning of the trading period. In order to cope with this issue, a generic model of strategy under uncertainty and suggestions of ET experts were used to develop a framework for an optimal corporate emission trading strategy. Further the specific conditions related to the development and administration of a greenhouse gas (GHG) market in Lithuania were examined including an analysis of the potential GHG market size. Then a hypothetical case of two major energy companies, one in Lithuania and one in Sweden, was used to interrogate the framework under the specific conditions of the GHG market in Lithuania. Finally, by using the framework, an optimal strategy was suggested for the trading partners taking into consideration issues of risks and profitability as well as environmental benefits.

The framework for the optimal corporate ET strategy suggests that the strategy should be developed according to the level of the uncertainty company is facing in the ETS. Before the beginning of the ETS, the uncertainty level is the highest (Level IV). This is due to the uncertainty about many of the political and administrative decisions to be made. Hence, before a formal ETS is in place, it is not advisable for companies to use a "*reserve the right to play*" strategy. In this case, the optimal strategy would be to take a *shaper's* position on the market and make "option" and "no-regret" moves. This implies that before 2005, an appropriate move for a company involved in ET, that is likely to experience shortage of allowances, would be to make moderate investments in installations for GHG emission reductions rather than starting early emission trading (by buying call options or swaps).

In the review of the conditions in Lithuania, the policy position is positive towards the use of emission trading for the purpose of the domestic GHG emission reduction. However the institutional capacity is not strong enough and has yet to be built. Several steps have already been made. One of them is ongoing initiative to create the carbon fund, which would buy emission reduction units from Joint implementation (JI) projects. There is also pending treaty with Sweden on the acceptance of emission reduction units on state level. Some funds have been accumulated in the ministry of environment for establishment of a national registry. The institutional capacity in the private sector is evolving more rapidly. Several consulting

companies have gained strong a background in JI and ET. These conditions should send a positive signal to international investors.

The energy market in Lithuania is envisioned to experience major changes due to the decommissioning of the Ignalina nuclear power plant (NPP) – (first reactor will be closed in 2005 and second in 2009). Ignalina NPP is the main source of the electricity in Lithuania. Hence, after its decommissioning, other energy producers in Lithuania will be required. The National Energy Strategy envisions Lietuvos Elektrine AB as the alternative for Ignalina NPP. The analysis shows that the installed capacity of the electricity generators in Lithuania is sufficient to satisfy the increased demand for electricity. Lietuvos Elektrine AB will bear the major part of the electricity production burden in Lithuania.

Due to the economic decline after 1990, GHG emissions in Lithuania dropped by about 50%. However, predictions made in this thesis show that a steep increase in emissions is expected in 2009 – 2010. Before and after that period a slight increase in expected. The potential of renewable energy sources for energy production has also been estimated. The results show that an additional 3 TWh of electricity could be produced in Lithuania from renewable energy and reduce CO_2 emissions by 2 million tonnes hence, the predicted emission level will also depend on the proportion of renewable energy utilised. Another factor influencing the emission level will be electricity export level.

The analysis shows that in any case emission levels will not exceed 1990 levels by 2020. Thus, Lithuania on, both state and corporate levels, is expected to have an excess of tradable GHG emission permits. The total amount of tradable Assigned amount units (AAUs) is projected to be about 126 million for the commitment period. The companies that fall under the EUETS should receive about 60 million allowances for the 3-year period (2005-2007) and 100 million for the 5-year period (2008-2012) if grandfathering is used as an allocation method (based on 1990 levels). About 30 million allowances would be traded during the first period. At the projected discounted value of EUR 5,5 the market would be worth EUR 165 million if allocation is done using grandfathering. For the second EUETS period (2008-2012) about 40 million allowances (comprising EUR 230 million) can be expected to be traded.. During the commitment period, Lithuania will have about 70 million of tradable Assigned amount units under the Kyoto agreement. This amount would be worth an additional EUR 400 million. Hence, the total expected market value during 2008-2012 would be about EUR 630 million at forecasted emission permit values.

A hypothetical trading case between Lietuvos Elektrine AB (Lithuania) and Vattenfall (Sweden) was used to test the optimal strategy framework. Lietuvos Elektrine AB is expected to be the major player on the GHG market in Lithuania. The estimations show that the company will have about 14 million allowances to sell during the two periods. Because of the expected steep increase in emissions during the second period i.e. in 2009-2010 the ET will play an important role for the company. One of the most important tasks for the company will be to redistribute allowances between the two periods and within the second period. The profits will largely depend on the strategy used. The suggestions for the company were made according to the optimal corporate ET strategy framework. It is suggested for the company to bank the major part of the allowances to the second period and start intensive trading after 2010. Such a strategy would reduce the uncertainty level and would allow the company to profit more from the allowances. Another suggestion was for so called no-regrets moves which mean that the company should invest in capacity building prior to the commencement of the ETS. *Option* strategic moves under a *shapers* position on the market is suggested for Vattenfall. This would mean that some moderate investments could be made in the emission reduction projects in Lithuania. A possible option could be to invest in fossil fuel installation

prior to 2005 and later, when the scheme starts, make a switch to biomass. Such a strategy would allow the company to generate extra allowances. The "reserving right to play" strategy is not recommended prior the start or at the beginning of the scheme due to the high uncertainty involved. This implies that that the early emission trade (e.g. call options and swaps) is not recommended on the large scale prior to the beginning of EUETS. Later intensive trade should not be performed earlier than 2006. The advisable general strategy direction is to concentrate more on the investments in emission reductions rather then than perform allowance acquisitions.

The implication of the proposed strategies for the environment would be positive because companies would make the reductions of their own emissions and would avoid the cheap "hot air" purchases from Russia and other CEE countries. Hence, the case study also reveals an important issue - how an optimal corporate emission trading strategy can help to address the flaws in the Kyoto agreement.

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1. Introduction

1.1 Context

Emission credit trading is one of the economic instruments that have been used for several decades. The idea of emissions trading was born in the US several decades ago and, since then, has been spread all around the world and has been used for different types of pollutants, such as SO2, NO2 and lead. The purpose of this instrument is to achieve pollution reduction in the most cost effective way.

Due to increasing concern regarding the climate change issue, the international community started to look for new methods to curb greenhouse gas (GHG) emissions. Emission trading, among other instruments was proposed to address climate change. Striking the agreement in Kyoto in 1997, as a follow-up for the UN Framework Convention on Climate Change (UNFCCC), emissions trading (ET) on the international level was kicked off. Emission trading is one of so-called "flexible mechanisms" introduced by the protocol.

One could say that the UNFCCC, with its consequent agreements and schemes, is the most developed and far-reaching global treaty in the world's history so far. International GHG trading among the other flexible mechanisms is probably the most highlighted part of the treaty.

Even though the Kyoto protocol is not yet in force, several countries have been proactive establishing their own domestic emission trading schemes. As a consequence of long debates, the EU also adopted GHG emission trading Directive in July 2003. The Directive establishes the GHG emission allowances trading scheme within the Community. The EU scheme is designed to be linked with the Kyoto flexible mechanisms.

Many countries, companies and organisations see emissions trading not only as a means for climate change mitigation but also as a business opportunity. The EU accession countries are anticipated to be main suppliers of the GHG emission allowances within EU due to steep GHG reductions in their territory. What opportunities and challenges companies, which will fall under the scheme, are facing in these countries? What are the business opportunities for the foreign companies in respect of the accession countries? These are the questions the thesis research is aiming to answer by analysing conditions for GHG trade in Lithuania, one of the EU accession countries.

Although there is lot of literature available on the general emission trading issues, just a few country specific studies have been performed on the implications of international GHG schemes. This observation is especially valid for the EU accession countries. No research has so far been done on the corporate level in Lithuania concerning GHG emission trading implications.

This Master's thesis aims to perform an assessment of the conditions for the emission trading that companies will face in Lithuania. The research includes the theoretical background for the emissions trading, analysis of the legal, economic and institutional capacity conditions in Lithuania related to the emissions trading, early corporate initiatives for the trade, analysis of the energy and GHG markets and finally, the case study of the possible cooperation between two energy companies in Lithuania and Sweden. The

suggestions for the companies on the predicted GHG market are based on the framework for the optimal corporate ET strategy that was developed at the beginning of the thesis.

The "optimal strategy" in the thesis is defined as a strategy that leads to profit increase and reduced environmental impacts of the company. This hypothesis is developed to determine whether a win-win situation is possible for both: the companies and the environment. Proposed strategy aspects are an alternative for the traditional approach, that in case of environmental protection, would aim to the reduction of the compliance costs

1.2 Research question

What steps would lead to the optimal corporate emission trading strategy on the greenhouse gas market in Lithuania under the EU emission-trading scheme?

Sub questions:

What are the theoretical prerequisites for the efficient trade to take place on the tradable emission permit market?

What are the actual and potential framework conditions for emission trading in Lithuania? And what is the foreseen potential of GHG market in Lithuania?

What is the most effective way for the companies involved in the emission-trading scheme to behave on the foreseen GHG market in Lithuania?

1.3 Scope

This thesis intends to suggest general strategy directions for the profitable and sustainable emission trading business under the specific emission trading market conditions in Lithuania. It is outside of the research scope to give suggestions to the Lithuanian authorities regarding the implementation of the provisions of the Kyoto Protocol and EU Emission Trading Directive (EUETS). The purpose is rather to suggest the optimal strategy for energy companies in Lithuania and their counterparts abroad for GHG allowance trading. The scope also involves research of the environmental implications of the proposed strategy.

1.4 Methodology

The logic behind the research performed in this thesis is to relate the ET trading and strategy theory to the allowance trading under the EUETS scheme in the specific economic, legal, and institutional, market conditions in Lithuania.

In order to make suggestions for the companies on the projected GHG market in Lithuania, a hypothetical framework for optimal emissions trading strategy was created. Secondary data were used for the development of the framework: the theory on the management strategy under high uncertainty and the recommendations of ET experts.

To give understanding about the emissions trading, the following issues are analysed: the mechanism of ET, the economics of ET and legal basis for international ET. The analysis of the legal basis is mainly based on the two documents: the Kyoto protocol and the EU

emission trading Directive. The analysis also includes the position of the main stakeholders towards the provisions of the legislation.

In the next step the conditions for the allowance trade in Lithuania are analysed. This includes analysis of the provisions in Lithuania's legislation related to climate change, economic conditions and institutional capacity. To this end, both primary and secondary data were used. Main environmental laws, legislative and strategic documents have also been reviewed searching for the provisions towards ET. The head of atmosphere department in the ministry of environment was interviewed, since the department will be responsible for the implementation of the EUETS Directive. The owner of a consultancy specialising in clean energy and climate change fields – Ekostrategija - was also interviewed.

In order to have an overall picture, the international context for ET in Lithuania is analysed. To this end, the cooperation between the Baltic States and the Baltic Sea region countries on energy issues are reviewed using secondary data – regional agreements and documents.

The aim of the energy market analysis was to project future CO_2 emission trends by linking it to the forecasted changes on the energy market. Calculations have been made to estimate the potential of the existing installations to cover the demand related to the decommissioning of the Ignalina NPP as well as predicted demand increase for the electricity. The potential to use renewable energy for the electricity production has also been estimated using input data on estimated primary renewable energy availability.

The future trends of GHG emissions were predicted by using results of the energy market analysis, data from the Second National Communication of Lithuania to UNFCCC, IPCC guidelines for the CO_2 estimation. MS Excel was used for calculations. The results have been compared to those of the PointCarbon analyst projections.

The results of the predicted GHG emission trends, the data of actual emissions and the results of legal basis analysis were used to estimate the key indicators of the GHG market in Lithuania. Some of these are: total and tradable amount of the Assigned Amount Units (AAUs), CO_2 emissions covered by the EUETS, the amount of allowances to be issued for Lithuanian companies under the EUETS and other. The indicators were used to evaluate the potential financial benefits for the state and the companies involved in EUETS scheme.

The findings are summarised and applied for the development of a case study of two energy companies in Lithuania and Sweden representing key players on the predicted market. By using the results of the GHG market conditions analysis and the framework for the optimal corporate ET strategy, companies are suggested an ET strategy for the both ET periods. The interviews with the executives and environmental managers of the companies have been taken in order to understand the position and preparedness of the companies to trade on the market. The final conclusions, besides the results of the research, also contain the environmental implications of the proposed strategy.

1.5 Thesis structure

The chapters in this thesis are interlinked. "Non-experts" in ET should start from the ET history (chapter 2.1) and ET mechanism (chapter 2.2) as well as the legal basis for GHG emissions trading (chapter 3). These chapters contain definitions of terms used for ET. The terms and shortcuts used in the following analysis refer to the mentioned chapters. The abbreviation list is given at the end of thesis.

The overall structure of the thesis is presented in the diagram below.

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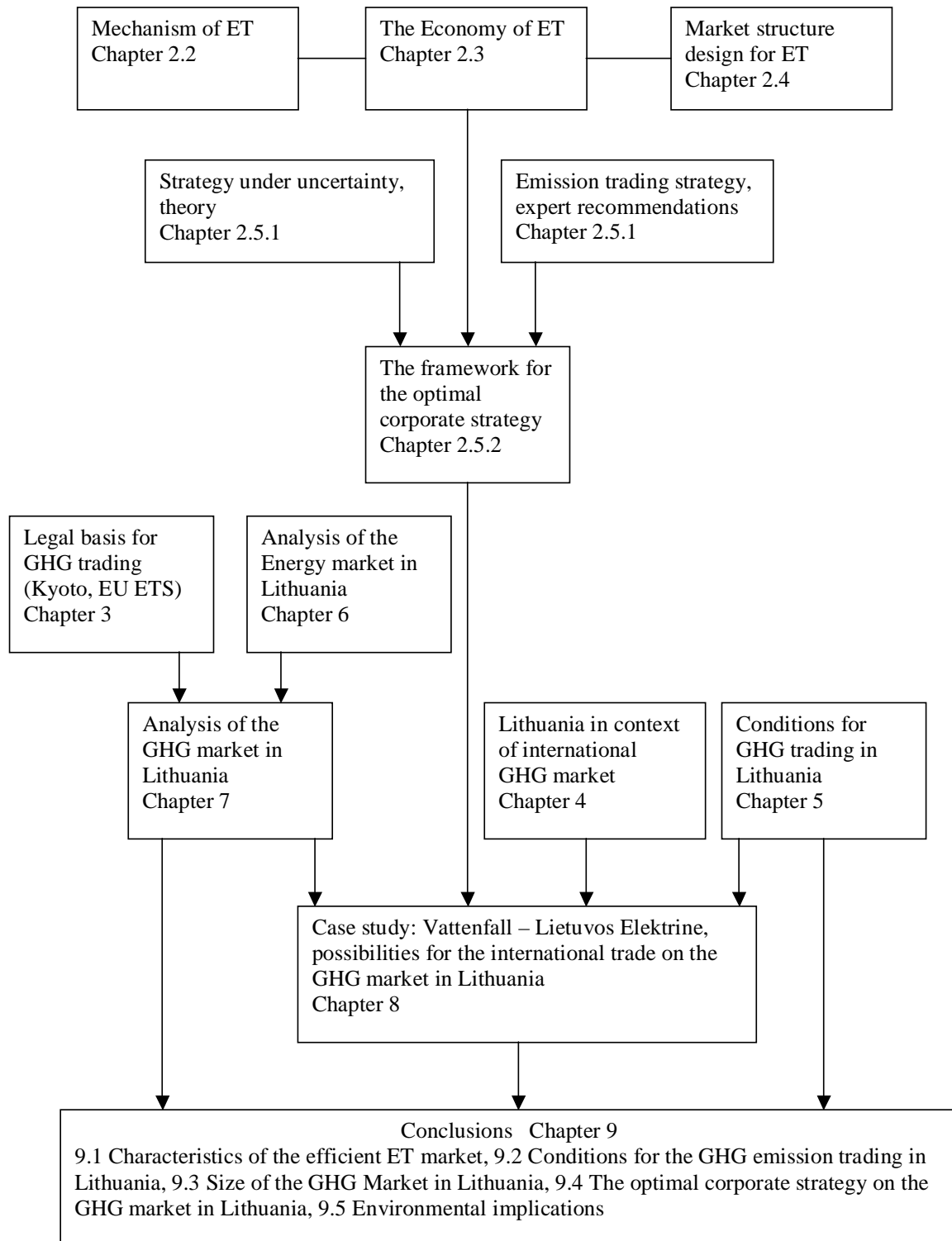
Figure 1 Thesis Structure

2. Background for Emissions Trading (ET)

Emissions permit   trading is an economic tool designed for environmental impact reduction with minimal costs. The tool itself, as any other instrument, does not guaranty the environmental improvement. The results depend on the way it is used.

Greenhouse gas (GHG) emission credit trading is the most prominent example of the ET idea. There are hundreds and thousands pieces of research done on both theoretical and practical GHG ET issues. Two main issues could be mentioned as triggers for such vast concern. One is the climate change issue related to anthropogenic GHG emissions, which is threatening the human kind with numerous catastrophes in the near future[1]. Another is the large projected market for international GHG emission credits trading.

While the climate change issue is more of concern for governments, the companies involved in ET are more interested in economic benefits[2] of ET.   The question here is on how these two purposes could go along with each other. One of the research targets of this thesis is to draw parallels between the economic and environmental benefits and test their plausibility in the case study within a particular GHG market. The question of the optimisation of the research is solved from the corporate perspective i.e. how can companies make profit while contributing to the improvement of environment.

This chapter aims to design the framework for the sustainable corporate strategy that would lead to both economic and environmental benefits. For that purpose the economics and market structure of ET is analysed. In the beginning of the chapter, the reader is introduced to the economy and market principles that the emission trading mechanism is based on. The short overview of the evolution of ET is also given at the very beginning of this chapter.

2.1 ET history

In early 1970's because of growing concern for environmental pollution, the economic method In the early 1970's, because of growing concern for environmental pollution, economic instruments to curb emissions were proposed. The idea to apply trading rules for air emission reduction first came into practice in the US in 1963 when the Clean Air Act (CAA) was passed. According to the CAA, the US EPA set the quality requirements for the ambient air for so called criteria pollutants: Carbon monoxide (CO), Lead (Pb), Nitrogen dioxide (NO2), Ozone (O3), Particulate matter (PM) and Sulphur dioxide (SO2). States, which exceeded caps, were obliged to introduce regional schemes for reduction of these pollutants in ambient air. The most prominent of the schemes used in the US since that time under the CAA were the Pb and SO2 allowance trading schemes. The methods used gave the desired results of emissions reduction along with the decrease in total costs for compliance. Nowadays, the case of the Pb and SO2 trading schemes in US are used as a classical example of how the emission trading can contribute to pollution reduction and minimisation of the abatement costs. These examples are briefly described below.

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[1] Scientists predict considerable changes in all the ecosphere of the Earth due to global warming in this century.

[2] It is not a rule though. Some governments perceive ET only as a business opportunity while some environmentally conscious companies that are concerned about the environment get involved in the voluntary schemes for the emission reduction.

In 1982, the US EPA introduced a cap for lead in gasoline at a limit of 1,1 g per gallon[3]. The cap was set for total amount of lead in petrol supplied by producers and importers. The credits for the lead quantities in petrol were allocated according to the levels of the certain period with the right to trade unused credits. In 1986, the US EPA lowered the cap for total lead amount in petrol to 0,1g per gallon. The results of the scheme led to the phase out of leaded petrol. (UNEP, 2002).

The amendments of the CAA in 1990 put a cap on SO2 emissions from electric utilities. The programme began in 1995. SO2 caps were set per amount of energy produced taking 1985 levels as a baseline. New installations were not given allowances after 1995, they had to buy them from old installations. The scheme led to SO2 emission reductions mainly through the use of low-sulphur coal use for energy production, improved efficiency and the use of control equipment. (UNEP, 2002).

The positive experience with the emission trading schemes in the US raised the idea to use this mechanism for GHG emissions reduction. The idea was adopted in Kyoto when countries reached the agreement on the GHG emission reduction targets and methods for achieving them. Among other instruments envisioned to curb emissions, the Kyoto protocol introduces the international GHG allowance trade. Although international GHG trading should start only in 2008 (if the protocol is ratified) some countries have already implemented their own domestic GHG trading schemes. The most prominent among them are the Danish and UK schemes. The trading scheme used in the UK is voluntary and covers all 6 GHGs[4] in various sectors (the energy sector is not included) while the Danish scheme is obligatory and covers only CO_2 emissions from large energy producers.

Quite a few companies throughout the world have been involved in voluntary GHG emission trading schemes and project based emission reduction mechanisms. The first voluntary international GHG emissions trade was performed between the Canadian company TransAlta and the German utility GEW in 2000. (Ku, 2001). There are three main reasons for companies to be involved in such schemes. One is the uncertainty about possible future GHG constraints. The companies believe that prior to the binding schemes they can buy emission reduction credits at a lower price and expect that these credits will be recognised in the bidding scheme. Another reason is the potential to gain experience in ET transactions. The third reason is the improvement of the company's environmental image.

The experience gained from ET schemes shows that they have a potential to reduce compliance costs significantly while achieving pollution reduction to the desired levels. Experience also shows that companies are positive to the idea of taking an active part in the ET rather than to be regulated by strict governance methods.

2.2 The mechanism of ET system

This chapter describes the idea behind the emission trading and the way it is implemented in practice.

Emissions trading is one of the economic instruments used with the purpose of pollution reduction. The idea of emission trading is to reduce pollution in the most cost effective way.

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[3] 1 gallon = 3,8 litres.

[4] Main 6 GHGs listed in the Kyoto protocol.

One of the most important features of ET is the ability to internalise environmental costs. The effectiveness and efficiency of ET depends very much on its design. The ET theory is built upon the synergy of two sciences: economic an environmental.

The environmental idea behind ET is based on the perception that the goal of the environmental protection is the improvement of the final quality of the ambient environment. Then it follows that in order to comply with the environmental quality standards, the overall emissions in the certain area should not exceed the amount that would lead to levels of pollutant concentrations higher than those that are harmful to human health. Following this idea, it is not important what quantities of pollutants are emitted from each source in the particular area, but rather that the total emissions in the particular area would not exceed the quality standards of the ambient environment. Since the target is to achieve the given quality standard of the pollutant concentrations in the environment, the total emissions quantity target in the area can be shared among the pollution sources.

The economic idea of ET is built upon the fact that the pollution abatement costs differ considerably among the sources (industrial or energy generating installations). Following the environmental idea of ET described above, the overall emissions reduction target in the certain area can be achieved by reducing emissions from the installations with the lowest abatement costs. The polluters with the high abatement costs then can purchase the right to emit extra emissions from those that achieved reductions with the low costs. Hence, the polluters with the high abatement costs save money on compliance and those with the low abatement costs gain additional profits from the emission trade. Thus, the overall abatement costs for achieving the desired quality of environment are reduced. The prerequisite for the trade is that the price of the "right to pollute" must be lower than the abatement costs.

ET is a very flexible instrument. In cases of high pollutant concentrations in certain areas, authorities using the instrument can simply lower the cap of total emissions allowed to emit in that area. This action increases competition between the polluters since they have to comply with the stricter requirements. As a consequence of increased competition, the abatement costs go up, as does the price of the "right to pollute". The final result is the achieved emission reductions at the desired level. The operating costs of ET application for governments are normally also lower than those of strict regulation.

ET schemes can be designed in different ways such as: bubbles, offsets, baseline emission reductions and cap & trade schemes. Bubbles are trading scheme in which a polluter that has several sources can reduce emissions from those ones with the lowest abatement costs by performing internal trading. Credit based (or offsets) emission trading schemes allow companies to earn legally recognised credits when they voluntary decrease emissions below the set limits. The earned credits then can be sold to other companies voluntarily participating in the scheme that exceeds the set amount. In the Cap & Trade scheme, the authority establishes a cap for the emissions and issues the amount of emission allowances consistent with the cap. The allowances can freely be traded on the market. Baseline emission reductions are project based trading schemes under which companies can buy credits resulting from projects that they implemented and result in emission reductions. (IETA, 2003a).

The "right to pollute" can be given in two forms: credits and allowances. Credits are gained in the ET system when the polluter voluntarily reduces the emissions bellow the given limit. In such a scheme, the polluter receives the amount of credits equivalent to the reduced emissions compared to the limit. Gained credits can then be sold to other polluters as a right

to emit an extra quantity. Allowances are used in formal cap-and-trade schemes. The allowance gives the right to emit a certain amount of pollutant. Unused allowances can be traded on the market and can be banked for the next year or the next period. (IETA, 2003a).

Baseline emission reduction schemes set the baseline for the emission level. If the polluter reduces his emissions below the baseline, he gains emission reduction credits that can be traded free on the market.

The "right to pollute" in cap-and-trade schemes are given by authorities in form of allowances for polluters in certain areas. The quantity that the polluter is allowed to emit is directly related to his economic profits or losses, hence the allocation of the "right to pollute" is one of the most important issues in such a scheme. There are four main methods used for allocation: grandfathering targeted allocation[5], charged allocation (auctioning) and "hybrid-systems" – a combination of grandfathering and charged allocation. Grandfathering is a common method for allocation. The idea of this method is that polluters get their rights to pollute according to the amount they emitted in a certain period of time in the past. A targeted allocation method is when allocation is referred to achievable reduction levels that are decided by authorities for each plant. This method can also refer to the best available technique (BAT). The permitted emission amount can be absolute or relative i.e. to allowed emissions per production unit. Charged allocation is often used in the form of auctioning. Participants included into the trading scheme are to obtain the allowances on the auction or buy it for a fixed price. Grandfathering and charged allocation can be combined together when the participants are to buy a part of required allowances. The rest are obtained according to their emission levels during a certain period of time in the past. Such method would be called a "hybrid-system".

2.3 The economy of ET

In this chapter, the main factors that influence ET mechanism are analysed. The aim here is to give an understanding on what drivers shape the outcomes of the system. The main factors in the ET economy are the price of the permits and transaction costs. Bargaining also plays an important role in defining the outcome of the negotiations in the bilateral ET transactions. These factors are described below.

2.3.1 The price of emission permits

Emission permits is a commodity that can be traded on the market. Hence, common market rules are applicable for this type of commodity as for any other type. In this subchapter, the factors that regulate the price of the tradable permits are analysed.

According to economic theory, the price is defined by demand and supply. On the demand side, price reflects willingness and ability of buyer to purchase a product, which is based on the satisfaction received. On the supply side, the price reflects the opportunity cost of production. (Amos Web Glossary, 2003). Theoretically, the price of permits should reflect emission abatement costs. The price at which permits are sold should be within the range of the abatement cost difference for the buyer and seller. The exact price level within the mentioned range would mainly depend on the supply and demand ratio of the permits. The

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[5] This term was created for the thesis research purposes referring to the EU ET Directive. It has not been used outside the research.

Point Carbon analysts (Point Carbon 2003a) mention the following factors that would influence permit prices in EUETS: reduction targets (caps), choice of base year, allocation system, participation by accession countries, links to "third countries", "opt-outs" (see chapter 3.2), emission baselines and inclusion of credits from project based mechanisms. In fact, these factors would influence the demand and supply ratio. Other factors like transaction costs and bargaining power would also have an impact on the price of emission permits. These factors are described separately in the following chapters.

ET for GHGs implies that fuel for the energy production will have a higher value than the price at which it is purchased. The actual price of the fuel will depend on its carbon content (the lower carbon content fuel use will result in additional allowances that can be sold).

"Some investors take the view that the market currently offers a portfolio of emissions reductions at a highly risk-discounted price, offering an opportunity to lower future compliance costs and offering a substantial return on investments. Other investors expect the market to be flooded with available emission reductions as the time remaining before the first Commitment Period shortens and this increase in supply will put pressure on prices." (CO2e.com, 2003).

Some instruments are used to hedge the future allowance price increases. A call option is one such instrument. In a call option, a buyer hedges the price without an obligation to buy allowances. For the seller, this instrument allows enhanced returns from a currently non-income producing asset and reduces future transaction costs. (CO2e.com, 2003).

2.3.2 Transaction costs

Transaction costs is one of the key issues of the ET economy. If such costs are too high – the instrument loses its cost effectiveness. The transaction costs consist of the costs for finding a trading partner, negotiations, approval, monitoring and insurance costs. An increase in transaction costs is followed by a price increase for the buyer and a decrease for the seller.

Transaction costs can increase if there are not enough traders on the market. In such cases, costs could be reduced if traders already know each other and communicate on a regular basis.

Information availability is another crucial point that defines transaction costs. The costs are reduced if traders have access to the low-cost information. According to this theory, the participation of the governments in emission trading would be less cost effective since companies have better access to information. (Woerdman, 2001).

2.3.3 Role of bargaining

Bargaining (negotiations) is any process through which two or more market participants try to reach an agreement by making offers and counteroffers. In emissions trading, bargaining would be present in bilateral transactions. When permits are acquired on the exchange market, auctioning is used instead of bargaining. Again, the bargaining outcome in bilateral ET transactions would depend on certain factors. The idea of Bargaining theory is shortly described bellow.

Bargaining theory aims to answer the following questions:

- What variables determine the outcomes of the negotiations?;

- What gives the power and strength to the negotiators?; and

- How this power could be enhanced?

The theory is based on the assumption that negotiation players would like to reach an agreement rather than disagree, in other words they are willing to cooperate. What confronts the participants of the bargaining is the need to reach agreement over exactly how to cooperate. But the problem here is that each player would also like to reach an agreement that is as favourable to him as possible. This leads to the fact that agreements are often reached after long and costly delays. Bargaining theory focuses on the efficiency and distribution properties of the negotiation.

First of all, the bargaining power of the negotiator depends on the direct gains and costs of the deal. The higher the bargaining power of the negotiator, the greater his/her payoff. Similarly, the higher the bargaining power the larger the cost of revoking. Other key factors that either increase or decrease bargaining power and determining bargaining outcome are: impatience of the players, risk aversion, outside/inside options, commitments and asymmetric information. (Muthoo, 2000). For a description of these factors see appendix I.

2.4 Market structure design for ET

This chapter analyses the optimal market structure needed for the efficient trade of emissions.

2.4.1 Market players

The ET market involves a remarkable number of players. Besides buyers and sellers there is number of other important trade participants who influence the outcome of the trade. These are brokers, auditors, consultants and financial institutions. Brokers help to reduce transaction costs by matching together suitable buyers and sellers. In this way, they reduce the costs that players would meet while searching for the right counterpart. They also develop special transaction structures that help them to meet individual needs of buyers and sellers. It is also important that brokers publicise the price at which transactions occur. In the case of ET it is more difficult to discover the price than in the case of a fixed commodity. Consultants can help companies to develop emission reduction projects and adjust corporate strategies to the GHG market. Auditors or verifiers provide assurance that the emission reductions meet minimum quality standards. Financial institutions such as banks and insurance companies provide financing and risk management services. Several European financial institutions have developed services tailored specially for the ET market, such as carbon funds.

2.4.2 Requirements for the optimal market design

Butzengeiger et al. (2001) claim that the efficiency of ETS strongly depends on its design. The Authors describe two options for proper ET market design: "high number of relevant emitters" and "an inhomogeneous pool of participants". If there is small number of participants, the emission trade would appear only periodically. In such a case there would be no reliable spot market price resulting in high uncertainty for the market participants. If

another option is not fulfilled i.e. the market is homogenous (abatement costs are the same for all participants) the emitter would not have an incentive to reduce emissions externally. (Butzengeiger, Betz, & Bode, 2001).

Further the authors argue the third party participation in ET is needed to ensure market liquidity. Financial intermediaries and professional traders play an essential role in the creation of a stable and liquid market. However, the market liquidity is the prerequisite for efficient emissions trading. In absence of the liquid market, the participating entities would have difficulties in developing their climate strategies and implementing risk management systems.

The environmental benefits of ETS depend significantly on the design of scheme. The important issue here is till what extent the profits of ET will be utilised for the further reduction of GHG emissions. It is possible to distinguish two types of profits from ET. The International ET scheme (IETS), under Kyoto, would result in profits for the participating states while the domestic or regional ETS (e.g. EUETS) would result in revenues for the private sector involved in the trade. The distribution of the IETS profits can be done in three ways: income to the national budget, carbon funds and assigned from the private sector. Evans (2001) argues that the profits utilised through the national budget are unlikely to be utilised for mitigation activities. The carbon fund establishment where revenues would be collected, according to the author would result in better utilisation of the resources for emission reduction activities. The drawback of such mechanism is possible corruption, especially in economies in transition. Evans concludes that the mechanism where the private sector is entitled to the major part of the profits would be the most effective. The extent to what private income will be utilised depends on what incentives the participants are given to invest in mitigation techniques. Similarly, the costs of mitigation will depend on the chosen allocation mode.

2.4.3 Possible market distortions

One of the most discussed traps associated with allowance allocation, as many authors believe, is the distortion of competitive power of the participating companies. In practice, it is almost impossible to assign companies with the equal "right to pollute". Thus, the outcome of the allocation in any case is likely to give advantages for some companies in favour of others.

Misiolek and Elder (1989) argue that the companies having market power (i.e. dominant) can distort the ET market. According to authors the dominant companies can hoard the allowances in order to reduce competitive power of the smaller firms. In such a case, fringe companies can have a lack of permits, leading to them having to abate emissions themselves at a higher price. This would automatically increase the price of production. The dominant firm then benefits from the increased market price and reduced competition (Misiolek & Elder, 1989).

Godby (1998) further develops this theory by performing ET simulation and relating market distortion to permit allocation. In this theory, the allocation would not have influence on the market in case of perfect competition. However, market manipulation breaks the relation between initial allocation and the final holdings. The results of the simulation show that the market was significantly distorted after the dominant firm received more allowances than it needed (Godby, 1998).

Butzengeiger et al. (2001) also points the fact that inclusion small emitters into the scheme would significantly increase transaction costs. The transaction costs for small emitters would be unproportionally high compared to the reductions they can achieve (Butzengeiger et al., 2001).

Stewart et al. (1996) also mentions the possible monopoly formation between the energy utilities. Such monopolies could have market power to influence prices of the allowances (Stewart, Wiener, & Sands, 1996).

2.4.4 Liability and compliance

There are several liability issues in the context of ET. One important question is whether the buyer or seller should be responsible (liable) for the integrity and validity of the emission permits. Edmonds et al. (1999) analyse the possible outcomes of both cases (Edmonds, Scott, Roop, & MacCracken, 1999) and find that in the case of buyer's liability, the buyer would be discouraged to buy permits from suspect sources. However, this feature would also imply that buyers heavily discount the permits or would not trade at all. Hence, the buyer's liability would reduce demand for permits, while in the case of seller's responsibility the supply of permits would probably be reduced. The UNCTAD analysis concludes that seller liability is preferable since it enhances standardisation and the tradability of permits.

According to CO2e.com (2003), "emission compliance can move up or down the supply chain, as firms attempt to divest liability to, or remove liability from, suppliers or consumers of their products." Hence, compliance is not necessarily borne by the participating companies. It could, for example, reflect higher electricity prices and hence the burden for the consumers.

2.5 Corporate strategy for ET

Good corporate ET strategy is likely to have a sophisticated design structure due to the vast uncertainties on the market. Uncertainties will be harsher, prior to, and at the beginning of the precommitment and commitment periods. This is due to the formation of a new GHG ET market, under political, economic and financial uncertainty. Once the GHG market is balanced, after the political decisions have been made, the corporate ET management will become easier. Hence, the companies that will be involved in international trading will build management capacity before the beginning of the trading scheme. Although uncertainties result in high risk, they also provide opportunity. Hence, the risk management is a crucial issue related to the economic performance of the companies.

2.5.1 Background for ET strategy

One of the major components of the ET strategy will be uncertainty management. Not all regular business tools can be applicable for this purpose due to the previously mentioned issues. Strategy Theory Initiative (STI) research addresses the development of corporate strategy under high level of uncertainty. Courtney, Kirkland and Viguerie (1997) – research co-authors explore the different levels of market uncertainty and suggest strategies for each level. (Courtney, Kirkland, & Viguerie, 1997). The main findings of the research are presented below. In addition, insights and recommendations of the ET experts for designing the corporate ET strategy are also given.

Courtney et al. (1997) point out the common mistakes made by managers under the conditions of market uncertainty. The authors state that it is popular among managers to perceive market in two ways – either "clear" or completely unpredictable. In the first case, they apply classic business tools while in the second they are either driven by "gut instinct" or avoid any action at all. Courtney et al. (1997) divide market uncertainty into four levels and argue that each level requires a specific strategy. The four levels of uncertainty are: I - clear-enough future, II - alternate future, III - range of futures and IV - true ambiguity. Level I uncertainty is when the future is more or less predictable so the consistent actions can be made according to the projections. Level II uncertainty is when several defined scenarios are possible. In the level III uncertainty, a certain range of futures is possible. Level IV is true ambiguity – no clear future predictions are possible. Level IV uncertainty usually does not last for long – it transforms to level II or III after some time. Strategy is divided into 3 possible strategic postures - *shaping*, *adapting* and *reserving the right to play* as well as 3 actions (moves) – *big bets*, *options* and *no-regret moves*. Different moves can be chosen within the same posture.

Big bets are major investments with big payoffs in one scenario and big losses in others. Big bets can be present only in shaping posture. Options secure the big pay-offs in the best case scenario and minimise losses in the worst case scenario. Under this action, modest investments are made and companies have the possibility to either increase investments or withdraw from investments. Pilot trials of the new product before fully entering the market could be an example of the option moves. No-regrets moves pay off no matter what happens e.g. investments in capacity building such as gaining skills and educating employees Suggestions for corporate strategy according to the STI model are summarised in Table 1 below. The ETS periods are allocated according to the uncertainty levels that they are likely to have.

Table 1 Strategy theory - STI model

Uncertainty level	Level IV True ambiguity (2003-2005)	Level III A range of futures (Precommitment period 2005-2007)	Level II Alternate futures (Commitment period 2008-2012)	Level I Clear enough future (Commitment period 2008-2012)
Suggested Strategy	Shaping posture with big bets and option moves Adapting posture, no regrets moves	Shaping, adapting and reserving the right to play postures	Shaping posture with big bets moves (Reserving the right to play)	Adapting posture with no regrets moves
Inadequate Strategy	Reserving the right to play			Shaping posture

Companies should not become locked into one strategic position. The position and moves should be, time to time, reviewed by management to ensure that the optimal strategic decisions are made. No regrets moves are an essential part of any strategy. Under the shapers position not only big bets are possible. It often makes sense to use option moves in this position.

Lately, many consultancies are offering emission management services. They suggest business and portfolio management tools as well as software tailored specifically for the companies involved in emissions trading. Among these are "Carbonsim", "environmental software providers", "Torrie Smith Associates" and "CO2e.com".

Experts from CO2e.com, a leading GHG emissions marketing company, suggest that ET strategy includes three ways to meet carbon compliance: internal emissions management, purchasing credits or allowances and external project investment. The strategy development process also includes carbon risk management procedures (CO2e.com, 2003).

CO2e.com (2003) argue that corporate strategy will be influenced by the following factors: the type of industry, competitive position, geographical spread, emission intensity of production, opportunities to invest in new technologies, relationships with competitors and partners and the ability to manage change. The experts state: "there is no "one size fits all" strategy to achieving emission compliance because every firm operates under a unique set of variables". They suggest that following issues should be considered when designing the strategy:

- ❑ Assessing the national regulatory regime under which each business unit will operate.

- ❑ Defining the liability of the future company's liability for emission reduction

- ❑ Identifying emission abatement opportunities across all jurisdictions.

- ❑ Infusing the concept of emission costs into their planning and operations.

- ❑ Assessing internal emission reduction assets and liabilities using conventional financial and strategic analysis.

- ❑ Developing marginal abatement cost (MAC) curves for all emission abatement opportunities.

- ❑ Comparing projected internal MACs against predicted price trends of tradable carbon permits, accounting for performance and price uncertainties.

- ❑ Identifying external investment opportunities (CDM and Joint Implementation (JI), with a particular focus on projects that fall within the firm's core competence and geographic reach.

- ❑ Outlining a risk management plan to map the potential consequences of committing to particular strategies, which may include using analytic tools designed to tackle uncertainty.

Price trends are suggested as a major factor of influence for corporate ET strategy regarding permit price trends. As the ET market is in the stage of formation, the price change predictions vary dramatically.

The intensive ET strategy is advised for companies "with a high ratio of emissions to profits or with high barriers to shifting their emission-intensive capital". The emission reductions could also be perceived as a competitive advantage while marketing so called "greenhouse neutral" products.

CO2e.com suggests a strategy to manage risk for the companies involved in ET. The experts point out that the first stage of developing a risk management strategy is to identify the range of potential risks and assess their likelihood and consequences. The CO2e.com analysts point out the following potential risks on the carbon market:

❑ Operational risks related to compliance with emission targets

❑ Reputation risks related to public scrutiny of emission reports and non-compliance.

❑ Expected supply side exposure associated with cost movements or supply impacts.

❑ Expected demand / market exposure related to product substitution and international competitive positions.

❑ Project risks associated with new climate change investments (for example, sovereign risk).

❑ Financial risks associated with emissions trading and currency exposure associated with Clean Development Mechanism (CDM) and other projects.

The potential risks are associated with the uncertainty of the policy regimes. Hence, many assumptions have to be made when developing ET strategy. CO2e.com suggests modelling instruments to model uncertainty factors. Also, the extent of the risks faced suggest that company's risk management specialist requires a strong understanding of the policy dynamics, operational impacts and alternate risk management strategies.

For the management of the identified potential risks, the next step is to consider how these risks may be adequately managed to meet the firm's risk profile. CO2e.com suggests the following strategies to manage the risks:

❑ Diversifying the risk base through insurance options.

❑ Purchasing enhanced emission credits with some form of financial or performance guarantee.

❑ Obtaining audit assurance over the carbon credit existence and reliability, and possibly the organisational financial viability.

❑ Developing operational strategies that enhance organisational efficiencies.

To ensure that risk management performed appropriately, ET strategies should be integrated with corporate decision-making process. It can be done in several ways. CO2e.com (2003)

suggests the following measure as an example: "overlaying a climate change review on all investment decisions and encouraging managers to consider the climate change implications of business decisions regarding both capital investment and operation."

Palmisano (2000) points out another important issue related to GHG ET – the credibility of the involved companies for financing. Palmisano, the president of Eco-Energo Trade, LLC argues that the financial institutions will start assessing how the companies in which they invest, lend money or insure are vulnerable to the emission restrictions or are likely to benefit from ET. This point particularly stresses the importance of corporate strategy.

Palmisano suggests using common Value-at-risk (VAR) model that is designed to measure the company's value according to corporate risk. Model includes accounting for fluctuations of interest rates, exchange rates and equity, bond and commodity prices. The advantage of the model is that it allows expressing risk in one figure and it is possible to evaluate the portfolio daily (short-term evaluation.) Palmisano suggests that this model could be extended to include effects of the GHG credit prices and also suggests using long term VARs to introduce senior management with positive and negative effects of the increased GHG emission control costs.

Palmisano also points out risk aversion instruments for companies involved in ET prior to the official beginning of international ET. These are GHG-credit options (call options) and swaps. GHG-credit options give the right for the buyer to buy permits at the agreed price but do not oblige him/her to do so. The agreements can hold a transaction option for 10 years ahead. Using another instrument, swaps, one party agrees to pay another one if the price is higher than the certain agreed level. If the price is below the agreed level – payments go another way i.e. second company pays the first one. This method has the advantage that allows both companies to hedge their position. None of these instruments guarantee the integrity with the upcoming regulatory schemes, meaning the risk that they can be ineligible for future compliance

As a possible risk management strategy, Palmisano (2000) also mentions the possibility to invest in a company that is likely to benefit from the excess permits. However, the costs as well as benefits of such policy depend on many factors.

Joshua and Gadd (2000) add that "Traditional NPV[6] valuation models will be inadequate in the new carbon economy." They state that present energy asset valuations include additionally "network value", "option values" and the "green premium". The authors conclude that "least-cost compliance strategies will be the key driver in the new carbon economy"

Karmali, Marlow, and Ebert (2000) conclude that risk management strategies for energy sector cannot be properly developed without understanding the opportunities and pressures existing in the energy marketplace. Authors argue that effective carbon risk management strategy must be an integral part of overall corporate business strategy. Any acquisitions and plans for operation change should consider changes in GHG emissions. There is also a lack of clarity in defining carbon as a discrete asset. The absence of generally accepted accounting principles leads to the uncertainty how carbon transactions should be presented on balance sheets.

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[6] Net Present Value

Some authors believe that early emission reduction is a sound risk-management approach since it gives more flexibility to adjust to the price signals during the commitment period. If not using such a strategy, players can be left with a situation where they will have to accept the price of the allowances set by early players.

2.5.2 Framework for the optimal corporate ET strategy

In this chapter, the STI model and the insights of ET experts (see previous chapter) were used to develop the framework for an optimal ET strategy. The definitions of strategic postures and moves from the STI model were applied to the emission trading system (for the analysis of the ET system see chapters 2.2, 2.3 and 2.4). Findings of the reviewed literature on corporate ET strategy were also used to develop the framework.

The framework is based on the concept that the aim of the *optimal corporate ET strategy* is to increase profits and to reduce environmental impacts of a company. Hence, companies can take two strategic positions according these two aims: either passive, trying to comply with the regulation or active by going beyond compliance and employing regulations for profit making and environmental impact reduction.

The company's economic and environmental performance under the ETS would significantly depend on the strategic position that it takes. The strategic actions then would be the outcome of the strategic posture (SP). Hence, the SP is the baseline for the actions and will be largely dependent on risk management design and the structure of the management portfolio. Since emission trading schemes feature a very high uncertainty, the STI model can be suitable for corporate uncertainty management for companies involved in ETS. The STI model suggests four levels of uncertainty management that are also related to the SP. The suggested four levels of uncertainty can also be applied to ETS. It is most likely that before the start of the ET schemes (2005 for EUETS and 2008 for IETS[7]) uncertainty level will be highest (IV), because of the continuing political decisions to be made, institutional capacity building processes and lack of the corporate experience. After the beginning of the schemes, the uncertainty should drop to level III. After several years of the operation of the ET schemes the uncertainty is likely to drop down to the lower levels.

Courtney et al. (1997) argue that even though the level IV situation contains greatest uncertainty it may offer higher returns for the companies that take shapers position. They also point out that in such situations companies shaping the market (shaping strategic posture) can reduce uncertainty to levels III and II. Hence, it is possible to summarise that the shapers before and at the very beginning of the ETS would have the greatest advantage. Courtney et al. (1997) mention that since no player on the new market necessarily knows the best strategy, shapers provide vision of the industrial standards that will coordinate the strategies of other players. Such a strategy would also make the market more stable.

The authors argue that even though reserving posture is common in the level IV situations, it is potentially dangerous. They say that in such situations it is extremely difficult to determine whether incremental investments "truly reserve the right to play or simply the right to lose". However, they advice not to become locked into one position through neglect. Strategic options should be revaluated once the uncertainties have been clarified.

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[7] See the list of abbreviations for explanation and chapter 3 for the description.

The implications of the STI model for the corporate strategy under ETS will very much depend on the availability of allowances. Companies that are likely to experience a lack of allowances would need a different strategy from those that will have an excess of allowances. Table 2 presents implications of the STI model on ETS.

Table 2 STI model implications for ETS

Moves Postures	Big bets	Options	No-regrets moves
Shaping posture	Major investments in emission abatement techniques	Pilot investment projects in abatement	
Adapting posture,	Large scale allowance acquisitions	Pilot acquisitions of allowances	Corporate capacity building. Development of emissions inventory and economics calculations. Strategy development
Reserving the right to play		Investments in joint ventures, allowance brokerage companies	Bilateral agreements with other allowance traders. Membership in trading organisations
Moves Postures	Big bets	Options	No-regrets moves

Hence, the optimal ET strategy for the period prior the ETS would be *shaper's* posture. The actions taken from this position would be different for the companies that are likely to have a shortage of emission permits and for those who are expected to have excess. *Options* and *no-regrets* moves would be most suitable for the companies with a shortage of emission permits. For the companies with anticipated excess of permits, *no-regrets* moves are likely to be suitable. Hence, prior to ETS, companies with permit shortage should consider moderate investments in emission abatement and installations. The investments can also be considered after scrutinising the options. In parallel, a company can pursue no-regrets moves by investing in capacity and skills building. Companies with anticipated excess emission permits should concentrate on capacity and skills building. The *reserving right to play* posture is not recommended before the beginning of the ETS i.e. companies should not rely too much on the call option and swap trading. According the STI model, investment in the *reserving right to*

play strategy is rather risky under very high uncertainty (it is very hard to predict if such investments will pay back).

After the beginning of the ETS (projected uncertainty decrease to level III) companies should adjust their strategies to the new options. Courtney et al. (1997) do not give any suggestions for strategic position in uncertainty level III. However, they mention that the *reserving right to play* posture is most common in such situations. Hence, it is more likely that this position would suit after the beginning of the ETS in 2005 (see Table 2 and Figure 2). . In case of ETS such a strategy would imply, for example, bilateral emission trading agreements between companies. In addition, moderate investments can be suggested for companies, independent of allowance availability, for the precommitment period. For those having an excess of allowances, this would imply using the revenues from the allowance trade for the abatement investments. For those experiencing a lack of allowances it would imply reducing investments after the more intensive investment period suggested by framework for 2003 – 2005.

When it comes to GHG emission trading, intensive trade (purchases) would be suggested for the companies that are likely to a experience lack of allowances for the precommitment period. For those with an excess of allowances, moderate trade (sales) could be advisable. Such a strategy would be driven mainly by the prices of the allowances, that are expected to be lower for the precommitment period, than for the commitment period. Hence the profits for both types of companies could be optimised by following such a strategy.

For the commitment period, due to the expected allowance price, it would be reasonable to intensify trade (sales) for the companies with an excess of allowances and reduce trade (purchases) for companies with a lack of allowances, in order to optimise corporate profits. It would make sense for companies with an excess of allowances to increase investments into abatement techniques by using revenues received from increased trade. Companies with a lack of allowances should keep investments on the same level as in the precommitment period.

Figure 2 below summarises the findings.

Excess

High   Low

Allowance
availability ————————————————————————————————→ Uncertainty

2003   2005   2008   2012

Lack
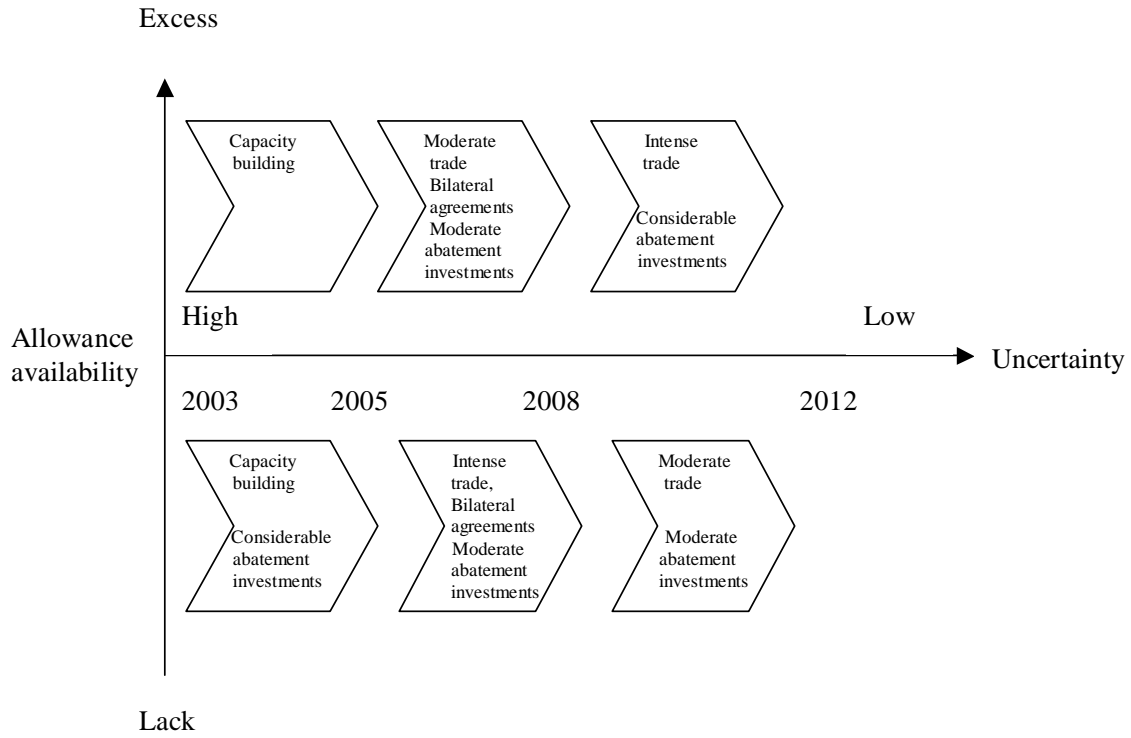
Figure 2 Framework for the optimal corporate ET strategy

The framework is not static. The important feature is that companies involved in emission trading have the possibility to change their vertical location on the framework i.e. allowance availability, and this position will depend significantly on strategic corporate abilities. The suggested emission trading strategy would have a positive impact on the environment. A company in the *shaping* position would strive to reduce emissions from its activities instead of making deals with cheap "hot air" dealers from Russia and CEE countries and GHG emission reductions would, therefore, be real.

3. Legal basis for GHG trading

This chapter aims to give an understanding in the use of legal instruments for international GHGs emissions trading. The provisions of the legal documents described in this chapter will be further used in chapter 7 in order to identify the calculation method of the key indicators of the GHG market in Lithuania. In this section, the Kyoto Flexible mechanisms and the EU proposed emission trading scheme (EUETS) are described. The emphasis in the analysis is on the EUETS since this scheme will have a major impact on companies in the EU member/accession countries. Due to recent changes in EU climate policy, the flexible mechanisms are now tied to the EUETS. The GHG emission reduction units gained via the project-based Flexible mechanisms can be traded on the GHG market as well as to exchanged to EUETS allowances. Therefore, the Kyoto flexible mechanisms are also described in the chapter.

3.1 The Kyoto flexible mechanisms

This chapter describes the Kyoto flexible mechanisms. The chapter is based on the following sources: "United Nation's Framework Convention on Climate Change" ("UN Framework Convention on Climate Change," 1992); "Kyoto Protocol to the United Nations Framework Convention on Climate Change" ("Kyoto Protocol," 1997); "Guide to the Climate Change Convention and its Kyoto Protocol" (UNFCCC, 2002) and "BASREC Regional Handbook on the Procedures for Joint Implementation in the Baltic Sea Region" (Ad Hoc Group on Climate Change, 2003).

At the third meeting of the Conference of the Parties (COP3) to the UN Framework Convention for Climate Change (UNFCCC) in Kyoto in 1997, countries agreed to tighten the rules of the UNFCCC. Annex B countries[8] of the Protocol took the legally binding commitment to reduce greenhouse gas(GHG) emissions by an average of 8% by 2008-2012, compared to the levels of 1990. The protocol targets 6 GHG gases: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6). The protocol has not yet been ratified by enough countries to be in force. However, it is expected that Russia will ratify the protocol soon and, therefore, bring it into force[9]. The GEF[10] is the designated body for financing the protocol activities.

According to the protocol, all Annex I countries are assigned with certain amount of GHG they are allowed to emit. The amount each country is allowed to emit is called the Assigned Amount (AA), which is measured in Assigned Amount Units (AAUs). One AAU represents one tonne of CO_2e[11] of GHG. The Assigned amount given to a country is equal to its emissions in 1990 minus its agreed reduction target amount[12]. Countries are allowed to bank

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[8] OECD countries and Central and Eastern European countries (Economies in Transition).

[9] The provision in the protocol says that the protocol will come into force after it is ratified by the number of countries whose total emissions will exceed 55% of the global GHG emissions. After the Russian ratification, this amount will be exceeded.

[10] GEF – Global Environmental Facility

[11] CO2 equivalent expressed according to the global warming potential trof GHG compared to CO_2.

[12] Countries are allowed to choose a year after 1990 as a baseline if they do not want to use 1990.

AAUs for the following years Reduction units generated from the project-based mechanisms may be banked under certain conditions.[13]

The protocol, among other political and economical instruments to curb GHG emissions, suggests three so-called flexible mechanisms. These are economic instruments that aim to allow emitters reduce their GHG emissions in the most cost effective way. These instruments are: Joint Implementation (JI), Clean Development Mechanism (CDM) and Emission Trading (ET). JI projects generate Emission Reduction Units (ERUs), CDM projects generate Certified Emission Reduction (CERs) and the LULUCF[14] activities generate so called Removal Units (RMUs). One tonne of CO_2 equivalent (CO_2e) is equivalent to one ERU, CER and one RMU. Units gained from the mechanisms, together with AAUs, must be registered in the national registries. To be eligible to use any of these mechanisms countries must have established an Assigned Amount and a National Registry.

Although flexible mechanisms are recommended for countries for achieving their commitment targets, the Marrakech accords[15] requires that the majority of emission reductions would be achieved by domestic measures. (UNFCCC, 2002). These mechanisms will now be discussed further with emphasis on JI and ET, as these two are the subject of this thesis.

3.1.1 Joint Implementation

The Joint Implementation mechanism gives opportunity for the Annex I countries to reduce emissions in other Annex I countries where reduction costs are lower. Projects can be implemented by companies, NGOs or governmental institutions of the investing country together with partners in the host country. JI can aim either for emission reductions or GHG removal by sinks, in both cases generating Emission Reduction Units (ERUs). ERUs are added to the Assigned Amount (AA) of the project host country and are later transferred from AA to the account of the investing entity (country) according to the stipulations of the agreement between the project developers.

In practice, projects are most likely to take place in Economies in Transition (EIT), where emission reduction costs are lower. Projects can be implemented already from year 2000, but ERUs may only be issued after 2008. Nonetheless, investing countries can accumulate ERUs and transfer them after 2008.

A two-track approach is used for the JI project development procedure. This means that there are two different standard procedures of the JI project implementation depending on the two sets of requirements that must be met by the countries. The requirements to be eligible for the first track are much stricter than for the second track. General prerequisites for JI project development under the both tracks are that participating countries must have established the National Focal Point for approving the projects; have prepared national guidelines and procedures for the JI implementation and have established national registries for the AAUs and other units (ERUs, CERs, and RMUs) generated from project based mechanisms.

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[13] Up to 2,5% of the assigned amount may be banked for the next year from CDM/JI projects. Credits earned by using GHG sinks are not bankable.

[14] LULUCF – Land Use, Land Use Change and Forestry sector – activities that lead to CO_2 sequestration.

[15] The later document adopted at the COP/MOP 8 – further development of the protocol provisions.

The first track procedure is applicable when, in addition to the general requirements, the host party fully meets all requirements stated in the Protocol's methodology. The additional requirements for the first track are for the country to have: a national GHG calculation system, annually submitted a GHG inventory report and the supplementary information regarding the Assigned Amount. In such a situation, the host Party can apply its own procedures for assessing the emission reduction additionality as well as to issue the ERUs to the investing party without the approval of Supervisory committee. The eligible country can also decide how to design the verification system on its own. Since there are no specific requirements for the verification of the ERUs under the first track procedure, the JI process cycle under the first track can differ from country to country. No country meets the requirements of track I so far.

For the second track procedure it is required that countries have calculated AA and have a national registry in place (general requirements). In the second track the proponents prepare a Project Design Document (PDD), which is evaluated by an independent entity that has been accredited by the Supervisory Committee[16]. The independent entity checks if the all the requested procedures are in place (i.e. transparent baseline, monitoring plan, environmental impact assessment, etc.) After the independent entity decides to approve a project, the parties submit a report on emission reductions and the independent entity will determine the amount of ERUs that the host party can issue to the investing party. Finally, the project must receive the approval of the Supervisory Committee. Hence, the second track procedure allows the host party to start Joint Implementation projects before the full requirements (first track) are met.

When the JI system is in place (after the Kyoto protocol is ratified), the list of countries that meet requirements of the first or second tracks will be publicly available. There will also be a list of countries that do not comply with the requirements, and therefore, cannot take part in JI projects.

Some issues associated with the JI make it rather complicated. The Supervisory committee will be established only during the first meeting of COP/MOP[17] that will be held after the ratification of the Protocol. If the Protocol is ratified in 2003, in the best case the Supervisory Committee will become operational in 2004. Before that time, all activities related to the JI development have no legal power. Also, the independent entities for the verification procedure cannot be accredited to verify projects before the Supervisory Committee is established. There is, therefore, a risk that the projects that are implemented prior to the legal system comes in to force will not qualify as a JI project (i.e. ERUs generated by these projects will not be legally accepted).

Despite the above-mentioned constraints, JI projects can be implemented from 2000 onwards. One option to secure the acceptance of the early-generated ERUs under the forthcoming obligatory scheme is to choose the verifier (Independent entity) who is accredited by CDM Executive Board for the CDM project verification. It is likely that the companies performing verification for the CDM projects will also become independent entities in the JI mechanism because the procedures for CDM and the second track JI are

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[16] Supervisory Committee – the highest authority for JI mechanism, that will be established after the Protocol will come into force.

[17] MOP – Meeting of the Parties - the annual meetings of the Protocol parties that will be held after the ratification of the Protocol.

similar. Hence, the project verified by such entities would be associated with more credibility and, therefore, more possibility to achieve official JI status when the legal basis is established.

3.1.2 Clean Development Mechanism

The Clean development mechanism (CDM) allows Annex B parties to implement projects that reduce emissions in the territories of non-Annex B countries. The Certified Emission Reductions (CERs) generated by such projects can be used by Annex B Parties to meet their emission targets. The mechanism is also intended to foster clean technology transfer to the developing countries and to help non-Annex B parties to achieve sustainable development. The CDM mechanism is designed for both emission reduction and carbon sequestration activities. Sequestration activities are presented by the so-called LULUCF (land use, land use change and forestry) sector. Hence, annex B[18] countries can implement either emission reduction projects or projects like aforestation that is intended to sequestrate CO_2. Aforestation and reforestation activities under this mechanism are limited to cover not more than 1% of the investing country's emissions. The CDM is also expected to contribute to the economy rising of the developing countries.

CDM projects need approval from designated authorities both from Annex B and Non Annex B countries. The central Executive board for CDM accredits independent organisations – Operational entities that are responsible for the project validation and emission reduction certification. In order to implement CDM project, parties must prepare a project design document (PDD) that includes the description of the baseline, monitoring plan, an environmental impact assessment and a description of the additional environmental benefits that the project will generate. After the validation by the operational entity, the document is forwarded to the Executive board that registers the project and either approves or rejects it. If the PDD is approved, the project developers then submit a monitoring report together with estimated CERs to the Operational entity (a different one from that which validated the PDD). The operational entity then certifies the CERs and, after 15 days, the Executive board will issue the CERs and transfer them to the project participants.

CDM project developers are obliged to pay a fee. 2% of CERs will be paid to the adaptation fund to help developing countries to adapt to the adverse effects of climate change as well as to cover CDM administrative costs. Projects can be started and generate CER from 2000 onwards.

3.1.3 Emission Trading

Emission trading under the Kyoto Protocol allows Annex B parties to purchase Assigned Amount Units (AAUs) from other Annex B parties. Similarly Annex B countries can acquire CERs (CDM projects) ERUs (JI projects) and RMUs (LULUCF).

Not all units may be traded. Each Annex B Party is required to hold a minimum amount of AAUs, CERs, ERUs and RMUs, which is known as a Commitments reserve and cannot be traded. The reserve is assigned for the whole five years commitment period (i.e. 2008-2012). According to the Protocol, countries are given two options for assigning their commitments reserve. The first option is to allocate 90% of AAUs to the reserve. The second option is to

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[18] The term "Annex B countries" refers to the Kyoto protocol and includes both Annex I and Annex II countries of the UNFCCC.

allocate 5 times its latest emission inventory amount to the commitments reserve. The tradable amount of AAUs is the difference between the commitments reserve and the Assigned amount (Baron, 2002).

The idea behind such a system is to prevent the overselling of emission permits that does not comply with the actual reductions and to make countries to reduce the main part of their emissions domestically. The two options for allocation of the Commitments reserve gives the possibility to choose the lower amount of the two i.e. to allocate more emissions as a tradable amount, since the variation of the GHG emission trends varies significantly among the countries.

In order to participate in international emissions trading, a country must meet general requirements for all flexible mechanisms: to have National Registry in place and established Assigned Amount. Additionally to the general requirements, the country must have an established commitment reserve and a tradable amount.

3.2 EU Scheme for GHG emission allowance trading

3.2.1 The Directive of GHG Emission Allowance Trading

This chapter is based on the recently adopted Directive for "establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC" ("GHG Emission Allowance Trading Directive," 2003) and texts adopted at the sitting of European Parliament, Wednesday 2 July 2003 (European Parliament, 2003).

In 2 July 2003, the European Parliament finally adopted the GHG Emission Trading Directive (EUET Directive) that was also accepted by the Council on 22 July 2003. The formal adoption, after the translation and text unification is envisioned for September 2003. The adoption finalises several years of harsh debate among EU officials, industries and NGOs, as well as other stakeholders. The proposal for the Directive has been amended twice before the final adoption.

The EUET Directive establishes cap-and-trade scheme for the GHG emissions within EU. The Directive sets the limits for the emissions of carbon dioxide from energy intensive sectors and industrial processes. The companies that will fall under the regulatory scheme will be allocated with the certain amount of emission allowances. One allowance gives the right to emit one tonne of CO_2e (carbon dioxide equivalent). Companies will be able to sell unused allowances on the market. Allowances can be traded within the Community as well as with countries outside the Community where such allowances are recognised. It is estimated that about 46% of the EU's total CO_2 emissions in 2010 will covered by the scheme and will involve about 12 000 companies. At the moment, the adopted directive covers only CO_2 emissions and the following sectors: combustion installations (>20MW), mineral oil refineries, production of ferrous metals (metal ore and pig iron or steel >2,5 t/hour), cement production (>500t/day), lime production (>50t/day), glass and glass fibre production (>20t/day), ceramic production (roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain > 75t/day), pulp production and paper production (>20t/day). However, among the latest amendments are provisions that allow include other GHGs as well as other sectors, such as chemical, aluminium production and transport. The Commission will assess the

coverage of the scheme before 30 June 2006 and will decide if it needs to be amended. The inclusion of other GHGs will also be considered.

The allowances for the installations will be issued by 28 February each year. They will be valid for the period they are issued i.e. either for the pre-commitment (2005-2007) or for the commitment period[19] (2008-2012). The member states must then ensure that by 30 April each year every installation under the scheme surrenders the amount of allowances consistent with emissions quantity it has released (article 12). For each excess tonne of the emissions to the surrendered amount of allowances operator will be obliged to pay fine of EUR 40 (for 2005-2007) and EUR 100 (for 2008-2012). After the paying fine, the operator will not be released from surrendering the lacking allowances i.e. company in addition to the paid fine will have to obtain allowances for the excess emissions.

At the end of each period, un-surrendered allowances will be cancelled. Member states are free to decide what quantities of allowances they will allocate for the required sectors. Corporate reports on the GHG emissions will have to be verified by the independent body before they are submitted to the authority. If the verification findings are not satisfactory, the company will not be allowed to trade until it meets all requirements.

The new text of the Directive emphasises the importance of the Community undertaking domestic action to achieve greenhouse gas emission reductions, alongside using credits resulting from the Kyoto JI/CDM projects outside the community.

One of new amendments indicates that the Community will support CHP (combined heat and power) technology installations, which are perceived as emitting less GHG. The transport sector is also given a lot of attention: "The Commission will, in particular, consider policies and measures at Community level in order that the transport sector makes a substantial contribution to the Community and its Member States meeting their climate change obligations under the Kyoto Protocol." (Amendment 32 of the ET Directive).

One very important amendment was made for article 10 of the ET Directive: "For the three-year period beginning 1 January 2005 Member States shall allocate at least 95% of the allowances free of charge. For the five-year period beginning 1 January 2008, Member States shall allocate at least 90% of the allowances free of charge." (Article 10). This provision implies that member countries are free to decide to sell part of the allowances while making their initial allocation. Hence, the companies can be obliged to buy up to 5% of their allocated amount for the precommitment period and up to 10% for the commitment period. The remaining allowances for both periods will be assigned free of charge.

Article 27 states that countries ask the Commission to exclude certain installations from the scheme until 31 December 2007. The list of such installations would then be published in official EU information sources.

The Commission keeps the right to change and amend the Directive, with the aim of further "harmonisation". Article 30 states that the Commission, referring to the progress made on GHG emission monitoring, can make a proposal by the end of 2004 to incorporate other

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[19] The terms commitment and precommitment periods are used for the Kyoto mechanisms. In this thesis they are also used for the two trading periods: for EUETS (2005-2007) and IETS (2008-2012) because the periods are consistent for both schemes.

GHG gases and activities into the scheme. Auctioning allocation method may also be included after 2012.

Probably the most debated issue was the provision related to the Kyoto project based mechanisms. Amended article 30 states that the credits gained from these projects (JI/CDM) will be recognized in the EU scheme. However, it is also stated in the Directive that use of the flexible mechanisms will be supplemental for the domestic GHG emission reduction measures. The article says: "The total quantity of allowances to be allocated shall not be more than is likely to be needed for the strict application of the criteria of this Annex. Prior to 2008, the quantity shall be consistent with a path towards achieving or over-achieving each Member State's target under Decision 2002/358/EC and the Kyoto Protocol." (Article 30)

Member states must designate the authority for the implementation of the Directive. The national registries will be established for accounting, holding, transfer and cancellation of allowances. Countries are also allowed to maintain their registries together with one or more member states. According to article 19 any person can hold allowances. The registry will be made publicly available and will contain accounts of each allowances holder as well as records about the transfers and issuances. The message of this provision is that the third party participation in the scheme will be allowed. That implies that allowances can be owned not only by emitters but also by traders – any financial or private body.

Operators are allowed to form pools of installations and receive allowances for the whole pool. A trustee who is responsible for the operation with the allowances issued for a pool must be assigned in this case.

The member countries must bring the provisions of the Directive into national law, regulations and administrative mechanism by 30 September 2004. This implies that the allocation, registry and the verification/validation mechanisms have to be established by that time. Each year, the member country is obliged to submit the report on the implementation progress of the Directive. The first report must be sent to the Commission before 30 June 2005.

3.2.2 Proposed Directive concerning the JI/CDM mechanisms

The proposal is the Directive amending the GHG Emission Allowance Trading Directive with the provisions in respect to the Kyoto Protocol's project-based flexible mechanisms. The Directive establishes the compatibility between the EU GHG allowance trading scheme and the JI and CDM mechanisms. The Directive was proposed on 23 July 2003, directly after the adoption of the ET Directive. The subchapter is based on the text from "Proposal for a Directive of the European Parliament and of the Council amending the Directive establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms" ("Proposed flexible mechanism Directive," 2003).

According to the proposal, member countries will be allowed to convert ERUs and CERs gained from JI and CDM projects into the Community's GHG emission allowances. The conversion rate will be 1:1. Hence, the operators will have the possibility to implement projects within or outside the EU and convert the gained credits into allowances while complying with the EUETS caps. ERUs and CERs generated from nuclear power projects and LULUCF activities will not be eligible for the conversion into allowances. However, the

credits from large hydropower power plant projects will be allowed to exchange into the allowances.

The amount of credits that may be converted into the allowances will be limited. There is no strict limitation so far, but the proposed Directive has a provision that envisages a revision when the amount of credits reaches 6% of the allowances allocated by member states for the period. The Commission reserves the right, after the revision, to limit the quantity of converted credits by the member country to e.g. 8% (not specified in the Directive proposal)

The proposal imposes responsibility on the member countries to assure that the credits comply with the actual emission reductions and that the reductions achieved from the project are additional to those which would have occurred anyway.

In addition to actual emission reduction, the proposed Directive considers technology transfer and capacity building in the developing countries and economies in transition through the implementation of the JI and CDM projects. An important proposed amendment in the Directive is that JI project verifiers are to be certified according to EMAS[20] procedure.

3.2.3 The implications of the Directives for accession countries

The EUETS Directive has no special provisions for the accession countries. This implies that accession countries have the same obligations and rights under the scheme as other member states. However, article 30.2 of the Directive states the following: "On the basis of experience of the application of this Directive and of progress achieved in the monitoring of emissions of greenhouse gases and in the light of developments in the international context, the Commission shall draw up a report on the application of this Directive, considering: (…) (i) how to adapt the Community scheme to an enlarged European Union (…)". The experience will, most likely, be based on the first report on the implementation of the Directive that member countries are obliged to submit by 30 June 2005. The Commission then is to submit the proposal for the Directive amendments, based on the reports, to the Parliament and the Council. It implies that no changes in the Directive, including ones concerning accession countries, will be made before the end of 2006[21]. Hence, at least for the first two years of the operation of the EUETS scheme, accession countries will have the same rights and obligations as other member countries.

The proposed amendments for the ETS Directive on the flexible mechanisms don't contain any special provisions for the accession countries either.

Another important issue is the burden sharing agreement among the EU members concerning jointly reaching the Kyoto target of the 8% GHG emission reduction. The possible redistribution of the burden sharing in respect of accession countries has not been discussed on the official EU level so far.

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[20] EMAS - Community Eco-Management and Audit Scheme

[21] To draw a proposal for the amendments and to adopt the amendments would take at least one year.

3.2.4 The position of stakeholders on the EU GHG Trading Scheme

Many stakeholders took part in the design process of the Directive – industries, agencies, governments (including accession countries), NGOs.   Environmental NGO's have been active in conveying their position towards the scheme. The WWF and the Climate Action Network (CAN) Europe took part in the round table discussions in September 2001 concerning the Directive provisions.

The main stakeholders – environmental NGO's, energy producers and emission traders – agree that the ET Directive is a positive step towards the climate change mitigation. They admit that the instrument itself is suitable tool for the achievement of pollution reduction targets with minimal costs. The most discussed issue is proposal for the Directive linking the EU ET scheme with the Kyoto mechanisms.

EURELECTRIC – the Union of the electricity industry of Europe, whose members' emissions comprise 60% of those covered by the EUETS, promotes the linking of the JI and CDM to the scheme. The organisation also sees one drawback in the Directive – unclear provisions on allowance banking between the pre-commitment and commitment period. (EURELECTRIC, 2003).

IETA - International Emission Trading Association welcomes linking EU ET scheme with the Kyoto mechanisms and contends that it wouldn't be possible to reach emission reduction targets without this measure. IETA also suggests that other greenhouse gases, in particular N20, should be included in the scheme,. IETA perceives public access[22] to the scheme as a negative characteristic and argue that it will lead to higher compliance costs. (IETA, 2003b).

WWF's Climate Change Programme is concerned that the proposed flexible mechanism Directive will remove the incentive for clean energy development within Europe. The WWF is afraid that the European market will be flooded with cheap credits, which represent badly supervised emission reductions and, hence, have no positive impact on climate change. The WWF is also concerned about large Hydropower stations and other projects in developing countries that cause more damage to the environment than the benefits related to Climate change. According to the WWF, so-called efficient coal and other fossil fuel plants that can be implemented under the flexible mechanisms do not represent sustainable development. .

The WWF urges the Commission to make changes in the Directive that would enable accepting credits only from clean renewable energy and energy efficiency projects. Hydro power plants should not exceed 15 MW. It is also suggested that the Directive should set strict limits on the credit volumes that can be converted to allowances for each country and installation.

If no changes are made, the WWF CCP argues that the considered policy instrument will become a worthless document that helps companies to meet their targets but has no benefits for the climate and environment. However, the WWF also believes that there are several positive aspects within the proposal such as exclusion credits gained by nuclear power and the proposals relating to carbon sinks. (WWF, 2003).

Similarly to the WWF, GREENPEACE points out the absence of the limit values for the credits that enter the system. GREENPEACE also argues against the large hydropower dams

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[22] Any person will be allowed to hold allowances in his account at a national registry.

as destructive for the environment and also contends that these constructions can be a source of a methane gas. (Greenpeace, 2003).

The CLIMATE ACTION NETWORK (CAN) Europe – the network of environmental NGOs – also points out the low credibility of the outside projects as well as the negative impacts of large hydro power plants. The organisation states that large hydro projects prove to be non-additional in terms of emission reductions and cause significant environmental and social damage. CAN claims that 30% of the Dutch ERUPT[23] portfolio comes from non-additional large hydro projects, which is equivalent to 5 Mt of CO_2e.

Similar to the WWF, CAN Europe suggests to accept credits only from clean renewable energy including small hydro. CAN Europe also argue that the cap should be imposed for the quantity of the credits that may be converted into allowances. CAN Europe welcome the exclusion of carbon sinks from the scheme. (CAN Europe, 2003).

3.3 Implications of the Kyoto protocol and EUETS

The legal documents for GHG ET in this chapter are analysed in the light of the thesis research purpose. To this end, the following questions are addressed: what advantages and disadvantages will companies face after the EUETS and IET begin and what impacts will the schemes have on the EU energy market.

One of the main issues related to ET under the Kyoto protocol is the so-called "hot air" trading. "Hot air" is the term that describes the surpass of emission credits in Russia and eastern European countries. This surplus leads to excess AAUs that can be sold on the international market, but are not actual emission reductions. It is believed that many JI/CDM projects can be prevented from implementation because of the large available amount of "hot air" credits. Some analysts e.g. Butzengeiger et al. (2001) suggest a few methods on how this problem could be solved. One of them is the possible exchange of the international debts into the excess credits. Another suggestion is to accept the credits in the EUETS scheme with the ratio 2:1 while exchanging them with allowances. However, it is likely that during the first commitment period this problem will not be solved because Russia, the main supplier of "hot air" is likely to ratify the protocol under the premise of being able to trade with this "hot air".

The Economies in transition are likely to bank significant amounts of AAUs because the price does not seem high enough to sacrifice the possibility of raising emissions in the future, or because they are not yet ready to perform such transactions. (Baron, 2002).

Emissions trading under Kyoto protocol is designed for trade between countries[24] while the EUETS will directly involve companies in the industry and energy sectors. Hence, EUETS is the issue that companies are mostly concerned about. The EUETS is expected to be a multibillion[25] Euro market in a few years. About 12 000 installations will be included in the scheme, which would cover about 40 % of the EU's emissions. Ecofys consulting company projects the market will grow up to 1,8 billion in 2008-2012.

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[23] ERUPT – the programme launched by Dutch government to foster JI projects. In this programme, ERUs are purchased from international JI projects performed by Dutch companies.

[24] The amendments can be made in later COPs allowing companies participate in IETS.

[25] EUR 1,8 billion in 2008-2012 according to Reuters Business Insight.

One of the most discussed issues relating to EUETS is the allocation of allowances. The main issue is whether the allocation will distort the competitiveness of companies involved in the scheme. While allocating allowances, it is likely that some companies will reap more benefits than others. Some stakeholders believe that the current form of the Directive allows for many different interpretations, which would lead to the distortions. Others argue that competitiveness distortions are, to some extent, inevitable. (Nicholls, 2003).

The company, "ICF Consultants" has performed a study of the allowance allocation (EUETS) impacts on the electricity market. ICF consultants, Karmali and Cornelius (2003) argue that the introduction of GHG constraints in the EU will have "dramatic consequences for the commercial viability of existing power stations in the region." At the same time, the consequences will mostly depend on the allocation method used and the way that it will be applied. The results show that the scheme will lead to the increased use of the natural gas (switching from coal and oil). It is also stated that power generators (e.g. in the UK) would benefit from the scheme, even when excluding the value of the allowances. The analysis also predicts changes in the electricity prices after the ETS is introduced. The authors state: "It is actually possible for carbon emissions trading to drive power prices downwards if the permit allocation system includes particular features." However, the results of their analysis are presented using a figure that illustrates the present downward trend of electricity prices in the EU that is reversed upwards after the introduction of the EUETS.

The perceptions that some companies will benefit more than others, depending on the allocation method chosen, and that a shift to natural gas will occur is in no doubt. However, one could argue on the assumptions regarding electricity price. The European electricity market is becoming more and more open to the free trade among the member countries. The EU energy policy is aiming to open the market entirely in the near future. Such policy implies the steady increase of competition among the power generators that is likely to become harsher on the fully open market. Hence, the electricity price is likely to experience significant downward pressure. The EUETS is more likely to have an impact on the profit distribution among generators rather than significant impact on the electricity price trends. The profits from the coal and oil energy will be questionable as will therefore, the margin between production costs and the electricity prices. Generators using natural gas and renewable energy will definitely be in a more favourable position. How much better will significantly depend on the allocation.

Another important issue is the compatibility of the EUETS and domestic ETS (e.g. in UK and Denmark). Rosenzveig (2002) and others argue that the incompatibilities between domestic and EU ET schemes can prevent some economically beneficial transactions and warn about the fragmentation of the market. They state: "Many of the provisions in the UK program also differ from those in the European Union's draft directive. If these differences are not ultimately harmonized, GHG trading may occur mostly within several fragmented markets, each with its own unique commodity, instead of in a single international market for a homogenous GHG emissions commodity."

If Rosenzveig's et all predictions are correct, then the theory of possible market distortion by dominant players (see chapter 2) will become reality for the EU emission trading scheme, from the beginning of its existence. Such a distortion would not occur if the market is fully integrated and free.

Further market distortions related to the transaction costs are hedged in EUETS. As discussed in chapter 2, the transaction costs for small emitters could be too high to allow for

adequate compensation with the benefits from the emission reductions (the capacity of emission reductions for small emitters is insignificant). EUETS includes only "significant" emitters i.e. only >20MW combustion installations are included into the scheme.

The liquidity of the market in EUETS is ensured by including third party in the emission trade. According to the ET Directive, any person or organisation can hold and trade allowances. As discussed in chapter 2, third party participation is the prerequisite for market liquidity.

Hence, the conclusion can be drawn that the design of the EUETS complies with the theoretical requirements for the optimal design for the ETS design. However, the scheme also faces several pitfalls that are mentioned above.

From the analysis presented here, it becomes obvious that after the EUETS scheme comes into force, the companies involved in the scheme will need a strong climate change strategy if they want to stay competitive on the market. Many consulting companies and financial institutions are preparing for the future demand for skilled advisory services in GHG emissions trading in the EU. However, the companies involved in the scheme, especially large multinational corporations, should not rely entirely on consultancies. Capacity building for future GHG market through the development of an in-house ET strategy and staff training related to GHG trading issues is recommended.

The behaviour of players within the scheme significantly depends upon the decision of national authorities on banking of the allowances. The Directive brings the responsibility for the member countries to decide whether they will allow banking of the allowances between pre-commitment and commitment periods. In any case, the actors will strive to achieve maximum revenues from trading. Hence, if the allowances are bankable between the two periods the player will strive to bank more allowances for the next period. That would imply the higher price of the allowances since the market experiences a shortage of allowances. Another outcome will occur if the decision will be to not to allow the banking between the two periods. In that case, a holder of the allowances will be obliged to sell the allowances at a lower price, instead of banking them for the next period, when the prices according are likely to be higher. The picture becomes a bit blurred when it comes to the ERUs and CERs that are anticipated to be available in large volumes that would, of course, reduce the market price. Also, the huge potential of available AAUs from Russia and other Eastern European countries could change the predictions.

The EUETS contribution to the environmental performance improvement will depend on the incentives that the scheme gives to the companies to reduce their GHG emissions. For the accession countries, these incentives are not likely to be significant at the beginning of the ETS due to the availability of excess emission credits. Hence, changes in environmental performance will depend significantly on the allocation method chosen by authorities.

4. Lithuania in the context of the international GHG market

The involvement of Lithuania in the international projects and treaties relevant to GHG emission trading is discussed in this chapter. The intention is to determine the potential impact that international relations could have on the GHG market in Lithuania and is important because of the international nature of GHG emission trading schemes.

4.1 Cooperation within the Baltic Sea Region

Energy ministers of the Baltic Sea region and the European Commission established the inter-governmental Baltic Sea Region Energy Co-operation (BASREC) in 1999 in Helsinki. BASREC is intended to enhance cooperation in fields of electricity production, energy trading and climate change issues. BASREC has four working groups (ad hoc groups) one of which is a climate change group. The group prepared the ground for the Energy ministers meeting in Vilnius in November 2002. At this meeting the ministers decided to establish a testing ground for the Flexible mechanisms with the emphasis on JI projects in the Baltic Sea region. The aim of testing ground is to build up a capacity for the Kyoto flexible mechanisms and to facilitate their implementation in the region, first of all JI. In order to achieve the given targets, the Testing Ground Facility (TGF),a financing body, has been established. (BASREC, 2003).

Organisations such as the World Bank's Pilot Carbon Fund (PCF) are also involved in the cooperation. The PCF has, so far, implemented a landfill project in Latvia and is investigating the conditions for further investments. The ERUs were generated in 2002 and will be transferred to the fund after 2008. The PCF also invested in 3 JI projects in Poland (geothermal and biomass). (BASREC Conference, 2002).

The idea of the testing ground is to give the incentive for the companies of the region to invest into JI projects within the region. In order to facilitate process, it is envisioned that the TGF project financing would give an incentive for companies to invest in JI. TGF is anticipated to buy the Emission Reduction Units (ERUs) from these projects prior to the beginning of the commitment period in 2008. The prerequisite for the financing will be that participating parties fulfil the first track requirements for JI projects. Contributors to the fund would, according to the proposal, initially be the governments, potentially municipalities and at a later stage, also private enterprises (e.g. suppliers of the equipment for the emission abatement). The facility is to be owned by the contributors to the fund according to its project. The TGF will focus on small and medium enterprises that have a large potential for emission reductions (BASREC Conference, 2002)

Although the testing ground framework and activities are under way, several activities have also occurred under the BASREC umbrella. These activities include a handbook for Joint Implementation in the Region prepared by Ad hoc Group for Climate change and CO_2 electricity as well as a GHG emission trading simulation game. The handbook aims to create a framework for the JI projects in the Region. It is designed for both project proponents and national government administrators to give guidelines for the JI procedure. The handbook focuses on the energy production activities prior to the commitment period in 2008. (Baron, 2002).

An ET simulation game was played in March-April of 2002 among the states of the Baltic Sea region. 20 energy companies participated in simulation as well as the government representatives of these countries. The purpose of the simulation was to explore the interactions between the electricity and CO_2 market and to explore more flexible mechanisms. The task for the government representatives was to comply with the emission reduction requirements. The International Energy Agency (IEA) model was used to define the future emission levels and mitigation costs. To comply with the GHG emission limit requirements the governments had the possibility to use several options: to reduce emissions, to buy allowances and ERUs or to launch virtual JI projects. (Baron, 2002).

The double auction system was used for trades, which took place on the purpose designed online trading platform. A double auction aims to create a competitive price mechanism. The best offer and the best bid are displayed on the platform and only they can lead to the transaction. Other bids and offers are also displayed but only for information purposes, they cannot lead to a transaction. Also countries and companies couldn't sell more allowances than their assigned amount and buyers had no means of negotiating the price separately with sellers (i.e. they could only make deals through the double auction). (Baron, 2002).

One interesting finding relates to the price range. Prices varied significantly between the prices of allowances traded internationally (EUR 17/t CO_2) and the prices of ERUs (EUR 11- 15/t CO_2). Some participants of the game did not believe that these figures reflected real prices because of the many assumptions and simplifications that were made in the simulation. However, it is still possible to make a conclusion that the lower price of ERUs reflects a risk premium associated with the JI projects (see chapter 3.1.1.).

The following lessons were learned from the simulation.

❑ The initial allocation influenced competitiveness of the companies.

❑ The cost of meeting emission targets depends on policy aspects such as early closing of nuclear power plants or premium prices for renewable energy.

❑ The ERUs price was lower than international emission trading price. The low price is likely to reflect a risk premium and transaction costs attached with the JI projects.

❑ A large seller can dominate the CO_2 market and consequently the market price of CO_2 depends partially on the policy of that seller.

❑ Banking plays a crucial role in government strategies. A seller would often avoid a bad trade by banking the allowances for the future.

❑ Countries with emissions well above the target during the commitment period will have little bargaining power, because sellers will know that these buyers have a limited margin to reduce emissions.

❑ During the game, the cost of carbon was reflected in the prices of allowances.

The following conclusions have been made from the simulation game:

The main motivations to start JI projects for the participants were: the lower price of ERUs, gaining experience in these types of projects, establishment of business contacts and the business opportunity. (Baron, 2002).

4.2 Cooperation between Baltic States

The electricity market of the three Baltic States is currently being unified. The common high voltage transmission line forms a so-called Electricity ring between the countries with the operating centre in Riga (Latvia). The possibility of creating a common Baltic Gas ring is also being considered. The main body for the cooperation between the Baltic States is the Council of Baltic Ministers. Energy issues are addressed by the Energy committee within the Council that is formed from the representatives of the Energy agencies of the Baltic States.

The important document prepared by the Committee is Baltic Energy Strategy. It has the following provision regarding climate change: "The current international agreements, such as the Kyoto Protocol, will allow the implementation of joint environmental policies in the energy sector. This joint implementation and emission trading could be of interest to the Baltic States, particularly when taking the different primary energy sources for electricity generation in the different countries into account". ("Baltic Energy Strategy," 1999).

The National Energy Strategy of Lithuania envisions the integration of the electricity market together with the other Baltic states into the Scandinavian electricity market. ("National Energy Strategy," 2002).

4.3 Cooperation Between Lithuania and Sweden

4.3.1 Assistance of Sweden in AIJ projects

Sweden is the country that has the most experience in Europe with the Kyoto mechanisms. The Swedish Energy Agency (STEM) implemented around 70 so-called Activities Implemented Jointly (AIJ) projects in eastern European countries during the past decade. These projects contain much valuable information for future projects as well as some general ideas regarding the Kyoto mechanisms. For example, Swedish experts have calculated that the average emission reduction costs were around USD 6,7 per tonne of CO_2 emitted. However, polish experts estimate that cost of one tonne of CO_2 emission reduction in Poland is around only one Euro per tonne. (BASREC Conference, 2002).

STEM together with Swedish International Development Agency (SIDA) have implemented several energy related projects in Lithuania. 10 fuel switching projects (fossil to biomass combustion) were subsidised between 1994 and 2001. Several industrial and boiler house installations were renovated and adjusted for biomass combustion. In 1999, the Lithuanian Energy agency performed an assessment of the combustion installations and presented 26 cases to STEM as potential renovation projects for the fuel change to biomass. Swedish experts have chosen 8 projects with the total investment costs of LT[26] 17 million (about 4,6 million SEK). These projects x are being carried out together with other Lithuanian institutions. The Swedish Energy Agency has also financed a 150 m² solar panel demonstration project. (Energy Agency of Lithuania, 2002).

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[26] Litas – the official currency of Lithuania.

4.3.2 Treaty with Sweden on JI projects

This subchapter is based on the text of "Proposed treaty between government of Lithuanian Republic and government of Swedish kingdom on the reduction of greenhouse gas emissions by joint measures". ("Proposed JI treaty," 2003).

The aim of the treaty is to help implement JI projects in Lithuania and to ensure the transfer of Emission Reduction Units (ERUs) to Sweden. Within this treaty, Lithuania also commits itself to transfer, as ERUs, the emission reductions that were made after January 1, 2000 under the Kyoto mechanism called Activities Implemented jointly (several energy efficiency projects).

The treaty envisages following projects that Swedish companies can develop in Lithuania: Energy efficiency, fuel switching to biomass, utilisation of anthropogenic methane and energy generation from renewable sources.

According to the treaty, parties are responsible for the creation of the verification and validation schemes as well as for national registries. In case Lithuania fails to comply with the emission reduction or transfer requirements, then the Swedish share of the project is transformed as a loan for a maximum of 10 years at a market-levelled interest rate.

The Treaty has not yet been signed and is waiting for the approval of the related ministries in Lithuania: the ministry of Economy and the ministry of Energy. After approval, it will also be signed by the Ministry of Environment. The negotiation and approval process has so far taken almost one year and is expected to be signed by the end of 2003.

4.4 Concluding remarks

Lithuania is party to two international treaties concerning climate change and the Kyoto flexible mechanisms in Lithuania. One treaty is a Memorandum of understanding with Finland on the cooperation on Climate change issues and the other is a pending treaty with Sweden on Joint implementation projects.

The international context for ET that Lithuania is facing is favorable towards JI. Two things are likely to contribute to JI project implementation in Lithuania: the establishment of a testing ground for JI under the BASREC agreement in the Baltic Sea Region and the state level agreement with Sweden on JI. The testing ground for JI projects implies that TGF funds will be used for the projects in the EIT countries of the Baltic Sea region. Lithuania, as one of the EIT countries, will also benefit from the implementation. The treaty with Sweden will give the legal basis for the JI agreement between Lithuanian and Swedish entities. Hence, after the agreement is signed (likely by the end of 2003), JI projects can be started (i.e. prior to the commitment period).

As the BASREC simulation game showed, the prices of ERU's were lower than those of the allowances. The price difference can also lead to the enhancement of JI. Since JI will be linked to EUETS, companies will be allowed to claim the allowances in exchange for ERUs while complying with their emission caps under the EUETS. Hence the JI can play an important role in the GHG market in Lithuania.

5. Framework conditions for Emissions Trading in Lithuania

The aim of this chapter is to define the readiness of Lithuania for GHG emission trading, both for the EUETS and international emission permit trading under the Kyoto protocol. To this end, legal, economic and institutional capacity conditions relevant to Climate Change policy are analysed.

5.1 Legal situation

According to the Law of Ambient Air Protection, the Ministry of Environment of Lithuania is responsible for setting the limits for pollutant emissions to the atmosphere. The Ministry sets limits for the total national emissions and for each region in Lithuania. Municipalities are responsible for the implementation of the measures for the emission reductions. ("Law of Air Protection," 1999).

The National pollution permitting system has been in place in Lithuania since 1999. So-called "Permits to use natural resources" must be obtained before any industrial activity. These permits are issued by the Regional environmental protection departments (REPD). Form the January 1, 2004 permits to use natural resources will be exchanged with the integrated pollution permits that are in accordance with the requirements of the IPPC Directive[27].

SO_x, NO_x and particulate matter emissions to atmosphere from industrial installations are charged in Lithuania. Table 3 shows the actual charges according to the type of the pollutant and the envisioned future increases in these charges. According to the Law of Pollution Charges, 70% of collected funds go to the budgets of the municipalities in the territory in which they are collected and 30% go to the Fund for the Environmental Protection Investments (LAAIF).

Table 3 Environmental charges LTL/t (EUR/t) for the air emissions. Source: ("Law on the Pollution Charges," 2002)

Pollutant	2003 m.		2004 - 2009m.	
	LTL	EUR	LTL	EUR
SO2	288	82,3	311	88,9
NO_x	479	136,9	587	167,7
Particulate matter	184	52,6	184	52,6

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[27] The Integrated Pollution Prevention and Control Directive establishes integrated pollution permitting scheme. Industrial activities regulated by the Directive can not operate without the integrated permits that set limits for pollutant releases to all medium.

If emissions exceed the permitted amounts, the tariffs for each additionally emitted tonne of the pollutants are multiplied by 1,5.

The new ordinance (starting in 2004) on the Requirements for Fuel quality regulates the content of the Sulphur in heavy fuel oil (HFO). Combustion of HFO that contains more than 1% of sulphur is not permitted. However, the law defines exceptions to this rule. ("Requirements for Fuel Quality," 2001).

CO_2 emissions are not included within permitting, charging or registry schemes under the law. However, targets and means of tackling climate change are envisioned in the national and sectorial strategies. Therefore, CO_2 regulation will be implemented into the national law in the near future. The main strategic documents of the state policy have provisions on climate change mitigation policy including emissions trading. These are: The National Long-run Development Strategy, The National Long-run Economy Development strategy, National Energy strategy, National Energy Efficiency Programme and the new Environmental Protection strategy (project). The mentioned provisions in the strategic documents are shortly described below.

The environmental sector of the National Long-run Development Strategy [28] envisions, among other economic instruments to be used for GHG emission reduction, the evaluation of the possibility for a national emission[29] trading scheme and its implementation. ("Long-run Development Strategy," 2002).

The National Long-run Economy Development strategy envisages the exploration and testing of Emission trading schemes for air and water pollution. ("Long-run Economy Development strategy," 2002).

The National Energy Strategy envisages the use of economic instruments for the prevention of pollution in the energy sector. The instruments to be used are environmental taxes, green certificates and emission allowance trading schemes. As an important means to tackle Climate change, target of 12% for primary energy produced from renewable sources, is set. ("National Energy Strategy," 2002).

Another important document is the National Energy saving programme. It envisions the improvement of energy efficiency and utilisation of renewable and indigenous sources of energy. The document includes a plan of implementation where the measures for the achievement of goals are prescribed. For example: "Based on the requirements of the UNCCC Kyoto Protocol, developing drafts of recommendations for greenhouse emissions trading". The institutions responsible for implementation are the Ministry of Economy and the Ministry of Environment. The implementation period is 2002-2003 and the total amount of the funds assigned for that purpose is LTL 150 000 (~ EUR 43 000). Funds for implementation are provided by the state and the assistance of foreign countries. ("National Energy Efficiency Programme," 2001).

The reorganisation of the environmental levy scheme and creation of a tradable pollution permit system are envisioned as part of the Environmental Protection strategy. The strategy stresses that the aim of the reorganisation of the environmental taxes is not only the financial

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[28] The document that describes the main directions of governmental policy in different sectors of the country.

[29] By default, it is meant different types of the pollutants.

benefits but also the appropriate incentives for the polluters. The strategy also assumes that the present pollution-permitting scheme being used in Lithuania could be transferred to the emission-trading scheme without significant difficulties. The preparation for such changes is expected to take around 1,5 – 2 years. Hence, the beginning of the ETS is likely to be 2005. The document envisions natural gas as the main strategic fuel for the country. The low content (1%) sulphur HFO is also expected to be used. ("Strategy for Environmental Protection," 2001).

5.2 Institutional capacity

The Department of Atmosphere (headed by Mr. V. Krusinskas) at the Ministry of Environment of Lithuania is responsible for the establishment of the national trading scheme under the EU ET Directive. Currently, the scheme is at the discussion stage of within the Ministry of environment. The main issue described by Mr. V. Krusinskas is the establishment of the national allocation plan for GHG allowances.

In reality, significant steps forward in the creation of the scheme are not expected in the near future, since the department of atmosphere consists of 4 persons, that are struggling with the workload due to compliance with other EU legislation requirements. Most likely, a significant part of the work will be performed by consultancies. Some funds are being accumulated for the scheme implementation. The Norwegian government has donated some funds for the establishment of the national registry in Lithuania

Some ideas are circulating within the department. The experts have the idea to combine ETS with the IPPC permitting scheme. The Verification body is envisioned to be an accredited third party (e.g. consultancy). The National allocation plan is presenting a significant issue, since the difference between 1990 levels and actual emissions is significant. If the allocation was made according to levels of 1990, the main part of the allowances would be given to the energy company Lietuvos Elektrine AB. This seems appropriate since Lietuvos Elektrine AB will be the main source of energy after the decommissioning of Ignalina power plant in 2009. (GHG emissions of the company are expected increase dramatically due to increased production after the decommissioning of the Ignalina NPP)

There are several initiatives for institutional capacity building. One of them is the potential restructure of the governmental Environmental investment Fund (LAAIF). LAAIF is formed from pollution taxes, with 30% of taxes going to the fund. The LAAIF board has been offered to create the tender for the emission reductions trade following the experience of the Hessen-tender[30] in Germany. Authorities of the fund passed the proposal to the Minister of environment for consideration and a decision regarding approval should be made in the near future. If the project receives an approval, the establishment of the tender will take about one year. The idea of the proposal is that the Ministry of Environment assigns the responsible institution (LAAIF) that would be responsible for the creation of the certification and validation bodies for the JI and ET projects. The fund would establish requirements for the emission reduction projects that are eligible for subsidy. Projects that meet these requirements would be subsidised. JI projects would be subsidised from foreign capital through the fund. In other words, the fund would buy in the emission reduction units

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[30] Several large German companies have established the fund that buys in the ERUs from JI projects. The fund organises tenders for the potential JI projects and strikes agreement with the wining company to buy in ERUs after the project was implemented.

(ERUs) from the investing companies and bank them. Later, the reduction units could be sold to the external or internal buyer. It is proposed that 75% of financing would occur on commencement and 25% after project realisation. The significant load of establishment work would be done by local and international consultancies. Their involvement would represent, for example, recommendations for scheme design and certification services.

Capacity building in the private sector is undergoing more rapid development. There are several companies specialising in climate change issues as well as in emission trading schemes. For example, the consultancy Ekostrategija based in Vilnius has a strong background in the Kyoto mechanisms. The managing director of the consultancy, Mr Martynas Nagevicius, has a background in heat system engineering and is finalising his PhD on the JI and ET impacts on the energy producers in Lithuania. The company mainly works with clean energy and energy efficiency projects.

5.3 Early corporate initiatives for the emission trading

Several attempts have been made for CO_2 emission trading in Lithuania so far. Two companies were involved in the activities related to ET: Lietuvos Elektrine AB – the largest energy producer in Lithuania (after the Ignalina NPP) and Danisko Sugar   AB – owner of the largest sugar producing plant in Lithuania.

Lietuvos Elektrine AB participated in the CO_2 trading simulation organised by Nord Pool, under the BASAREC[31] agreement. Energy companies and authority representatives form the Baltic Sea region states took part in the simulation. The tendering process was held on the Internet for a few months for several hours each week. Participating companies could buy and sell AAUs online through the online platform managed by Nord Pool. The tradable amount was calculated for all commitment period taking a reference year of 1990. The price depended on the time frame and fluctuated from 14 to 22 euros. Mr V.Gaidys, the chief manager of the development department in Lietuvos Elektrine AB, was in charge of the simulation on behalf of the company. Gaidys reflected that he was able to make a profit not only by selling emission permits but also by purchasing and reselling them.

Danisco Sugar Lietuva AB is implementing project in its subsidiaries in Lithuania for reducing CO_2 emissions by technical means. The company plans to transfer saved emission reductions to the subsidiaries of the company in Denmark. This is a good example of the case when the emission reduction can be achieved with lower costs in another country.

5.4 Summarising the conditions

Lithuania has, in place, a pollution permitting scheme. Any industrial activity needs to be granted "permits for the natural resource use". Atmospheric emissions are regulated for certain industrial activities. SO_x, NO_x and particulate matter are subject to charges. If emissions of regulated pollutants exceed limits, the tariff is multiplied by 1,5 times for each additional tonne. From 2004, permits for the natural resource use will be substituted with the Integrated Pollution permits according to the IPCC directive.

CO_2 emissions are not yet regulated in Lithuania, however a global warming mitigation policy is envisioned in the main strategic documents where the significant attention is given to the

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[31] Treaty on the cooperation in the energy field among Baltic sea region states.

emission trading. The pollution permitting scheme existing now in Lithuania could, without significant difficulties, be modified into the emission permit trading scheme.

The EUETS implementation is at the discussion stage in Lithuania. The Ministry of environment has plans to combine the scheme with the IPPC permitting system. A significant part of the work will most likely be performed by consultancies. One of the ongoing initiatives is the establishment of the tender for JI projects (similar to the Hessen tender).

Several corporate attempts for ET have been made so far. It shows that several companies are behaving proactively regarding the upcoming EUETS and are trying to gain experience in emissions trading. Several private organisations have a capacity for consulting in GHG emission trading and JI projects.

6. Analysis of the energy market in Lithuania

In this chapter the analysis of the energy market in Lithuania and projections for the future development trends are performed. It is necessary to make projections of future GHG emissions because changes in the energy sector will be the major contributor to increased GHG emissions. The findings of the energy market analysis are used for the GHG emission projections in the next chapter. The GHG projections are then used for the identification of important GHG market indicators.

The analysis is more focussed on the energy sector, since this sector will be included within the EUETS scheme. Other sectors, such as transport, are mentioned only briefly as they will not be regulated by the scheme, although it will have an impact on allowance trading.

The input data for the analysis have been used from different sources. The main of these are: the National Control Commission for Prices and Energy (2002), the Energy Agency of Lithuania (2003), the National Energy Strategy of Lithuania (2002) and the National Energy Efficiency Programme of Lithuania (2001).

The primary issue discussed lately and predicted to most significantly influence the energy market in Lithuania is the state's commitment to close Ignalina NPP – the main source of electricity in Lithuania. The main document regulating decommissioning of NPP and related energy issues is the National Energy Strategy. This document presents the position and guidelines for state policy within the energy sector. The position of the government expressed in this document is to support economically and politically three fundamental areas of development within the sector. These areas are: renovation of selected largest thermal power plants in Lithuania, support for renewable and indigenous energy and the installation of a new nuclear reactor.

Three of the largest electricity generators have been designated as the main alternative sources of electricity production after the decommissioning of Ignalina NPP. These are: Lietuvos Elektrine AB (TPP), Vilniaus Elektrine AB (CHP) and Kauno Elektrine AB (CHP). State support includes subsidies for the modernisation of these plants.

The National energy strategy also envisions integration of Lithuania's power sector into the European power system. High voltage power lines to Poland are projected for that purpose. The strategic position of the state on this issue is to support politically and legally the construction of a connection to the Polish power grid and to ensure that this connection is owned by Lithuania. The strategy also has a provision aimed at avoiding market domination by investors from any individual foreign country.

Further on energy production is analysed, and projections for future energy demand and production capacity are made.

6.1 Present state of the market

6.1.1 Primary energy consumption

Nuclear power, oil and natural gas are the main energy sources in Lithuania, comprising approximately 90% of total domestic primary energy consumption. Sources of total primary energy consumption in 2000 are presented in Figure 3 below.
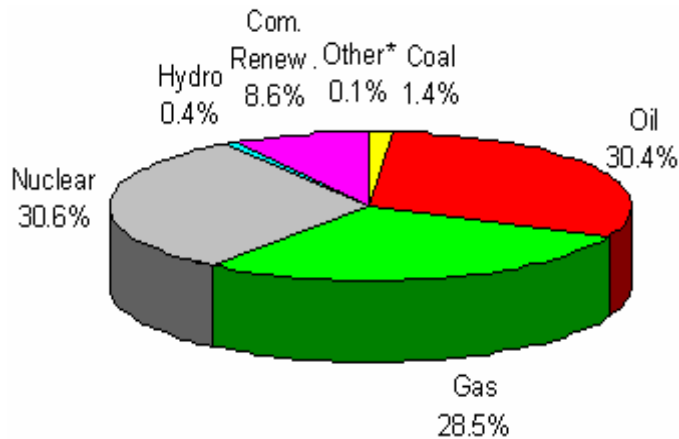

Figure 3 Total primary energy supply. (IEA, 2003)

The major part of crude oil is imported from Russia. Indigenous stocks are also present in limited quantities and are exploited at about 0,5 million tonnes (t) annually. Neither of the imported nor indigenous oil is used for energy production in thermal PPs. Combustion installations predominantly use heavy fuel oil (HFO) supplied from the oil refinery in Mazeikiai. Lithuania has secured the capacity for oil export and import. Two oil terminals are in year–round operation – one at the ice-free seaport in Klaipeda (capacity 8 million t annually) and the buoyant terminal in Butinge. At the moment these are used mainly for the export of oil products as well as for oil transition services[32] .

Natural gas is imported only from Russia. 2,6 billion m^3 of natural gas was imported during 2000. The total potential capacity of gas pipe supply is 6 billion m^3 natural gas per annum. The National Energy Efficiency programme (2001) defines natural gas as the most prospective type of organic fuel for the country's future energy supply. A feasibility study of connection with Polish gas pipe networks for an alternative gas supply is envisioned in the National Energy Strategy (2002)

Renewable energy sources are mainly represented by biomass (wood) combustion, comprising about 7% of total primary energy use. All other types of renewable energy together comprise about 1%. More detailed analysis of renewable energy is presented in chapters 6.1.4 and 6.2.2.

6.1.2 Electricity production

The electricity market analysis is emphasised in this chapter and those following as changes in CO_2 emissions are predicted to depend primarily upon the electricity sector in Lithuania.

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[32] The only service user at the moment is Russian Federation.

The future trends of the electricity market and its relationship with CO_2 trading are analysed in the following chapters.

About 38% of the primary energy is used for the electricity production. 14.7 TWh was produced in Lithuania during 2001. Total demand for electricity comprised 10.5 TWh. Domestic electricity consumption comprised as much as 6.5 TWh, whilst approximately 4 TWh was exported. The main source of the electricity in Lithuania is the Ignalina NPP. In 2001 the plant produced 11.4 TWh (78%), whilst 2.6TWh (17%) was produced by thermal power plants. 0.3 TWh[33] (5%) was produced by hydropower plants. Sources of electricity production are presented in Figure 4.
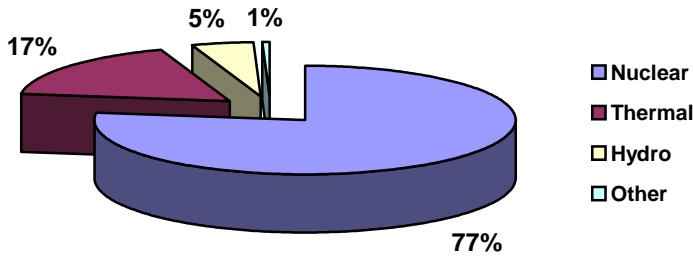

Figure 4 Sources of the electricity produced in Lithuania in 2001.

Respective shares of electricity produced by individual generators are presented in Figure 5.
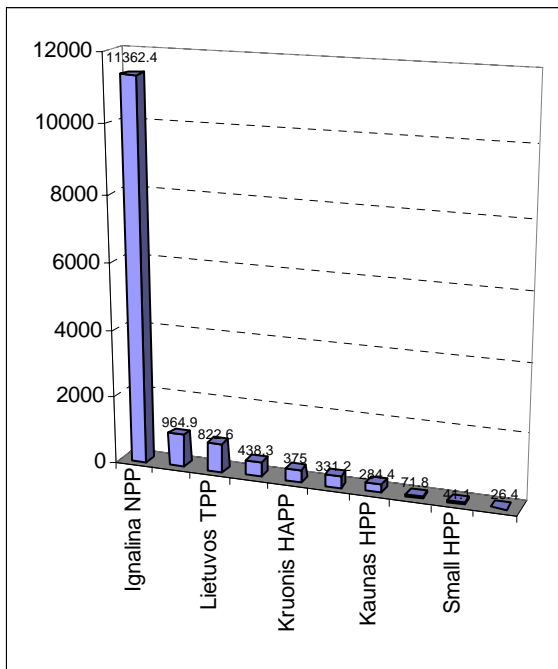
Figure 5 Electricity produced by generators in 2001. (GWh)

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[33] The Figure includes Kruonis Hydro Accumulating PP (375MW) that has been built to level grid fluctuations, mainly due to the Ignalina PP. The plant pumps water into a reservoir during off-peak periods and releases it to turbines during peak periods. The final electricity balance of the HAPP is actually negative, whilst it adds about 3% to the total electricity pool.

As can be seen from Figure 5, Ignalina NPP produces the major part of electricity in Lithuania. Three other generators – Lietuvos TPP, Vilnius CHP and Kaunas CHP – are the largest thermal power pants.

Figure 6 below presents generator share by installed capacity.
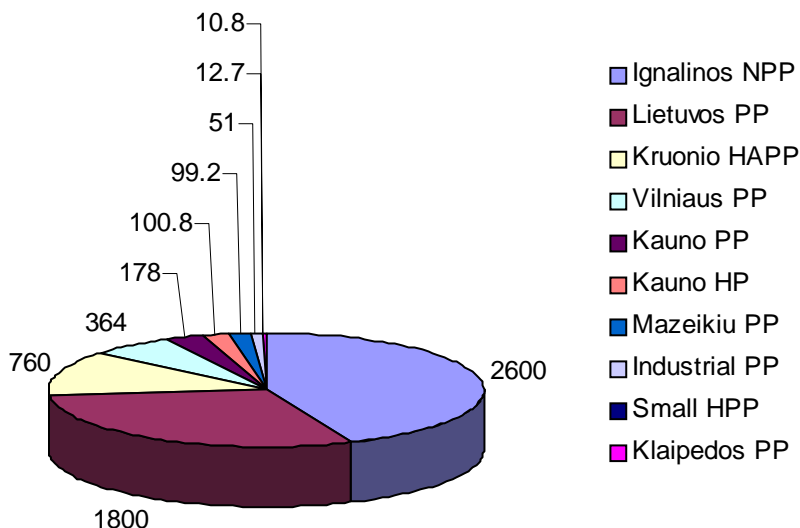

Figure 6 Shares of installed capacity among electricity generators in 2001. (MW)

The balance of total installed power system capacity in Lithuania is presented in Figure 7 below.
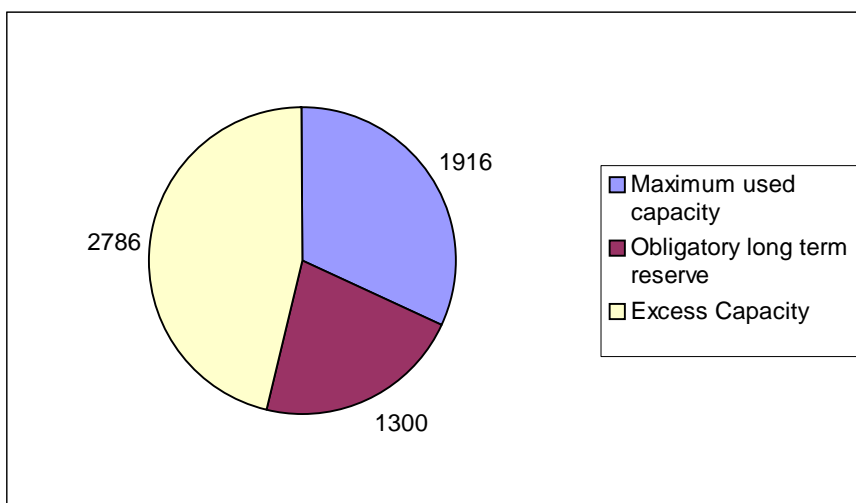

Figure 7 Balance of installed electric capacity. (MW)

Players within the electricity market are presented in Table 4.

Table 4 Players within the Lithuanian electricity market. (National Control Commission for Prices and Energy, 2002)

No	Market players	Number of issued licenses	Number of operating market players
1.	Eligible Electricity Customers	12	6
2.	Electricity Producers	-	6
3.	Transmission System Operator	1	1
4.	Distribution System Operator (excluding local distribution networks)	2	2
5.	Electricity Suppliers	20	2
5.1.	Public Suppliers (including local distribution networks)	7	0
5.2.	Independent Suppliers	13	2
6.	Total	35	17

6.1.3 Heat production

14.6 TWh of heat energy was produced in 2001. The final domestic consumption comprised 10 TWh, dominated by households consuming 6TWh. Heat production will not be analysed further in detail since there are no significant changes predicted for the heat market in the future.

6.1.4 Renewable energy utilisation

Lithuania at the moment utilises four types of renewable energy: biomass, hydro, solar and geothermal. Wind power projects are presently under construction – the first windmill park of 15MW is under project and will be in operation next year.

There is 700MW installed capacity of hydropower, 180MW for biomass combustion, 50 MW of geothermal, 10MW for straw combustion and 4MW for biogas utilisation.

According to International Energy Agency (IEA) statistics and calculations of the National Energy Efficiency programme of Lithuania (2001), the share of renewable energy in the total primary energy[34] supply (TPES) comprised 9% or 7.5 TWh in 2000. Wood burning constituted the largest share – 6.9 TWh, which is 8.6% of TPES or 90% of primary renewable energy consumption in Lithuania. Hydro[35] energy represents 5%, while biogas, straw and geothermal together comprise 3% of primary renewable energy share. Figure 8 below presents the shares of consumed primary renewable energy.

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[34] 7,12 Mtoe (83TWh) in 2000 according to ("National Energy Efficiency Programme," 2001) and (IEA, 2003).

[35] Share of the hydro accumulating plant (0,36TWh) is not included in presented share of hydro energy.
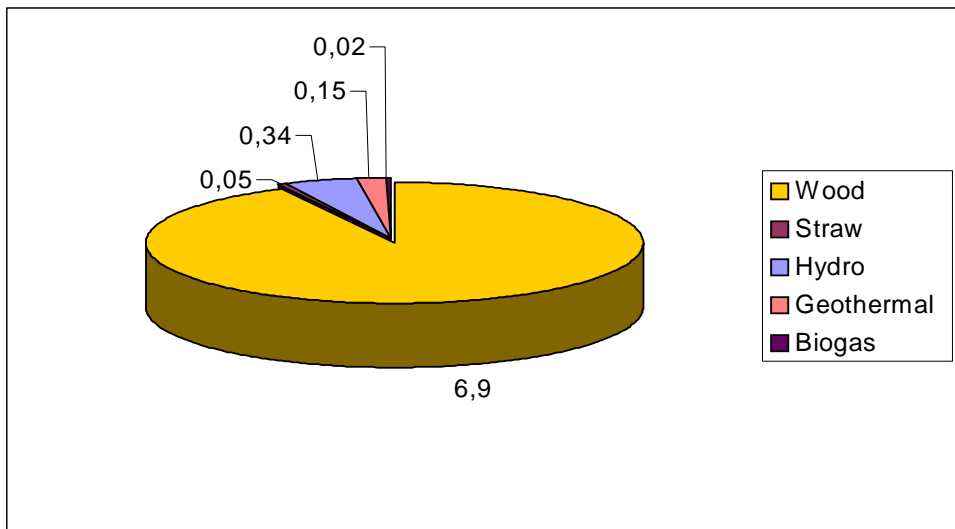
Figure 8 The composition of primary renewable energy supply. (TWh)

In order to show what 8.6% of biomass share in TPES means, the energy content of firewood consumed by the 25 largest thermal plants[36] in Lithuania was calculated. The results show that their total share of biomass consumption comprises only 0.6% (0.48 TWh) of TPES. Hence the given share 8.6% of biomass in TPES in the national energy statistics includes total biomass consumption in Lithuania for all domestic purposes and is a relative figure. Also, one should keep in mind that there is a difference in the perception of the meaning of primary energy for biomass where compared to other renewable energy. For example, only one third of the primary biomass energy is converted to electricity, whereas for hydroenergy this factor is 100%. It means that primary hydroenergy is perceived as equal to the quantity of electricity produced.

6.2 Projected changes

6.2.1 Projected changes after the decommissioning of the Ignalina NPP

The National Energy Strategy of Lithuania foresees three thermal power plants as the main alternative for the Ignalina NPP after its partial closure in 2005 and then final closure in 2009. The main of them is envisioned to be Lietuvos Elektrine TPP with 1800 MW of installed capacity for electricity production. Two others are Vilniaus Elektrine CHP (360MW) and Kauno Elektrine CHP (180MW). Total combined installed capacity of these plants is 2340 MW, which is 70% of the total installed capacity of 3380[37] excluding Ignalina NPP. The proportions of their installed capacity are presented in Figure 9 below.

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[36] These TPP have the main share of energy produced in Lithuania.

[37] Figure 8 includes Kruonis Hydro Accumulating PP (375MW) that has been built to level fluctuations on the grid, mainly due to the Ignalina PP. The plant pumps water into a reservoir during off-peak periods and releases it back to turbines during peak periods. The final electricity balance of the HAPP is negative.
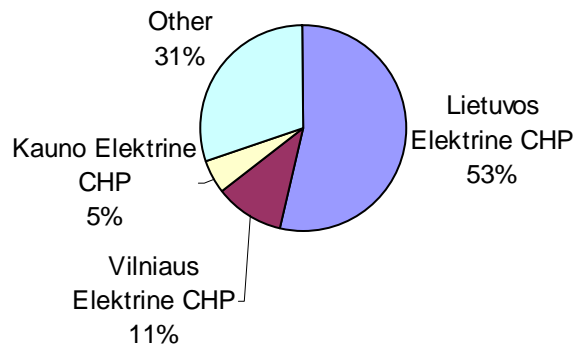
Figure 9 Shares of the total installed capacity among the main electricity generators. (Ignalina NPP and Kruonis HAPP excluded)

The maximum peak load in Lithuania at the moment is about 2000MW. The required long-term capacity reserve for the power system is 1300MW. Hence, the installed capacity is sufficient to meet the demand of the system. In case of unpredicted capacity shortage, the National Energy Strategy envisions the building of new CHPs in Klaipeda, Siauliai and Panevezys. The building of several large hydro power plants with a total capacity of about 200 MW on the largest Lithuanian river, Nemunas, is also regarded as a potential alternative.

The model used within the National Energy Strategy predicts 13.2 TWh of electricity demand in Lithuania by 2020. This would entail a demand of 8.5 TWh in 2005 and 10.1 TWh in 2010 assuming that demand increases steadily.

The decommissioning of the NPP will be undertaken in two stages: shutdown of the first reactor will take place in 2005 whereas closure of the second rector and final decommissioning will be performed in 2009. At the time of closure of the first reactor total projected electricity demand (including exports maintained at the 2001 level) would be approximately 12TWh. This amount can be supplied by running other power plants at the present production level (3 TWh) and utilising the second NPP reactor at average 90% capacity annually, assuming that power losses in the system are at the level of 1 TWh. This implies that no significant changes in the power system should occur from 2005, during the precommitment period. At the beginning of the commitment period, the end of 2009, a shortage of electricity for export (at 2001 levels) is likely to occur. Additional 1.6TWh of production would be needed to maintain export levels. Substantial changes on the electricity market in Lithuania are expected to commence in 2010 when generators will have to substitute for the decommissioned NPP.

Three major electricity producers, foreseen for substitution of NPP, generated 2.2 TWh of electric power in 2001. After the decommissioning of the Ignalina NPP, they would be required to produce a much greater proportion of electricity. Figure 10 below summarises the calculations made by the thesis author regarding the potential of these power plants to meet electricity demand after the decommissioning of NPP.

To calculate the potential electricity production an annual full load factor of 5300h has been used referring to the suggestion of the Lithuanian Energy Institute. This value is referred to as the "Technical potential" in Figure 10. The hypothetical (maximum) potential has also been calculated, assuming full capacity load throughout the year. The export level in 2020 has been assumed to be at the level of 2001.
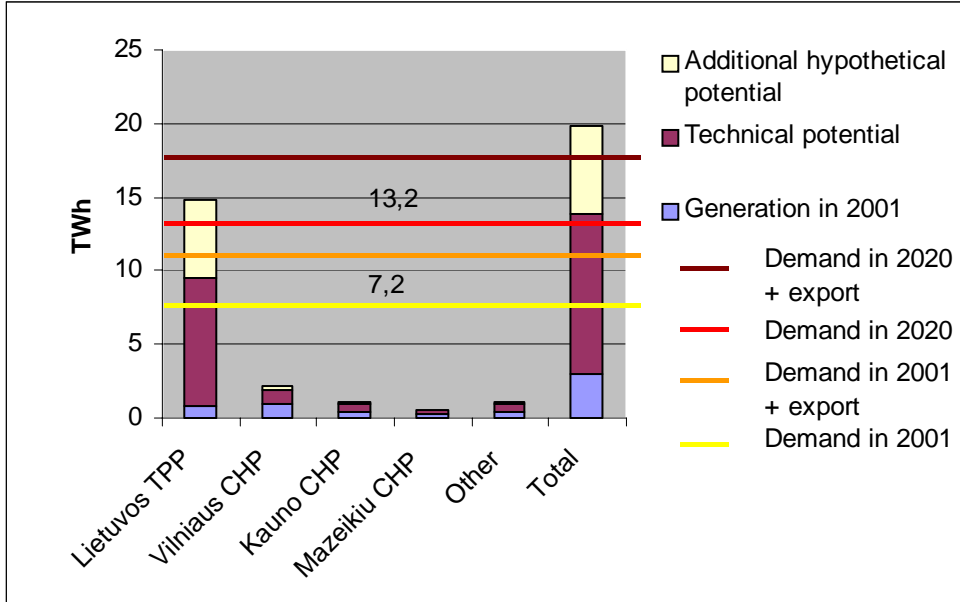

Figure 10 Electricity generation potential of the main energy producers after the closure of the NPP

As the results show, the projected demand from 2010 onwards can be fully met by using actual installed capacity (NPP excluded). The total technical potential of the operating power plants is approximately 14 TWh and exceeds the projected demand of 13.2 TWh in 2020. The additional capacity in this case will depend significantly on changes in electricity export, which is increasing steadily at the moment (about 5 TWh was exported by August of 2003). As can be seen from the graph, the main burden of electricity supply will be borne by Lietuvos Elektrine TPP.

6.2.2 Capacity to use renewable energy

In this chapter the results of estimations done by the thesis author are presented. The potential of renewable energy to cover part of the electricity demand has been estimated. Input data on the potential of primary renewable energy has been taken from the following sources: the National Energy Efficiency Programme ("National Energy Efficiency Programme," 2001), two studies regarding wind power utilisation possibilities in Lithuania: (Lithuanian Energy Institute, 2000) and (Paulauskas, 2001), a report on geothermal power use in Lithuania (Manomaitiene, 2002) and the Lithuanian Renewable Energy Server (http://saule.lms.lt/). In order to convert predicted biomass utilisation potential to potential electricity production, an energy conversion factor of 0.33 was used. It has been hypothetically assumed that all additional projected primary energy potential would be converted into electricity. In some cases the range of projected potential fluctuates significantly, e.g. the projected potential for wind energy varies from 0.2 TWh ("National Energy Efficiency Programme," 2001) to 18 TWh (Paulauskas, 2001). For the estimations within this study, a potential 170MW of installed wind energy capacity was used, whereas this amount has been capped by the government for the period until 2010.

The reason why geothermal and solar energy have not been included in the estimations is that they are not used nor are t likely to be used in the near future for large-scale commercial electricity production in Lithuania. The results are presented in Figure 11 below.
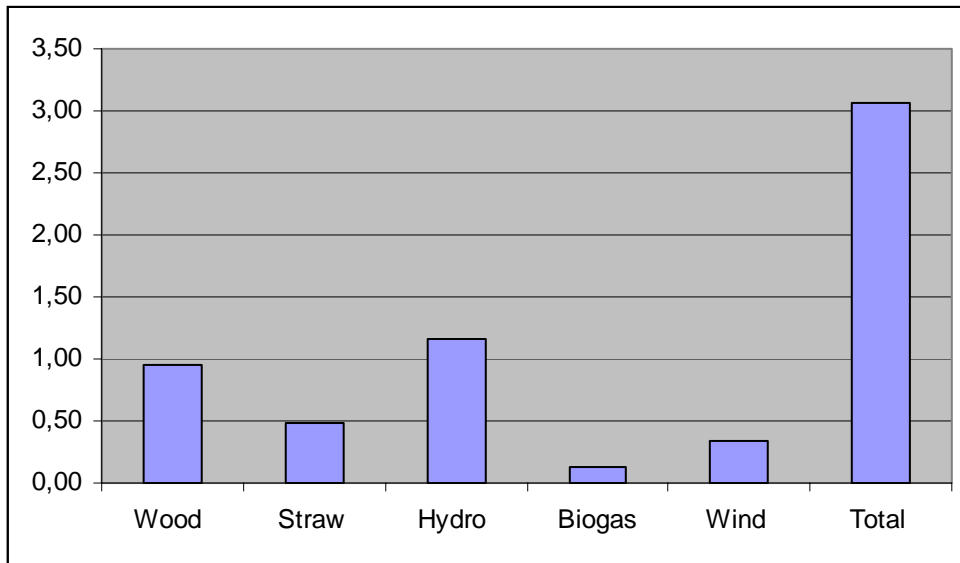

Figure 11 Estimated potential for additional electricity production from renewable energy sources

The results show the total additional hypothetical potential for 3TWh of electricity produced from renewable energy sources in Lithuania. This data will be used in following chapters to estimate the implications of estimated potential on the GHG emissions of the main generators in case renewable energy is used as an alternative fuel to meet electricity demand.

6.2.3 Projected changes in future energy demand

Changes in energy demand at a national level have been calculated using MAED[38] model. The model incorporates many variables among which are: changes in GDP, energy use variation within different sectors and different technical parameters. The results of the modelling are used in the National Energy Strategy. ("National Energy Strategy," 2002).

The results of the analysis show that demand of final energy[39] in 2020 would not exceed demand level in 1990. According to the basic scenario, final energy consumption will be 71% (6,2 Mtoe) of the 1990 level in 2020. See Figure 12 below.

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[38] Model for Analysis of Energy Demand

[39] Final energy here used as total primary energy plus total secondary energy.
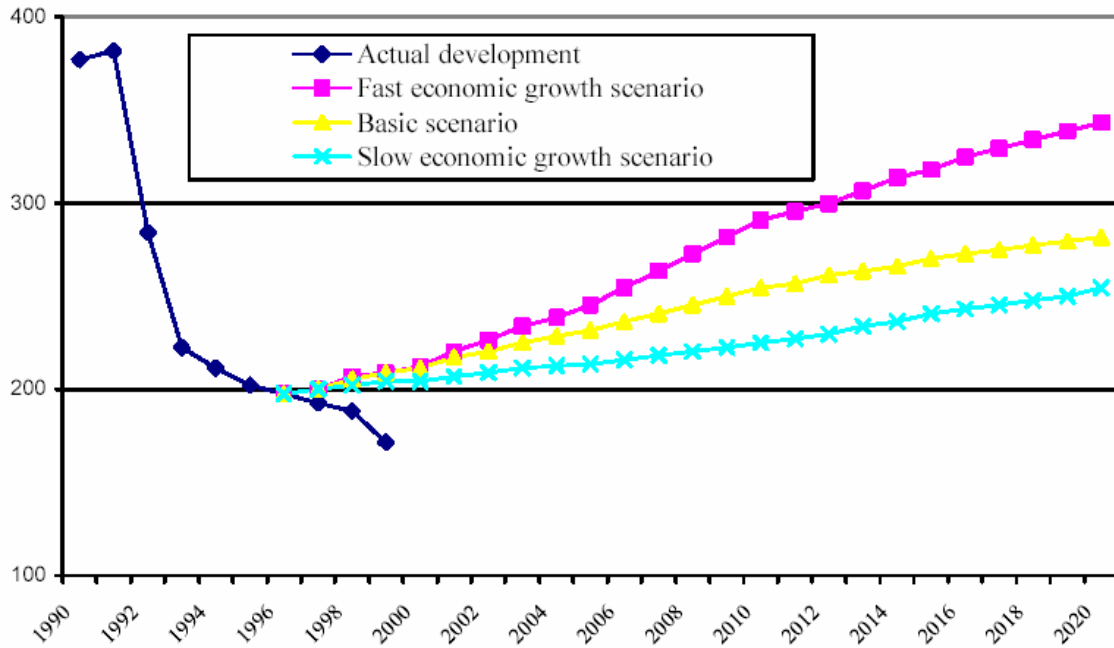
Figure 12 Final energy demand projections. MAED model, PJ (Ministry of Environment, 2002)

The MAED simulation showed that after the decommissioning of Ignalina NPP the demand for primary energy would increase by 30% by 2020, as compared to 1990. However, the demand for fossil fuel would increase 1.9 times within 20 years, from 5 Mega tonnes of oil equivalent (Mtoe) in 2000 to 9.4Mtoe in 2020.

Electricity demand according to the model will increase 1.1 times by 2020, as compared to the 1990 level (on average 4.3% annually). The increase of demand is due to projected economic growth. Electricity consumption in Lithuania at the moment is 1860 kWh per capita, which is 3 times less than the average of Western Europe countries.

Centralised heat demand, according to the model, will not reach 1990 levels in any scenario. It is anticipated that it will increase 1.3 times that of 2000 levels[40] by 2020 (that is, half that of 1990).

The projected fuel demand is depicted in Figure 13 below. :

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[40] 2000 level is less than half that of 1990.

Figure 13 Projected consumption of primary energy. (Ministry of Environment, 2002)

As can be seen from the Figure, nuclear power will be substituted by natural gas. During the forecasted period the share of natural gas in th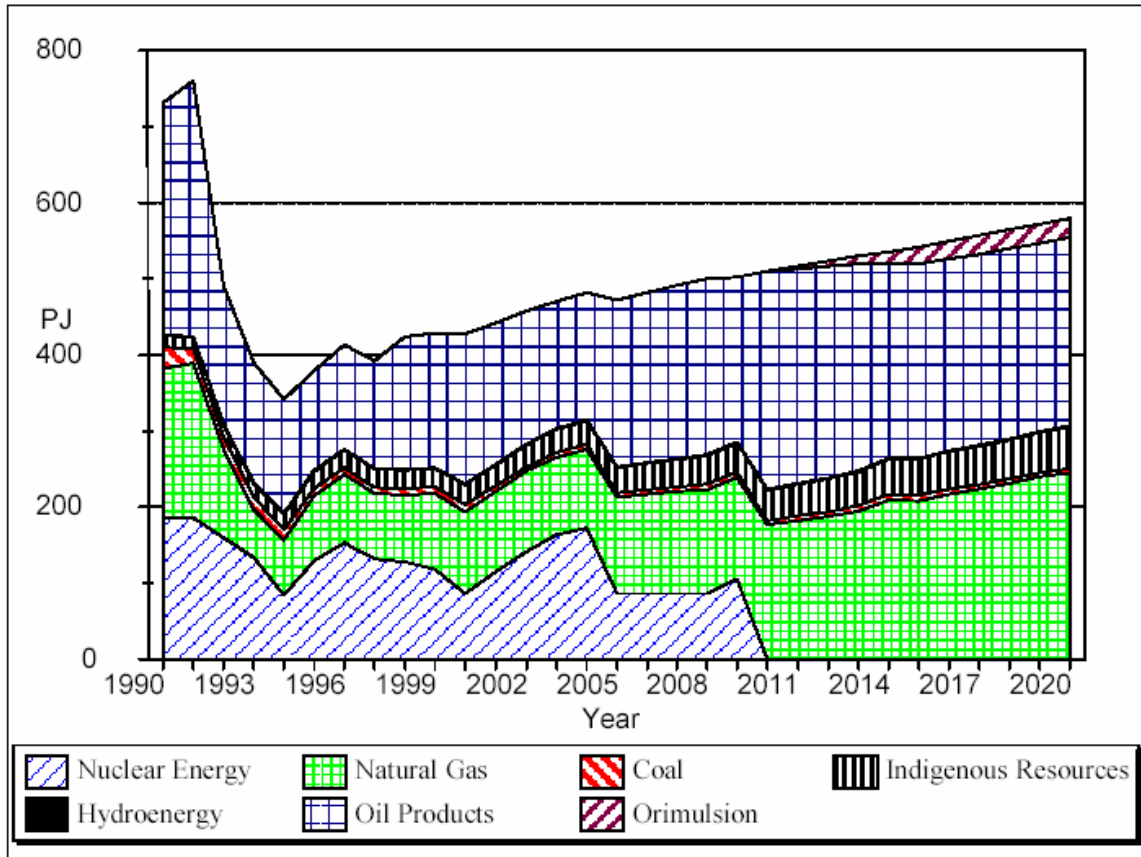e primary energy balance would increase from 28.5% to 53% of the primary energy balance. This would mean an increase from 2.1Mtoe (2.58 billion m³) in 2000 to 5Mtoe (6.14 billion m³) in 2020.

The share of the indigenous and renewable energy source is predicted to increase to 14% of primary energy source by 2020. An increase of oil product consumption is also projected.

The increase in oil product consumption is mainly caused by increased motor fuel use due to transportation growth. It is forecasted that motor fuel consumption will increase 1.5 times (Ministry of Environment, 2002) and will comprise up to 2 million tonnes per annum (t.p.a.) by 2020. Use of heavy fuel oil is predicted to decrease slightly. ("National Energy Strategy," 2002).

6.3 Conclusions

The increased demand for energy results from economic growth in Lithuania. Two sectors are mainly responsible for the projected energy demand increase, and hence also for increase in CO_2 emissions: industry and transport.

The increased demand for the final energy will result in demand growth primarily for the three types of fuels: motor fuel, natural gas and renewable energy. Motor fuel is the major contributor to the predicted demand for oil products, as a result of transportation growth. A minor share of oil product demand growth is also due to increased industrial fuel demand.

Natural gas and renewable energy demand increase is a result of increasing electricity demand in the industry as well as the Ignalina NPP decommissioning. These projections also coincide with the state position given in the National Energy Strategy, which foresees natural gas to be the main primary energy source after the decommissioning of the Ignalina NPP. Heavy fuel oil use for energy production is projected to decrease. The demand for heat energy will increase insignificantly.

It can be concluded that nuclear power will be mainly substituted by natural gas and partially by renewable energy. As the analysis has shown, Lithuania has a potential for both the import of natural gas and the use of indigenous renewable resources. It follows then that an increase in CO_2 emissions, covered by EUETS in Lithuania, will mainly depend on the amount and proportion of natural gas and renewable energy use. Another important factor for total domestic CO_2 emissions increase will be changes in motor oil consumption.

No significant changes on the power system are expected starting 2005 after closure of the first reactor of Ignalina NPP. The second reactor will be capable to meet needs for electricity (at 2001 export levels) in Lithuania. An additional 2.5 TWh (0.5 TWh p.a.) would be needed by the end of 2009 to meet export demand.. Substantial changes in the power sector will occur after the final decommissioning of the NPP starting 2010. The calculations show that generators currently operating on the system are capable of meeting total electricity demand until 2020 using their available installed capacity.

Estimations show that by modest expectations renewable energy sources have the potential of additional 3 TWh electricity productions.

7. Analysis of the GHG market in Lithuania

This chapter aims to project the Greenhouse Gas (GHGs) market in Lithuania under both international (Kyoto) and EU emission trading schemes. The previous chapter's results concerning energy demand projections are used to forecast future CO_2 emission changes. References to the provisions of the Kyoto protocol and the EUETS directive (chapter 3) are used in order to calculate the main GHG market indicators: tradable amount of Assigned Amount units (AAUs), the allocated amount of allowances that will be traded and the economic value of the market.

7.1 Methodology of the CO_2 emission calculations

The main domestic and sectorial GHG emission figures have been taken from Lithuania's Second National Communication Under the Framework Convention on Climate Change (2002). The forecast for total future emission trends from the predicted fuel consumption changes as well as corporate CO_2 emissions were calculated using the IPCC guidelines. (1996). This chapter describes briefly the method and the logic behind the calculations.

CO_2 emission calculations comprised a remarkable part of the thesis work. The importance of precise calculations is obvious – in the near future GHG emissions will have certain economic value , hence using the right calculation method is crucial at this point. There are several official methodologies for CO_2 emission calculation. Main of these methodologies are: IPCC[41] guidelines for National Greenhouse inventories, joint EMEP[42]/CORINAIR[43] Atmospheric Emission Inventory Guidebook, UNEP Guidelines for Calculating Greenhouse Gas Emissions for Businesses and Non-Commercial Organisations, and Corporate Accounting and Reporting Standard by Greenhouse Gas Protocol Initiative[44] hosted by WBCSD[45]. The IPCC and CORINAIR guidelines are used for countries to calculate their domestic emissions (including CO_2) and report them to the responsible authorities. (IPCC – to the Conference of the Parties (COP) for UNFCCC, CORINAIR - to the EU Commission). UNEP and WBCSD guidelines are used for voluntary corporate accounting and reporting of CO_2 emissions.

The logic behind all of these calculations is approximately the same. Calculations for CO_2 emissions from the energy sector are based on the input data of fuel consumed. CO_2 emissions depend upon the fuel's carbon content and structure. Carbon content is calculated per calorific value of the fuel. In order to secure more precise calculation results, the fuel carbon content (carbon emission factor) is given per amount of energy content in the reference Tables. Energetic or calorific value of the same type of fuel can differ significantly so this method avoids the need for many cumbersome tables containing the final value of carbon content for a wide variety of fuels. By using this method, all that is needed is to

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[41] Intergovernmental Panel for Climate Change

[42] EMEP - Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air pollutants in Europe under the Convention on Long Range Transboundary Air Pollution (LRTAP).

[43] CORINAIR - the EU emission inventory programme.

[44] The Greenhouse Gas Protocol Initiative (GHG Protocol) is an international coalition of businesses, NGOs, government and inter-governmental organizations. It operates under the umbrella of the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI).

[45] World Business Council for Sustainable Development

simply find a specific calorific value for fuel used in a particular country or even in a particular plant, and multiply it by standard carbon content per energy value of the certain type of fuel. Not all carbon is oxidised into CO_2 in combustion process; part of it is released as soot and ash. Hence the next step is to determine the amount of carbon oxidised, which is done using oxidation factors for different fuel groups. Finally, estimated amount of carbon is converted to CO_2. Since the CO_2 molecule has a total atomic weight of 44, whilst carbon has 12, the conversion factor 44/12 is used.

IPCC and EMEP/CORINAIR in fact use the same calculation formula and methodology for CO_2 calculation. (However, the IPCC has developed a more thorough handbook on methodology.) Differences in approach occur on the so–called double counting issue for other GHGs released from the combustion process. Combustion processes emit other GHG gases as well, such as CH_4, N_2O as well as other products of incomplete burning: CO and VOCs. The IPCC approach is to include oxidised CH_4, CO and VOCs within the total amount of CO_2 from combustion processes, whilst EMEP/CORINAIR avoids double counting of these compounds by including them individually within the inventory.

WBCSD and UNEP guidelines are in fact based on the IPCC methodology. Their calculation methods are simplified to tables of CO_2 emission factors per amount of country–specific fuel used. Obviously these methods are less thorough.

The IPCC methodology has been used for the calculations performed in this thesis. Only CO_2 emissions have been calculated, as other GHGs need more specific input data for calculation. The proportion of other GHGs in combustion process is not significant compared to CO_2. In cases where projections for total GHG amounts were given – the projection has actually been slightly increased in order to partially compensate for this discrepancy.

An important issue here is biomass burning. According to the IPPC guidelines GHG emissions from biomass combustion are to be included in the national registry for information purposes only. This means that CO_2 emissions from biomass burning does not require a corresponding amount of AAUs, so therefore these emissions are not to be included in quantities related to emission trading. The EUETS does not include these either.

In case of allowance trading, emission calculations and distribution take the crucial role. There are also sophisticated procedures to calculate emission reductions from the JI and CDM projects. Similarly, national allocation plans need precise calculations. This is due to the fact that emission amounts will be directly tied to corporate and national revenues as well as expenditures. Hence, accurate accounting and registry schemes are essential for both UN and EU emission trading schemes.

Hence, keeping the above-mentioned issue in mind, the projections made in this thesis have been kept as feasibly close to reality as possible. Obviously no projection can provide exact predictions due to the number of assumptions made whilst calculating, and this thesis is not an exception. The following pitfalls can be mentioned: barely predicable levels of electricity export and extent of renewable energy utilisation and emissions from sectors other than energy. These factors have not been included in the calculations. However it can be definitely said that the emissions from other sectors are likely to increase in modest quantities. Export levels are also likely to increase. An increase in renewable energy utilisation is also plausible. The assumption has been made that the increase of these two variables will compensate each other in terms of GHG emissions.

7.2 Actual GHG emissions

Total GHG emissions in Lithuania in 1998 comprised 24.6 Mt of CO_2e of which CO_2 emissions comprised 17.8 Mt. Fuel combustion activities for energy production for residential and industrial sectors comprised around 9 Mt of CO_2 emissions - 7.9 Mt and 0.96 Mt respectively in 1998. Industrial processes emitted 1.2 Mt in 1998. Cement and lime production processes (these sectors fall under the EUETS regulation) comprised approximately 0.5Mt (Ministry of Environment, 2002). Total combustion processes are responsible for 90% of total domestic CO_2 emissions.
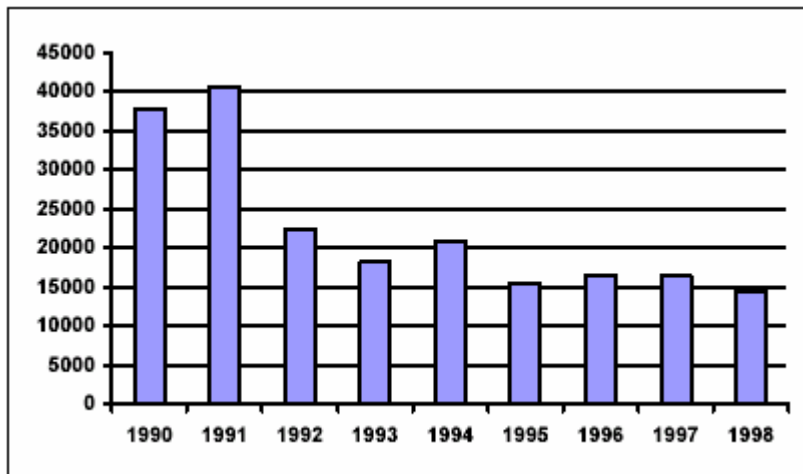

Figure 14 GHG emissions from fuel combustion in Lithuania 1990-1998, thousand t. (Ministry of Environment, 2002)

As can be seen from the graph GHG emissions from the energy sector and accordingly total GHG emissions decreased steeply after 1991. In 1990 GHG emissions comprised 54.3Mt whereas CO_2 was 42.3Mt. Hence, total GHG emissions decreased by 30 Mt (~55%) in 1998 as compared to the 1990 level. The steep decrease is due to the decline of industry after the restoration of independence.

7.3 Projections for future changes in GHG emissions

As stated in the conclusions of chapter 6, the predicted total future increase in CO_2 emissions will be dependent mainly on the proportion of natural gas and renewable energy use, as well as motor fuel consumption. This chapter intends to identify the quantities of CO_2 emission increase per sector related to the above mentioned changes on the energy market.

Following these arguments the conclusion can be drawn that future CO_2 emissions covered by the EU trading scheme will mainly depend on the decommissioning of the Ignalina NPP as well as on changes in electricity demand, which is projected to rise steadily. As was argued before, the increase in electricity demand will be followed by an increase in natural gas and renewable energy consumption. How will the allowance market in Lithuania be influenced by such changes?

Substantial changes in CO_2 emission quantities are not likely to be experienced at the beginning of 2005. Until Ignalina NPP is in operation emissions from energy production sector are not likely to change. The slight increase in emissions will be due to the prevailing steady economic growth, predicted to boost after Lithuania joins the EU. By the end of 2009

the increase in emissions from energy sector would be 1.5 Mt (equivalent to 2.5 TWh of electricity produced from natural gas assuming a conversion factor of 0.33) and the increase in transport emissions would comprise about 1Mt (forecasted increase of motor fuel consumption of a factor of 1.5 by 2020 would comprise a 1.9 Mt increase as compared to actual emissions). Keeping in mind a possible slight increase of emissions from other sectors it is possible to forecast total increase by approximately 3 Mt of CO_2 emissions by 2010. Although it is difficult to predict changes after 2010 due to this long time span, models predict a steady increase for energy demand for all periods. It has been assumed that the rate of GHG emissions increase will remain consistent for 2010-2020;that is, another 3Mt or 0.3 Mt annual increase. In reality, the actual increase will also depend on the extent of renewable energy utilisation.

A significant increase in CO_2 emissions should be expected at the beginning of 2010. The shift from nuclear energy to natural gas will add about 7 Mt of the CO_2 emissions in 2009-2010. Hence total emissions will increase by about 10Mt by the beginning of 2010. Since then, the assumed increase will remain steady and will increase by a total of 3 Mt by 2020 as mentioned before. So the total increase of 13 Mt of CO_2 is likely to occur by 2020 starting as of now. The said calculations imply an increase of CO_2 emissions totalling about 28Mt in 2010 and about 31Mt in 2020. Other GHGs, namely CH_4 and N_2O were not included in the calculations; it was instead assumed that their growth will be proportional to growth inCO_2. In such case, total GHG emissions would comprise 35 Mt by the end of 2010 and 38 Mt by 2020. The calculation results are presented below and compared to those of the projections made by PointCarbon[46].
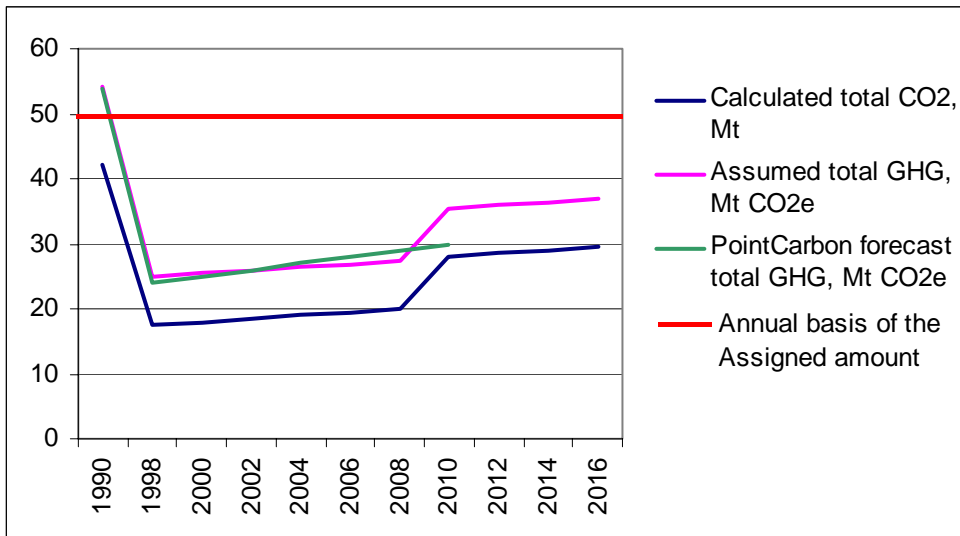
Figure 15 Estimated GHG emission projections according to anticipated changes in energy market

The graph reveals the sharp increase in CO_2 emissions after 2009 related to the final decommissioning of the Ignalina NPP. Such projections besides the above presented calculations also have economic validity. The fixed costs of the Ignalina NPP exceed 100 million Euros a year. It follows that economic reasons will lead to the full capacity exploitation of the second reactor in order to compensate the costs. Since nuclear energy would be on the edge in meeting electricity demand after 2005, the slight growth in electricity

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[46] PointCarbon is Norway based company specialising in the analysis of the carbon market.

demand will result in a slight increase of GHG emissions from other generators and then a sharp increase after 2009. It seems that the forecast made by PointCarbon does not take into the consideration the timing of the Ignalina NPP decommissioning.

The forecasting does not include possible utilisation of renewable energy and changes in electricity exports. It is assumed that those two variables will compensate for each other in terms of GHG emissions. Keeping this assumption in mind the fixed electricity export level of 2001 is used in the forecast calculations.

Renewable energy use is likely to increase resulting in reductions of GHG emissions. The legal situation analysed in the previous chapters favours renewable energy utilisation. National energy strategy foresees an increase in its use by a factor of 1,5 by 2020. Finally, the analysis of the energy market performed in previous chapters reveals the potential of the renewable energy utilisation for electricity production. So what is the potential of renewable energy to reduce GHG emissions? If we assumed that forecasted potential of renewable energy is fully utilised for the electricity production, then about 2Mt CO_2 emissions could be reduced.

In the case of electricity export, it can turn out that it is more profitable for the country to sell additional AAUs rather than to increase emissions in order to meet the export demand for electricity. The future EU electricity market is difficult to predict. One thing is clear – the market is going to be fully opened to member states, and hence the marginal profit of electricity sales can be very low.

Bearing in mind the above-mentioned issues it can be stated that the future GHG emissions trend forecasted in this thesis is likely to be close to its upper limit. I would imply that actual GHG emissions are not likely to exceed the forecasted margin. These values are used for the calculations in the following chapters to ensure that the GHG permit market is not overestimated.

7.4 Projected size and nature of the market for AAUs and allowances

This chapter aims to identify the potential of AAUs and CO_2 allowance market in Lithuania. For that purpose a number of estimations based on the previous chapters have been made. In order to understand the logic behind these calculations, chapter 3 (legal basis for emissions trading) should be read thoroughly prior to this one. The key indicators of the potential GHG market in Lithuania have been identified in this chapter. Main of these indicators are: the total and tradable amounts of AAUs, the quantity of CO_2 emissions that would fall under the EUETS, the number of allowances to be issued via grandfathering and the maximum possible amount of allowances to be issued. The next step was to identify the potential for international trade of AAUs and allowances. The input data (actual and projected GHG emissions) for the calculations in this chapter was used from chapter 6 (the results of the energy market analysis) and Lithuania's Second National Communication Under the Framework Convention on Climate Change. (Ministry of Environment, 2002). Further, the calculation results and their interpretation are presented.

Referring to the Kyoto protocol and to the total domestic GHG emission level in 1990, the Assigned Amount (AA) of AAUs has been calculated for the commitment period (2008 – 2012). Factor 0.92 has been used to adjust the (AA) to the 8% GHG emission reduction target for Lithuania. A tradable amount of AAUs was estimated by calculating obligatory

commitment reserve of AAUs for the commitment period. The second option of the Protocol has been used for commitment reserve estimations, i.e. five times the latest GHG inventory. Emission levels of 1998 were used as a "latest GHG inventory". The calculation results show that the total amount of AAUs to be received by Lithuania for the commitment period (2008-2012) is about 250 million. Tradable amount would comprise 126 million AAUs.

The size of the EU allowance market has been identified by calculating the amount of CO_2 emissions from combustion installations in energy and industry sectors as well as CO_2 emissions from industrial processes covered by EUETS. According to the EUET Directive, only the large (>20MW) combustion installations and several types of industrial processes will fall under the scheme. Experts from PointCarbon, a carbon market analyst firm, argue that it is possible to use UNFCCC national reports to estimate CO_2 emission amounts that will fall under the EU trading scheme. (Point Carbon, 2003b). According to them, the categories called "Energy industries" and "Manufacturing industries and construction" from reports to the UNFCCC match well with the sectors covered by EUETS. The average conversion ratio suggested by Point Carbon is 95% (0.95) when converting GHG emission values from those of the UNFCCC to those of the EUETS. (Point Carbon, 2003b). Bearing in mind the number of small combustion installations and highly developed chemical (e.g. Ammonia production) industry[47] in Lithuania, a factor 0.9 (less than average) was used for transferring emission figures from the National Communication to UNFCCC to the projected EUETS sectorial GHG emissions coverage.

By using the above explained method it was calculated that activities covered by the EUETS were responsible for 21.5 Mt of CO_2 emissions in 1990. Hence, 21.5 Mt is the reference figure if grandfathering method (referring to 1990) is used for allowance allocation. The amount of issued allowances has to be consistent with Lithuania's Kyoto target (8% reduction). Hence, 19.8 million allowances are to be issued for one year in case of grandfathering referred to 1990. Then the total amount for precommitment period (2005-2007) would be 59.4 million and for the commitment period (2008-2012) - 99 million allowances. The maximum possible amount to be issued was calculated by subtracting the amount of forecasted emissions for the considered period from the total Assigned Amount of AAUs.

Such a method for calculation is not precise due to the approximation of CO_2 amount covered by EUETS. However, the range of possible projection variations is not likely to range within a wide interval. The projected allowance quantities, in this thesis, are valid under three conditions. The first condition is that allowances are allocated by using grandfathering referred to 1990 levels. The second condition is that the EUET Directive is not amended with the specific provisions towards the accession countries. The third condition is that the EU burden sharing agreement towards the Kyoto target is not amended by including the accession countries. In contrast, the calculated total amount of AAUs to be received does not depend on any condition. However, the tradable amount of AAUs will depend on GHG emission level changes recorded in latest GHG inventory that is due to be submitted to the UNFCCC during the following years by 2008.

The results of the calculations are presented in Table 5.

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[47] These installations are not included in the EUETS.

Table 5 Results of the calculations for key figures of the CO₂ market in Lithuania

Total domestic GHG emissions in 1990 (baseline), Mt CO2e	54,34
Total domestic CO₂ emissions in 1990 (baseline), Mt	42,34
Total domestic GHG emissions in 1998 (latest inventory), Mt CO2e	24,69
Total domestic CO₂ emissions in 1998 (latest inventory), Mt	17,55
Number of AAUs to be received for 2008-2012 (referred to baseline), Million	249,96
Tradable amount of AAUs, (referred to latest inventory), Million	126,51
Total GHG emissions forecasted for 2005-2007 period, Mt CO2e	77,07
Total GHG emissions forecasted for 2008-2012 period, Mt CO2e	134,65
CO₂ emissions from activities covered by EUETS in 1990, Mt	21,54
CO₂ emissions from activities covered by EUETS in 1998, Mt	9,07
GHG emissions outside EUETS activities in 1998, Mt CO2e	15,62
Forecasted CO₂ emissions covered by EUETS in 2005-2007, Mt	30,22
Forecasted GHG emissions outside the EUETS in 2005-2007, Mt	46,85
Forecasted CO₂ emissions covered by EUETS in 2008-20012, Mt	56,56
Forecasted GHG emissions outside the EUETS in 2008-20012, Mt	78,09
The amount of allowances to be issued via grandfathering for 2005-2007, Million	59,45
Maximum possible amount of allowances to be issued for 2005-2007, Million	103,12
The amount of allowances to be issued via grandfathering for 2008-2012, Million	99,08
Maximum possible amount of allowances to be issued for 2008-2012, Million	171,87

Estimations show that around 37% of total actual domestic GHG and 52% of total domestic CO₂ emissions will be covered by the EUETS in Lithuania. The exact number of allowances to be allocated will be decided by the authorities. The decision on allocation quantities should, among other, include such considerations as the potential of GHG emission changes in the sectors outside the EUETS, predicted changes on electricity market and the economic value of the GHG emissions.

Two remarkably different emission trading periods for Lithuania are ahead: 2005-2007 and 2008-2012. For ease of reading, these periods will be named according to the Kyoto

protocol's terminology: precommitment period (2005-2007) and commitment period (2008-2012). During the precommitment period only the EUETS will be in operation. During the commitment period both the Kyoto international emission trading (IET) and EUETS will take place. Further these two periods are analysed.

The market size will greatly depend on the national allocation plan. There are several ways to allocate allowances. The EU Commission is committed to releasing guidance for the national allocation plans by the end of 2003 with instructions on how to use these methods. Thus the national authorities do not need to decide on allocation before that time. However, despite that, market projections are a valuable tool for decision-making, hence it is highly advisable for the authorities to simulate the future GHG market.

Practice shows that the most common method for allocation is grandfathering, that is companies are assigned with amounts according to their emissions level during a certain period in the past. It is likely that Lithuanian authorities will chose the grandfathering method referred to the 1990 GHG emission levels. As it was argued above, about 60 million allowances are to be issued for the precommitment period if grandfathering to 1990 is used. Experts say that EUETS will cover about 200 installations in Lithuania. The major part of allowances will be received by energy generators[48] while industrial process installations, represented mainly by cement producers and an oil refinery will be assigned with less prominent quantities. The industrial process sector[49] (see the EUETS description in chapter 3) should receive around 7 million allowances for the precommitment period, if using grandfathering to 1990. According to such a scenario, about 30 million[50] allowances could be traded during the precommitment period. Referring to the latest allowance price forecasts made by PointCarbon (2003a) the projected price of allowance is $6.3/tCO_2e$, which discounted (7%) value for 2005 comprises EUR 5.5. Hence, approximate estimations would give an EUR 165 million value allowance market for the precommitment period (2005-2007).

Different scenario is also possible theoretically if authorities decide to place allowance receivers in a favourable position towards international trade. The main requirement for allocation in member countries is to be in line with the Kyoto targets. This would imply that theoretically the emission difference between 1990 levels (reduced by 8%) and forecasted GHG emissions outside EUETS coverage for 2005-2007 could be allocated as allowances for the precommitment period. Hence, the maximum possible amount to be allocated would comprise 103 million for precommitment period. The additional amount of allowances could be distributed proportionally to the allowance receivers according to their historic levels in 1990. There are several pitfalls in such allocation method. One of them is the possibility of over-allocation, which could occur due to the future emission forecast uncertainties. Hence, in the case of such a scenario, some "future emission reserves" should be kept. The secure reserve, for example, could amount to over 10 million CO_2e emissions for both periods. Hence, in such a scenario, about 90 million allowances could be allocated and 60 million could be traded at total value of EUR 330 million during the precommitment period.

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[48] "Energy generation" also includes combustion installations within industry.

[49] One should distinguish the difference between the emissions from combustion installations used in industry and emissions from industrial processes. 7 million allowances in the text are referred to industrial processes.

[50] The difference between the total amount of allowances allocated for the precommitment period and the projected emissions for the precommitment period from the sectors covered by the EUETS. (See Table 5).

The second scenario is not likely to become reality because of two reasons. The first reason is due to that the EU Commission reserves the right to check if "not more than needed" allowances are allocated by each member country for the EUETS (see chapter 3). Another reason is that ET theory implies that large companies can distort ET market if they are allocated with more permits than necessary. (See chapter 2)

It is most likely that authorities in Lithuania will decide to issue all allowances free of charge for the precommitment period, due to lack of experience for such type of mechanism. (According to the EUETS directive, member countries can charge up to 5% of allocation amount for the precommitment period). It is quite feasible that the allocation will be partially charged for the commitment period (member countries are free to decide to charge up to 10% allowances when allocating for companies under the scheme)

The commitment period will be more complex in Lithuania since both emission trading schemes will be combined at the same time (International trade at a state level will start in 2008, in addition to EUETS). By that time, as it was argued at the beginning of this chapter, Lithuania should receive about 250 million assigned amount units (AAUs) for the commitment period. The tradable amount, calculated in line with the "latest inventory" (1998) would be 126 million. The proportion of traded AAUs will depend on the amount of allowances allocated under the EUETS for the commitment period. 42 million[51] allowances could be traded during the commitment period under the EUETS in the case of grandfathering allocation method to 1990. In such an allocation scenario, Lithuania would have an additional 72 million[52] of AAUs to sell on the international GHG market for the commitment period, under the Kyoto agreement.

The amount of allowances traded during the commitment period would comprise at EUR 230 million at a projected allowance value of EUR 5.5. The international trade of AAUs on a state level would amount to an additional 396 million. The revenues during the commitment period would then be EUR 626 million. The total revenues for the national economy during the both trading periods could be as high as EUR 790 million, at predicted allowance prices[53].

7.5 Conclusions

CO_2 emissions will not exceed 1990 levels by 2020. Except 2009-2010, the emission increase is expected to be about 0.3 Mt annually. Other GHGs, comprising a minor part of total GHG emissions, are not likely to increase drastically either. CO_2 emissions in Lithuania will depend substantially on the decommissioning of the Ignalina nuclear power plant (NPP). A steep increase in CO_2 emissions is expected at the end of 2009 after the final closure of the NPP, adding approximately 7 Mt to CO_2 emissions at the beginning of 2010.

Estimations show that around 37% of the total actual domestic GHG emissions and 52% of total domestic CO_2 emissions will be covered by EUETS scheme in Lithuania. The exact number of the allowances to be allocated is to be decided by authorities, which should

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[51] The difference between the amount of allowances to be allocated for the commitment period and the forecasted CO2 emission level for the commitment period. (see Table 5).

[52] The difference between Assigned Amount and sum of allowances to be issued for the commitment period plus forecasted GHG emissions outside EUETS for the commitment period. (see Table 5).

[53] It is assumed that the price of AAUs is equal to the price of allowances projected for 2005.

consider the potential of the emission changes in other sectors, the potential changes in electricity market and economic value of the emissions.

Analysis shows that Lithuania will be a net supplier of the AAUs on the international emission trading market during the first commitment period. The calculated tradable assigned amount for the commitment period (2008-2012) is around 126 million of AAUs. Roughly 70 million of AAUs are likely to be traded (sold) on the international market during the first commitment period at a total value of EUR 396 million.

Approximately 60 million of CO_2 emission allowances are to be issued for the precommitment period under the EUETS, using the grandfathering method for allocation referred to 1990. If such a method is used for allocation, Lithuanian companies will have an additional 30 million allowances to sell abroad under the EUETS for the precommitment period. The total value of allowances traded would comprise EUR 165 million. About 100 million allowances will be allocated for the commitment period if the allocation is performed via grandfathering to 1990 levels. In such a case companies are expected to have 42 million allowances to sell under the EUETS that would comprise EUR 230 million for the commitment period. Total revenues for the national economy from GHG emissions trade for the both periods from could be as high as EUR 790 million, at the predicted discounted allowance value of EUR 5.5.

The calculated amount of allowances for Lithuania is valid under two conditions. The first condition is that accession countries have the same status as other EU members in respect of the EUETS regulation. The second condition is that accession countries will not be involved in the EU burden-sharing agreement for the Kyoto targets. If any of these conditions are changed, the number of allowances traded will differ significantly from those calculated in thesis. As argued in chapter 3, provisional changes in the EU ET Directive towards accession countries are not likely to be made prior to the end of 2006. Possible changes in the EU burden-sharing agreement for the Kyoto targets, due to the inclusion of accession countries, have not been discussed at an official EU level yet.

The calculated Assigned Amount does not depend on any conditions. The tradable amount of AAUs will depend on GHG emission level changes in the "latest GHGs inventory" for the following years by 2008.

8. Case study: Lietuvos Elektrine AB– Vattenfall possibilities for international trade

In this chapter the framework for optimal corporate ET strategy that was developed at the beginning of the thesis is hypothetically tested with a case study. The framework is applied under the specific conditions of the GHG market in Lithuania, which were defined in the previous chapters. To this end, two major energy companies – one in Lithuania and one in Sweden – were selected and interviewed. The aim was to make suggestions that would contribute to the optimisation of the corporate ET strategy for players on the forecasted GHG market in Lithuania. The case study is intended to describe the opportunities and pitfalls that domestic and international players may face on the projected market.

8.1 The position of Lietuvos Elektrine AB on the GHG market in Lithuania

Lietuvos Elektrine AB is the second largest energy producer in Lithuania after the Ignalina NPP. 90% of company shares are state owned and the rest owned by private investors. The National Energy Strategy envisages Lietuvos Elektrine AB as a major electricity source in Lithuania after the decommissioning of the Ignalina NPP in 2009. The strategy also envisages renovation of the plant.

Lietuvos Elektrine TPP has 1800 MW of installed capacity for electricity production and 1100MW of installed heat capacity. In 2002 the power plant produced only 9% of its production level in 1990. Lietuvos Elektrine AB produced 7812 GWh of electricity and 277GWh of heat in 1990. Electricity production dropped to 737GWh and heat production to 152GWh by 2002. Drops in energy generation resulted in the GHG emission reduction.

If the allocation is performed using grandfathering referred to 1990, Lietuvos Elektrine AB will receive about 15.6 million allowances for the precommitment period. For the commitment period a total 26 Mt should be received. This would comprise 27% of the projected total allowances to be issued for both periods under the EUETS scheme within Lithuania.

Actual emissions of the plant were only 0.44 Mt of CO_2 in 2002. It seems that company has a great potential for trade in allowances. This is true for the precommitment period, but not for the commitment period. Further on the potential of the company's allowance trading will be analysed for both periods.

As projected in the National Energy Strategy (2002) the demand for heat will not increase significantly during the next 20 years (by 30% compared to the present). The demand for electricity will increase by average 4.3% annually. As analysis in chapter 6.2 shows, the projected electricity demand in 2005 can be met after the first reactor closure of NPP without increasing production in other plants. By the end of the precommitment period in 2007, a shortage of about 1 TWh could occur (at present export levels) due to the increased demand that is related to projected economic growth.

Let us assume that all increases in electricity demand will be met by Lietuvos Elektrine TPP. As also argued in chapter 6, the additional electricity would be produced mainly by using natural gas. The additional production of 1TWh would increase CO_2 emissions by about

0.6Mt of CO_2. It then follows that total emissions of the company for 2005-2007 would be roughly 2Mt. Hence the company will be able to trade 13.6 million allowances during the precommitment period, with a total value of EUR 75 million at the projected allowance value for 2005.

The situation for the commitment period looks differently. As argued in chapter 6, an additional 7Mt of CO_2 is expected after 2009. The major part of these emissions will be emitted by Lietuvos Elektrine TPP (see chapters 6 and 7). Let us assume that all additional electricity after the decommissioning of the Ignalina NPP is produced by Lietuvos Elektrine TPP. In such a case, an additional 29Mt of CO_2 would be emitted from the plant during the commitment period. This would exceed the amount of allowances that the company will obtain for the commitment period by 3Mt. However, obviously not all additional electricity after the decommissioning of NPP will be produced by Lietuvos Elektrine AB – some will be shared by other generators. Thus, GHG emissions will also be shared amongst them. Besides, the second reactor of Ignalina NPP is likely to be in partial operation during 2009. Hence it is not likely that company's emissions would exceed the amount of allowances during the commitment period, although emission levels could be close to the limits.

There is also a probability that the government will decide on a different allocation method and would allocate more allowances for the company for the commitment period. In any case Lietuvos Elektrine AB would need an emission trading strategy for both periods. Further different possibilities for the company will be explored.

8.2 Suggestions for improvement of the corporate ET strategy for Lietuvos Elektrine AB

It is likely that Lietuvos Elektrine AB will be allowance seller on the market. As previous calculations show the company should have about 14 million of allowances to sell during the both periods. This entire excess amount will be received during the precommitment period. The allowances received for the commitment period will be used to cover emissions, so excess allowances are not predicted for the commitment period.

The role of the ET strategy will be important factor defining the profit of the company. Another very important factor will be the decision of the authorities on the bancability[54] of allowances between the two periods. A favourable decision for the company would be to allowed banking between the periods. If this is the case, the main task for Lietuvos Elektrine AB will be to redistribute the allowances throughout both periods. In this respect, the framework for optimal corporate ET strategy (see Figure 2 on p. 20 in chapter 2.5) suggests that it is more reasonable to bank the major part of the allowances for the commitment period. Some allowances could be sold during the precommitment period. Saving allowances for the 5-year period would have two reasons. The first one would be to secure compliance endangered by increased emissions (in 2009) and the second to secure higher profits due to the predicted higher allowance prices during the5-year period. Intensive trade should not be performed prior to the end of 2009 due to the high uncertainty in the emission increase level.

Hence, Lietuvos Elektrine would be expected to start major allowance trading in 2010. The amount sold starting 2010 could be around 10 million. The rest, 4 million, could be sold

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[54] EU member states are to decide if they will allow the banking of unused allowances from the precommitment period for the commitment period (see chapter 3.2).

before that time not exceeding secure levels. Any additional allowance sales would depend upon the company's ability to deploy renewable energy in its power plant. The main alternative would be biomass utilisation with zero emissions, generating extra allowances and in the same way additionally increasing profits.

As the framework for optimal corporate ET strategy suggests (see Figure 2 on p. 20 in chapter 2.5), one of the most important strategic actions for Lietuvos Elektrine prior to the beginning of the ETS would be capacity building. Such investment, according to STI nomenclature, would be *no-regrets* move that pays back in any scenario. Since the company does not have enough knowledge and information on ET, it should start developing these skills. This could be done by training existing staff or/and hiring experts with an ET background. The optimal move would seem to be hiring experts with a thorough understanding of both the ETS mechanisms and green portfolio management, preferably with an economic and management background. A department for green portfolio management could be established. In addition, some personnel from the financial department could be trained and involved in procedures of green portfolio management. Such a tactic could lead to a huge payback in the near future with minimal investments.

The *adapting* posture could be changed into the *shaper's* posture by the end of precommitment period and during the commitment period. As the framework suggests, the company could use the revenues from the allowance trades to make investments into GHG emission abatement measures. Moderate investments would be reasonable for the precommitment period and significant investments would be appropriate for the commitment period. Such a strategy would comply with the hypothesis of the optimal corporate ET strategy presented at the beginning of the thesis, since it would increase revenues and reduce actual GHG emissions.

8.3 The position of Vattenfall

Vattenfall is the largest energy generating company in Sweden and one of the largest in Europe. The company has recently expanded to Poland and Germany by acquiring power plants in these countries. A limited amount of energy is also produced in Finland. 44% of Vattenfall's electricity is produced using fossil fuel, 34% is produced from nuclear energy and 22% from hydropower plants.

Due to the high proportion of fossil fuel use, Vattenfall will be significantly influenced by GHG emission regulations. The company admits that GHG emissions are one of the most significant environmental risks that the company is facing. CO_2 emissions from fossil fuel-based power plants are perceived as a key challenge for Vattenfall's business. Hence, the company is putting a lot of efforts into carbon risk management. In order to secure future compliance, Vattenfall is being proactive by looking into early solutions to curb its emissions.

8.4 Suggestions for the improvement of corporate ET strategy for Vattenfall

Vattenfall's strategy would differ from that of Lietuvos Elektrine since Vattenfall is more likely to experience a lack of allowances. Hence, the lower part of the framework for optimal corporate ET strategy would be applicable to the company. This implies that to optimise its strategy, Vattenfall should take a *shaper's* posture prior to the commencement of the EUETS in 2005. The framework for a company in such a position suggests the concentration on

abatement investments prior to the commencement of the EUETS. An example of such investments could be the acquisition of existing fossil fuel-based power plants in Lithuania. The *option* moves should be used to allow the company to increase investments or to retreat, depending on the changing situation. One option could be to acquire fossil fuel-based power plant (s) with the total installed capacity of more than 20MW(Such a plant would fall under the EUETS and would generate allowances. In the long run perspective, when the regulation comes into force, a fuel switch to biomass in the acquired plant could be made. Since the GHG emissions from biomass fuel are not registered under the scheme, the generated allowances could be used to cover emissions from the company's other installations. As the analysis of the Lithuania's energy market shows, biomass supply has a great potential to be utilised. The market price for firewood is currently low, however it may certainly rise in future. The possibilities of such a strategy of course would need further analysis.

Following the framework for the optimal corporate ET strategy, the "reserving right to play" strategy by acquiring call options is not recommended before 2005 due to the associated high uncertainty (IV) level. It is advisable to start trade after the beginning EUETS when uncertainty will be lower. Generally, it is recommended to design the ET strategy more towards internal emissions reduction and secure allowance generation rather than to rely on the allowance acquisitions that are most likely to be a "hot air" at the start of the scheme. Such a strategy would follow the hypothesis of the optimal corporate strategy stated at the beginning of the thesis.

A framework agreement with Lietuvos Elektrine AB is possible to minimise risks of the compliance. The agreement could include both allowance acquisitions and other measures of GHG emission mitigation. According to the framework such agreements should be made in the precommitment period, when the uncertainty will decrease (see chapter 2.5.2).

8.5 Concluding remarks

Lietuvos elektrine AB will be a major player on the GHG market in Lithuania. Projections show that the company will trade about 14 million allowances under the EUETS. There is a strong need for the company to start building its ET capacity prior the start of the scheme. Green portfolio management and climate change policy will define the company's revenues.

Significant investments in emission abatement for Vattenfall are recommended prior the precommitment period (2003-2005). For Lietuvos Elektrine, the framework for optimal corporate ET strategy suggests a concentration on capacity building during that period. Intense allowance trade is suggested for Vattenfall during the precommitment period while moderate trade is suggested for Lietuvos Elektrine during the same period.

Cooperation between Vattenfall and Lietuvos Elektrine has a potential to reduce compliance costs and increase profits for both companies. A framework agreement could be developed between the companies enabling allowance acquisitions, Joint implementation projects, joint ventures and other measures to curb emissions at a lower cost.

For Vattenfall, the agreement could be a means to reduce future compliance risks. The agreement would secure the purchase of the allowances at more stable price and desired quantities. Such an agreement could also pave the way for further joint ventures between the companies.

The implications of such a strategy for environment are likely to be positive. The excess allowances of the Lietuvos Elektrine AB will not be "hot air" because of the expected steep increase of the company's emissions that will need to be covered by allowances. Hence, the company will be interested in real emission reductions.

9. Conclusions and suggestions

The purpose of the thesis was to suggest steps for the optimisation of corporate ET strategy for the projected GHG market in Lithuania. The optimal ET strategy was perceived as a strategy that leads to the increased profits and reduced environmental impacts of the company. In order to make suggestions the following intermediate questions have been answered: What are the theoretical prerequisites for the efficient trade to take place on the tradable emission permit market? What are the actual and potential framework conditions for emission trading in Lithuania? And what is the foreseen potential of GHG market in Lithuania? And finally what is the most effective way for the companies involved in the emission-trading scheme to behave on the foreseen GHG market in Lithuania? This chapter summarises the findings and answers to the research questions above.

9.1 Characteristics of the efficient ET market

The efficiency of emission trading scheme strongly depend on its design. Four main prerequisites are needed for the efficient trade to take place. These are: high number of relevant emitters; no small emitters included into the scheme; different abatement costs of emitters; and third party participation in the market. High number of emitters helps to keep lower prices of the permits on the spot market. Third party participation ensures the liquidity of the market, which is prerequisite of the efficient trade. The transaction costs for the small emitters can be too high on the market for the effective trade.

The environmental effectiveness of the ET market depends on how the revenues from the emission trading are utilised. Revenues can be allocated as investments into clean technologies and further abatement of the GHG emissions. The distribution of the revenues can be done in three ways: income to the national budget, carbon funds and assigned to the private sector. The experience shows that the revenue utilisation is normally more efficient in the private sector than on the governmental level.

The EUETS design as it stands now complies with the general requirements for the efficient ET market. The number of the emitters is sufficiently high. Small emitters are not included into the scheme. The abatement costs are different among the EU countries due to involvement of the accession countries. Market liquidity is ensured by involving third party into the trade (Any institution or private person is entitled to hold and trade the allowances).

The probability of the EUETS market distortion however does exist. The possible pitfalls are the fragmentation of the market and monopolies. Fragmentation is possible due to the discrepancies of the domestic schemes with EUETS. Monopolies are less likely, but have theoretical probability to occur if the large emitters will be allocated more allowances than needed.

9.2 Conditions for GHG emission trading in Lithuania

Lithuania has in place atmosphere pollution permitting scheme. Any industrial activity needs a "permits for the natural resource use". The atmospheric emissions are regulated for certain industrial activities. SO_x, NO_x, and particulate matter are charged. From 2004, permits for the natural resource use will be substituted with the Integrated Pollution permits according to the IPCC directive.

The pollution permitting scheme that exists now in Lithuania could without significant difficulties be modified into the emission permit trading scheme. There are ideas circulating in the Ministry of environment to combine EUETS with IPPC permitting scheme. This would potentially reduce costs of the scheme administration.

CO2 emissions are not yet regulated in Lithuania, however the global warming mitigation policy is envisioned in the main strategic documents where a significant attention is given to the emission trading. One of the ongoing initiatives on the proposal level is the establishment of the tender for JI projects that would buy-in the emission reduction units from JI projects.

There are several drawbacks associated with the lack of institutional capacity. This would imply that scheme administration costs would be higher at the beginning of the EUETS since government will need to use the services of the consultancies to large extent. However there are some solutions on the way. Some funds have been accumulated for the establishment of the registry system. Several private consultancies have strong background in climate change and clean energy issues that could be hired for the scheme design and administration work.

The potential of the renewable energy in Lithuania is high. The estimations show that additional 3 TWh of electricity could be produce by using renewable energy sources. Biomass comprising mainly wood and straw is estimated to have one of the highest potentials. The prices for the biomass is low compared to the prices in Western Europe. Hence the potential for the fuel switch from the fossil fuel to biomass is high.

The conclusion can be made that framework conditions in Lithuania have a high potential for ETS creation. The conditions for the renewable energy utilisation are also positive. The renewable resource potential including biomass is high. These conditions should send the positive signal for the international investors in clean energy and other abatement techniques in Lithuania. A point of caution, the thesis did not look into legal provisions towards the renewable energy utilisation, which slightly reduces the credibility of the analysis.

EUETS Directive doesn't contain any specific provisions for the accession countries regarding specific design of the ETS. The changes can be made by the Commission for the specific requirements for the accession countries however they are not expected to come into force before the end of 2006. The decision could also be made to amend the EU Kyoto target burden sharing agreement including the accession countries, however no clear discussions on this issue have been performed so far.

9.3 Size of the GHG Market in Lithuania

Analysis shows that Lithuania will be the net seller of the emission permits (both AAUs and allowances). The country is expected to have about 120 million of tradable Assigned amount units (AAUs) during the commitment period. Part of the commitment period AAUs will be allocated as allowances for the EUETS scheme depending on the decision of authorities.

EUETS in Lithuania will cover around 37 % of total actual domestic GHG and 52 % of total domestic CO_2 emissions. Companies under the scheme are expected to receive about 60 million allowances for the 3-year period (2005 - 2008) and about 100 million allowances for the 5-year period (2008 – 2012) if the allocation is done using grandfathering referring to 1990 levels. Calculations show that total amount of 72 million allowances would be traded during both periods if the allocation is made using grandfathering to 1990. The proportion

of allowances traded during the two periods will depend manly on the decision of authorities to allow or not allowance banking between the two periods. If the transitional banking is not allowed the proportion allowances traded would be as follows: 30 million for the first period and 42 million for the second. In case the transitional banking is allowed more allowances will be sold during the second period.

Total value of the allowances traded during both periods would be about EUR 400 million at the projected discounted value (EUR 5,5) of the allowance for the beginning of the 3-year period. Hence, this amount would represent the minimum total value of the allowances. The revenues would be received almost entirely by the Lithuanian companies since it is not likely for them to experience the shortage in allowances if the allocation was done according the 1990 emission levels. Some allowances could be bought by the new installations on the market, but it is not clear whether government would decide to allocate allowances for the new installations free of charge (since it will have extra AAUs) or they will be forced to buy allowances on the market.

In addition to the allowance trade, the State will have about 73 million AAUs to sell on the international ET market at a total value of another EUR 400 million during the commitment period. Hence, the total country revenues from the GHG emission trading can be expected at EUR 800 million at the lower value level. It is up to the State authorities whether to share part of the State revenues with the companies by allocating extra amount of allowances from the disposable 73 million AAUs. Experience shows that utilisation of the revenues on the corporate level normally is more effective.

Lietuvos Elektrine AB will be one of the major players on the GHG market in Lithuania. Calculations show that the company will have about 14 million allowances to sell during the 2005-2008 or ¼ of the allowances available on the market. However during the second period (2008-2012) the company balance will be close to the maximum of the allowed emissions due to the expected steep GHG emission increase.

9.4 Towards the optimal corporate strategy on the GHG market in Lithuania

There is no ET strategy that would suit all companies involved in GHG emission trading. The suggestions made in the thesis are based on the framework for the optimal ET strategy that was built on a generic model of strategy under uncertainty (STI model) and the findings of the ET experts and tailored for large energy companies, hence they are not applicable for all companies on the market. Since emission allowances represent type of commodity, the general economic and management rules are applicable for the ETS. The specific of the ET strategy is due to very high market uncertainty especially prior the trading period. Hence, the uncertainty management takes up one of the major place in ET strategy.

The ET strategy as any other strategy can be defined as a mix of strategic postures and strategic moves. The mix and the way it is performed will define the outcome of the ET strategy in terms of profitability and environmental implications. In case of GHG market in Lithuania the optimal corporate strategy would be different for the local companies and the international ones. The *shaper's* strategic posture with *option* moves is suggested for the foreign companies, while *adapting* posture with *no regret* moves is suggested for local companies prior to the commencement of the EUETS.

An *adapters* posture with *no regrets* moves for the companies based in Lithuania after the beginning of EUETS would mean that the revenues received from emission trading are transferred to major investments into further abatement techniques. The strategy optimum here would be expressed in economic benefits of the further emission curbing and benefits for the environment in reduced impact on global warming. The two main issues that need special attention of the Lithuanian companies are capacity building and allowance distribution within and between two trading periods. The capacity building would also represent no-*regrets* strategic moves under high market uncertainty meaning that investments will pay back in any case. By making moderate investments in own capacity building, the companies would avoid future expenses for consultancies services and loses due to ineffective investments or trade. It is advisable for large companies to hire an ET expert and to form green portfolio management departments using staff from company's economic department. The allowance distribution between the two trading periods will be one of the key factors influencing the business. The companies are advised to bank significant amount of allowances for the second period because of expected steep increase in GHG emissions in Lithuania as well as due to expected increase in the allowance prices. It is likely that most profitable decision for the allowance sales are feasible in 2010 (The strategy is valid in case the transitional banking is allowed between the two periods).

Under the *shaper's* position, international investors would have two options for action prior and at the beginning of the EUETS: *big bets* and *option* investments. *Option* investments are suggested for an optimal strategy. This would mean that moderate investments in abatement techniques or acquisitions are made. The international companies could for example buy fossil fuel based power plants in Lithuania prior the EUETS and make fuel switch to the biomass after the beginning of the scheme. This would be economically viable in Lithuania. Such strategy should result in steep emission cuts and increase in the extra allowances generated. The *"reserving right to play"* is not recommended for the international investors prior to the beginning of EUETS and right after the beginning due to very high uncertainty. Hence, early intensive call option and swap trading is not likely to be optimal corporate strategy.

9.5 Environmental implications

Due to the global dimension of GHGs impacts, the benefits from pollution reduction are not country or region specific. The reductions would contribute to preventing global warming issue regardless of the place it has been achieved. Emission trading is an economic tool that doesn't guaranty the environmental benefits by itself. Actual pollution reductions depend on the use of the instrument. This implies the importance of ET strategy for both state and corporate level.

Thesis research revealed how the proposed corporate ET strategy can address "hot air" issue. According to the proposed strategy, companies prior to the emission trading period are advised to make investments into the emission reduction techniques instead of buying permits (which most likely would be the "hot air" at the beginning of ETS). Companies should concentrate more on the internal emission reductions through asset acquisitions and projects prior to the beginning of the ETS. The analysis shows that such strategy would also lead to lower risks, hence to higher profitability. In this case, the strategy would have both features of the optimal strategy described at the beginning of the thesis: the increased profits and reduced environmental impacts. Moreover it would result in technology transfer to the less developed countries. In general, emission trading has the potential to incorporate environmental costs into the product price, which is one of the main objectives of

environmental economics. If the environmental costs will be included depends significantly on the distribution of the "right to pollute" or allocation. If the allocation is done in a fair way the pollution cost should be included into the production. However, in practice it is very difficult to do allocation in an optimal way. The given global distribution of the "right to pollute" doesn't give much hope that the environmental costs will be included in a fair way due to the market distortions through allocation.

The actual emission reductions will depend not only on allocation of the "right to pollute" but also on the way generated revenues from ET are distributed. It is likely that the gains from emission trading on the corporate level would be utilised for further abatements. Such trend would be driven by the market mechanisms. Companies would strive to gain more benefits by reducing the emissions, hence investing into abatement techniques in countries with the lower abatement costs. The optimal revenue distribution on the state level will be more complicated since there are several ways of doing so, and countries are to choose the optimal method. There are also some pitfalls associated with the fund utilisation. The most suitable method seems to be the establishment of the carbon fund that would be used for further investments in pollution reduction. However, in countries with high corruption level the fund may not work well. Thus, the conclusion is made that countries (especially accession countries) should strive to allocate more permits for the private sector involved in the ETS rather than seeking to be involved in the international emission trading on the state level.

GHG emission trading schemes will have significant impact on the biomass use for energy production purposes. Since the CO_2 emissions from biomass is not calculated into the national GHG registry – the switch to the biomass from the fossil fuel would result in zero emissions while generating allowances. Companies will get incentive to invest in the fuel switches to biomass.

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Abbreviations

CEE	Central and Eastern European countries
CHP	Combined Heat and Power plant
CO_2	Carbon dioxide
CO2e	Carbon dioxide equivalent
EIT	Economies in transition
EPA	Environmental Protection Agency
ET	Emission trading
ETS	Emission trading scheme
EU	European Union
EUETS	EU emission trading scheme
GEF	Global Environmental Facility
GHG	Greenhouse gas
GW	Giga Watt (billion Watts)
GWh	Giga Watt hours
IETS	International emission trading scheme (Under the Kyoto agreement)
IPCC	Intergovernmental Panel for Climate Change
KW	Kilo Watt (1000 W)
KWh	Kilo Watt hours
Mt	Mega tonne (million metric tonnes)
NPP	Nuclear Power Plant
STI	Strategy Theory Initiative
TPP	Thermal Power Plant
TW	Tera Watt (trillion Watts)
TWh	Tera Watt hours
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme

Appendix I – Factors influencing the bargaining power

First of all the bargaining power of the negotiator depends on the direct gains and costs of it. The bargaining power of the negotiator higher the greater is his payoff. Similarly, bargaining power is higher the larger is his cost of revoking. Other key factors determining bargaining outcome are: impatience of the players, risk aversion, outside/inside options, commitments and asymmetric information. These factors either increase or decrease bargaining power. Further down they will be shortly presented.

Impatience of the negotiators

One of the factors that influence the outcome of negotiations is players' degree of impatience. The bargaining power is higher the lower is player's impatience. If the negotiator doesn't suffer any costs of the negotiation, the process can last for a long time without results since negotiators have no incentive for. However in real cases time is an asset for the parties and that makes them impatient.

The bargaining power of the player is higher the more patient he is compared to other negotiator. The impatience can depend on the financial issues for example. Normally, poor person would be more impatient than the rich one since he is more eager quickly obtain gains from the cooperation.

It follows that in order to increase bargaining power a player should strive to reduce his negotiation costs and increase the other's negotiators haggling cost. The haggling costs can be reduced even before the negotiation starts e.g. by increasing inventories if the negotiation is about material supply.

Risk aversion

The negotiators can be afraid that the negotiations can break down because of the several factors that are uncontrollable and try to avoid such risk when negotiating. The bargaining power is higher the less risk averse is negotiator compared to his opponent. Risk avoided can be because of the uncertainties about: human behavior, possibility of the third party intervention and market instability.

Human behaviour can have an influence on the outcome simply in the way that someone will get fed up with the negotiations and will retreat from the transaction. Another factor - probability of the third party intervention that could take over the gains from agreement while the negotiation process is continuing (e.g. while two companies negotiating on how to divide the shares from new technology, the third firm can install the same technology making the previous one obsolete). The market in stability is also important factor since negotiators would try to avoid the risk of the decrease of the value.

The surplus would be split equally if the both negotiators are equally impatient and risk averse. Then the exact partition of the surplus among the negotiators will depend on their degrees of impatience and upon their degrees of the risk aversion. (In case if other factors didn't exist).

Outside options

The outcome of the negotiation also depends on the fact if negotiators have the option to choose another partner to deal with. The outside option can increase bargaining power only if that option is sufficiently attractive for negotiator. Otherwise it will not have influence. From that also follows that negotiator should not allow to be influenced by threats that are not real (another negotiator has no enough attractive outside option)

Inside options

The inside option of the negotiator is the payoff he gets during the negotiations. If the inside option is high enough it can be as an incentive to protract the process of the negotiations since the negotiator would have benefits from doing so.

The ratio of the attractiveness of outside and inside options is also important and influences the outcome of negotiations.

Commitments

Before negotiations start, the negotiators can have made commitments on the bargaining position to the third party. This position is revocable but revoking can be costly choice. The example could be commitments given to shareholders or stakeholders. The commitment tactics sometimes are used as a weapon in negotiations. However, it can increase the bargaining power only if the costs of the revoking for the player, that is using such tactics, are high enough.

Asymmetric information

Knowledge is the power in negotiations – it increases bargaining power of the better informed. Quite often in the bargaining situations one party knows more about the bargaining issue than another does. The situation when one player possesses more information about the factors that another one doesn't have would lead to the inefficient outcomes of the negotiations – disagreements or costly delayed agreements. The outcome also can be that the agreement would not be made even if it was beneficial for both parties.

It follows that important factor is the extent to which the information about the different variables is known to the negotiating parties. The bargaining theory states that if the negotiators knew all abilities of their own and their opponents, then they would avoid the decisions that do not lead to the optimal outcome.

Other factors

Making offers in the negotiations increases bargaining power rather than responding to them. Another factor that can increase bargaining power is a good reputation (well known) of the players. It enables to make more favourable deal rather than those without the reputation. Coalitions also can enhance bargaining power. (Muthoo, 2000).