Norwegian School of Economics

Bergen, Spring 2013

Climate Change mitigation,

A Carbon Tax or an Emissions Trading Scheme?

An analysis of the Norwegian perspective

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Double-Degree Program

Master in Economics and Business Administration

Major Energy Natural Resources and the Environment

ABSTRACT:

Climate Changes are a latent issue which has to be addressed in a correct way in order to mitigate it; to have a Climate policy is important to work against the effects of climate change which have been caused by mankind.

The objective of this Master's thesis is to contribute to the analysis of emissions trading and emissions taxation as climate policy instruments. Hence, the regulations of the European Union emissions trading system (EU-ETS) are presented and analyzed, and then applied to the Norwegian system.

Acknowledgements.

I would like to express my gratitude to my thesis supervisor, guide and role model Gunnar Eskeland, for his interest and orientation, and his willingness to ignite the curiosity on me. Because he not only gave me useful comments and feedback, but he opened his hands to share his time and knowledge, and helped me to reach my goals.

This thesis represents a team-effort; I would like to thank my mother María de Jesús Medina Márquez, my grandmother María Elena Márquez Saliz and Runar Bukkestein Terøy, my boyfriend, for their patience, love and support.

And special thanks to Norunn Johanne Økland, for always being there giving me support and a shoulder to rely on.

Another important persons during the process of writing this thesis: Sebastián Rodríguez, and Josh Elle.

Bergen, Norway. June 2013

TABLE OF CONTENTS:

1. Introduction …… 5

1.1 The Objective of this Master's Thesis …… 8

2. Theoretical Background …….. 9

2.1 Price Policy versus Quantity Policy …… 10
2.1.1 Criteria for the Evaluation of Environmental Policies 12
2.1.2 Price Policy scenario……. 14
2.1.3 Quantity Policy scenario …….. 15
2.1.4 Comparison of Price Policy and Quantity Policy….. 16

3. Norwegian Climate Policy …….. 17

3.1 The Kyoto Protocol ……. 17
3.2 The CO2 Law …….. 21
3.3 The CO2 Tax …….. 22
3.4 Emissions Trading ……. 24

4. European Union (EU) Emissions Trading System …… 26

4.1 Development and History …….. 26
4.2. Directive 2003/87/EC …… 29
4.3. Directive 2009/29/EC ……. 32

5. Norway Emissions Trading System …… 34

5.1. Development and history …….. 35
5.2. The scope of the national emission trading system for 2008-2012. 37
5.3. Norwegian Challenges for the future …….. 39

6. Conclusions …….. 40

6.1 Norway, A Carbon Tax or an Emissions Trading Scheme? ……. 42

7. References …… 43

1. Introduction

One of the main issues of this century is the Climate Change; nowadays the scientists mostly agree on the fact that this Climate Change really occurs and that is a problem we need to solve. Every region in the world is and will be affected in a certain way by climate change, and even if the impact will not be as marked in European countries as it will be in Asia or Africa. (EC1, 2009)

European countries, like Norway are already experimenting the impact of the Climate change, for example Norway is expecting the annual mean temperature to rise by 2.3–4.6 degrees by 2100. And their growing season is also expected to become 1–2 months longer in most lowland areas and 2–4 months longer in most high-mountain areas. In much of the country, the growing season is already 2–3 weeks longer than it was in the 1980s. (Directorate for Nature Management, 2013)

Several changes are already tangible in Norway, as the temperatures are rising on land, freshwater and in the sea; migratory birds are arriving earlier, animals are spawning areas used by fish in the sea are changing. Climate change in Norway is expected to result in an adjustment in all habitat types. (Directorate for Nature Management, 2013)

Based on the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), we can see that it is a fact that mankind has mainly contributed to global warming, and his have been through the increase in anthropogenic greenhouse gas (GHG) concentrations; Scientists approve that an additional increase in harmful GHG emissions would make global warming grow and cause bigger damage to the climate system than experienced so far.

The most important GHC, the Carbon dioxide (CO2), is said to be responsible for a big amount of the temperature increase, being its primary source the emissions of fossil fuels (IPCC, 2007)

GHG concentration needs to be stable, and to achieve it negotiation parties in the political climate discussions agreed on a benchmark on the maximum temperature increase. This benchmark is of two degree Celsius and should not be exceeded; any additional increase can lead to large damages in the climate system. (EC1, 2009)

In order to maintain this benchmark, different policy instruments have been established, and these instruments are eco-political tools to accomplish a lower level of CO2 emissions. One of this policy instruments is the taxation of said emissions, which basically increases the price of emitting them; and that increase in the price steers to a reduction of CO2 emission levels.

Then we have another eco-political tool, which is the emissions trading system (ETS); where the diverse governments set an overall cap on their countries CO2 emissions, and the total emissions allowed in a trading system will be equal to the total number of emission allowances distributed by government. Then, the allowance to emit CO2 emissions are traded on the market, which establishes a market price for emission allowances. (IEA, 2005)

In the Kyoto Protocol, Norway's commitment is to restrict its increase of GHGs to 1% above the 1990 level and they plan to do this by the commitment period 2008–2012

Back in 2003, their total emissions were 9% above the 1990 level, where 99% of Norway's electricity were from CO2-free hydropower. Oil and gas extraction activities contributed 74% to the total increase of CO2 in the period 1990–2003.

The Norwegian government (UNFCCC, 2005)projected a rise in GHG emissions of 15% from 1990 to 2010. (IEA, 2005)The measures and policies adopted after autumn

2008 are not included in the baseline scenario (for example the predicted emissions that would occur without additional policy measures) for this projection.

In contrast, the European Union's (EU) climate change policy is mainly based on the EU-wide ETS; and since the emissions trading is still young and not well known ad a policy instrument, there exists the need for further research which can lead to analyze the effects it might have.

1.1 The Objective of this Master's Thesis

This Master's thesis objective is to contribute to the future investigations of emissions trading and emissions taxation as a climate policy instrument in the Nordic countries, in specific in Norway. Hence, the effects of the Norwegian climate policies are evaluated and compared with the European Union (EU) Emissions Trading System.

The structure of this thesis is organized like as follows: Chapter 2 presents the theoretical economic arguments around the price policy and the quantity policy.
Chapter 3 gives an overview of the Norwegian climate policy as Chapter 4 explains the European Union (EU) Emissions Trading System. Then, Chapter 5 analyzes the situation of Norway in the EU Emissions Trading System, and answers the question of whether Norway can reach its climate policy target, or if Norway actually needs to make modifications, finally presenting the main Norwegian challenges for the future.
The Chapter 6 presents the probability of a bigger use of an hybrid policy between Carbon Tax or an Emissions Trading Scheme? And in Chapter 7 the conclusions are displayed.

The economic theory related to the diverse environmental policies is studied, showing the advantages and disadvantages of both instruments. (CO2 taxation and Emissions trading are compared).

The Norwegian climate policy and the European Union climate policy are compared. Using the EU because is basically based on an Emission Trading System (EU-ETS) and Norway is part of the 2020 goals, we believe it is important to analyze how Norway is approaching to those goals.

2. Theoretical Background

One of the types of negative externality problem is global warming, an externality surges because of the production or the consumption of a specific good where the external effect of this good has no price and also is not compensated by the causer. Because of this, we can see how two of the main conditions of a good-working economy are violated in this case.

The first condition is when prices of goods do not reflect the real costs; and the second condition is when the utility of a single individual is not independent of activities which are carried out by other individuals. Basically, the market fails to allocate resources in an efficient way (Helbling, 2012)

Then, we can see that the Coase theorem basically assumes that individuals can solve an externality problem by negotiating the efficient allocation of the resources, without having governmental intervention. To do so, they need to keep the transaction costs, so this do not arise and the property rights of resources have to be clearly defined (Kolstad, 2000)

But in reality these assumptions are not considered to be realistic. Then, government has to have certain degree of intervention as soon as a negative externality occurs, when individuals are not able to solve the problem on their own (Kolstad, 2000)

There are several ways to correct such a negative externality being one of them to implement the polluter pay principle by defining prices for the external effect of these goods, but also having the choice of implement orders, standards or restrictions.

2.1 Price Policy versus Quantity Policy

The consumption of fossil fuels is an example of a negative external effect; when said fossil fuels are burned, CO2 emissions take place, which produce negative externality because they damage the environment and this is not compensated by the consumer. However, the consumers and producers do not consider the costs and therefore there is an overproduction of emissions, which gets a level of non-optimal

One of the ways to control this is when the government introduces a price for the emissions, or a limit of the quantity of emissions permitted. Also, the government can have a price policy, which is basically an emission tax.
In comparison, the quantity policy normally takes the form of a cap-and-trade system (Pizer1, 1999)

According to Mankiw (1998), the marginal emission costs are the ones acquired to reduce an additional unit of emissions. The marginal abatement costs curve displays a negative deviation which demonstrates that when the emission level is high, the costs to reduce one unit of emissions are relatively low. In contrast, if the emission level is already low, the costs for a further reduction are higher. (Mankiw, 1988)

We then can see that, it does not matter how the first policy instruments are fixed, there will be a corresponding response to set the other policy instruments to reach the same results.

But, as Weitzman (1974) said, the identity between the two policies is only true if complete knowledge about costs and perfect certainty about the future happens (Weitzman, 1974).

The marginal abatement costs in reality are unclear, because the information and knowledge about costs in the future is uncertain, which means that these contrary policies will lead to distinct results and hence, different welfare effects.

2.1.1 Criteria for the Evaluation of Environmental Policies

In this section, the policy instruments are explained in a detailed way, founded in the ground of six diverse evaluation criteria, based in the Stephan and Ahlheim (1996). (Stephan, 1996)

The first criterion we present is the transaction costs; these costs are the ones which emerge from the implementation of a new policy, (for example, formulation of new targets, realization or vigilance of implemented laws). With this criterion we can evaluate the effort made for consumers and producers to procure information concerning the diverse policies.

The second criterion, ecological accuracy, is the one which evaluates if a certain level of emissions can be achieved with the given policy or not; this criterion looks to answer if the policy is able to reach certain levels of emission, or it cannot be fixed.

Then, Economic efficiency*, which* refers to reaching a target with the smallest costs possible (only the cheapest abatement reductions are undertaken) and the level of emission is actually reduced if the marginal abatement costs are below the marginal utility.

Other criterion is the allocation effect, this concept implies that each governmental intervention has an effect on income. And it is feasible to absorb the allocation effect through redistribution of the tax revenue, or adding another forms of compensation for the individuals affected negatively.

The acceptability of a policy is based in two different agents who are affected in a different way through a policy. These agents are consumers and producers.

The consumers usually have opposition to new policies, while consumers depend in a direct way on the policy configuration; and the acceptance by both of these agents is crucial to gain political approval.

And then, we have incentive for innovation and investment, which means that a given policy should give strong incentives to improve technologies and also should finance research and development of new technologies.

2.1.2 Price Policy scenario.

A fixed price incentive needs to be created when implementing a price policy; this setting steers to a price ceiling of the policy, and no strict limits on the levels of emission are guaranteed, which brings uncertainty.

If the price established by the government is low, the people will be agreeable to pay the price because the marginal abatement costs of CO2 emissions are higher when compared to the emission price. Hence, it is cheaper not to abate CO2 emissions and pay the price, which leads to a higher emission levels.

According to Pizer (Pizer1, 1999)this argument also applies for the opposite situation. If the price for CO2 emissions is staggering, the abatement activities then will be cost effective and opposed to the payment of the tax, which will steer to an undercut of a specified emission level.

Only the cheap reductions are taken, and this means that a price policy is economically efficient, even thought the ecological accuracy won't be reached because the levels of emission are not clear. (Pizer1, 1999) (Pizer2, 2002)

If the revenue flows to the government, a tax policy will be generally opposed by the consumers. (Pizer1, 1999) On the contrary, the producers have the possibility of giving prices on the consumer without increasing their own cost.

According with the United Nations Development Program (UNDP)a price policy gives strong incentives for innovation and also for investment; through the elevated price a permanent incentive will be given to invest and more efficient and competitive technologies. (UNDP, 2006)

2.1.3 Quantity Policy scenario.

The quantity policy can be defined as an efficient market-based mechanism; this policy evaluates what the price policy is not able to do so a limitation of the levels of emission.

In this scenario, the total of CO2 emissions allowed will be equal to amount of emissions allowances under a “cape-and-trade” system; this allowance enables the emission of certain amounts of CO2.

Nevertheless, the cost to achieve the levels of emission are not clear; prices are built into market depending on the supply and demand emission allowances, which means that the prices are volatile and individuals can buy and sell emission allowances to reduce their costs.

Then, if the participants reduce their CO2 emissions cost to a lower level than the market price, they will probably sell their emission allowances; even thought the participants who have high marginal abatement costs might buy emissions allowances instead of taking the effort and risks by themselves.

According to (Pizer1, 1999)the quantity policy accomplish ecological accuracy but it cannot give a fixed price incentive for abatement activities. Adding that the system is controlled through prices which means that the economic efficiency is given (Pizer1, 1999); (Pizer, 1997)

Then, the levels of acceptance of a quantity price rely on the allocation of the emission allowances, which can be in a free distribution scheme or an auction.

The government will get the same revenue if the emission allowances are auctioned or if they implement a tax policy, nevertheless the producers expect that the emission allowances can be distributed for free, paying only for additional allowances. (Pizer1, 1999)

Then, two aspects to evaluate the transaction costs have to be considered; the government has high transaction costs (because of implementation and regulation of the "cap-and-trade" system (Tom Tietenberg) but these costs can be lowered if they introduce said system on the international arena because the "cap-and-trade" has a regressive allocation effect. (Pizer1, 1999)

2.1.4 Contrast of Price Policy and Quantity Policy

According to Weitzman, the main difference between these policies comes from how the price is calculated. (Weitzman, 1974)

In the tax policy scenario, the government sets the price and on the contrary, in the quantity policy scenario, the government defines the amount of emission allowences and the price they will get on the market. Both of these policies are cost efficient because they undertake only the cheapest reductions. (Pizer1, 1999)

3. Norwegian Climate Policy

Norway has an important paper into the mitigation fight against climate change; they have been leading the international scenarios since the relation between Climate Change and the development of human activities and threatening lives on the earth.

Norway is one of those countries that are on the top of the lists of commitment to limit the change of temperature to up to 2 degree Celsius. And according to Larsen and Bruvoll (2003), despite the international binding agreements, Norway is a pioneer in adopting economic instruments to reduce emission.

This can be exemplified with the fact that Norway was the first country that implemented the Carbon tax for the energy intensive industry in 1991 and this implementation has helped to mitigate greenhouse gas emissions in millions of tons. (Bruvoll, 2003)

3.1 The Kyoto Protocol

The Kyoto Protocol is an international agreement which is linked to the United Nations Framework Convention where the industrialized countries agreed to a binding limitation of GHG emissions. (UN, 2013)

The Kyoto Protocol has set Norway's emissions target at one percent over 1990 levels for the first commitment period (2008–2012), but at the same time it allowed it to exceed the target if Norway purchases additional quotas from other countries.

Then, articles 17 and 6 from the Kyoto Protocol Agreement declare that these purchase of abroad quotas must be seen only as "supplemental to domestic actions"; then the regulatory framework established in Marrakech added that the domestic

actions need to be a “significant” element of the efforts taken by a country to achieve their targets. (UN, 2013)

According to Andreas Tjernshaugen (2002), the European Union proposed to put a ceiling on the amount of quotas that each country could purchase from abroad, but this proposition was rejected. The Norwegian government have also rejected this proposals, but at the same time has supported that the buying of quotas from abroad should be consider as a supplement to domestic efforts. (Tjernshaugen, 2002)

In the Figure 1 (SN, 2013), we can see the emissions of greenhouse gases and its per cents changes. This table shows that 52.9 million tonnes of greenhouse gases were emitted from Norwegian territory in 2012, which represents 0.4 million tonnes, or 0.8 per cent, less than in 2011. Then, the 2009 emissions are the lowest since 1995 (they were reduced because of low economic activity).

The emissions per NOK produced (fixed prices), known as emission intensity, continued to drop. The year 2012 saw both a higher activity level in the Norwegian economy and a decline in greenhouse gas emissions, and said emissions were 5.1% higher than in 1990.

Emissions of greenhouse gases. Preliminary figures. Million CO2 equivalents [1]

	2012	Change in per cent	
		Since 1990	2011 - 2012
Emissions from Norwegian territory	*52.9	*5.1	*-0.8
Oil and gas extraction	*13.7	*76.7	*0.5
Manufacturing industries and mining	*11.8	*-38.2	*0.4
Energy supply	*1.6	*393.5	*-24.1
Heating in other industries and households	*1.4	*-46.7	*-11.2
Road traffic	*10.1	*30.1	*0.4
Aviation, navigation, fishing, motor equip. etc.	*7.4	*30.6	*0.9
Agriculture	*4.5	*-10.3	*-0.2
Other	*2.5	*14.6	*1.1

[1] Does not include international sea and air traffic.

Figure 1. Emissions of greenhouse gases. Preliminary figures. Million CO2 equivalents (SN, 2013)

The Norwegian Pollution Control Authority (SFT) calculated in their latest projections that without new climate measures the annual emissions of Norway would exceed its Kyoto target by up to 9 million metric tons, or by 13 million metric tons if the three planned gas-fired power plants are constructed. (Tjernshaugen, 2002)

These cost estimates suggest that if the firms are free to choose the cheapest alternative, then the process of purchasing quotas from abroad may take an important part of the Norwegian mitigation efforts; according to SFT, the measures that cost less than 50 NOK per metric ton will result in a reduction of under 3 million metric tons. Then, compared with the reality, this gap must be covered by measures or quota purchases which somewhat will be bigger than suggested above.

The Norwegian authorities had to clarify how they are interpreting the supplementarity clause of the Kyoto protocol, since their purchase from abroad makes up more than half of their mitigation effort. (Tjernshaugen, 2002)

The Norwegian firms are interpreting the clause of buying from a broad too widely, Norway should be giving a more strict understanding and try to set a ceiling of how many quotas they should actually be able to buy from abroad; this would help them to increase the quota price on the Norwegian market.

In fact, the pricing for emission quotas in the international market (under the Kyoto protocol) is expected to be lower than the current Norwegian carbon taxes on gasoline and emissions from the petroleum industry; basically this means that it can be cheaper for the Norwegian firms to pollute. (Tjernshaugen, 2002)

3.2 The CO2 Quota System

From the beginning, the main policy instrument to reduce greenhouse gas emissions in Norway was the taxation system, with a smaller participation of voluntary agreements and licensing. Since 1999 Norway implemented these CO2 taxes and by 1999 these cover about 65 % of the total CO2 emissions at varying rates. (Stiansen, 1999)

The OECD, in 1999 recommended to Norway to get a bigger coverage than the existant taxation system, including “as many sectors as possible”, the OECD also mentioned that it was going to be a challenge to allocate the use of quotas, and the decision of auction quotas or give them for free had to be a political matter.

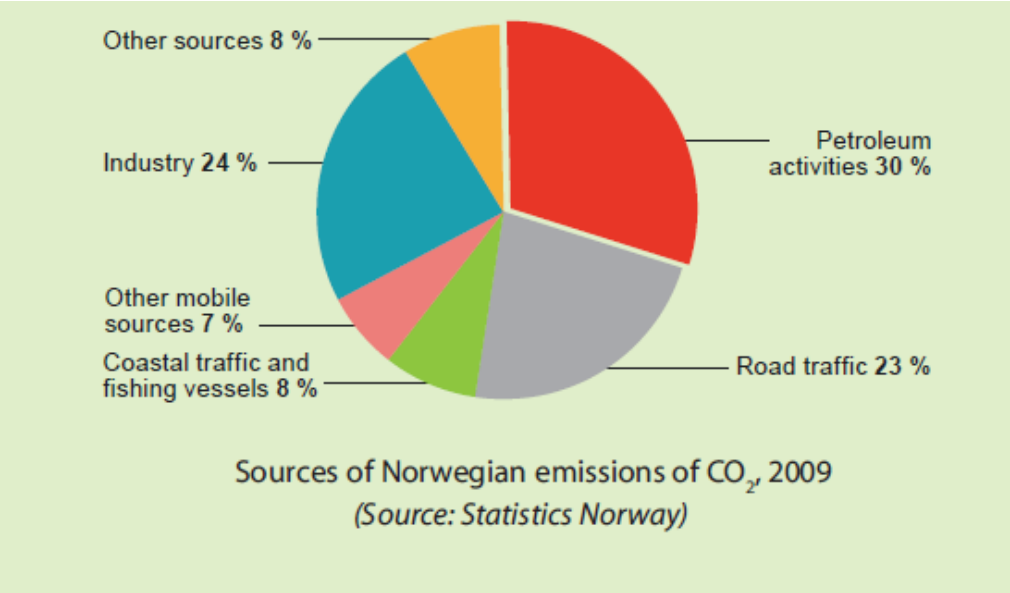

Figure 2. Sources of Norwegian emissions of CO2 in 2009. (SN, 2013)

In a later stage, Reuters recoded that Norway was ready to adopt a carbon dioxide (CO2) quota trading system for the period of 2008-2012 in which the overall burden on industry would be the same as with schemes they already had. This quota system was planned to cover more than 40% of the emissions coming mainly from energy

production, oil refining, metallurgic sector, work industries and fisheries, as showed in the Figure 2.

And being a non-European Union country, Norway decided that the European Union's emissions quota directives would actually became valid in Norway, with certain differences adapted to the Norwegian system. (Reuters, 2007)

Presently, about 70 % of Norwegian emissions are either covered by the emissions trading scheme or subject to a CO2 tax. (RYEK, 2013)

3.3 The CO2 Tax

Something interesting about the Norwegian taxation system is that, the CO2 taxes are highly diversified .This means that, the average CO2 tax vary within sectors, depending of the diversity of the taxation rates, the utilization of fossil commodities and the use of those commodities (in stationary, mobile or process purposes). (Bruvoll & Dalen, 2009)

In Norway, the CO2 taxes were implemented in 1991; these taxes on mainland activities are still levied on the utilization of mineral oils and petrol; and in the offshore area they are levied on the burning petroleum and natural gas.

Back in 2005, a new system for trading with CO2 emission permits was introduced, and it included the offshore sector, having a reduction of the CO2 taxes equivalent to the price on permission permits, but still in 2006 the quota system was restricted to only 42 Norwegian companies. (Bruvoll & Dalen, 2009)

As in most of the cases, the levels of greenhouse gas taxes in Norway are diversified depending on the sources of the emissions, the different types of gases and also which parts of the economy system are causing the emissions.

With this variations, the marginal cost of reducing emissions has several changes, for example in 2008, the CO2 taxes were in between cero and 345 Norwegian krone (NOK) per tone of CO2. (Bruvoll & Dalen, 2009)

The CO2 taxes are controlled by the high taxes on emissions that come from the oil industry and the transportation, and also by the tax exemptions from the process industry.

These CO2 taxes are collected on the mineral oils and petrol rather than on the actual emissions, showing a relationship which is fixed, between the use of fossil fuels and the emissions, with no carbon capture. (Bruvoll & Dalen, 2009)

Bruvoll and Dalen (2009)mention that the Norwegian CO2 taxes are actually regulated by two different laws (which are the *Act concerning sales tax* and *Act relating to CO2 tax in the petroleum activity on the continental shelf*). But also, they count with taxes on emissions of the greenhouse gases liberated by methane from waste disposal, HFC and PFC.

3.4 Emissions Trading

Norway has had an emissions trading scheme in operation since January 1st 2005, exactly like the European Union. The main goal of the Norwegian government is to make their own scheme the first to link up to the EU. (EI, 2008)

The Norwegian scheme is supposed to be compatible with the European Union-ETS, Norway chooses to use the same cap-and-trade form, and at the beginning they only covered the CO2 emissions from the same sectors as the EU.

The Norwegian scheme covers energy installations which were not covered by its CO2 tax and this includes gas powered plants, oil refineries, iron and steel producers and the cement, glass, lime and ceramics sectors. (EI, 2008)

There are some significant exemptions from scheme participation with the offshore sector, which is actually responsible for 28% of Norwegian CO2 emissions), and also with the pulp and paper sector.

A small part of the Norwegian process industry is included in the scheme, and around only 10 per cent of Norwegian greenhouse emissions are covered. Which can be compared with the 38% of the EU's emissions which are covered by its trading scheme. (EI, 2008)

Avoiding the use of permit obligations, the Federation of Norwegian Process Industries became part of a non-binding arrangement with the Ministry of the Environment and it agreed to reduce emissions voluntarily.

And actually at the time, the offshore sector wanted to be included in the scheme but the government decided not to permit them to participate, being the main reason for their non-inclusion the fact that the offshore installations are already covered by the CO2 tax and the government was very reluctant to see this revenue lost. (EI, 2008)

As mentioned before, the Norwegian target inside the Kyoto protocol is to limit the growth of their greenhouse gas emissions to 1% above their 1990 level during the first commitment period.

Norway actually emitted 52.1Mt of CO2e in 1990 and that means that it cannot emit a 52.6Mt on average in the 2008-2012 period. And still, Norway is expected to overrun their limit and to emit around 65Mt in 2010. Then we see that, according to the Norwegian Ministry of Environment, the Norwegian ETS will yield somewhere between 500,000 and one million tonnes in reductions annually. (EI, 2008)

These said reductions are the tryouts to cover less than 10% of the gap which relies between the Kyoto target levels and their estimated emissions through trading.
But the key point of reduction might reside in the decision of not including the offshore sector, as we said before, could be a milestone since it could reduce 12.5Mt annually if they actually purchased that amount from abroad; and that decision could help to reach Kyoto's target. (EI, 2008)

From the European Union's perspective, the design that Norway choose to structure their ETS is not significant in terms of size and even compared with market relevance to the EU.

This scheme is not expected to make a significant contribution as Norway struggles to meet its Kyoto target, even thought the access that the Norwegian companies will get to a larger and liquid market (EU-ETS) represents a big step to the Norwegian companies development.

4. European Union (EU) Emissions Trading System

Back in 2007, the European Union committed itself to reduce its CO2 emissions to at least 20% by the year 2020, compared with the level of 1990. And this policy is not about which action every countries take, but about meeting the goal.
The EU-ETS is the base of the European climate policy to reach the reduction target and also to work under the Kyoto Protocol (EC2, 2009)

4.1 Development and History

The biggest market for emission allowances is the EU-ETS, and it makes the EU the world leader in this field. The EU-ETS was established through the Directive 2003/87/EC and it entered into force in October 2003.

The first phase of the trading system started in January 2005, and then they had a three-year-phase from 2005 to 2007 which was a start-up phase to gain experience with the trading of emissions. Later, after the start-up period, a five-year-phase from 2008 to 2012 was started and approximately 11,500 installations12 from all 25 EU countries13 were included in this first phase. At that time, they accounted for 45 per cent of all European CO2 emissions. EU-ETS included large emitters from the power and heat generation industry and energy-intensive industries (for example combustion plants, oil refineries, coke ovens, iron and steel producers and the cement, lime, brick, ceramic, pulp and paper industry) (EC, 2005)

The installations comprised in the EU-ETS have to hold emission allowances equal to their emission output, which means that one emission allowance represents the right to emit one tonne of CO2, and the allocation of emission allowances is in the

responsibility of each of the member state. These allocations are mostly free of charge and only a small part of total emission allowances was auctioned.
Then in the first trading period, at least 95% of the allowances had to be allocated free of charge, because in fact, most member states did not auction the emission allowances but distributed all of the emission allowances for free.

Then in the second trading period, the cost-free allocation had to be at least 90% of total allowances. In reality, only four countries used auctions to sell a small part of emissions allowances (EC, 2005) (EC2, 2009)

Said allocations are recorded in a country's national allocation plan (NAP), which should be consistent with a country's Kyoto target; thence, the total amount of emission allowances allocated plays a key role.

The EU-ETS is based on six fundamental principles. The first of them is a pure cap-and-trade system; the second of them is the initial focus which lies on CO2 emissions from big industrial emitters. Third, the implementation of the trading system takes place in different phases, and due to this application the opportunity to change and improve the system is given. The fourth principle, the allocation plans of the EU countries are remade for each period. Fifth, compliance is monitored in a strong way and sanctions are hard. And the last one, the CO2 emission allowance market is EU-wide and it is linked with the rest of the world through acknowledgment of emission reduction projects from abroad and possible linkages with compatible trading systems from other countries (EC, 2005)

The price for emission allowances increased rapidly when the start-up phase was launched. The power sector immediately started buying emission allowances for covering their emissions, while other players did not yet sell their surplus allowances. This development created an artificial scarcity increasing the price of emission allowances to 30 Euros in March 2006.

In April 2006, the European Commission released the information about the emission data from 2005 for all the installations included in the EU-ETS.
The data record showed that a surplus of emission allowances was allocated and essentially no scarcity existed.

The national allocation plans were too close to the current emissions, and even in some cases they were above the actual emission level. Hence, the price of emission allowances declined quickly and converged to zero by the half of 2007. The over-allocation of emission allowances is often referred to as the collapse of the EU-ETS (Convery F., 2008)

Then, after the start-up phase, a five-year period (2008-2012) started in accordance with the Kyoto period, and, due to the price collapse in the previous period, the allowance prices of the first and the second trading period were completely disconnected. The allowance price of the second period was steady in a relative way, which reflected a real abatement target and with a stricter view of the European Commission when reviewing the NAPs for the second trading period (Convery F., 2008)

4.2. Directive 2003/87/EC

This directive started to be in force since 2003 and it is one of the main underlying legal obligations of the EU-ETS.

The importance of this directive relies in the establishment a system for GHG emissions trading within the European countries. Where the goal of the EU-ETS is the reduction of GHG emissions in a cost effective and economically efficient way. (EC4, 2003)

This directive covers diverse activities, from the production of energy, metal, cement, glass, ceramics, synthetics and paper. An actually, the type of activity is the constant that creates the first criterion for the addition of an installation into the EU-ETS. Then, the second criterion is the definition of a capacity threshold, which basically represens the amount of a combustion unit for fossil fuels in an installation.

The installations that have a combustion capacity over the threshold are included in the EU-ETS regardless what type of activity they perform. And this said threshold is defined as the total rated thermal input of 20 megawatt (MW). (EC4, 2003)

The output of the emissions can only be a derivation from the combustion capacity, and this is because it depends on the effectiveness of a combustion unit but also because it depends on the type of fossil fuel used.

There are several different emissions (GHGs), which include Carbon dioxide (CO2), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. (EC4, 2003) But even thought the list of GHGs is not small, the main focus of the Kyoto protocol is the CO2 emission levels.

Every state member of the EU has to create a NAP, in that way all the installations with their corresponding number of emission allowances are listed. But first, the

European Commission has to verify the NAP of each and every one of the countries country and in addition has the right to reject the plan or certain parts of it. (EC4, 2003)

Then, the total amount of emission allowances to be distributed should be consistent with the actual country's compromises with the Kyoto protocol and their own national climate change programs. Basically, the NAP should be constant with the technological development of activities and should not make any degrees of discrimination between companies and sectors. (EC4, 2003)

The allocation established has to be free of charge for at least 95% of emission allowances in the first part of the trading period and then for at least 90% on the second trading period. (EC4, 2003)

Something interesting about these emission allowances is that they are only valid for one particular trading period. Which means that the emission allowances that were issued for the first trading period from 2005 to 2007 are only valid in these three years. And basically, the emission allowances that are not used in their current period of establishment are canceled at the end of the period; but they do not disappear in a total way, they are replaced by another emission allowances that are issued for the subsequent trading periods (EC4, 2003)

This procedure is also known as "banking of emission allowances", and in the case that the emissions of an installation are not covered by emission allowances previously established, an excess emissions penalty must be paid. Said penalty is already fixed, and it is 40 Euros for each tone of excess emissions in the start-up phase and it raises to 100 Euros in the following periods. (EC4, 2003)
This system is flexible, because under the directive an unilateral inclusion or exclusion of determined installations is allowed. And the type of activities and GHGs that are not listed on this directive, and even installations with a quantity of emission output below the capacity can be included into the EUETS; if the European Commission accepts this changes with specific countries (EC4, 2003)

In the contrary, there are certain installations that can be temporally excluded from the trading system, but the possibility for that exclusion is just granted for the start-up period (EC4, 2003)and this kind of procedures are named opt-in and opt out.

This directive, in its article 25, establishes the opportunity of linking the EU-ETS with another GHG trading systems to supply with mutual recognition of the emission allowances between the diverse systems; and in fact, that kind of link would increase the cost-effectiveness of the EU-ETS, but this is restricted to the countries that have ratified the protocol and that are part of the Annex B. (Nations)And this is relevant to this thesis because Norway is part of the Annex B of the Kyoto protocol list of countries. Another main point of this directive is that the EU-ETS should only be a part of a package of policies and measures leading to a decrease of emissions. This means that other policies should be implemented on the internal level of each country (EC4, 2003)and it is also written that the instrument of taxation that may be used to reduce emissions from the installations and production processes is actually not part of the EU-ETS (EC4, 2003)

This point is one of the milestones for this thesis, because understanding that every country should have their own local regulations to reduce emissions, we can apply the EU directive to the Norwegian system, taking into consideration the Norwegian CO2 taxation system.

4.3. Directive 2009/29/EC

In June 2009, the directive 2009/29/EC, entered in force, this directive is in fact an amendment of the directive 2003/87/EC, and it is being applied with the start of the third trading period in January 2013.

The apparent inefficiencies of the EU-ETS in the start-up phase lead to many changes and improvements. The most important of these changes was made with the inclusion of new sectors and new gases into the EU-ETS.

With the new sectors, the production of petrochemicals, ammonia and aluminum was included, as well as the another activities like aviation. (EC3, 2009)

These activities were included because, in their production processes they include CO2, and this needed to be covered in EU-ETS, for example nitrous oxide and perfluorocarbons.

Then, thanks to the wider scope in the third trading period, approximately 50% of all European CO2 emissions got covered in the EU-ETS. Knowing that these emissions need to be reduced by 21 % in 2020 compared to the level of 2005 (EC3, 2009)

The emission allowances have to be reduced each year for this purpose, these reduction has to be by the linear factor of 1.74% when compared to the average annual total quantity of emission allowances for the period from 2008 to 2012 (EC3, 2009)

A difference of this period is the fact that the allocation of emission allowances will be auctioned for the most part. But then again, there are exceptions and special cases.

For example, full auctioning is the rule for the power and electricity sector; and for the energy intensive sectors (which are at a high risk of relocating their production to countries with weaker environmental policies) they can obtain their emission allowances predominantly for free.

And this distribution method is based on the definition of benchmarks. And this means that, if any of the installations is bellow the previously specified benchmarks, he installation will receive free emission allowances. (EC3, 2009)

5. Norway's Emissions Trading System

The framework necessary for the allocation of the installations which are obliged to surrender emission allowances under the emissions trading scheme are set out by the Norwegian National Allocation Plan (NAP). (Regjeringen)

The Norwegian emission trading system (ETS) covers over 40 % of the greenhouse gas emissions from the diverse Norwegian sources, and therefore it has become an important part of the Norwegian efforts to ensure compliance with the Kyoto Protocol.

The allocation of allowances process is really important, and its principles for allocation give incentives for emission reductions, and also they enable a higher level of costeff-ectiveness across different sectors. Some allowances will be allocated free of charge to existing installations, but actually more than half of the whole amount of allowances could be sold at market conditions. (Regjeringen)

The period between 2008-2012 consisted of an allocation free for trading, and this allocation had to be calculated based on the historical emissions of the prior stage between 1998-2001.

The main governmental position was that no business shall rely upon allocation free of charge post 2012. (Regjeringen)

5.1. Development and history.

The joint Committee of the European Economic Area agreed to incorporate the Emissions Trading Directive 2003/87/EC on 26 October 2007, and also they added several new implementations for provisions into the Agreement on the European Economic Area (EEA). (Regjeringen)

In this decision entered unto force when it was approved by the EFTA/EEA states Iceland, Liechtenstein and Norway. And according to the directive 2003/87/EF dated on the 13 of October 2003, it has been applied in the facts that Norway must develop a National Allocation Plan. (Regjeringen)

The Norwegian National Allocation Plan, settled down the framework for the allocation of the diverse allowances to the installations that where obligated to surrender their emission allowances under the emissions trading system, and this reflected the provisions made by the EEA legislation and its application through the Norwegian laws and regulation system.

The NAP had to be approved by the EFTA Surveillance Authority (ESA) before Norwegian installations could transfer their allowances between accounts in the European emissions trading system. (Regjeringen)

The Norwegian government in its hard work to reduce the greenhouse gas emissions, considers that the emission trading system is an important tool; hence, the Norwegian greenhouse gas emission trading act entered into force on 1 January 2005 and the amendments from to the period 2008-2012 entered into force 1 July 2007. Said amendments were assigned to make the law consistent with the Directive's provisions for 2008-2012. They indeed extend the scope of their trading scheme and they also defined the framework for allocation of allowances.

The Norwegian emission trading system (ETS) is planned to cover more than 35 % of the greenhouse gas emissions coming from Norwegian sources, and then the goal is to become a vital part of the Norwegian efforts to ensure compliance with the Kyoto Protocol. (Regjeringen)

The principles used for allocation are giving incentives to reduce emissios, prmoting a system of cost-effectve development across the diverse sectors. Their aim is that, the total quantity of allowances will not exceed 15 Mt/year when compared to an emission level of around 18 Mt for the trading sector in 2005 and they also presented a projection of around 21 Mt in 2010.

As said before, some allowances were allocated free of charge to the existing installations, but in fact, more than half of the total amount could be sold at market conditions. And, the units from the project based Kyoto mechanisms as joint implementation and the clean development mechanism could be used up to a level of 3 Mt as an annual average, based on 20 % of the total quantity of allowances.

And for the most recent stage, the period between 2008-2012, the allocation free of charge was calculated based on the prior installations' historical emissions in the period 1998-2001. (Regjeringen)

As said before, the government's position was that no business shall rely upon allocation free of charge post the period of 2012, but this situation is still being considered.
The period between 2005-2007 was used as a test period, and various of the elements of the trading system were implemented and tried before the first commitment period under the actual Kyoto protocol. It was clear that Norway established an optimal system of functioning procedures for the application and distribution of permits and allowances, and also to monitor and report their work.

5.2. The scope of the national emission trading system for 2008-2012

The 2008-2012 scope reflected the industrial structure built over the years in particular on natural resources of hydro power, oil and natural gas. When we can see that two thirds of the European Union system covers mainland production of electricity and heat, in contrast the Norwegian emissions from such categories are relatively small.

Which means that the emissions from other industrial sources which are more dominant in the European Union have a bigger dominancy compared to other parts of Europe. (Regjeringen)

Norway included the petroleum sector in 2008, which represents around 60 % of the emissions covered by the scheme. On the mainland, the system had to at least cover combustion installations and also district heating systems.

These last elements actually represent a slight amount of the Norwegian energy mix, and some of these installations were already included in the 2005-2007 system. (Regjeringen)

The power plant Naturkraft (at Kårstø) and the plant of Statoil (at Mongstad) were included in the plan previous their actual construction and their ignition of operations. Then the pulp and paper industry was included in 2008, with 20 installations, taking into consideration that the emissions from energy combustion in production of fishmeal and oil also entered but with less than 8 installations. (Regjeringen)

With all these examples we can see that the government wanted the emission trading system to be as broad in scope as practically possible, taking into account both greenhouse gases emission and the diverse activities.

The Norwegian government is actually thinking about the possibilities for including emissions from other kind of energy intensive industries in the ETS, for example emissions of CO2 and PFCs from the production of aluminum.

But these are process that are related to the emissions, not necessarily in a direct way. Anyways, other countries had done this kind of integration before, and for Norway to do so it only requires to develop a separated MRG and to be accepted by the ESA. (Regjeringen)

5.3. Norwegian Challenges for the future.

Norway has had a not so difficult story of development and adjustment into the Kyoto protocol and the reduction of emissions.
The main long term targets that Norway is facing are:

* Reduce their global greenhouse gas emissions by the equivalent of 30 % of its own 1990 emissions by 2020.
* Be carbon neutral by 2050; serving as a driving force in the efforts to develop a comprehensive international agreement on climate change after the first Kyoto commitment period. Norway has to take responsibility for reducing their global greenhouse gas emissions by the equivalent of 100 % by 2050.

Which means that the emissions from Norwegian territory will be neutralized by emission reductions Norway pays for in other countries, and through emissions trading or other mechanisms that become available. (NME, 2006-2007)

Several problems are linked with the climate change, and they are serious and based in long-term basis; Norway will need to keep a global consensus when considering their targets.
Some simpler challenges will be to keep the understanding of the social environment and constraints, also to learn more about the instruments to introduce new technologies and to implement their climate policy in an international perspective.

Norway is a rich developed country, who has found to have a social responsibility and a global understanding of the environment, and who seems to know the problems that climate change will bring if not mitigated on time, hence Norway knows about the social consequences of climate change, such vulnerability and adaptation to climate change.

6. Conclussions

Global warming and climate change issues are not a new subject; In the last few decades these subjects have been discussed in order to mitigate their effects.
Hence, in order to prevent a higher level of damages in a collaborative and global focus, the Kyoto Protocol was introduced to the countries in order to mitigate their emissions and to be more accountable for their share of the global crisis.

To achieve this goals, two main policies were discussed; the carbon Tax and the introduction of an Emissions Trading Scheme (trading with quotas). Norway took part from the beginning, implementing taxation in the CO2 emissions, but then, with the closer development of the Kyoto protocol, Norway has been adapting itself to the diverse stages that it implies, which means that Norway adapted a system of ETS.

It is clear that there exist several studies about the effectiveness of these policies in other countries and even made by the main system of the European Union, but it is also understandable that even if the research question might be basically the same, every researcher provides with different discoveries, because of the use of diverse information, theories and personal mindset, so we believe that every study on this field is important.

There is also visible that in the mind of most politicians and in the researcher's mind, the environmental issues that the climate change is providing need to be analyzed and fixed as soon as it is possible. With this thesis we saw that more policies should be legislated in order to manage and regulate the individuals and the businesses behavior to decrease the quantity of the emissions.

This thesis mentions the general policy instruments, which are a central element of the system. We saw that when Norway joined to the EU-ETS, around 70% of its domestic emissions were covered by their own ETS or CO2 their taxation

With the analysis of the directives, we emphasize that certain sources of emissions cannot be incorporated into the ETS or the CO2 tax, but that it is not impossible to manage it, because the specific country authorities are the ones who should use

In such cases, the authorities must use other instruments to reduce greenhouse gas emissions.

In most of the government's points of view, that specific regulation as a rule should be avoided in the areas that are already regulated by general policy instruments; but at the same time, the governments want to keep the probabilities of using another policy instruments in addition to the ones already established
In this case, we see that the government will use economic incentives to promote the development of new technologies to create new licenses.
This thesis demonstrated that global warming is part of anthropogenic greenhouse gas emissions, and this is the greatest environmental problem facing the world community today.
And for example, several changes are already tangible in Norway, as the temperatures are rising. (Regjeringen)

6.1. Norway, A Carbon Tax or an Emissions Trading Scheme?

As we have seen in the development of this thesis, Norway has been a pioneer about the climate change mitigation, since their early implementation of a taxation policy to their adaptation of the Kyoto protocol.

Norway seems to be working in the right way, the reduction of emissions is something that cannot be done from one day to another, and the results that Norway is getting are satisfactory.

In my personal opinion, Norway is still not 100% ready to work in a more intensive way, and its mitigation policies are still in a growth development, making a fusion between Carbon Taxation and Quotas trading; basically Norway is still building a system of an “hybrid policy” with a mix of the European Union standards, the Kyoto protocol expectative and their own national goals, rules and limitations.

And this “hybrid policy” will help them to achieve their Kyoto protocol goals but also they will be seen as an example of an effective adaptation and implementation of the emission reduction tools, and because of their genuine interest in the human development and the protection of the natural resources and the environment.

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