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The inclusion of aviation in the EU ETS and its relevance for international aviation

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List of abbreviations

ACI	Airport Council International
APU	Auxiliary Power Unit
CAEP	Committee on Aviation Environmental Protection
EC	European Commission
ECSC	European Coal and Steel Community
EEA	European Economic Area
ETS	Emission Trading System
EU	European Union
GHG	Greenhouse Gas
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICSA	International Coalition for Sustainable Aviation
IPCC	International Panel on Climate Change
KP	Kyoto Protocol
NAP	National Allocation Plan
NGO	Non-governmental organisation
RF	Radiative Forcing
SARP	Standards and Recommended Practice
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

From 2012 onwards the aviation sector will be part of the Emission Trading System (ETS) of the European Union (EU) which was introduced in 2005.

The main aim of the EU ETS is to reduce greenhouse gas emissions by means of a trading system. Firstly, a cap for the emissions of every participant is determined. After one year each participant must submit enough allowances covering its emission. Excessive allowances can be purchased by the emitter whereas missing ones need to be bought by the concerned participant. The environmental purpose behind it is that due to scarcity in the market and a lowered cap over time the emitters will reduce their emissions.

However, since the aviation sector is globally operating the EU and other countries aim at finding also an international solution for the regulation of aviation emissions. Considering the worldwide continually increasing growth rates of this sector it also seems to get more and more urgent. But taking into account the different interests of states and the value they ascribe to reducing greenhouse gas emissions this might be a rather difficult task.

On the international scene the Kyoto Protocol (KP) has been a very important step towards combating climate change. It also comprises rules for domestic aviation emissions up to a certain extent. Moreover the Chicago Convention held in 1944 aimed at regulating the aviation sector and setting limits for its emissions. In cooperation with the International Civil Aviation Association (ICAO) these tasks should be realised.

The international character of the business necessitates a framework with common rules and regulations for all participants to follow.

The proposed bachelor thesis will focus on the specific characteristics of the EU ETS especially for the aviation sector. The objective will be to see '**if**' the framework of the ETS is transferable to the international level. It will not approach '**how**' this could be done since that would be too extensive.

The main findings with regard to the 'if' are that the applicability is good with regard to the air operators as trading entity, the cap and trade trading principle, the assessment basis and the allocation method. Concerning the responsible entity for emission rights and the type of system there need to be some more considerations made.

The main research question leading to this results reads as follows:

'To what extent does the EU ETS serve as a model for a global aviation emission trading system?'.

After a short introduction in chapter 1 a look at the field of European Integration Theory will follow. Thus in chapter 2 the appropriate theory will be chosen to explain the foundation of the ETS as well as its sectoral extension. Chapter 3 will then describe the used methodology. In chapter 4, the ETS, its framework and main characteristics will be presented. It also refers to the inclusion of the aviation sector and ends with an interim conclusion. Chapter 5 of the thesis will focus on the applicability of the EU ETS to the international level. It is divided into four parts starting with the presentation of international aviation emissions regulations currently in place. The different actors and interests in international relations represent part two. The applicability of the ETS will be tested in part three and a future prospective will be the fourth part. Finally, the conclusion will summarise the findings in chapter 6.

2. European integration theory: neofunctionalism

To show how theoretical approaches explain and characterise sectoral integration in the European Union this section will focus on the neofunctionalism as one major theory of European integration. This approach serves the aim of this thesis best and therefore is the most appropriate one to describe the integration of the aviation sector in the Emissions Trading System.

The theory of functionalism emerged in the nineteen-thirties. It was developed by David Mitrany to have regard to transnational problems which cannot be solved at national level solely. The scope of international cooperation arises from requirements in specific sectors. An extension and ramification of integration follows. Thus, competencies and sovereignty will be transferred more and more from the national to higher levels of decision-making like transnational institutions and international organisations (Weidenfeld, 2010).

The advancement of this approach followed in the fifties by Ernst B. Haas. He developed the neofunctionalist approach focusing on the spill-over effect. On the basis of cooperation in technical or economic sectors a spill-over to adjacent political areas will set in. The institutional design results from economic or political tasks. That is described with the term 'form follows function' (Weidenfeld, 2010).

The need for more economic cooperation was one reason for the emergence of the functionalist school. Objectives for the development of the national economies were approaching in the Western European countries. Functionalists believed that integration becomes automatic if both national politicians and non-governmental elites realise and support these objectives. As a consequence political unification might take place as well (Haas, 1964).

Against the background of a Soviet-American dominance in the international economic system and the increasing importance of countries from Asia and Africa an economically united Europe seemed more qualified to keep pace (Haas, 1964).

Starting in specific sectors further integration will spill over until reaching complete economic unity. This effect will be borne by elites perceiving potential in other economic or political areas for more integration (Haas, 1964).

Haas clearly divided between supporters and those who did not take part in the development of the functionalism:

> *'The economic technician, the planner, the innovating industrialist, and trade unionist advanced the movement – not the politician, the scholar, the poet, or the writer.' (Haas, 1964, p. XIX)*

In 1950, Haas claimed, there was a 'drive for a united Europe' (Haas, 1964, p. XVI). The citizens of European countries felt that the national states where no longer able to provide for basic needs. People wished for peace, security and welfare. Only the uniting of the national states in a common European framework seemed to be an appropriate alternative. In this way some of the lost power of each of the national governments after World War II could be regained. Therefore Haas describes the unification of Europe as 'instance of voluntary 'integration'' (Haas, 1964, p. XXXI).

Inherent in the concept of neofunctionalism is the term supranationality. It characterises the hand over of power from the national to a higher, central level. Supranational entities therefore are situated between international organisations and national governments. Between the national and supranational level there is interdependence. The new central agency is dependant on the states when it comes to the transfer of duties and responsibilities. On the other hand, national governments have to comply with rules and regulations set by this new governing body (Haas, 1964).

The application of the theory of neofunctionalism to the integration process in terms of the ETS and its sectoral extension will be done in chapter 4.2. But at first chapter 4 and 4.1 will describe the system and the inclusion of aviation more in detail.

3. Methodology

In this section the research methodology will be explained focusing on the content and document analysis.

In general the content analysis refers to a systematic contemplation and appraisal of different sources such as texts, films and pictures. However it does not only focus on the content alone but also on formal characteristics like syntax or word usage. The target is to draw conclusions on the basis of this information (Diekmann, 2010).

According to a simple model of a communication process two stages are involved. Firstly, the sender encodes a message in the form of a text or picture for example. Secondly, the recipient decodes this message again. A major problem arises if the recipient is not able to understand the coding of the sender e. g. the used symbols. Then the whole meaning of the content might get lost (Diekmann, 2010).

An advantage of the content analysis on the other hand is the possibility to access material and information from long ago and thus to identify specific developments over time. Other advantages are the data about social changes and the non-reactive character of the data (Diekmann, 2010).

Diekmann (2010) recommends having a formulated research question or hypothesis already in mind while doing the content analysis. Within a wealth of sources this would make it easier to keep track.

The aim of the analysis is the reduction of material leaving only the crucial and important information for the research purpose (Atteslander, 2006).

For the present bachelor thesis texts from books and journals were included. Moreover, Internet sources mainly from the website of the European Commission were used Those comprised material concerning the ETS with the inclusion of aviation, the aviation sector, European integration theories, theories of international relations and the methodology itself.

The document analysis is a qualitative and interpretative approach. It comprises mainly certificates and records but can also include texts or film for example. The target is to use these to explain human behaviour. The access to a variety of materials is an advantage of this method. Moreover, the data is often already available with no testing or interviewing necessary. Hence the subjectivity of the researcher does not play a role in data collection but only in selecting the documents (Mayring, 2002).

Essential is the qualitative interpretation of the material. Especially with regard to historic events the document analysis plays an important role. Another crucial aspect is the formulation of the research question as first step of the analysis. Secondly, the researcher has to define and collect its material. After that the value of each source for the answering of the research question is determined. Finally, the interpretation of the chosen material to answer the question will be done (Mayring, 2002).

The document analysis in this bachelor thesis encompasses reports conducted for the EU or regarding the topic in general. Additionally, the Directive 2003/87/EC referring to the establishment of the ETS and the Directive 2008/101/EC with regard to the sectoral extension will be included.

4. The Emission Trading System

To fulfil the intended emission target of 20% lower greenhouse gas emissions than in 1990 the EU implemented the ETS scheme on 1 January 2005. It is a system dealing in emission allowances which is exceptional because it indirectly sets a price on emissions and thus makes them a tradable unit. The amount of allowances will be decreasing with every year. In the end the total reduction will then be 21% in 2020 compared to 2005 (European Commission, 2010).

Therefore the EU adopted the Directive 2003/87/EC wherein the establishment of an emission trading system for greenhouse gases is regulated. An amendment of that Directive followed one year later with the Directive 2004/101/EC. It extended the ETS by including allowances for environmental projects in third countries also belonging to the Kyoto Protocol. Furthermore, the Directive of 2004 aimed at involving the transport sector and other relevant sectors for further emission reduction purpose (Wit et al., 2005).

30 countries participate in the ETS (European Commission, 2010). Those are the 27 Member States of the EU as well as the other three countries of the European Economic Area (EEA): Iceland, Norway and Liechtenstein (European Commission, 2008). They followed with the inclusion of the EU ETS Directive into the EEA agreement in 2007 (European Commission, 2011).

The system covers about 11,000 installations, like power stations and industrial plants at the beginning (European Commission, 2010). In 2012 over 4,000 aircraft operators also entered the scheme (European Commission, 2011). Further extension is planned in 2013, when industries dealing in petrochemicals, ammonia and aluminium are incorporated (European Commission, 2010).

To take part in the emission trading every applicant needs to have a trading permit. Those are issued by the Member States. If participants do not obey the ETS regulations the permit will be repealed (Wit et al., 2005). Furthermore, on the national level there will be competent authorities which will among others tasks issue the emission allowances (European Union, 2003).

The first trading period started with the beginning of the scheme on 1 January 2005 and ended three years later in 2007. The second trading period followed from the beginning of 2008 and is running for 5 years until the end of 2012. The third trading period will then start in 2013 and it will last 8 years (European Union, 2003).

The trading rests on a 'cap and trade' principle setting a cap on the quantity to be emitted by the entities involved in the system. They are allowed to sell or buy allowances within this limit (European Commission, 2010). For the second trading period the cap was set at approx. 6.5% below the level of 2005. However, the cap system will change from the beginning of phase 3 onwards. In the first two trading periods the Member States set national caps. As of 2013 there will be an EU-wide cap (European Commission, 2008).

The emissions of the sectors included in the EU ETS shall be reduced by 21% in 2020. Correspondingly, the maximum of allowances by then is 1,720 million (European Commission, 2008). For the first trading period approx. 2,190 million have been allocated (Wit et al., 2005). And the total quantity submitted by the Member States for phase 2 was 2,083 million. However, it should be mentioned that these figures do not include the aviation sector nor the emissions by the three EEA countries (European Commission, 2008).

The emission allowances are comparable to a trading currency giving the amount of emissions a specific value. A company in the system is allowed to emit either one tonne of CO_2 or the quantity

of another greenhouse gas of equal value. In addition, a company has the opportunity to compensate its emissions with credits for emission-reducing investments in third countries. The use of these credits is only possible up to the level of 50% of the EU-wide reductions. Moreover, measures reducing emissions within the EU that are not part of the ETS can be credited (European Union, 2003).

During the first two trading periods, each of the Member States needed to design a national allocation plan (NAP). It contained both the total number of greenhouse gas emissions for the country (the national cap) and the splitting of allowances for each of the national installations in the scheme (European Commission, 2008). The Member States could decide individually how to divide the national allowances to their sectors making it possible to also include thoughts on competitiveness against other countries (Wit et al., 2005). After the period of one year every entity of the system needs to prove that it has enough allowances to cover all its emissions within that year. Companies with a surplus of allowances can either sell them to other companies in need for it or save them for themselves for the future (European Union, 2003). However, as of 2013 there will be no NAP's anymore but only the EU-wide cap and allowances (European Commission, 2008).

If entities do not have enough allowances to cover their emissions by 30 April there will be a fine for each tonne of additionally emitted CO_2. Moreover, they are obliged to surrender those missing allowances during the next trading period ancillary (Wit et al., 2005).

A decrease in greenhouse gas emissions is supposed to derive from measures taken by companies having more emissions than allowances. Those either need to buy additional allowances from other companies or they need to try to reduce their emissions so that they comply with their allowances. Investments in more energy-efficient technology and the use of less carbon-intensive sources of energy are two examples for such measures. It is assumed that those investments are made where it is most cost-efficient (European Commission, 2008).

International progress in the field of greenhouse gas emissions should be done by linking the ETS with other similar systems (European Commission, 2010). The 'development of a global network of emission trading systems' is the defined goal of the European Commission (European Commission, 2008, p. 10).

4.1 The inclusion of aviation

In times of increasing air traffic emissions of the aviation sector are increasing correspondingly (European Commission, 2012). They have a share of approx. 3% of the total greenhouse gas (GHG) emissions of the European Union. This seems rather small. However, the emissions from the aviation sector in the EU are about twice that of 1990 (European Commission, 2011). In the period of 1990 to 2003 the carbon dioxide (CO_2) emissions increased by 73% (Wit et al., 2005). Moreover, forecasts show an ongoing growth for the future (European Commission, 2011). Looking at the total transportation sector the share is also much higher with about 12% (Brenninkmeijer, 2000).

Thus, the EU considered several options to involve the sector in climate action measures. In 2009, it decided to include aviation in the EU ETS on the basis of Directive 2008/101/EC. Hence, there will be a cap on emissions for the participating entities (European Commission, 2012). But mainly the CO_2 emissions will be covered since they are the only ones that can be calculated reliably (Wit et al., 2005).

Within the scheme aviation became the second largest sector responsible for emitting GHG emissions by entering it on 1 January 2012. The electricity generation sector participating from the beginning in 2005 in the ETS remains the largest one (European Commission, 2011). Hence, the total amount of allowances traded within the ETS increased a lot. Besides the aviation sector is assumed to be a potential net buyer of allowances. That means other sectors included in the system would sell their excess allowances to aviation (Wit et al., 2005).

All flights arriving at or departing from one of the airports in the EU will be involved in the system (European Union, 2008). Thereby, many international flights operated by non-EU carriers will also come within the scheme.

That brought critic especially from US, Chinese and Russian airlines. Finally, some US airlines and their trade association put the inclusion of the aviation sector in the ETS before the court. The European Court of Justice decided on 21 December 2011 that the inclusion transgresses neither the sovereignty, nor the territoriality of other countries. Moreover, the principle of non-discrimination is satisfied since the flights of all aircraft operators falling under the scheme are treated equal (European Commission, 2012).

Air operators will be the ones responsible for verifying enough allowances for the emissions of their flights. They are assumed to be most suitable for taking measures to reduce emissions (European Commission, 2012). Aviation emissions result from aircrafts which are owned by

operators. Thus technical and/or operational measures can be best dealt with by them. This will also be most effective since an operator itself also has an interest in achieving emission reductions by least possible cost (Wit et al., 2005). For the case that the operator is unknown the aircraft owner will be held responsible. The identification of an air operator will mainly be done by a specific designator assigned by the ICAO or by the aircraft registration (European Commission, 2011).

Exempted from the inclusion in the EU ETS are flights with very light aircrafts (max. 5.7 tonnes) as well as flights operated for military, police, search and rescue, customs, governmental or training and testing purpose. Additionally, Annex I of the EU ETS Directive determines that flights of commercial operators who performed less than 243 flights in 4 sequential months or emitted less than 10,000 tonnes in one year is exempted (European Union, 2008).

The administration of an individual operator will be done by the Member State in which the operator is registered or where most of its flights take place. A list of all participating air operators in the scheme is published by the Commission. So, if an operator undertakes flight activities that fall under the scheme firstly the operator will need to transmit a monitoring plan to the Member State that issued its operating licence. After monitoring the emissions according to the approved plan the operator establishes an emissions report for the concerned year. This report needs to be submitted to the administering country by 31 March of the following year (European Commission, 2011).

In the case that an operator does not have enough allowances to cover its emissions penalties can be imposed by the responsible Member State. These penalties are not EU-wide harmonised. Each country can express them in accordance with its national law (European Union, 2008).

The cap for emission allowances for air operators are calculated on the basis of the average value of the years 2004 until 2006. Those historic emissions consist of data calculated for the actual route length per flight and data on the actual fuel consumption by the aircraft and for the auxiliary power units (APUs) on the ground. Thus, the calculated amount accounts for 212,892,052 tonnes in 2012 and 208,502,525 from 2013 onwards. As a result the reduction of CO_2 will be approx. 183 million tonnes (46%) by 2020 (European Commission, 2011).

It should be noted that these figures only refer to GHG emissions. NOx emissions just as effects from contrails and cirrus clouds are not included (European Commission, 2011).

The allocation of allowances to the air operators will be split in 82% free of charge allocation, 15% through auctioning and 3% as reserve for new entrants and fast growing operators. The benchmark for the free allocated allowances is based on an air operator's passengers and freight numbers and the total travel distance in 2010 (European Commission, 2011).

Regarding the effects of the inclusion of aviation in the ETS several topics need to be considered. First of all, there will be no direct effects on ticket prices. However, airlines will pass on some of the additional costs for the emission trading to their customers (European Commission, 2011). This *'impact on ticket prices is relatively* small', concluded the CE report (Wit et al., 2005, p. 137). With auctioning being the main allocation method the cost increases are much higher. Even then the CE report estimated 9 € as the highest increase in ticket prices for a round trip and with no passing on of opportunity costs (Wit et al., 2005). The European Commission (EC) stated that the maximum price increase on a long-haul flight will be about €12 (European Commission, 2011).

Looked from an international perspective the inclusion of aviation in the EU ETS was not the only feasible or desired solution to manage emission trading for this sector in the EU. However, it was the only possible one since a global system could neither be established by the United Nations (UN) nor the International Civil Aviation Organisation. Beyond that the EU is still looking for possibilities to unite its system with similar ones to build a global framework in the end (European Commission, 2011).

A possible drawback for the economic targets of the ETS is the fact that newer technology is producing more contrails. Air operators are required to invest in more efficient and thus environment-friendly technology to play a part in contributing to reducing emissions. Although contrails as such are not part of the ETS the formation of them advances global warming (Wit et al., 2005).

4.2 Interim conclusion

To summarise the already given explanations this section will explain the progress of the ETS by the help of the theory of neofunctionalism (see chapter 2).

The EU ETS was established to combat climate change. Therefore it focused on greenhouse gas emissions. Those emissions have environmental impacts irrespectively of national borders. According to the neofunctionalism they represent a transnational problem. Due to the cross-border effects national states cannot solve this problem alone.

Neofunctionalists argue that in such a case national competencies need to be transferred to a higher level. This usually goes hand in hand with a loss in sovereignty over certain fields of policy. However, through cooperation between the participating states on the higher level (binding) regulations can be set to mutually act against the problem. Correspondingly, the current member states of the ETS have given competencies to the European Union, particularly the European Commission.

The willingness to cooperate in emission trading then led to the establishment of the Directive 2003/87/EC. The neofunctionalist approach explains that with its assumption that 'form follows function'. So, at first the national states perceived the need for cooperation to regulate emissions, to establish a cap and to give incentives for further (voluntary) reductions. After the agreement on the regulatory content and specific mechanisms the regulatory framework could be built.

At first the ETS comprised sectors with installations such as power stations, combustion plants, oil refineries, factories making glass or paper. With the beginning of 2012 the aviation sector entered the scheme. Moreover, as of 2013, factories making petrochemicals, aluminium or ammonia will be included. In accordance with the neofunctionalism this development represents the extension from specific sectors at first to further integrating other sectors related to the system.

Furthermore, this is also connected with the assumption of spill-over effects occurring during the integration process. Those will start on the more functional level and then expand to concrete policy fields. Once the spill-over effects have set in the integration will not stop to make further progress. For the EU ETS this would mean the integration of more and more relevant sectors. Additionally, extension concerning the comprised GHGs or the member states is possible.

The next chapter will continue with the applicability of this system for the international level.

5. Regulating international aviation

Chapter 4 gave an overview of the emission trading system currently in place in the EU. It described the process of integration in that field and the inclusion of aviation more in detail. The following chapter will now focus on the second part of the research question: the international level of aviation emission trading. Starting with section 5.1 the status quo of rules and regulations including relevant actors will be characterised. Section 5.2 focuses on the neo-institutionalism as theory of international relations to explain prevailing opinions on cooperation and institutionalisation. In section 5.3 the research question: To what extent does the EU ETS serve as

a model for a global aviation emission trading system? will be analysed more in-depth. Finally, section 5.4 will give a future perspective on the development of a global aviation emission trading system.

Before looking at the international level a short view on the relevance and especially the diverse emissions of the aviation sector will be given. This is necessary for the following considerations in section 5.3.

The aviation sector is especially interesting since it is economically important. It not only serves as means of transportation of passengers and freight but also has several other direct, indirect, induced or catalytic effects (Wald, 2007). Direct effects are those on airlines, airports, air traffic control and aircraft manufacturers. Indirect effects concern suppliers and service providers e. g. by providing jobs linked to aviation. Expenses for day-to-day needs of direct or indirect employees form induced effects. Finally, catalytic effects arise in sectors like trade and tourism through aviation activities. Hence aviation contributes to international value added (Biermann & Vespermann, 2007).

Concerning the climate effect of aviation the International Panel on Climate Change (IPCC) published the report 'Aviation and the Global Atmosphere' in 1999 (Wit et al., 2005). By using the measure of radiative forcing (RF) the report assesses the impact of aviation emission. The IPCC defines radiative forcing as

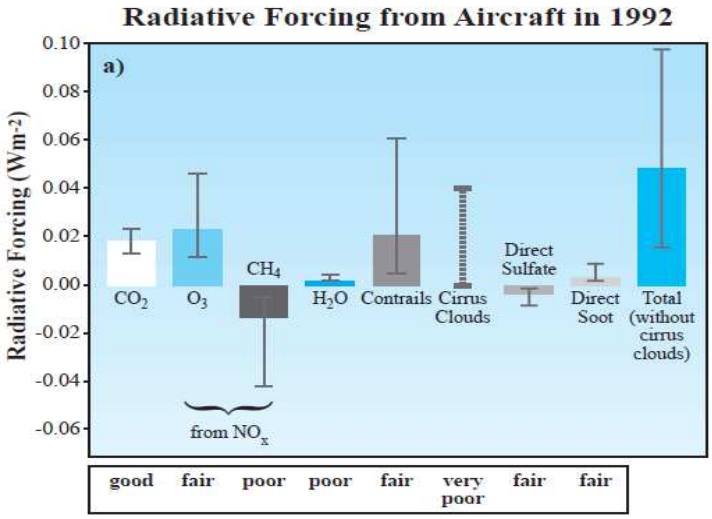
' a measure of the importance of a potential climate change mechanism. It expresses the perturbation or change to the energy balance of the Earth-atmosphere system [...]. Positive values of radiative forcing imply a net warming, while negative values imply cooling.' (Penner et al., 1999, p. 3).

The aircraft emission components influencing RF positively and negatively according to the IPCC report (1999) are as follows:

- carbon dioxide (CO_2) – positively
- ozone (O_3) through NO_x emissions – positively
- methane (CH_4) through NO_x emissions – negatively
- water vapour – positively
- contrails – positively
- cirrus clouds – positively
- sulphate aerosols – negatively

- soot aerosols – positively

In figure 1 the effects of the emissions are summarized for the year 1992. The illustration is based on estimates. Thus there are some smaller or bigger uncertainties displayed. Especially the cirrus cloud research was not mature enough to make sound assumptions on their impact as it is still the case in many aspects (Penner et al., 1999). Regarding contrails more recent research has shown that the estimated impact is lower than anticipated by the IPCC (Cames & Deuber, 2004). The line below the graph depicts an evaluation of each of the components.



Source: Penner et al., 1999

The contribution of aviation RF effects to the overall RF was calculated with 3.5% by the IPCC with a further tendency to grow up to 5% in 2050 (Penner et al., 1999).

5.1 Status quo

The following section will describe the most prominent actors in the field of international aviation. Moreover, it will refer to their contributions towards regulating this sector and especially with regard to the establishment of a global aviation emission trading system.

In 1992 the United Nations Framework Convention on Climate Change (UNFCCC) was founded and currently has 195 member states (UNFCCC, 2012a). The target of the Convention is to reduce greenhouse gas emissions and thereby to combat the worldwide climate change. Developed countries are encouraged to decrease their emissions by 15-30 % until 2020. The measures taken should be cost-effective and enforced by national programmes. The Convention also referred to

the transport sector by asking for technology supporting the emission reduction targets (Wit et al., 2005).

The Kyoto Protocol was launched as one result of the UNFCCC. It currently has 191 member states (exclusively the USA) plus the EU as economic integration organisation and is in force since 16th February 2005 (UNFCCC, 2012b). Again it refers to the transport sector as a whole (Wit et al., 2005). In article 17 the KP recommends to establish a global emission trading system (Cames & Deuber, 2004). Additionally it says that emissions generated by aviation fuels shall be reduced in cooperation with the International Civil Aviation Organisation (Wit et al., 2005). One important characteristic of the Kyoto Protocol regarding aviation emissions is that only domestic air traffic is included and no international flights. The result is that no reduction targets are included. Moreover, it comprises only CO_2 emissions ignoring other exhaust gases also emitted by aviation such as NO_x or water vapour (Cames & Deuber, 2004).

Those two regulations are legally binding for their parties (Wit et al., 2005).

The same is true for the regulations of the Convention on International Civil Aviation ('Chicago Convention') with its 191 members. The convention was held in 1944 aiming at regulating international civil aviation. It defines sovereignty for each country over its airspace. Moreover it claims non-discrimination for all regulations with regard to the nationality leaving states with the task to treat foreign aircrafts as national ones. Concerning emissions the convention involves Standards and Recommended Practices (SARPs) by the ICAO. Those refer to NO_x, hydrocarbon (HC), CO and smoke emissions. The SARPs define maximum values for each of these emissions allowed for new aircraft engines in order to be certified (Wit et al., 2005).

The specialised agency of the United Nations, ICAO, was founded with the signing of the Chicago Convention (Cames & Deuber, 2004). It adopted the Resolution A35-5 on emissions trading in 2004. For the international aviation sector it declares an open emission trading system to be desirable. Two approaches are possible according to the ICAO. The first one is creating a trading system on voluntary basis for states and international organisations. The second one would aims at combining existing trading systems of the member states with aviation's emissions with the assistance of the ICAO (Wit et al., 2005). The advantage of such trading systems lies in the possibility to reduce greenhouse gas emissions in a very cost-efficient way according to the ICAO (Cames & Deuber, 2004).

Furthermore, the ICAO has a special Committee on Aviation Environmental Protection (CAEP) concerned amongst others with the emissions of aircraft engines (Wickrama, 2000). It supports

the ICAO in defining new standards, deals with market-based approaches to reduce emissions and gives advice concerning the costs and benefits of considered measures. As result of the Kyoto Protocol the CAEP published a report with different approaches to reduce emissions. After that the CAEP concluded to establish an open emission trading system within the next years. Finally it should be integrated into the Kyoto Protocol. Moreover developing countries shall be involved. The plenary meeting of the ICAO agreed and asked the council to create guidelines as well as a possible framework for global aviation emission trading (Cames & Deuber, 2004).

The representation of interests for airlines globally undertakes the International Air Transport Association (IATA). The counter part responsible for the airports is the Airport Council International (ACI) (Wald, 2007).

On the part of non-governmental organisations (NGOs) the International Coalition for Sustainable Aviation (ICSA) accuses the ICAO of only being able to adopt regulations for developed countries instead of a global implementation (Cames & Deuber, 2004).

Finally, there are bilateral air services agreements wherein contracting states regulate international air services within or between their airspaces. With regard to the Chicago Convention the countries agree to obey each others national rules and regulations. Moreover the agreements limit the amount of taxes and charges for the parties. But no restrictions to operational measures such as traffic volume or frequency are allowed for both countries (Wit et al., 2005).

5.2 International relations: the theory of neo-institutionalism

To connect the international perspective of the research question with a theoretical background this section will concentrate on international relations. Especially the theory of neo-institutionalism explains the interdependence between the national and international level well.

The neo-institutional idea emerged as reaction to the neo-realist approach. Uncertainties in the international system are coped by means of cooperative agreements instead of maximizing national resources. The neo-institutionalism supposes the willingness of states to cooperate. Thus, anarchy in the international system can be overcome. Furthermore it will have a positive effect on keeping peace (Gu, 2000).

Robert Keohane is the leading representative of this school of thought. Stephen D. Krasner and Joseph Nye are two other prominent scientists in this field. They all are counted among the regime theory which is a subcategory of neo-institutionalism (Gu, 2000).

There are five assumptions serving as a basis for the neo-institutionalism which will be explained hereafter. Firstly, the constitutional assumption emphasizes the relevance of political elites and their integration objectives for the advance of integration itself and the decline of the extent of anarchy, respectively. Secondly, the interdependent assumption implies mutual dependences in international policy. Against the background of more and more relationships of dependency and a growing complexity of the international political system there is a need to establish international institutions or regimes. Thirdly, the focus is laid on non-governmental organisations and their international linkage of activities with like-minded organisations. This autonomous transnational action will lead to a displacement of national actors according to the transnational assumption. Fourthly, a functional-automatic extension of integration is alleged by the functionalistic assumption. This is closely related to the spill-over effect stating that once integration has started it is very hard for countries to back off again. Finally, the rational assumption underlines the willingness of states to cooperate on the basis of rational thinking and acting. This is due to the fact that they want to get a certain extent of control over the behaviour of other countries (Gu, 2000).

Neo-institutionalists do also criticise the liberal approach and its assessment of the influence of international institutions. They find fault with the fact that institutions are only believed to have an effect on the national political system. Within the international system their effect is not being considered although it also has an impact on intergovernmental processes. Moreover, international institutions also influence national identities and interests as it can be seen in the case of the European Union (Schieder, 2003).

A new aspect of the neo-institutional theory is the understanding of institutionalisation. It does not only focus on international organisations but also on intergovernmental cooperation on the international level. Those appear in the form of international regimes regulating a specific policy area for example international marine law (Gu, 2000).

Applicability for a global aviation emission trading system

The underlined relevance of international institutions by the neo-institutionalists becomes apparent when looking at the role of the ICAO, for example. It was put in charge by the Kyoto Protocol to realise the target of reducing aviation emissions on an international level. Thus, it appointed the CAEP for assistance and information on strengths and weaknesses of different market-based approaches. It concluded the work with a report preferring the solution of an international emission trading system for the aviation sector for the next years to come.

The willingness of national states to cooperate within the international system arises from the nature of the problem. Since aviation emissions are not only globally generated but do also have global effects they cannot be combated by a single state. Therefore, national governments perceive the international solution to be the best option in confronting a transnational problem.

Closely connected to that is also the assumption of interdependence of the national and international policy level. International institutions depend on cooperative behaviour of states. Otherwise they will not be able to establish a legitimated international emission trading system. On the other hand, states rely on this establishment to have a legal framework for the implementation on the national level.

5.3 Applicability of the ETS

In this section the extent to which the EU ETS is applicable to the international level will be determined. Therefore, three hypotheses were created and analysed. In addition, further important factors for the degree of applicability are described. All these aspects should help to answer the research question: To what extent does the EU ETS serve as a model for a global aviation emission trading system?

Hypothesis 1

The first hypothesis reads as follows:

The more aviation emissions are included the higher the efficiency of the system.

The amount of aviation emissions constitutes the independent variable (X). The system's efficiency corresponds to the dependent variable (Y).

The ETS currently solely covers CO_2 emissions with one exemption of the Netherlands as only country accounting for N_2O emissions, as well. As of 2013, N_2O emissions of some specific production sectors will be included for all participating states, too (European Commission, 2008).

The CE report concludes that

' a CO_2-only based scheme will most probably reduce both CO_2 and NO_x emissions in the shorter term and longer term' (Wit et al., 2005, p. 15).

To determine the CO_2 emissions for each flight air operators first of all measure the actual trip fuel. With the amount of carbon content in it the CO_2 emissions can then be calculated. For that an emission factor is used (Wit et al., 2005). Brought into a formula it will look like this:

CO_2 emissions = fuel consumption per year * emission factor

'An emission factor often used for kerosene is 3.154 kg CO_2 per kg fuel burned.' (Wit et al., 2005, p. 109)

The measurement of the actual fuel consumption instead of an average value should be preferred since it represents the polluter-pays-principle and thus it is ecological efficient. However, this approach is only feasible with regard to future measurements (Cames & Deuber, 2004).

The Kyoto Protocol uses a CO_2 equivalent for the effects of emissions as basis of assessment. This means that the other five emissions included in the KP (CH_4 - methane, N_2O - nitrous oxide, CFC - chlorofluorocarbon, HCFC - hydrochlorofluorocarbon, SF_6 - sulphur hexafluoride) are expressed through this figure. Cames and Deuber (2004) for instance indicate a CO_2 equivalent of 3.178 t for 1 t water vapour and 136.46 t for 1 t NO_x both emitted at cruise level (Cames & Deuber, 2004).

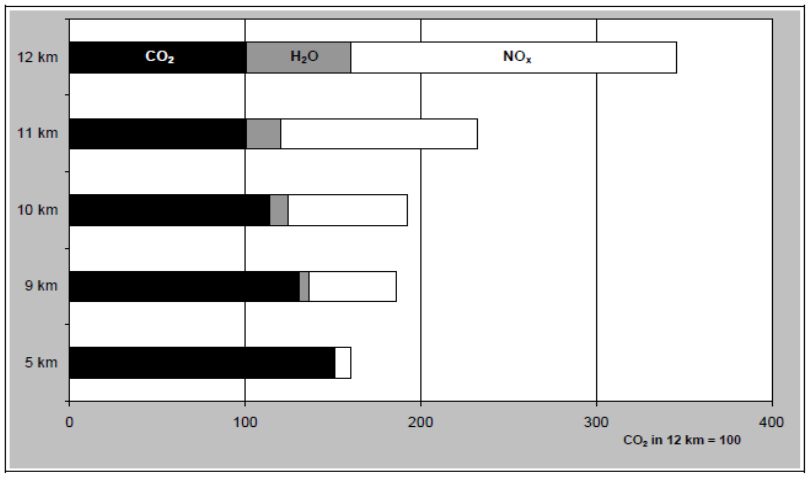
Thus an easier linkage to it can be ensured if the international scheme will also use carbon dioxide. On the other hand CO_2 does only account for one third of total aviation emission. Hence there might need to be flanking instruments regulating NO_x emissions for example to prevent ecological misdirection (Cames & Deuber, 2004).

For NO_x emissions the ICAO published data in the context of the LTO (Landing and Take-Off) Cycle. On their basis and in combination with the take-off weight and the flight distance estimates for the cruising flight can be made (Cames & Deuber, 2004).

Including contrails in the assessment basis would mean a better incentive effect to invest in environmentally friendly technology. For the development of contrails several factors play a role: water vapour, sulphate and particle emissions as well as temperature and humidity. Hence the required data sources to estimate the effects are more extensive, too. It would therefore be advisable to avoid certain flight levels if unfavourable weather conditions exist. Such a decision can be made during the flight under the guidance of the air traffic control but also before the flight on the basis of the weather forecast for the flight. Hence the development of contrails can be prevented. However, a change of flight altitude will also have an impact on the emission of other greenhouse gases (figure 2) (Cames & Deuber, 2004).

Title: Relative greenhouse effect dependent on the flight altitude

Abbildung 8: Relativer Treibhauseffekt in Abhängigkeit von der Flughöhe



Source: Cames & Deuber, 2004

The above mentioned hypothesis can be verified on the basis of the following results from these considerations:

1. Aviation emits several diverse GHGs. Hence an environmentally efficient should comprise more than one of these.
2. The Kyoto Protocol already refers to six different emissions. Thus it would be easier to integrate a higher share of emissions for a global system linked to it.
3. The integration of more aviation emissions would also mean a higher incentive to invest in environmentally friendly technology. This would lead to an additional reduction of the overall emissions comprised by the system.

Hypothesis 2

The second hypothesis is:

The more open a system is the easier the linkage to the Kyoto Protocol.

The independent variable (X) is the degree of openness of the trading system. The dependent variable (Y) symbolises the degree of simplicity for the linkage to the KP.

For establishing a global aviation emission trading system there are three kinds of system types considered: an open, semi-open and a closed system.

The variant of an open system means that emission trading is possible in both ways between the aviation sector and other sectors. The advantage of the system is the inherent incentive to reduce emission within the sector. These emission reductions are made where it is most cost-efficient. Through the possibility of buying allowances of more effective sectors reduction targets can be determined more optimistic. On the other hand abatement costs for airlines to reduce emissions are relatively high (Cames & Deuber, 2004).

Another option would be a semi-open trading. It would divide the ways of trading in two parts. As a consequence it excludes using emissions rights from international aviation in emission trading of the KP. Thus this option should account for the more complex structure of aviation emissions (Cames & Deuber, 2004).

The opposite to an open emission trading system would be a closed one which will be independent of other economical sectors. This means that the trading with allowances would only happen between the air operators but not in connection with other sectors (Cames & Deuber, 2004).

Having a closed system would counteract the content of the Kyoto Protocol since it already comprises several very different sectors. A linkage to it would therefore be impossible. It can only be established next to the KP but not integrated in it.

In contrast, an open system can be integrated in the KP far easier. Both the emission trading system as well as the Kyoto Protocol refer to various sectors. Structures and mechanisms can be better coordinated saving administrative effort and transaction costs. Thus emission trading can also be performed in both ways referring to the KP and its instruments (Cames & Deuber, 2004).

Looking at the perspective of international actors they also favour an open emission trading system with monitoring, reporting and sanctioning measures which is compatible with the Kyoto Protocol. The challenge is to exactly define the content and structure of this system and how to integrate it in the KP (Cames & Deuber, 2004).

Criticism concerning the open system arises when looking at possible economical misdirections. For this kind of system those are rather likely. With airlines being net-buyers of emission allowances of other sectors the effects of emissions connected to CO_2 (e.g. NO_x) will increase (Cames & Deuber, 2004).

Another more critical aspect is the possible extension of the assessment basis of the system. For instance, water vapour and nitric oxide could be included in it. But then there would no longer be a compatibility with the KP possible since those are not part of it. To get the necessary data for the determination of these other factors would also be more complex. The integration of water vapour would also mean to include contrails as reaction product. Since the research on contrails is not that far developed to get reliable data this would mean another hindrance (Cames & Deuber, 2004).

Concerning the above mentioned hypothesis it can be stated that although an open system is the best option for a linkage to the Kyoto Protocol there are some weaknesses about that approach that need to be considered first.

Hypothesis 3

The third hypothesis reads as follows:

The amount of (voluntary) emission reductions increases the higher the share of auctioning in allocation.

The independent variable (X) is the share of auctioning. The degree of (voluntary) emission reductions represents the dependent variable (Y).

There are three allocation methods incorporated in the current ETS: grandfathering, benchmarking and auctioning.

Grandfathering refers to the free allocation of emission allowances on the basis of historic data (Cames & Deuber, 2004). During the first trading period almost all allowances were distributed free of charge (European Commission, 2008).

According to the benchmark principle a specific point of reference will be determined to allocate the allowances similarly to the companies (Wit et al., 2005). Such a benchmark might for example be the amount of past emissions (European Commission, 2008).

For the auctioning of allowances no historic emission date is required. This method refers to actual data for the setting of prices. In phase 2 less than 4% of the allowances in the ETS were auctioned. From 2013 onwards this figure will increase to more than 50% making auctioning the preferred trading method. In the long term it should serve as the only method of operation meaning a rate of 100% (European Commission, 2008).

Auctioning is believed to be the more efficient method because it works according to the polluter pays principle and it minimises the possibility of windfall profits (European Commission, 2008). A CE report prepared for the European Commission named also three other advantages of auctioning: 'equal treatment of new entrants', 'lower administrative burden' and 'flexibility' (Wit et al., 2005, p. 9).

However, an increase in financial costs for the air operators is expected to set in with the rising of auctioning to approx. 50% in 2013 in the ETS (Wit et al., 2005).

Member States are recommended to use 50% of the revenues generated through the auctioning to combat climate change within the EU and in developing countries (European Commission, 2008). Other ways of utilisation are for example the reduction of taxes in national economies or the financing of other climate measures (Wit et al., 2005).

Measures taken by the air operators to reduce emissions can be both, technical or operational ones. Depending on the prices for allowances air operators will calculate when it is worthwhile for them to invest in emission-reducing measures rather than pay for additional allowances (Wit et al., 2005). Below the most likely and most effective measures are explained.

Firstly, the airline may think of changing its fleet composition. Compared to larger aircrafts regional jets have a 40 – 60% lower fuel efficiency (Wit et al., 2005). An early conversion from smaller to larger aircrafts might therefore be worthwhile.

Secondly, adaptations to the existing fleet can be made. Through the technical refitting of certain aircraft components such as winglets, riblets and newer engines fuel would also be saved (Wit et al., 2005).

Thirdly, in the long term airlines are expected to promote the development and implementation of fuel-efficient technologies because if the additional costs they are facing by the emission trading. Examples for such technologies are airframes with less weight or drag and engines with a higher fuel efficiency (Wit et al., 2005).

Fourthly, every single flight can be environmentally optimised by modifying operational measures. Altering the flight path especially with regard to altitude or the climb angle and adapting the flight speed will save emissions. Moreover reducing the empty weight of an aircraft will result in less fuel consumption (Wit et al., 2005).

Finally, for the whole carrier network some adjustments can be made. To increase the load factor is one of them which is also always one of the main targets of an airline itself. For that, either frequencies or the aircraft type need to be adapted (Wit et al., 2005).

Comprising, the allocation according to the polluter pays principle also means that the less emissions an air operator emits the less costs he will have. Additionally, since prices for allowances on the auction market might rise than operators that have already invested in emission saving technology will have an advantage. Moreover, the utilisation of financial revenues for environmentally friendly projects does play a role and might encourage participants to take action to profit from this means.

Therefore the above mentioned hypothesis can be verified.

Other influencing factors

Concerning the *responsible entity for emission rights* of an international trading system there are two alternatives. Either national states will be responsible for emission targets and thus sanctions in the case of non-compliance or a legal person such as a air operator will be held responsible. After receiving the emission rights national states will be able to allocate these to a legal person for the purpose of trading (Cames & Deuber, 2004).

Against the decision for air operators speaks the incompatibility with the Kyoto Protocol since this is only focused on national states. Additionally, states are better able to implement sanction measures. To conclude, political and legal factors rather support the national states to be the ones responsible (Cames & Deuber, 2004).

This is also what is regulated in the EU ETS. Participating states play an important role as connecting link between the European level and the individual trading entity of air operators.

Administrative task such as monitoring and reporting are handle on the national level. Therefore, each state appointed a responsible authority handling all the emission data of the corresponding state.

Taking states as responsible entity there need to be a minimum that are participating otherwise the problem of free riding gets to threatening. This would mean approx. 30 to 35 countries consistent with the Annex I of the Kyoto Protocol. Obviously the amount of emission reduction is increasing the more participants the scheme has. Moreover, there should be a voluntary participation opportunity to diminish evasion movements. Especially states like the USA which have not ratified the KP or do not belong to Annex I but which do have a high volume of air traffic should be considered as candidate country. Thus more aircraft movements would be included as well as more gases emitted by these (Cames & Deuber, 2004).

However, questions remain about the implementation. Who will be responsible for a flight departing in country A, flying to the biggest part over county B before arriving in country, for example?

Other questions are: Who is responsible for flights concerning states that are not part of the system? And to what extent might this be the case? (Cames & Deuber, 2004).

Regarding the *trading entity* the ETS decided to go with air operators instead of airports or fuel companies, for instance. At the moment there are more than 4,000 operators taking part in the system. Of course this figure would be much higher if being transferred to the international level.

However, airlines should be favoured because of the following facts (Cames & Deuber, 2004):

- easy allocation of allowances on the basis of historic emissions
- accessibility of emission data like fuel consumption
- ability to implement technical and operational avoidance mechanisms
- promotion of political acceptance (considers the polluter pays principle)

One further positive aspect to mention is that airlines already expressed their acceptance of a global aviation emission trading system. This will also support the political acceptance of the scheme.

Looking at the *principle of trading* the EU ETS rests on the so-called cap and trade principle (see chapter 4). During the first two trading periods there were national caps. From the beginning of phase 3 an EU-wide cap will be introduced.

The EU-wide cap will be calculated as follows:

average of all emission allowances (phase 2) - allowances for excluded installations * 0,9826

Hence the annual amount of allowances will decrease linear by 1.74% from phase 3 onwards (European Commission, 2008).

The Kyoto Protocol is also based on a cap and trade principle making the compatibility concerning the usage of absolute reduction targets a lot easier. Thus the linkage between the scheme and the KP will be better manageable and transaction costs can be saved (Cames & Deuber, 2004).

To summarise this section it can be said that:

1. To apply the assessment basis of CO_2 only to the international system would not be a problem. But the integration of further aviation emissions would automatically lead to better economically efficiency and should therefore be aspired.
2. The application of the open system type of the ETS will need some more considerations but is the most suitable.
3. Auctioning should be preferred as allocation method as it is the case in the ETS from 2013 onwards.
4. To take national states as responsible entities seems most reasonable. However, distinct differentiations with regard to the sphere of responsibility need to be constituted.
5. Concerning the trading entity and the principle of trading the application from the EU to the international level should be simplest.

5.4 Future perspective

During the last 15 years there was a large growth of the aviation sector (European Commission, 2011). The average annual growth during the last 50 years was about 9% (Biermann & Vespermann, 2007). The amount of passengers transported by scheduled international airline services was 9 million in 1945 raising up to over 1.4 billion in 1998 (Wickrama, 2000). Until 2025 further growth is expected to range about 4% annually. Somewhat higher prognoses exist for the freight being transported with an annual average of 5-6% for the next two decades. Both growth figures differ globally with moderate rate increases in mature markets like Europe and North America and higher increases in emerging markets e. g. Asia (Biermann & Vespermann, 2007).

More traffic also means more and bigger aircrafts being necessary. Indeed the worldwide orders for (widebody) aircrafts are increasing with especially Arabic airlines wanting to extend their fleet (Biermann & Vespermann, 2007). This is not only a challenge for airport facilities on the ground and air traffic control but also for the environment. Aircraft manufacturers are expected to take account of that development by focusing on environment-friendly technology.

This might also affect the price of allowances in the long run. To regulate the market, the price may increase. But the higher allowance price would then also represent a better incentive to reduce emissions (Wit et al., 2005).

Manufacturers work on more fuel-efficient aircrafts especially concerning the engine and airframe. Forecasts assume an increase in efficiency rates of about 40-50% until 2050, compared to 1990 (Biermann & Vespermann, 2007).

The option of having an international emission trading system is favoured to be the long-term choice (Biermann & Vespermann, 2007). Since a new international legal framework might most probably be necessary this seems to be the only reliable perspective (Cames & Deuber, 2004).

So, why is this system not yet operating?

On the one hand actors in international aviation perceive the growing impact of air traffic on climate change and agree to the necessity to have international regulations combating this development. On the other hand they do not agree on how far reaching those should be. NGOs claim reduction targets also for international air traffic according to the Kyoto Protocol, market-based measures and mandatory standards (Cames & Deuber, 2004).

Additionally, there are some tasks that need further consideration. There is a need for better reporting of aviation emissions meaning more precise, consistent and comparable data (Cames & Deuber, 2004). Further problems to be solved are the concrete definition of reduction targets, the allocation method, the relationship between national and international air traffic as well as arrangements for flights with one participating and one non-participating country (Cames & Deuber, 2004).

6. Conclusion

Concluding, the applicability of the EU ETS to the international level is only restrictively given. The most important facts are:

1. The assessment basis of CO_2 only should be extended compared to the ETS.
2. National states should be responsible for the administration and the reduction targets.
3. Air operators will be the trading entity in both cases.
4. The preferred allocation method should be auctioning.
5. A linkage to the Kyoto Protocol should be given.

The thesis firstly looked at the European level by introducing the ETS, the inclusion of aviation and the process of integration by means of the theory of neofunctionalism. Secondly, it included the international level by determining the status quo, explaining the theoretical background on the basis of the neo-institutionalism and applying the characteristics of the ETS.

After having determined if the ETS is applicable to the international level further research can be conducted on the specific way to do it.

Supporting the argument of a global aviation emission trading system is the fact that it is a very cost-efficient way without having serious market distortions. However this is only possible on the basis of cooperative behaviour of the national states (Cames & Deuber, 2004).

Other advantages of international regulations against national solo attempts are that necessary coordination measures between different systems are obsolete and that common standards are set (Cames & Deuber, 2004).

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Declaration of authorship

by Marit Thiele

I declare that the work presented here is, to the best of my knowledge and belief, original and the result of my own investigations, except as acknowledged, and has not been submitted, either in part or whole, for a degree at both of these or any other university.

Formulations and ideas taken from other sources are cited as such. This work has not been published.

Location, Date Signature