Kommentar:

CENTRE FOR ENERGY, PETROLEUM AND MINERAL LAW AND POLICY

STUDENT NUMBER: 999944060

PROGRAMME: LL.M European Energy and Natural Resources Law and Policy

COURSE: Downstream Energy Law

TITLE OF THE RESEARCH PAPER: Should domestic or international regulatory authorities allow the trading of air pollution permits as an alternative environmental policy option instead of traditional command-and-control or emission taxation approaches?

ABSTRACT OF THE PAPER:

This research paper examines the theoretical and practical merits of domestic and international emissions trading as a means of internalising the social costs of industrial activities. It underlines that this approach minimises the marginal abatement costs. However, careful design of the trading system and adaption to the legal and institutional framework is indispensable.

Wordcount: 5482

PRESENTED TO: Stephen Dow

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Research Paper

Should domestic and international regulatory authorities allow the trading of air pollution permits as an alternative environmental policy option instead of traditional command-and-control or emission taxation approaches?

by

Henning Matthiesen

University of Dundee

Centre for Energy, Petroleum and Mineral Law and Policy

LL.M Programme

Table of Contents

Abbreviations

AOSIS	Alliance of Small Island States
BACT	Best Available Control Technology (U.S.)
CAAA	U.S. Clean Air Act Amendments of 1990
CDM	Clean Development Mechanism (Kyoto Protocol)
COP	Conference of the Parties (UNFCCC)
ERC	Emission Reduction Credit
EC	European Communities
EPA	U.S. Environmental Protection Agency
EU	European Union
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation (Kyoto Protocol)
LAER	Lowest Achievable Emissions Results (U.S.)
NAAQS	National Ambient Air Quality Standards (U.S.)
RACT	Reasonable Available Control Technology (U.S.)
RECLAIM	Regional Clean Air Incentives Market (California)
TPP	Tradeable Pollution Permit
UNFCCC	United Nations Framework Convention on Climate Change

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D. Harrison Jr., *Turning theory into practice for emissions trading in the Los Angeles air basin*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea, eds., Cheltenham, UK: Edgar Elvar Publishing Ltd, 1999) p. 64.

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1. Introduction

This paper will discuss both the legal and the economic rationale of an air pollution permit trading system so as to evaluate whether emissions trading is a proportional strategy of domestic and international environmental policy. It will question if such a system is superior to the command-and-control [CAC] strategy that traditionally dominates the air pollution related environmental legislation and administration. This approach is not only justified by the growing evidence of the human influence on climate change[1] but also by the theoretical and experimental findings of economists, the practical results of domestic emission trading regimes. The international component relies on the fact that the dangerous climate impact caused by greenhouse gas [GHG] emissions[2] is not based on local concentrations near to the emitting source which denotes a significant difference to SO_2 and NO_x emissions and their trading schemes. Thereby, international co-operation is an essential tool for the regulation of GHG emissions. Bearing this in mind, the adoption of the Kyoto Protocol[3] [KP] to the United Nations Framework Convention on Climate Change[4] [UNFCC] marks an important step by promoting three flexible mechanisms. After having defined the legal and economic theory of emission trading, the paper will examine the efficiency of the three basic environmental policy options regarding air pollutants: command-and-control, taxation and emissions trading.

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[1] This influence exceeds the factors which naturally affect the climate by far.
[2] Carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per fluorocarbons and sulphur hexafluoride pursuant to Annex A of the Kyoto Protocol (infra).
[3] Kyoto Protocol to the United Nations Framework Convention on Climate Change, December 11, 1997, FCCC/CP/1997/L.7/Add.1, United Nations, Bonn, http://www.unfccc.de/resource/docs/convkp/kpeng.html (visited on 10 January 1999) [hereinafter: Kyoto Protocol].
[4] United Nations Framework Convention on Climate Change, May 9, 1992, 31 ILM 849 (1992). [hereinafter: UNFCCC].

Applied Emissions trading schemes are examined in the next section. The following part analyses both the development and key-provisions of the emerging international legal framework concerning climate change. Finally, it will be concluded that a trading regime is the best available policy option for domestic and international regulatory authorities seeking to internalise the social costs of air pollution in a cost-efficient way.

2. Background: The Economic Concept of Emissions Trading

Emissions trading is a complex economic concept which was developed in the late 1960s and early 1970s as an alternative to the traditional command-and-control approach of administrative law in order to include environmental externalities[5]. Before the concept is evaluated its basic features will be introduced.

2.1 Legally Binding Definition of Emission Targets

The idea of emissions trading is based on a legally binding definition which overall emission level of pollutants should be allowed in a specific area over a stated period of time[6]. Secondly, a tradeable pollution permit [TPP] system is designed. At this stage it is important to distinguish between conventional uniformly mixed pollutants and non-uniformly mixed pollutants[7]. The former category denotes emissions whose geographical allocation is irrelevant regarding the achievement of the emissions

[5] R.M. Isaac, *The Scope for Laboratory Experiments on Marketable Pollution Permits, in* Designing Institutions for Environmental and Resource Management (E.T. Loehman and D.M. Kilgour, ed.: Cheltenham, U.K., Edward Elgar Publishing, 1998) p286.
[6] Z.X. Zhang, Greenhouse Gas Emissions Trading and the World Trading System, Journal of World Trade 219 (1998) p 222.
[7] Both conventional pollutants are sometimes called criteria pollutants pursuant to the Clean Air Act requires the Environmental Protection Agency [EPA] to develop criteria for maximum concentration standards: q.v. T. Tietenberg, Environmental and Natural Resources Economics, p 393; nota bene: This paper ignores the further distinction between assimilative and accumulative pollutants, q.v. S. Sorell and J. Skea, *Introduction, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 9.

policy target[8]: GHG fall in this category. The latter group consists of pollutants whose regional concentration is significant for their impact on the environment and for the policy objectives[9]. The acid rain substances SO_2, NO_x and lead emissions belong to this group as they cause regional damages depending on prevailing weather and wind conditions. A third category is formed by the so called hazardous pollutants[10]. These substances are so dangerous for human wealth that even the smallest recognisable amount of emissions will cause severe detriments. This prevents regulatory authorities from setting up a legally tolerable standard. Therefore, a trading system is not feasible for them.

2.2 Legal Design of Tradeable Pollution Permits

Beginning with a legal theory perspective, a TPP is an immaterial property right[11]. Property rights are classified by a commercial value facilitating the individual's life and two functions: transferability and exclusivity[12]. In order to organise an emissions trading system the legal design of TPPs has to be precisely drafted. Two different approaches are discussed. The first model, the allowance trading scheme, is based on TPPs which represent tradeable pollution allowances. The latter is defined as the

[8] N. Hanley, *Economic Incentives for the control of pollution: modelling tradeable permit systems, in* Environmental Valuation, Economic Policy and Sustainability, Recent Advantages in Environmental Economics (M. Acutt and P. Mason, ed.: Cheltenham, U.K., Edwar Elgar Publishing, 1998) p 99-100.
[9] S. Sorell and J. Skea, *Introduction, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 9; N. Hanley, *Economic Incentives for the control of pollution: modelling tradeable permit systems, in* Environmental Valuation, Economic Policy and Sustainability, Recent Advantages in Environmental Economics (M. Acutt and P. Mason, ed.: Cheltenham, U.K., Edwar Elgar Publishing, 1998) p 99 and 102.
[10] T. Tietenberg, Environmental and Natural Resources Economics, p 393 and 414.
[11] S. Sorell and J. Skea, *Introduction, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p3.
[12] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 14.

volume of pollutants one plant is permitted to emit in a certain period[13]. The literature refers to annual caps as quotas. The alternative trading scheme defines TPPs as emission reduction credits[14]. Such a credit is awarded if a polluting source reduces its emissions to an agreed level which is far below the level defined by its allowances. The benefit of the credit system is that it is easier to implement as it takes time until a sufficient number of credits is generated so that the market for credit will slowly evolve[15]. However, this system impedes the market development and consequently the reduction of abatement costs. It may also create a contra-productive incentive to increase the allowance level as one unit earns the more credits the higher the allowance level is[16]. Although the allowance scheme may be more difficult to implement due to the large number of initial TPPs, it is superior for numerous reasons: The huge number TPPs facilitates fast market development which is crucial for cutting emission abatement costs.

2.3 Registration of Relevant Emitting Sources

Another key-element of emissions trading is the reliable registration of individual emitters in order to define the future participants of the TPP market[17]. Three different options exist how to define the relevant group of emitting sources. The upstream

[13] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p2.
[14] Tietenberg, Environmental and Natural Resources Economics, p 406; S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p2.
[15] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 11.
[16] D. Harrison Jr., *Turning theory into practice for emissions trading in the Los Angeles air basin*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 68.
[17] Z.X. Zhang, Greenhouse Gas Emissions Trading and the World Trading System, Journal of World Trade 219 (1998), p 222.

trading system registers the producers and importers of fossil fuels[18]. As this strategy covers the whole amount of later emissions by concentrating on relatively few major entities without having to deal with small consumers the administration is facilitated to a large extent and existing institutions of the energy sector could supervise the system[19]. A relevant drawback is that the number of marketers may be too small in minor countries so that the domestic market may not achieve a significant growth[20]. Furthermore, there is a serious potential of market failure as dominating competitors are more likely to occur on small markets. These entities could transfer their power in product markets to the emissions market by hoarding TPPs. Additionally, one may criticise that due to retail competition the final consumers may not receive adequate pricing signals which are necessary to achieve reasonable levels of energy conservation[21].

The second variant is called the downstream trading system and focuses on the downstream energy sector by recording every location of primary energy consumption. This approach alleviates the initial market development due to the large number of buyers and sellers and encourages innovation[22]. However, the complex administration is a relevant drawback. Additionally, small consumers may fail to trade their permits as either the transactions costs concerning very small

[18] T. Hargrave, *US Carbon Emissions Trading: Description of an Upstream Approach*, p 8: e.g. crude oil importers, oil refineries, natural gas pipelines and processing plants, coal mines and processing plants.
[19] Z.X. Zhang, *Greenhouse Gas Emissions Trading and the World Trading System*, Journal of World Trade 219 (1998) p 226.
[20] F.C. Menz, *Transborder Emissions Trading between Canada and the United States*, Natural Resources Journal 803 (1995) p 807: e.g. few large SO_2 and NO_x polluters in Canada.
[21] Z.X. Zhang, *Greenhouse Gas Emissions Trading and the World Trading System*, Journal of World Trade 219 (1998) p 226.
[22] Z.X. Zhang, *Greenhouse Gas Emissions Trading and the World Trading System*, Journal of World Trade 219 (1998) p 226.

volumes of TPPs may be deterrent or an information deficit may occur. Some of these difficulties may be eliminated by a carbon tax for small polluters[23].

A hybrid trading system is generally based on an upstream system. Marketer's who supply fuels to minor consumers receive the additional obligation to purchase further TPPs covering the emission of their final vendees and to add the costs for these TPPs to their retail prices[24]. Such a system combines facilitated market administration with sufficient incentives for consumers to conserve energy. It also effectively includes all minor sources of pollution.

2.4 Allocation of Pollution Permits

The question how to distribute the initial TPPs in the chosen trading system is controversially discussed. One model favours the allocation of TPPs pursuant to the past legal emission levels of entities. This procedure is called "Grandfathering"[25].

Its advantage is both its simplicity and the avoidance of major cashflows. It does not seem to be politically persuasive to charge polluters for TPPs as they invested large amounts of capital under the traditional CAC regime which allowed them to emit specific volumes of pollutants for free[26]. Imposition of heavy charges for traditionally accepted volumes looks like an expropriation which is subject to compensation. However, a second scheme uses grandfathering only for the initial allocation of TPPs and arranges the final distribution by means of a government auction. initial recipients have to offer TPPs immediately in this auction and the offer is

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[23] This is a dangerous solution as taxation usually causes political resistance.

[24] Zhang, Z.X. and A. Nenjes, *International Tradeable Carbon Permits as a Strong Form of Implementation*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 329.

[25] M. Carley and Ph. Spapens, Sharing the World, Sustainable Living and Global Equity in the 21st Century (1st ed.)(London, U.K., Earthscan Publications Ltd, 1998) p 183.

[26] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p3.

accompanied by the recipient's demand schedule for TPPs[27] which he is interested in acquiring. The highest bids win and their bidders pay the amount of the highest bid which failed to be accepted. Every participant who looses TPPs is paid by the winning bidders. This procedure is called competitive auction or "zero revenue" auction[28].

The third regime is generally similar to the second approach but is based on a discriminative auction. The initial recipients who place their bid in order to achieve the final TPPs pay the monetary amount of their bids and face the risk that they will receive nothing in exchange if the placed bids are below the level of the last accepted one[29]. This approach is obviously imbalanced.

A fourth category promotes a hybrid trading system based on a final allocation of some TPPs by grandfathering and whereas the remaining TPPs are sold in a discriminative government auction[30]. This approach is supreme as it avoids the equity problem of pure grandfathering and enables the government to gain some revenues which may be transferred to the victims of emissions.

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[27] The schedule consists of a series of bids for TPPs at different price levels.

[28] R.M. Isaac, *The Scope for Laboratory Experiments on Marketable Pollution Permits*, *in* Designing Institutions for Environmental and Resource Management (E.T. Loehman and D.M. Kilgour, ed.: Cheltenham, U.K., Edward Elgar Publishing, 1998) p 286.

[29] This auction is called "zero-out" discriminative auction. q.v. R.M. Isaac, *The Scope for Laboratory Experiments on Marketable Pollution Permits*, *in* Designing Institutions for Environmental and Resource Management (E.T. Loehman and D.M. Kilgour, ed.: Cheltenham, U.K., Edward Elgar Publishing, 1998) p 288.

[30] D. Burtraw, *Cost Savings, market performance and economic benefits of the US Acid Rain Program*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 59.

2.5 Monitoring of Emissions

Another precondition of effective emissions trading is the close supervision of all emissions as otherwise the system would not succeed in curtailing the emissions to the targeted level and would lose its credibility[31].

2.6 Enforcement of Emission Targets and Sanctions

The next key-element of successful emissions trading schemes is the enforcement of its rules and stringent imposition of adequate fines in case of infringements. Additionally, enterprises having broken rules may be required to buy additional TPPs for future periods in order to cover the exceeded volume of the past[32]. It is worth while stressing that non-compliance with an emissions trading regime can be worse than similar behaviour under a command-and-control (CAC) approach[33]: An enterprise emitting more than allowed in terms of its TPPs may state an "official emission level" below its actual TPP volume and may sell the surplus of TPPs to another company. Finally, twice as much pollutants are discharged and the violating entity even gains profits by selling TPPs.

[31] Z.X. Zhang, *Greenhouse Gas Emissions Trading and the World Trading System*, Journal of World Trade 219 (1998) p 223.
[32] q.v. U.S. Clean Air Act, 42 U.S.C. § 7651j (1990).
[33] Z.X. Zhang, *Greenhouse Gas Emissions Trading and the World Trading System*, Journal of World Trade 219 (1998) p 223.

2.7 Concepts of Administrative Law incorporated in TPPs

Furthermore, a TPP may combine several policy options of administrative law.

2.7.1 Offset Policy

The offset policy concept denotes the function that TPPs may facilitate the process of erecting a new plant even if a region already reaches its pollution target. The investor is required to dedicate or purchase a specific amount of TPPs which equalises the future emissions[34]. As these TPPs are a result of transfers from other plants which will emit less than their initially allowed maximum due to added abatement technology, the construction of new emission sources is no longer a thread for the environment but an incentive for abatement technology.

2.7.2 Bubble Policy

The bubble concept expresses that one company owning one plant with several emission control points may flexibly achieve its obligations by emitting more pollutants at specific points as long as other units are either not operating or only consuming cleaner fuels or emitting less emissions in order to gain TTP which are transferred to the exceeding emission point[35].

2.7.3 Netting Policy

The rationale of netting deals with the fact that an entity undergoing slight amendments is exempted from specific preconstruction requirements and environmental impact assessments as long as the overall emission rate is not

[34] T. Tietenberg, Environmental and Natural Resources Economics, p 406.
[35] T. Tietenberg, Environmental and Natural Resources Economics, p 408; The acquired TPPs due to superior abatement technology form an imaginative bubble of TPPs which distributes them to exceeding sources; S. Sorell and J. Skea, *Introduction, in* Pollution for Sale: Emissions Trading and

affected[36]: Increased emissions in amended sections of an industrial site may be balanced by less emissions in its other sectors due to newly installed control technology. The economic incentive is that abatement costs may largely vary between different operational units.

2.7.4 Banking Policy

The market value of TPPs is heavily influenced by the banking policy. This strategy ensures that TPPs of present commitment periods can be used with greater flexibility as they will not expire at the end of the period if they remain unused[37]. They may be stored for usage in future periods related to offset, bubble or netting purposes.

2.7.5 Surrounding Legal Framework

Finally, the legal framework has to be adjusted in order to balance the decisions between capital investment in emission abatement technology and buying or even leasing of TPP[38]. While capital investment is a subject of depreciation in order to reduce the tax burden, TPPs are regarded as immaterial property rights which are not classic subjects of depreciation. Consequently, the legal framework has to reflect this issue so as to avoid distortions of the future TPP market.

Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 4.

[36] T. Tietenberg, Environmental and Natural Resources Economics, p 407.

[37] N. Matsuo, *Key elements related to the emissions trading for the Kyoto protocol*, Energy Policy 267 (1998); T. Tietenberg, Environmental and Natural Resources Economics, p 409.

[38] D.R. Bohi and D. Burtraw, Utility Investment Behavior and the Emission Trading Market, Colorado School of Mines, Seminar Paper, p 3.

3. Rationale of Emissions Trading

As emissions trading is obviously a demanding concept it is worth while to question if it will be superior to competing environmental policy options like CAC, emission charges/taxation.

3.1. The CAC Approach

The traditional CAC approach of environmental law is based on legally fixed standards of emissions limits which are deemed not to be risky. Every single polluting site must not exceed specific average short-term and long-term emission threshold regarding single pollutants[39].

The advantage of this concept is that is offers the simplest and most stringent strategy to enforce emission targets. This approach is justified if only one set of measures is appropriate to tackle emission problems especially if hazardous pollutants are involved. However, CAC has numerous limitations in the area of non-hazardous pollutants. First of all, the definition of emissions standards assumes that emissions below the standard do not cause any serious risk for human beings. This approach is falsified as nearly every pollutant is also dangerous in doses below the standards as specific people are more sensitive towards specific pollutants than others[40].

Secondly, the standard emission limits only reflect the concentration of pollutants near to the source without having regard to the exposure. Exposure is defined by the number of persons who are affected by certain pollutants in the ambient regions[41]. Despite of same concentrations, the exposure may extremely vary due to weather

[39] T. Tietenberg, Environmental and Natural Resources Economics, p 398 and 399.
[40] L.B. Lave and E.P. Seskin, Air Pollution and Human Health (1st ed.) (Baltimore, U.S., Johns Hopkins University Press, 1977) p 38.
[41] T. Tietenberg, Environmental and Natural Resources Economics, p 402.

conditions and population density. Thirdly, fix emissions thresholds do not reflect extreme weather conditions like thermal inversions: Under these conditions, the threshold emissions concentrations are no longer reduced but aggregated and cause serious risks. Furthermore, the thresholds are formulated without having regarded the control costs[42]. Finally, the CAC approach does not facilitate the development of marginal abatement costs as every plant has to fully comply with the standard although a second plants might be able to reduce emissions far below the standard at minor costs so that the first plant could emit more without altering the exposure[43].

3.2 Emission Charges and Taxation

The second policy variant deals with emission charges and taxation. These concept may intend to recover the monitoring costs[44] or the expenditure for medical treatment of air pollution victims[45].

However, this concept faces serious disadvantages. One major drawback is that it does not work exactly[46]: The state is not able to precisely predict the percentage rate which is necessary to achieve the appropriate incentive to invest in control technology or to conserve energy in future periods. Therefore, taxation is not a suitable tool to guarantee that specific emissions targets achieved. Finally, amendments of the taxation system are always sensitive measures. Furthermore, this concept closely affects national sovereignty so that it is not suitable for international

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[42] T. Tietenberg, Environmental and Natural Resources Economics, p 418.
[43] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p3; T. Tietenberg, Environmental and Natural Resources Economics, p 402.
[44] T. Tietenberg, Environmental and Natural Resources Economics, p 413.
[45] e.g. Japanese system since 1973.
[46] R. Pritchard, Hot Air about Emissions Trading, O.G.L.T.R. 2 (1999): Carbon Taxation is called a "blunt alternative"; S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 13.

authorities as countries are reluctant to transfer taxation competences to transnational bodies[47]. Emission charges lack the most of the benefits which are expressed by TPPs as they link offset, bubble, netting and banking policy.

3.3 Theoretical Superiority of Emissions Trading

The first economic benefit of emissions trading is that it introduces marginal abatement costs for all marketers. As abatement costs will utterly vary between different plants and locations it enables the owners to choose between three options how to comply with the emissions targets: A company will invest in control technology as long it is cheaper than purchasing TPPs. Alternatively, it will purchase TPPs if even the initial abatement costs are higher. Thirdly, one company - already complying with the targets - will invest in additional control technology as long it is cheaper than the market price for TPPs as further profits are feasible by selling these TPPs which are no longer required. Finally, the overall compliance costs are significantly smaller in comparison with the CAC policy[48]. The second advantage is the introduction of highly flexible compliance strategies[49]. It is worth while stressing the aspect of public expenditure for monitoring. Emissions trading includes market based incentives for polluters to cut their emissions while CAC policy usually creates a climate in which polluters are reluctant to co-operate. Thereby emissions trading is likely to reduce the costs of monitoring and enforcement. Subsequently, these aggregated benefits lead to greater average rates of compliance regarding the emissions targets[50]. It has to be pointed out that emissions trading increases the

[47] e.g. Failure of the attempts to create a European Carbon Tax.
[48] F.C. Menz, *Transborder Emissions Trading between Canada and the United States*, Natural Resources Journal 809 (1995).
[49] T. Tietenberg, Environmental and Natural Resources Economics, p 410.
[50] T. Tietenberg, Environmental and Natural Resources Economics, p 410.

demand for state of the art emission control technology so that the small supply industry is developed which will lead to lower prices in the long run. Finally it should be borne in mind that due the complexity of the concept the trading scheme needs to create a large competitive market in order to give clear price signals and to avoid inequity[51].

4. National Emissions Trading Schemes

Most of the applied emissions trading regimes are found in the U.S.. This finding may be caused by the fact that emission trading needs sufficient market size.

4.1 Lead Emissions Trading in The U.S.

After having started a CAC lead phasedown with continuously lowered thresholds in 1973 the EPA implemented a temporary emissions trading scheme on the federal level concerning the lead emissions which was applied between 1982-1988. Refineries and oil importers traded the right to add lead to gasoline[52]. The evaluation of the system is influenced by administrative difficulties[53]. However, as both significant trading activities and huge cost savings in refineries occurred[54], this system can still be regarded as successful.

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[51] R.M. Isaac, *The Scope for Laboratory Experiments on Marketable Pollution Permits, in* Designing Institutions for Environmental and Resource Management (E.T. Loehman and D.M. Kilgour, ed.: Cheltenham, U.K., Edward Elgar Publishing, 1998) p286.
[52] N. Matsuo, *Key elements related to the emissions trading for the Kyoto protocol*, Energy Policy 264 (1998).
[53] The monitoring of the rights to add fuel was to slow and caused a gap concerning fines. q.v. G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 141.
[54] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 140.

4.2 Federal Emissions Trading Program in The U.S.

The federal emissions trading programme is based on the Clean Air Act and was developed on a step by step basis[55]. It addresses a large number of fix emission points (downstream system). The TPPs are designed as emission reduction credits. The latter are rewarded if one source emits less compared to its allowance and if this result is enforceable, permanent and quantifiable[56]. TPPs incorporate the denoted offset, bubble, netting and banking policies. The EPA sets national ambient air quality standards [NAAQS] for different regions which deal with SO_2, NO_2, CO, particulates and ozone emissions. Additionally, these standards determine whether a source either has to install best available control technology [BACT] or may define own tools to get lowest achievable emissions results [LAER] or whether the installation of reasonable available control technology [RACT] is regarded as being sufficient[57]. An assessment of this system is difficult as the evaluation in the literature is controversial. On the one hand, it is stressed that the scheme should be regarded as successful as huge numbers of about 7,000-12,000 netting policy transactions occurred leading to abatement related costs savings of $ 10 billion[58]. On the other, it is pointed out that the savings did not exceed 1% of the abatement costs in a CAC approach[59]. It is worth while criticising that the offset and bubble policies never

[55] Major amendments were introduced in 1970, 1976 and 1986.
[56] T. Tietenberg, Environmental and Natural Resources Economics, p 406.
[57] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 131 and 132.
[58] S. Sorell and J. Skea, *Introduction, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 5; T. Tietenberg, Environmental and Natural Resources Economics, p 410.
[59] The regulation covers 47 pages; q.v. D. Harrison Jr., *Turning theory into practice for emissions trading in the Los Angeles air basin, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 64.

achieved significant importance[60]. Another drawback is that the formal trading requirements are too complex[61]. A crucial weakness is caused by frequent amendments of the legal framework which prevented the marketers from developing confidence in legal security[62]. Finally, the market development was impeded by the chosen emission reduction credit approach. However, this system serves as first practical evidence that the predictions of emission trading theory and experiments are valid.

4.3 Federal Acid Rain Control Program

The Clean Air Act Amendments of 1990 [CAAA] introduced the federal acid rain control programme which consists of an emissions trading system concerning sulphur dioxide beginning in 1995. The system defines the objective to decrease SO_2 emissions by 50% of the 1980 level[63]. It primarily addresses large power stations in its first commitment period between 1995-2000 and will expand to minor ones later (downstream-system). Contrary to the former discussed scheme, the acid rain control programme is designed as an allowance trading system. The TPPs are allocated annually by means of grandfathering and a legally stated emission rate[64]. A small amount of permits is awarded by government auctions held by the EPA and focusing on marketers who install new power stations[65].

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[60] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 5.
[61] The regulation covers 47 pages; q.v. D. Harrison Jr., *Turning theory into practice for emissions trading in the Los Angeles air basin*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 64.
[62] e.g. The offset policy was introduced 1976, the bubble concept followed 1979.
[63] U.S. Clean Air Act Amendments, 42 U.S.C. § 7651 (1990) part IV.
[64] F.C. Menz, *Transborder Emissions Trading between Canada and the United States*, Natural Resources Journal 806 (1995).
[65] United States Environmental Protection Agency, Acid Rain Programme Allowance Auctions and Direct Sales 1 (1980).

Similar to the above discussed system, the installation of specific abatement technology will be rewarded with additional allowances. Every single TPP allows the holder to emit a tonne of SO_2 in a specific year or later[66]. Since 2000, a cap of 8.95 million tons of emitted SO_2 is introduced.

The core argument assessing this system deals with rapid market development: Between April 1993 and March 1994, only 226,384 TPPs were conveyed privately compared to 176,200 TPPs sold in auctions[67]. However, the private market traded 5,000,000 TPPs in the period of 1996-1997[68]. This growth is facilitated by the allowance system. Another factor is that every citizen of the United States is eligible to purchase TPPs[69]. Although it was predicted that TPPs would be utterly expensive the real prices are reasonable[70]. A Spot market is established and derivatives are traded, too[71]. The enforcement is accompanied by strict penalties and a must use additional TPPs of future periods to cover the excesses of the past[72]. Additionally, the scheme decreases the marginal abatement costs by 42% compared to a fictitious

[66] United States Environmental Protection Agency, Acid Rain Programme Allowance System, EPA 430/5-92/018, p 2 (Dec. 1992).
[67] A.D. Ellerman and R. Schmalensee and P.L. Joskow and J.P. Montero and E.M. Bailey, *Summary evaluation of the US SO_2 emissions trading program as implemented in 1995*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 32.
[68] A.D. Ellerman and R. Schmalensee and P.L. Joskow and J.P. Montero and E.M. Bailey, *Summary evaluation of the US SO_2 emissions trading program as implemented in 1995*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 32.
[69] United States Environmental Protection Agency, Acid Rain Programme Allowance Auctions and Direct Sales 2 (1980).
[70] Prices of $1000 per ton were predicted but the real price level is about $ 90 per ton; q.v. S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 6.
[71] A.D. Ellerman and R. Schmalensee and P.L. Joskow and J.P. Montero and E.M. Bailey, *Summary evaluation of the US SO_2 emissions trading program as implemented in 1995*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 32.
[72] U.S. Clean Air Act, 42 U.S.C. § 7651j (1990).

CAC approach[73]. The system even caused emission reductions beyond the original targets[74]. Consequently, this system can be summarised as flourishing.

4.4 Ozone-depleting Substances Trading System

The EPA set up a domestic trading system for U.S. production and consumption allowances of ozone-depleting substances in order to implement the Montreal Protocol[75]. The system is designed as an upstream-system[76]. It is based on declining thresholds and takes the internationally traded substances into account[77]. The system design seems to be very efficient. Some authors predicted cost savings of 40% compared to a CAC framework[78]. However, a close analysis is difficult as the transaction data is partly confidential and as the market for these substances is dominated by few companies[79]. Throughout the world, certain other national schemes are applied but there are not discussed because of their minor political and commercial relevance[80].

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[73] D. Burtraw, *Cost Savings, market performance and economic benefits of the US Acid Rain Program*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 47.
[74] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 6.
[75] Montreal Protocol on Substances that Deplete the Ozone Layer, September 9, 1987, 26 ILM 1550 (1987) as amended 30 ILM 539 and 541 (1991), as amended 32 ILM 875 and 878 (1993)[hereinafter: Montreal Protocol].
[76] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 142.
[77] q.v. Art. 2 (5-11) Montreal Protocol.
[78] A. Palmer and W. Mooz and T. Quinn and K. Wolf, Economic Implications of Regulating Chlorofluorocarbon Emissions from Nonaerosol Applications, EPA-560/12-80-001, p 6.
[79] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 144.
[80] e.g. Danish Power Plants Quota; Dutch Sector Covenant; German Air Emission Offsets; New Zealand Fisheries License Trading.

4.5 Local Emissions Trading Regimes in The U.S.

Below federal level, several states implemented regional schemes. The most famous is the Regional Clean Air Incentives Market [RECLAIM] which covers Southern California since January 1994. It replaced the 1991 air quality management plan but kept its stringent emission targets concerning SO_2 and NO_x. The framework is designed as an downstream allowance trading system which covers 400 large plants which annually emit at least 4 tons of NO_2 or SO_2. TPPs expire after one year and no banking is allowed. A declining cap is introduced.

A major advantage of this system is that is uses two parallel and overlapping sets of TPPs so that every 6 months a series of TPPs becomes invalid[81]. Due to the overlapping validation periods, it is easier for marketers to ensure that they hold enough TPPs to cover their emissions without being forced to purchase TPPs in the last minute at an extraordinary price level. Although the abatement technology savings are controversially discussed even the most critical author expect at least reductions of 42%[82]. Therefore, this system can be evaluated as beneficial.

Another system is introduced in Michigan concerning criteria pollutants in terms of the Federal emissions trading program[83]. This system has to analysed in analogy to the federal scheme as it uses the doubtful concept of emission reduction credits[84].

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[81] S. Sorell and J. Skea, *Introduction*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 7.
[82] q.v. D. Harrison Jr., *Turning theory into practice for emissions trading in the Los Angeles air basin*, *in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p. 66.
[83] supra at 4.2 .
[84] Air Pollution Control Rules Part 12. Emission Averaging and Emission Reduction Credit Trading, R 336.222 Purpose (4/13/99) Rule 1202 (as amended April 13, 1999).

4.6 Failure of The U.K. SO_2 Emissions Trading Proposal

In contrast to successfully implemented trading schemes, the proposal for a U.K. SO_2 emissions trading regime[85] failed to gain the political support[86]. The reasons will underline that legal, political and institutional obstacles can overwhelm economic arguments. First of all, the legal context is far more complicated in the Member States of the European Union [EU] as both the treaties and the secondary legislation of the European Communities [EC] have an impact on the freedom of domestic legislature pursuant to the harmonisation principle of EC law. The area of air pollution is especially covered by the Air Framework Directive[87], the Large Combustion Plant Directive[88] and the Integrated Pollution Prevention Directive[89]. Other Directives deal with fuel quality standards or and ambient air quality[90].

Secondly, the then ongoing process of privatisation and liberalisation of the British energy sector made it more difficult to replace the traditional CAC environment[91]. Another counter-argument against the proposal was that the SO_2 emissions were already declining as many power stations switched to cheaper, more energy efficient and cleaner natural gas due to the new competitive structure of the energy sector. Additionally, the regulatory culture of the U.K is significantly different from the U.S.

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[85] q.v. Second Year Report on the Environment White Paper, Department of the Environment (1992).
[86] S. Sorell, *Why sulphur trading failed in the UK, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 170.
[87] Council Directive 84/360/EEC of 28 June 1984 on the combating of air pollution form industrial plants, OJ L 188, 16/07/1984, p 0020 - 0025: The directive deals with air pollution from plants and demands the installation of "Best Available Control Technology Not Entailing Excessive Costs".
[88] Council Directive 88/609/EEC of 24 November 1988 on the limitation of emissions of certain pollutants into the air from large combustion plants, OJ L 336, 07/12/1988, p 001 - 0013.
[89] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control, OJ L 257, 10/10/1996, p 0026 - 0040.
[90] Council Directive 80/779/EEC of 15 July 1980 on air qualitiy limit values and guide values for sulphur dioxide and suspended particulates, OJ L 336, 07/12/1988, p 001 - 0013.
[91] q.v. Privatisation and liberalisation of the electricity sector: Energy Act of 1983; Electricity Act of 31 March 1990; Privatisation and liberalisation of the gas industry: Gas Act 1986; several inquiries of OFGAS, OFT and MMC; Gas Act 1995.

as negotiations, discretion and flexibility of administrative units are more common in the U.K. than in the U.S. where the former CAC regulation was strictly enforced[92]. Consequently, some negative effects of the CAC environment were already compensated. Finally, conflicts about the TPP allocation decreased the remaining political support of the proposal[93]. The outcome of the U.K. proposal stresses that the concept of emissions trading has to be adapted to legal and institutional environments in order to succeed. This finding is crucial in the context of national resistance against the ratification and implementation of the Kyoto protocol.

5. International Emissions Trading

Current systems of international emissions trading are either related to the Montreal protocol[94] or to the Kyoto Protocol.

5.1 Montreal Protocol

The Montreal Protocol[95] contains a very simple emissions trading system. Art.2(5) of the Protocol enables the parties under specific circumstances to transfer their production contingents of ozone-depleting substances to other Member States. Additionally, Art.2(5bis) enables industrialised countries to convey their allowed consumption units to other industrialised nations.

Kommentar: ?????????????

[92] S. Sorell, *Why sulphur trading failed in the UK, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 193.
[93] S. Sorell, *Why sulphur trading failed in the UK, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 195 and 199.
[94] Montreal Protocol on Substances that Deplete the Ozone Layer, September 9, 1987, 26 ILM 1550 (1987) as amended 30 ILM 539 and 541 (1991), as amended 32 ILM 875 and 878 (1993).
[95] It was set up in order to specify the objectives of the Vienna Convention on the Protection of the Ozone layer: Vienna Convention on the Protection of the Ozone Layer, March 22, 1985, 26 ILM 1529 (1987).

The Montreal protocol lead to significant reductions of production and consumption of these substances. However, international trading of production units has not yet occurred as the secretariat was never notified pursuant to Art.2(5)2[96]. Apart from its minor practical relevance, this trading system is a theoretical predecessor of the Kyoto Protocol.

5.2 Kyoto Protocol

After difficult negotiations, the Kyoto Protocol was adapted by the third conference of the parties [COP] of the UNFCCC. After having briefly outlined the climate change policy, the key-provisions of the Kyoto Protocol and its certain weaknesses are discussed.

5.2.1 Development of international climate change policy

Boosted by the discussions following the first assessment report of the Intergovernmental Panel on Climate Change [IPCC] in 1990[97], the UNFCCC was established in 1992 with the goal to stabilise anthropogenic GHG emissions[98]. Its key-concept is that it only offers a consistent legal platform how to prepare later protocols which shall contain legally binding tools. This approach is not only justified by the core negotiation strategy that, at first, one shall focus on general easily agreeable issues before trying to negotiate difficult details[99] but also by the fact that scientific evidence was still doubtful in 1992. The major disadvantage of this approach is that institutionalised procedures like regular COPs and subsidiary body

[96] G. Klaassen, Acid Rain and Environmental Degradation, The Economics of Emission Trading (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1996) p 168. nota bene: This result has nothing to deal with domestic trading of production and consumption allowances.
[97] The IPCC was founded by the United Nations Environment Programme and the World Meteorological Organisation.
[98] Art. 2 UNFCCC.

meetings tend to focus on procedural questions rather than negotiating substantive improvements: Neither COP-1 nor COP-2 were able to agree on rules of procedure[100]. Another drawback is that countries which are reluctant to climate change policy may join a framework agreement but try impeding the later substantive negotiations[101]. However, after the 2nd assessment report of the IPCC of 1995 had stated the substantial human influence on climate change, the political pressure to reach a consensus increased[102] and new substantive proposals were submitted[103]. The Kyoto Protocol is adopted but has not yet entered into force[104]. It mainly depends on the ratification by the U.S. Senate as the U.S. are the world largest producer of GHG[105].

5.2.2 Joint Implementation under Art.6 Kyoto Protocol

Joint implementation [JI]forms the first variant of three different emissions trading schemes of the protocol which are summarised as flexible mechanisms[106]. The basic emission reduction target is defined in Art. 3 which refers to the Annex-B countries and their individual Annex-B thresholds[107]. These countries are enabled to trade

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[99] e.g. specific legal commitments or exemptions for specific groups of countries.
[100] S. Oberthür, *The Second Conference of the Parties*, Environmental Policy and Law 199 (1996).
[101] These countries may use formal or substantive measures: e.g. OPEC Countries who seem to doubt scientific results in order to promote consumption of fossil fuels; q.v. S. Oberthür, *Sign of Progress*, Environmental Policy and Law 160 (1996).
[102] S. Oberthür, *Sign of Progress*, Environmental Policy and Law 158 (1996).
[103] M. Ehrmann and S. Oberthür, *Spring in Climate Negotiations*, Environmental Policy and Law 193 (1997); M. Ehrmann, *Meeting of the Subsidiary Bodies*, Environmental Policy and Law 85 (1997).
[104] Art. 25 (1) demands 55 ratifications representing 55% of GHG emissions. It was rapidly ratified by 7 countries which are members of the AOSIS; q.v. B.H. Desai, *Institutionalizing the Kyoto Climate Accord*, Environmental Policy and Law 163 (1999).
[105] about 38% of world-wide GHG emissions.
[106] S. Tromans, Carbon Emissions Trading - A Primer for Business, O.G.L.T.R. 347 (1999).
[107] Annex-B contains Industrialised Countries and provides an average reduction of 5.2 % of the 1990 levels during the first commitment period between 2008-2012.

emission reduction units among each other. Credits are awarded for projects reducing GHG sources or enhancing sinks[108].

The efficiency of JI is impeded because only emission reduction unit are tradeable instead of allowances. Another bottleneck is that Art. 6 (1) (c) states that this scheme should be supplemental to domestic measures. This terminology is extremely vague. Some countries suggest that at least 50% percent of emission reduction have to be achieved by domestic action[109] while others promote the usage of flexible mechanisms up to 75%[110]. This first view may be backed by the wording. However, it seems superior to interpret this clause very extensive as the rationale of emissions trading demands intensive trading in order to cut the marginal abatement costs. It is important to underline that the concept may be circumvented if investors in a country decide to erect a plant with intentionally low control standards so that another country is enabled to offer a emission reduction project[111]. A final evaluation is not yet feasible as guidelines have to be formulated[112] and evidence of practical projects is needed.

[108] Art.6(1)(b) Kyoto Protocol. Sources are defined in Art. 1 (9) UNFCCC, sinks in Art. 1 (8) UNFCCC.
[109] E.U. and Switzerland; q.v. R. Hamwey and A. Baranzini, *Sizing the global GHG offset market*, Energy Policy 123 (1999) p 126. This clause was introduced by the E.U. who tried to prevent the U.S. from meeting its obligations by buying surplus TPPs from the Economies in transition.
[110] Japan, U.S., Canada, New Zealand; q.v. R. Hamwey and A. Baranzini, *Sizing the global GHG offset market*, Energy Policy 126 (1999). The so called JUSCaNZ group.
[111] I.O. Walker and F. Will, How effective would Joint Implementation be in stabilizing CO_2 emissions?, OPEC Bulletin 17 (November/December 1994).
[112] Art. 6 (2); These are still under discussion. q.v. Anonymous, *Implementation Measures Discussed*, Environmental Policy and Law 164 (1998).

5.2.3Clean Development Mechanism pursuant to Art.12 Kyoto Protocol

The Clean Development Mechanism [CDM] enables Annex-B countries to undertake emission reduction activities in an Non-Annex-B country[113]. The COP will constitute a specific transnational body which will decide about eligible projects and the number of emission reduction units using specified criteria[114]. The involved Annex-B country is entitled to use the certified units to meat its commitments[115]. It is worth while stressing that projects undertaken since 2000 may be used to address the commitment period[116]. This emissions trading scheme is utterly valuable as it facilitates the technology transfer to Developing countries. Mutatis mutandis, the Annex-B countries benefit from low abatement costs in the project countries.

5.2.4Emissions Trading under Art.17 Kyoto Protocol

Art.17,1-2 introduces an emissions trading regime between Annex-B countries in order to fulfil their Art.3 commitments. The system is threatened by the supplementation doctrine[117]. A final assessment is difficult as the COP is entitled to draft the precise design of the future system using its discretion to define verification, reporting and accountability. COP-4 only set the timetable for the task[118].

However, some of the other relevant issues are already a subject of academic discussion:

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[113] Art. 12 (2) Kyoto Protocol.
[114] Art. 12 (5) (a-c) Kyoto Protocol.
[115] Art. 12 (3) (b); Art. 3 Kyoto Protocol.
[116] Art. 12 (10) Kyoto Protocol. This procedure called "early crediting"; q.v. S. Parkinson and K. Begg and T. Jackson, *Does early crediting compromise the Kyoto Protocol?*, Energy Policy 431 (1999).
[117] Art. 17,3 Kyoto Protocol; q.v. Art. 6 (1) (d); supra at 5.2.2 . The U.S. argued in favour of emissions trading whereas the E.U. preferred a Carbon Tax and insisted to add the supplementary doctrine; q.v. E.A. Smeloff, *Global Warming: The Kyoto Protocol and Beyond*, Environmental Policy and Law 65 (1998).
[118] R. Pritchard, *Hot Air about Emissions Trading*, O.G.L.T.R. 1 (1999). COP-4 was held in Buenos Aires on 2 November 1998.

One major factor is that the transnational trading system has to reflect that TPPs may be transferred not only between countries, but also between the following partners: private entities - if Member States implemented domestic GHG trading systems compliant to the Protocol -, international organisations and non governmental organisations[119].

Furthermore, it is not clear whether an allowance or credit trading system will be chosen. UNCTAD favours the former[120] and it is already stated that this regime contains the superior solution[121]. According to the allocation of TPPs various options are discussed. Four models have already been discussed[122]. Other approaches ask for either the GDP as a proportional or the per capita emissions as a reverse proportional allocation criterion or the population number or density. The different approaches may be combined[123]. Grandfathering is criticised due to a lack of equity as the most responsible countries may generate profits by selling TPPs[124]. However, it seems obvious that it will be at least the initial criterion. Additionally, Banking and borrowing of TPPs are discussed and it is proposed to introduce two different sets of TPPs similar to the RECLAIM system[125].

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[119] UNCTAD, Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability, Executive Summary; J. Skea, *Flexibility, emissions trading and the Kyoto Protocol*, in Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 374.
[120] UNCTAD, Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability, Executive Summary.
[121] supra at 2.2 and the insufficient performance of the U.S. Emission Credit Trading at 4.2 .
[122] supra at 2.4 .
[123] tree-type which amends one major criterion; mixed-type which equally mixes two types; selection-type which enables the Member States to choose, categorisation-type which forms different groups of Member States; q.v. N. Matsuo, *Key elements related to the emissions trading for the Kyoto protocol*, Energy Policy 272 (1998).
[124] M. Carley and Ph. Spapens, Sharing the World, Sustainable Living and Global Equity in the 21st Century (1st ed.)(London, U.K., Earthscan Publications Ltd, 1998) p 182 - 183; A.D. Sagar and T. Banuri, *In fairness to current generations: lost voices in the climate debate*, Energy Policy 512-513 (1999).
[125] N. Matsuo, *Key elements related to the emissions trading for the Kyoto protocol*, Energy Policy 266 and 268 (1998).

6. Conclusion

This paper has discussed the legal and economic rationale of emissions trading in order to assess its competitiveness against to CAC or taxation concepts. After having discussed both theoretical criteria and applied systems it has to be concluded that it is a superior approach to internalise the social costs of air polluting industrial activities as it minimises the marginal abatement costs. Moreover, the analysis of applied trading schemes underlined its superiority as long as it is carefully adapted to the surrounding legal, institutional and cultural environment. The most persuasive solution is the allowance system providing not only a rapid development of liquid markets but also early cost reduction. Liquid TPP markets are a precondition for later evolving spot markets[126]. The latter will be the basis of markets for derivatives[127] which allow financial risk management in order to hedge the marketers against the price risk of TPP. Regarding the Kyoto protocol, it shall be stressed that several problems remain unsolved: Firstly, its future practical value mainly depends on its further elaboration by the COP and on its ratification although BP/Amoco and the World Bank have recently announced that they were designing TPP transaction schemes. Secondly, it is important to focus on the so called GHG bubble in the transitional economies as the collapse of the Soviet Union and slow economic growth may enable countries to sell so many TPPs that the industrialised countries could honour most of their obligations by simply purchasing permits which do not reflect abatement technology investments in the selling nations[128]. Another problem might be the compliance of emissions trading related sanctions with WTO law.

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[126] q.v. S. Tromans, Carbon Emissions Trading - A Primer for Business, O.G.L.T.R. 348 (1998).
[127] Derivatives are forwards, futures, options, and swaps.
[128] R. Hamwey and A. Baranzini, *Sizing the global GHG offset market*, Energy Policy 124-125 (1999); B.H. Desai, *Institutionalizing the Kyoto Climate Accord*, Environmental Policy and Law 160 (1999).

7. Annexes

7.1 Marginal Abatement Costs due to Emissions Trading

[Graph omitted in the online version, please contact the author]

MAC Marginal Abatement Costs of a company.

e_f represents the initial number of permits allocated by grandfathering.

p* represents the market price for TPPS

The company will keep e* permits as its MAC to replace these by investment in control technology are higher than the market price.

It will sell the remaining TPPs (e_f - e*) as for these permits it is cheaper to invest in control technology so that the sale creates additional revenues

Source:

Hanley, N., *Economic incentives for the control of pollution: modelling tradable permit systems, in* Environmental Valuation, Economic Policy and Sustainability (M. Acutt and P. Mason, ed.: Cheltenham, U.K., Edgar Elvar Publishing Ltd, 1998) p 101.

7.2. Comparison between The Allowance Trading System and The Emission Reduction Credit Approach

[Image omitted in the online version, please contact the author]

Source:

Sorrell, S. and J. Skea (ed.), Pollution for Sale, Emission Trading and Joint Implementation (1st ed.) (Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 11.

7.3 Savings due to Efficient Emission Trading Pursuant to the CAAA in 1995

[Image omitted in the online version, please contact the author]

Source:

Burtraw, D., *Cost Savings, market performance and economic benefits of the US Acid Rain Program, in* Pollution for Sale: Emissions Trading and Joint Implementation (S. Sorrell and J. Skea ed.: Cheltenham, UK, Edgar Elvar Publishing Ltd, 1999) p 47.

7.4 Emissions Trading pursuant to Art. 17 Kyoto Protocol

[Image omitted in the online version, please contact the author]

Source:
N. Matsuo, Key elements related to the emissions trading for the Kyoto protocol, Energy Policy 266 (1998).

7.5 Parallel Series of TPPs

[Image omitted in the online version, please contact the author]

Source:
N. Matsuo, Key elements related to the emissions trading for the Kyoto protocol, Energy Policy 268 (1998).

7.6 UNFCCC Hot Air Problem concerning Russia

[Image omitted in the online version, please contact the author]

Source:

Hamway, R. and A. Baranzini, *Sizing the global GHG offset market*, Energy Policy 125 (1999).

7.6 UNFCCC Hot Air Problem concerning Russia

[Image omitted in the online version, please contact the author]

Source:

Hamway, R. and A. Baranzini, *Sizing the global GHG offset market*, Energy Policy 125 (1999).