# Hot Air as an Implicit Side Payment Arrangement: Could a Hot Air Provision have Saved the Kyoto-Agreement?

*Urs Steiner Brandt*
*Gert Tinggaard Svendsen*

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Urs Steiner Brandt
Department of Environmental and Business Economics
University of Southern Denmark
Niels Bohrs Vej 9-10
DK-6700 Esbjerg
Tel.: +45 6550 4184
Fax: +45 6550 1091
E-mail: usb@sam.sdu.dk

Gert Tinggaard Svendsen
The Aarhus School of Business
Department of Economics
Fuglsangs Allé 4
DK-8210 Aarhus V
Tel.: +45 8948 6408
Fax: +45 8615 5175
E-mail: gts@asb.dk

# Abstract

The purpose of this paper is to analyse whether the presence of Hot Air trading jeopardizes the environmental target of an international environmental agreement. We argue that Hot Air can be used as an implicit side-payment mechanism to actually bring about higher environmental protection compared to the situation without the trade option. We point to the existence of a fundamental trade-off between costs of compliance and the creation of dynamic incentives to develop cheaper reduction technologies. Implicit side-payments, in terms of Hot Air provision, may be needed in order to establish a compromise between these opposing demands. We identify the shortcomings and benefits of allowing fully flexible permit trading including the allocation rule of grandfathering.



JEL Classification: Q28; H2; H4.

**Keywords**: Hot Air; Global GHG trade; Kyoto protocol; Grandfathering; Cost issue; EU; US.

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# 1. Introduction

Did the presence of Hot Air jeopardize the Kyoto agreement, or did the resistance against cheap reduction opportunities? And what are the long run implications of different methods of complying with environmental targets in the short run?

This paper sets out to clarify the effects of including Hot Air into a tradable permit system. It will be argued that the presence of Hot Air actually can increase environmental protection in the long run, since it might overcome the main obstacle for progress in the reduction of international environmental problems, that being the high costs of emissions reduction. We will discuss the option of using Hot Air as an implicit side-payment mechanism that may actually bring about higher environmental protection compared to the situation without this trade option. The insight gained from this analysis will be applied to study the Climate change negotiations with special focus on the risk of making an agreement unnecessarily costly.

In the beginning of the 1970s, the growing concern regarding the increased transboundary character of environmental problems lead to the formulation of the first guidelines to help alleviate these problems. The necessity of common responsibility to control transboundary pollution was formulated at the UN conference in 1972 in Stockholm: ”*States have in accordance with the charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damages to the environment of other states or of areas beyond the limits of national jurisdiction”*.[1] With this declaration the international society accepted the application of the polluters pay principle. But there is a long distance between this acceptance and the political reality: The problem is that this principle is in opposition to both the political structure of the international society and the prevailing economic incentives.

The political structure is defined by the absence of a supranational authority empowered to enforce legislation upon states. The sovereignty of nations im-

1 In: Principle 21 in ”The Declaration of the Human Environment” accepted by the OECD countries at the UN conference in 1972 in Stockholm.

plies that any contribution to alleviate an international environmental problem must be on a voluntary basis.[2] Varming *et al.* (2000) note that achieving a fully co-coordinated global solution to the problem of climate change is going to be difficult because no global institution is in place for enforcing the agreement. Thus, because cost-sharing and the control system are not strictly enforced by one global authority, the collective good provision of $CO_2$ reduction may not take place even though it pays for the group as a whole (see logic of collective action analysis in Svendsen, 2003).

As a consequence, questions about design of an agreement must inevitably concentrate on finding the right conditions, such that all (or at least the most important) countries have an incentive to join the agreement.[3] This is particularly relevant in situations when the intrinsic prisoner's dilemma structure cannot be altered. Here the only way to encourage countries to participate is to find a compromise that in the best possible way takes into account the individual countries' conditions.

A minimum requirement for participation is that each participant perceives a net gain from entering the agreement. An important observation of international environmental agreements is that because participation in such agreements must be totally voluntarily and a country should never be expected to sign an agreement that makes it worse off compared to no agreement. Given this hypothesis, without a net gain, there will be no agreement. Hence, if a country does not achieve an overall net gain from an agreement, one would expect an unstable agreement that is not likely to succeed in the longer run. This view is supported by Barrett (1998a), Bohm (1999) and Sandler (1997).

One compromise could be to use side payments to encourage participation. Such arrangements, based on a (partially) victims' pays principle are seldom seen: Mäler (1993, p27) mentions that: "it is somewhat surprising that instances where international environmental problems have been solved with the aid of

2 "Standard solutions for transboundary environmental externalities are therefore not available, and the protection of the international commons is left to voluntary agreements among sovereign countries. It is precisely this fact, which requires a shift in our analysis, from a literature on government intervention to a literature between nations and international policy government". Carraro and Siniscalco, 1992, p. 380.

3 Stavin mentions that climate agreements have to be founded on "sound science, rational economics, and pragmatic politics". (R.N. Stavin: Briefing for H.E. Kofi Annan, 24 April 2002).

side payments are very rare". He states three main reasons, first it stands against policy recommendations (the polluter pays principal). Moreover, the paying countries might be labeled weak negotiators, and side payments might create expectations of precedence. Last, as with subsidies, it has a risk of creating the wrong set of incentives.

Although it would seem that side payments are not politically feasible, their relevance in order to promote cooperation cannot be ignored, especially when countries differ greatly with respect to net gain or national income. This will be the point of departure of our paper: There might be good reason to search for less visible ways of payment to "bribe" countries to participate in an agreement. The presence of Hot Air can be seen as such an instrument: Nentjes and Woerdman (2000) and Woerdman (2001) argue that the Kyoto figures were negotiated on the prospect (at least from the side of the US and Russia) of the availability of free trade. Thus, the presence of Hot Air cannot be seen independently of the negotiated target levels in Kyoto.[4]

At the risk of losing some realism but at the same time gaining simplicity and predictive power, we assume that negotiators are fully informed and economically rational decision-makers with the best economic interest of their countries at heart at all times.[5]

Section 2 examines the implication of Hot Air in the short run and the long run. Section 3 examines the Kyoto agreement and the section 4 looks at the presence of Hot Air in the climate change issue. Section 5 is concerned with the dynamic perspectives given various scenarios about the short run achievements in the climate change issue. These analyses lead to a concluding policy recommendation in Section 6.

4 Woerdman (2001, page 9): "Eastern Europeans seem to consider the tradable Hot Air as a legitimate compensation for the emissions reductions induced by the economic decline which resulted from the deliberately established economic transition process".

5 When the decision makers are not full informed, one should be even more cautious with too high reduction demands. One reason for this is that industrial groups might point to the highest cost estimates and put more pressure on a government for a weakening of environmental targets, especially if the industrial groups have superior information about the true reduction costs.

# 2. Implications of Hot Air

Hot Air is generated in situations where, even without any policy action, emissions are likely to be significantly below target levels. In conjunction with an international permit trading system, the increased "free permits" (permits that are not a result of emissions reduction effort), can be sold as Hot Air to other participating countries and used to offset their GHG emissions. In the Kyoto protocol, for example, Russia's actual emission level is lower than the number of grandfathered permits and in connection with a tradable permits system, Hot Air is created. "Grandfathering" simply means that the property right to emission rights is freely transferred on the basis of certain distribution rules (Tietenberg, 1995).

## *2.1. An example of Hot Air*

We provide a very simple example that shows why the presence of Hot Air does not jeopardize the agreed upon overall emission target of an international environmental agreement. Let there be a uniformly mixed pollution emitted in two countries, A and B. Country A has an emission of 100 units and agrees to reduce by 10%, in year X. Country B also has an emission of 100 units and agrees to reduce by 10%, in year X. The new agreed upon total emission is 180, which defines the environmental target of the agreement. Now, due to an economic recession in country B, even without any abatement effort, in the year X this country will only have an emission of 85. Thus, if country A meets it's agreed upon reduction, the actual emission in year X is 175.

If we allow the countries to trade emission rights freely, such that each country is given 90 emission units, the first 5 units of country B are provided "at zero costs" and will be bought by country A. (This amount is, for obvious reasons, called Hot Air). This increases emission units in country B by 5, without changing the actual emission in country A. If more trade prevails, this will not change the total emission. In a free-trade situation, the emission level will be 180, which is exactly the agreed upon environmental target.

The effects of Hot Air in this example:

- Environmental target is still secured

- Marginal costs of country A have been lowered considerably
- The 10 units of Hot Air have reduced total compliance costs of country A considerably
- Country B has received a large payment

Now, since country B has experienced a large recession, it might be reasonable to expect that it is not likely to undertake costly abatement efforts.[6] Hence, without the presence of Hot Air, it will not sign the agreement, and there will be no agreement, leaving the emissions at 185. Hot Air has been a mechanism of implicit side payments, and has secured the originally stipulated environmental target.

This is the heart of our arguments. Once signed, agreements are more likely to be kept with Hot Air.[7] Hot Air might actually increase the total amount of environmental quality (emissions reduction) that an agreement can sustain.

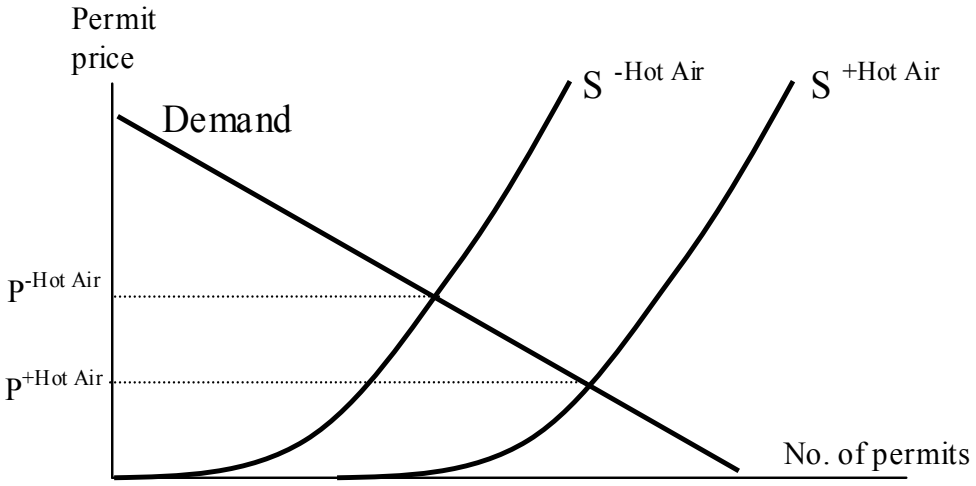
## *2.2. How Hot Air affects permit price?*

One of the objections against the use of Hot Air is that it reduces the incentives to support non-renewable energy supply systems and reduces the incentives to develop new and less polluting energy supply system. The demand curve for permits can be defined as a country's willingness to pay in order to avoid another unit of reduction (which is equal to the marginal abatement cost). The supply curve, measuring the cost of providing another permit, is simply the marginal abatement cost, the opportunity costs of reduction. Therefore, the supply curve at the first unit of permits is equal to the lowest marginal cost of meeting the emissions reductions target, while the demand curve is the highest cost. Permits will be traded until the cost a buying country avoids by emitting one unit more is equal to the cost a selling country incurs of reducing another unit, which can be seen in figure 1. Since Hot Air is emission units that can be provided without any costly reduction effort, it can be provided at zero costs and, hence, shifting the supply curve to the right.

6 We here implicitly assume that at the time of signing the agreement, the recession is already a reality, while the base line emissions refer to a date before the recession.

7 Or, because of the flexibility, targets are more likely to be signed in the first place.

***Figure 1: How Hot Air affects permit prices***




In figure 1, this is illustrated by a shift in the supply curve from $S^{-Hot\ Air}$ to $S^{+Hot\ Air}$. The effect is that trade increases and the equilibrium price is reduced. The marginal costs under free trade are equal to the permit price under free trade. The reason is that each country can either buy permits or reduce its emissions, and it will always choose the cheapest option. In this way, no country's marginal costs will ever be above the permit price in equilibrium. It cannot be lower either, since then this country could make further reductions and sell with a gain. Hence, inclusion of Hot Air reduces the marginal costs of meeting the pre-defined emissions reduction targets.

## *2.3. Negative effects of Hot Air*

Market-based instruments have the potential to provide powerful incentives for companies to adapt cheaper and better pollution-control technologies. This is because with market-based instruments, it always pays firms to clean up a bit more if a sufficiently low-cost method (technology or process) of doing so can be identified and adopted.[8] One main objection to the inclusion of Hot Air is that is lowers the incentives to develop cleaner technologies, since the higher the marginal reduction cost (of the last unit of reduction), the higher such incentives. In a tradable permit system, such incentives are determined by the prevailing permit price. From figure 1, it is obvious that Hot Air reduces the permit price.

8 See Stavins (2002).

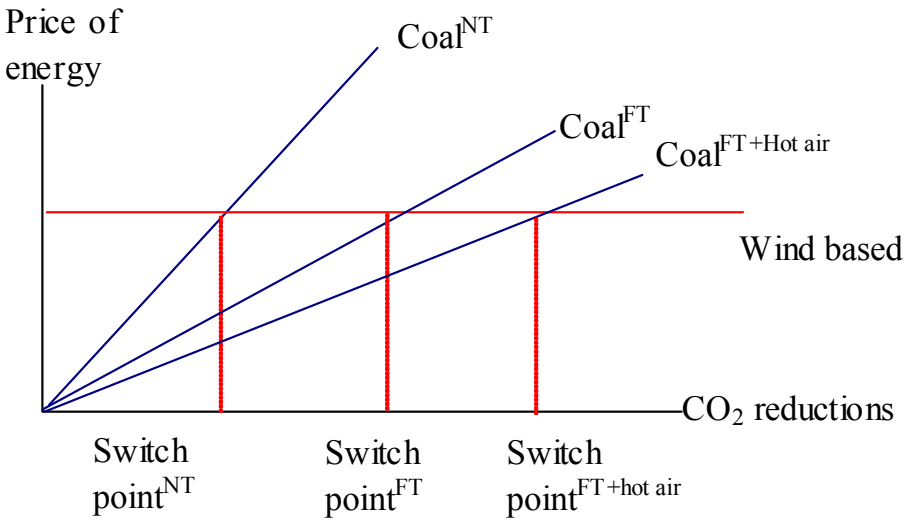
What is the implication of including Hot Air on the relative competitiveness of different energy supply systems? In order to answer this question, it will prove informative to look at how different reduction policies to cope with the climate change issue influence the relative prices of various energy supply systems.

The marginal costs of fossil-based energy production can be assumed to rise over time. For example, coal producers have to dig deeper mines or have to use less efficient coal. development towards the use of renewable energy sources may be sped up if the environmental costs are added to the price of fossil fuels, for example by taxing fossil fuels or by adding the permit price of $CO_2$ emissions. In this way, more stringent $CO_2$ reduction obligations increase the relative price of non-renewable fossil fuels compared to renewable energy. Eventually, it may suddenly pay to switch to a renewable resource, for example from oil to wind or solar energy in power plants.[9]

A switch point approach can yield valuable insights into how different policy options influence the timing of switch points. To illustrate this point, figure 2 shows a situation where only two possible types of energy production exist, coal fired and wind-based, where wind based energy production is $CO_2$ neutral. Here we compare two policy options, a fully flexible situation, where no restriction on international trade in permits exists, and one where only domestic emission reductions are allowed. $Coal^{NT}$ identifies the price of energy produced by coal in a non-trade scenario, while $Coal^{FT}$ is defined as the coal based energy price in a full trade situation. Obviously, wind-based energy production becomes competitive compared to coal-based energy production at a lower emissions-reduction level in a non-trade situation. Inclusion of Hot Air even moves the switch points further to the right.

9 An in depth analysis of this can be found in Brandt and Svendsen (2003) and Grübler *et al*. (1999).

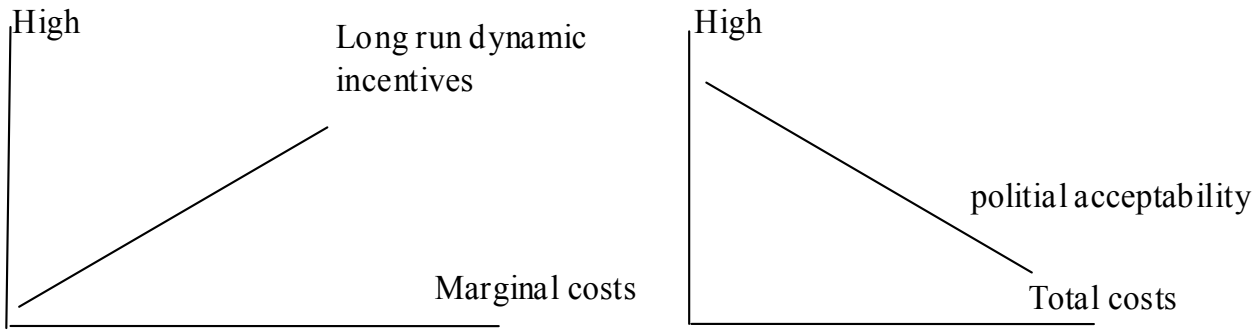
***Figure 2: Change in relative prices from different reduction policies***




## *2.4. Long run consequences*

Whether or not the presence of Hot Air trading reduces long run incentives for development and implementation of cleaner technologies remains unclear. Creation of dynamic incentives means that new cleaner technologies are developed. Such developments reduce abatement costs and causes further progress. However, such thinking stems from national regulation theory, and does not consider resistance from the regulated entities, or sovereignty issues in the international community. Since countries are free to leave/not sign an agreement, approaches that increase the costs run the risk of reducing the number of participating countries.

***Figure 3: The level of reduction costs influences long run progress***




As an example, if the purpose of the Kyoto-agreement was not only to secure the 5.2% reduction of the Annex B countries, but also to promote incentives to

develop new abatement technologies, then the best way to achieve these two objectives on the basis of the cost structure is by applying an approach that simultaneously yields low overall costs of compliance (to secure maximum political acceptability), and high marginal abatement costs of the last reduced unit (to secure maximum incentives to develop new and cleaner technologies). This reasoning is reproduced in figure 3.

Note, however, that the inclusion of Hot Air both reduces total costs and marginal costs of emissions reductions. On the other hand, restriction of Hot Air trading increases both marginal and total reduction costs, increasing the probability of non-ratification and "dead-lock" of further negotiations.[10]

It is possible to identify situations where high short run political acceptability is a pre-requisite for the long run incentives to be achievable. Such a situation exists in the case, where progress to reduce the international dispersed pollutant take place successively and where future reduction requirements are linked to past performances.

The main reason why we come to this conclusion is that a break-down of ongoing negotiations is likely to result in persistently negative consequences in the long run. This can be seen from the fact that a number of international environmental agreements are built-up by successively tightening the individual and total reduction obligations. In efforts to control the climate change problem, the first negotiations in Rio in 1992 stipulated stabilization of emissions, whereas the Kyoto agreement stipulated a total 5.2% reduction by 2008-2012 compared to 1990 levels for most industrialized countries. The same successive increase in demands has been identified in the efforts to control the European acid rain problem (see Greene, 1996 and Klaassen, 1996) and to control the ozone layer depletion problem (Barrett, 1997).

There is also evidence that future demands are linked to past performances. In OECD (2000) it is argued that future agreements on environmental issues will depend on the initial steps ("path dependency"). In the Second Sulphur Protocol this has been observed directly, since the individual reductions were calculated

10 For the EU, one of the main reasons for subsidiarity has been that "main part of reduction should be undertaken domestically, for the sake of developing new technologies" (Woerdman, 2001).

on the basis of cost-efficiency, subject to the condition that countries carry out reductions they would have undertaken anyway (see Klaassen, 1996). Examples of this "path-dependency" can also be found in the climate change issue, which will be discussed in section 5. Note, however, as a consequence of this path-dependency, after the withdrawal of the US from the Kyoto-agreement in 2001, mainly on reasons of concerns about costs, once the US enters again, it now has a large bargaining strength to receive low reductions relative to its original Kyoto-target. We will come back to the issue.

### *2.5. Positive and negative consequences of Hot Air, a summery*

The positive consequences of the inclusion of Hot Air are that, it reduces the total cost of compliance and therefore, in the best possible way, supports the achievement of the stated environmental objectives, and it increases the political acceptability, by reducing the costs of compliance. Hot Air can be used as an "implicit side payment arrangement". It might be very difficult for countries that have experienced a large economic recession to engage in costly abatement actions. Since the amount of Hot Air is linked to the size of the recession, the larger the economic downturn, the more permits the country in question could sell, which in most cases would yield a higher amount of compensation for this country. Such compensation can be seen as the price the international community has to pay in order to including, e.g. Russia in the Kyoto agreement.[11]

The main negative effect of including Hot Air in a permit trading system is that as long as this implies a lowering of the permit price, it reduces long run dynamic incentives to develop new cleaner technology. That is, the switching point between conventional energy production and energy production that is environmentally friendlier will be achieved at a later date.

We are now in the position to evaluate the effect that the restrictions on the possibilities to trade have on the Kyoto agreement, but before doing so, let us in briefly summarize the achievements of the Kyoto protocol.

11 Nentjes and Woerdman (2000) and Woerdman (2001) argue that the Kyoto figures were negotiated on the prospect (at least from the side of the US and Russia) of the availability of free trade. Thus, the presence of Hot Air cannot be seen independently of the negotiated target levels in Kyoto.

# 3. The Kyoto agreement

The Kyoto agreement was signed by 149 countries and included two main breakthroughs. First, a five-year commitment period (2008–2012) is defined in which the emissions targets for individual countries listed in ”Annex B” have to be reached. 38 industrialised ”Annex B countries” committed themselves to an emission ceiling for a group of six greenhouse gases.[12] Second, the Kyoto agreement allows countries to trade greenhouse gases as one of the three ”flexible mechanisms”. Emissions trading mean that trade of, for example, $CO_2$ emission permits can take place between the 38 Annex B countries. In principle, the United States could in fact increase its 1990 emission of greenhouse gases if it buys the corresponding permits from Russia, for example. Note that the distribution rule of grandfathering, which was used in the American ”Acid Rain Program” and was suggested in the EU $CO_2$ market, also forms the basis of the Kyoto Protocol. Initially, the United States strongly advocated the idea of global $CO_2$ trade because of the positive experiences the United States has had with buying and selling environmental permits (Svendsen, 2003).

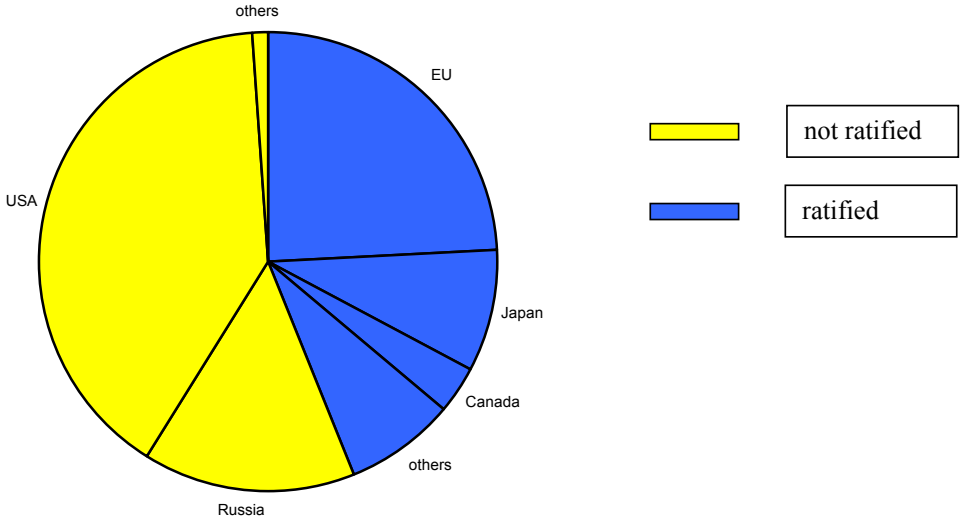
The two other flexible mechanisms are joint implementation and the clean development mechanism. Joint implementation means emissions-reduction projects between Annex B countries. The clean development mechanism means emission-reduction projects between Annex B and non-Annex B countries, i.e. between industrialised and developing countries where the latter did not commit themselves to any specific emission ceiling. Overall, the Kyoto agreement, with its new focus on the emissions trading system, has attracted considerable international attention, at the expense of the other two project oriented mechanisms. The Kyoto agreement will come into force once it is ratified by at least 55 parties representing at least 55 per cent of the total greenhouse gas emissions of Annex B countries in the year 1990.

The first condition, that a minimum of 55 countries become party to the treaty, was fulfilled with Iceland’s ratification on 23 May 2002. Now, the main focus is on how much is left to meet condition number two: 55 per cent of 1990 $CO_2$ emissions from the Annex B (industrialised) countries. The score is currently

12 Carbon dioxide ($CO_2$); methane ($CH_4$) and nitrous oxide ($N_2O$). Also included are three types of chlorofluorocarbons (CFCs), namely: hydrofluorocarbons (HFCs); perfluorocarbons (PFCs) and sulphur hexafluoride ($SF_6$), EPA (2002).

43.9 per cent (December 2002) as shown in figure 4. The EU ratified the Kyoto Protocol on 31 May 2002 and Japan on 4 June 2002 whereas Australia and the United States remain unlikely to join in the near future (CAN, 2002). However, ratifications by Russia would be sufficient to reach the 55% emission.

***Figure 4: Status of ratification, Kyoto protocol, December 2002. Percentage of emissions***




Source: Cicero (2003).

# 4. The Kyoto protocol and Hot Air

## *4.1. The level of Hot Air implied by the Kyoto protocol*

In the case of the Kyoto agreement, GHG emission rights are allocated according 1990 levels, i.e., historical emission rights, for most countries. Due the economic recession in eastern European countries, the issue of Hot Air has emerged as this had led to some of those countries having excess permits. In table 1, the level of Hot Air is depicted.

***Table 1: GHG emission indicators for Poland, Russia, and Ukraine***

| Indicator | Poland | Russia | Ukraine |
|---|---|---|---|
| Reduction commitment in 2008–2012 compared to baseline year | 8% Reduction | Stabilization | Stabilization |
| Baseline year | 1988 | 1990 | 1990 |
| Baseline year $CO_2$ emissions (MtC) | 118 | 635 | 182 |
| 1997 $CO_2$ emissions (MtC) | 95 | 422 | 106 |
| % Decrease | 24% | 34% | 42% |

Source: Meredydd *et al.* (2000).

The presence of Hot Air can mean that countries do not have to undertake real reductions when actual emissions are already lower than 1990 levels. For example, Russia can sell their surplus of permits to the United States, thus relieving the latter of the responsibility to reduce domestic emissions. Also other countries have Hot Air. As reported in Christiansen and Wetterstad (2003) and Schleich *et al*. (2001), German reductions (18.7% $CO_2$ emissions from 1990 to 1999) have, to a significant degree, been the result of economic restructuring in former Eastern Germany since 1990, while British reductions (14% $CO_2$ emissions from 1990 to 1990) have been an unintended outcome of privatization in Britain's energy sector.

### *4.2. Will Hot Air secure the environmental targets of the Kyoto protocol*

As shown in section 2, the presence of Hot Air trading does not impede the achievement of the defined target levels. The 38 countries that signed the climate agreement will be given a $CO_2$ quota of permits corresponding to their emissions in 1990. In this way, the number of $CO_2$ permits in circulation is "frozen" and the $CO_2$ emissions cannot increase further. Then, by 2012 at the latest, each individual country will face devaluations of its permit holdings corresponding to the target level for that country.

### *4.3. Have Hot Air been used as "implicit side payments"*

The United States had strongly advocated the idea of global $CO_2$ trade for two main reasons. The first reason is because the tradable permit system worked in the United States. Second, the option of buying cheap $CO_2$ permits from Eastern Europe would create significant gains from trade for both parties. The par-

ticipation of Eastern Europe and thereby the supply of low-price permits was secured by the presence of Hot Air. Table 1 showed how Eastern European countries would be favored by surplus allocations in the $CO_2$ market. Because, for example, Russia and the Ukraine were allowed to stabilize emissions at their 1990 level, they could readily offer the $CO_2$ reductions created by structural changes in their economies. Such Hot Air trade would provide Western Europe with cheap permits and Eastern Europe with hard currency. As pointed out by Daugbjerg and Svendsen (2001), the United States, Russia and the Ukraine all signed the Kyoto Protocol in the belief that Hot Air trading was possible. It was the United States that rewarded the Ukraine and Russia with Hot Air during the negotiations. By doing that, the United States also created a loophole for acquiring cheap permits for itself. Hence, by facilitating trade in this way, the United States has already committed itself to maintaining the possibility of Hot Air trading. If Hot Air were to be excluded, the agreement would no longer be a credible commitment because countries would no longer gain from participation.

Although the Hot Air provision appears to be a loophole, had it not been created, other Annex B countries would have insisted that their own emission constraints should be relaxed. If the use of Hot Air is restricted, the agreement will no longer be a true commitment because some countries might no longer receive net gains from participation. The US position in The Hague negotiations mirrors this, since the US claimed the original Kyoto targets were based on the presumption of free trade and full and unlimited access to all three flexible mechanisms (i.e. permit trading, joint implementation and clean development mechanism) in the Protocol. Restricting trade would change the costs of meeting the original targets, and given such cost figures, the US would not have accepted the original Kyoto targets. The papers by Bohm (1992) and Boom (2000) support this argument. The latter shows, in a fairly general model, that it is rational for low cost (potential selling) countries to opt for higher emission levels and for high cost (potential buying) countries to accept a more stringent emission ceiling (compared to the situation without trade) when permit trading is feasible. This is explained by the fact that increases in the total trade volume imply lower reduction cost for the buying country and higher total payments to the selling country.

### *4.4. How does Hot Air influence costs of meeting the Kyoto Targets?*

Many models have been used to estimate marginal abatement costs, permits prices and total abatement costs under different possibilities regarding the flexibilities used to implement the Kyoto targets. We now summarise some of the main findings.

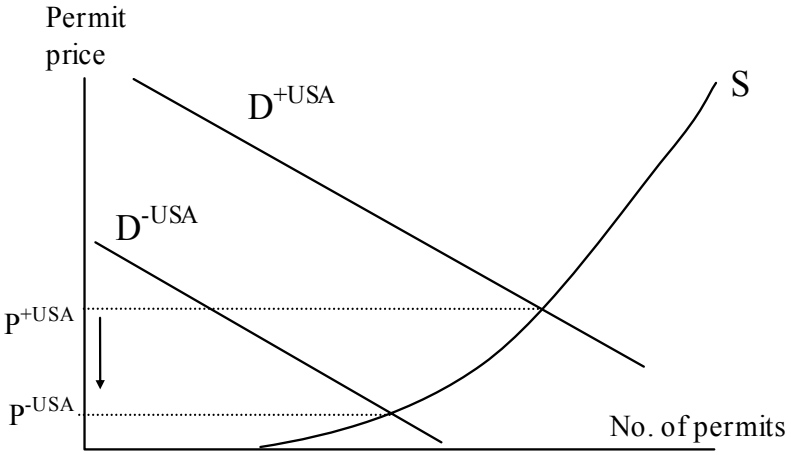
First, using flexible mechanisms to implement the Kyoto targets reduces costs significantly. Springer and Varilek (2003) report from several different models that fully flexible implementation (including Hot Air) of the Kyoto targets, permit prices estimate from $3 to $74 per ton. The large variations in the estimation of permit price are caused by differences in business-as-usual emissions projections and model design features. The marginal costs of implementing the Kyoto Protocol solely by use of domestic measures are reported in Brandt and Svendsen (2002) as being from $125 to $250 per ton. In Springer (2002) it is reported that several researchers examine the effect of various forms of restriction on emissions trading under the Kyoto Protocol. Overall, such restrictions lead to diverging marginal costs among Annex B countries and higher total abatement costs.

Estimates of the increases in costs given restrictions on trade also exist. In The Hague EU promoted national emission ceilings that would require each country to implement 50% of its reduction commitment nationally (the so-called supplementarity principle). The main reason for this proposal has been to reduce the amount of Hot Air and to promote development of new technology. Estimates of the effect of the EU proposal on overall compliance costs, depending on the model and its assumptions, show a cost increase compared with unrestricted emissions trading varying from about 20% (e.g. Zhang, 2000) and 50% (Gusbin *et al.,* 1999) to even more than 50% (Ybema et al, 1999). Woerdman (2001) concludes that the effect of the EU proposal on the permit price is not entirely clear since there are restrictions in play both on the supply and the demand side. Most authors seem to agree that the overall result of these restrictions is primarily a lower permit price (e.g. Zhang, 2000 and Ybema *et al*, 1999).

What are the effects of Hot Air? From Chen (2003) we get some indications of the effect of Hot Air on the permit price, analysed as changes in the permit

price when countries carry all their Hot Air over to subsequent periods, compared to when none is carried over. Two estimates are reported; one shows that the permit price increases by 336% from \$6.29/tC to \$27.46/tC.[13] The other shows a more moderate increase in the permit price from of \$50.10/tC to \$56.37C.[14] The large difference in the level of increase is caused by the different amount of Hot Air in question.

***Figure 5: Change in permit prices, when a major buyer withdraws from the market***




After the withdrawal of the largest buyer of emissions permits, the market for tradable permits for GHG changes significantly. As reported in Springer (2002), in the absence of the US, aggregate permit demand from Annex B countries is more or less equal to "Hot Air" from the former Soviet Union and Eastern Europe. Springer (2002) estimates that permit prices would fall to from \$0 to \$12 per ton $CO_2$. The reason for the fall in the permit price is reproduced in figure 5.

One way of increasing the permit price would be to restrict the supply of Hot Air. However, as clearly indicated by figure 4, following the withdrawal of the USA, Russia has gained a high level of negotiating power: If Russia ratifies the Protocol, it comes into force, but if Russia does not ratify, the Protocol will not come into force.

13 This estimate uses the global trade and environmental model (GTEM) developed by the Australian Bureau of Agriculture and Resource Economics. The amount of Hot Air in question is reported as 419.9 MtC.

14 This estimate uses emissions prediction and policy analysis (EPPA), developed by the MIT, USA. The amount of Hot Air in question is reported as 85.0 MtC.

### *4.5. The reduction levels of different scenarios*

Next we identify 4 emissions scenarios under different reduction possibilities, which are reported in table 2. Since the amount of Hot Air remains uncertain, we report four cases, from a situation with no growth in the $CO_2$ emissions from the Hot Air producing counties (low growth scenario) to a high growth scenario with an increase in $CO_2$ emissions from these countries of 30% from the base-line year to 2010. In scenario 1, the Kyoto protocol is implemented with full use of flexible mechanisms without any restrictions on Hot Air trading. Here, the Hot Air is traded, but it will not affect the overall reduction and the total annex B reduction will be 5.2%. If Hot Air trading is not allowed, then the total reduction is dependent on the $CO_2$ development in the countries that potentially have Hot Air. In the extreme event that these countries' emission stays at their 1997 level as reported in table 1, then, since these countries emit less than what they have the right to do, the total reduction will be increased. In the no-growth case, total annex B reductions amount to 13.1% and in a moderate growth scenario (10% increase in $CO_2$ in 2010 compared to 1997) the total annex B reduction is 11.4%. The third scenario considers the case where the largest emitter, the US, leaves the Kyoto-agreement and its $CO_2$-emissions are assumed to increase by 1.3% annually. If all the other countries stick to there reduction obligations, and the fully flexible trade situation emerges, then total annex B emissions (including the US), increase by 6.2%. The fourth scenario shows that restrictions on Hot Air trading reduce this increase, but not enough to reach the original reduction target. The numbers are reported below in table 2 and in figure 6.

***Table 2: Reductions under alternative scenarios***

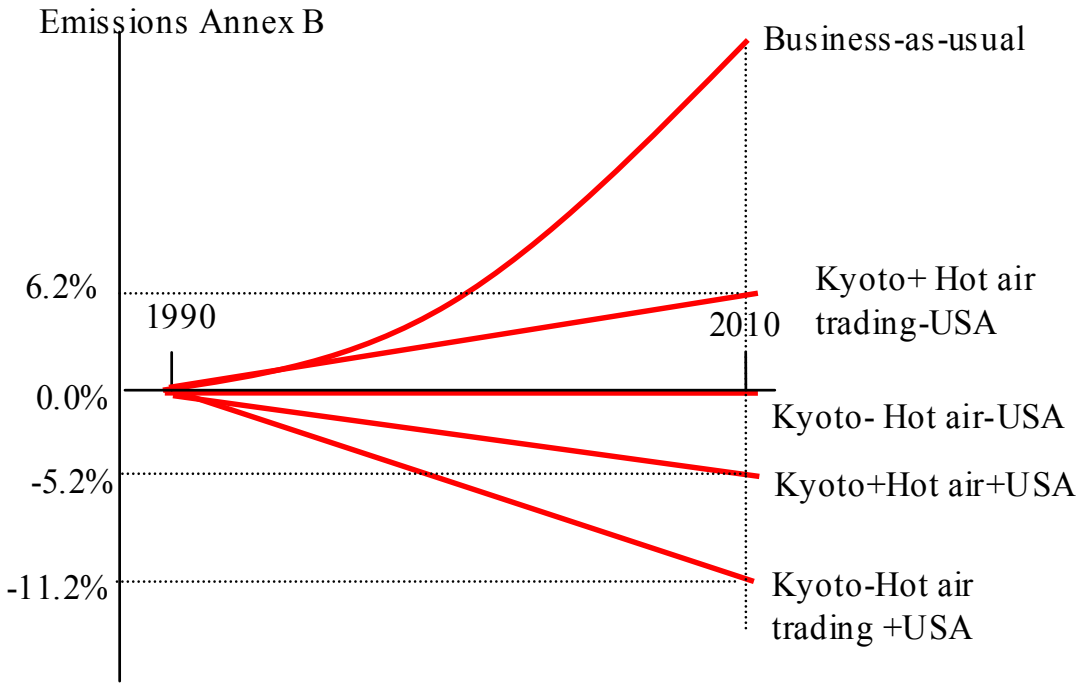
| Growth in $CO_2$-emissions for Hot Air countries compared to the 1997 level reported in table 1 | Scenario 1: Kyoto+Hot Air | Scenario 2: Kyoto-Hot Air-trading+USA [a] | Scenario 3: Kyoto-USA+ Hot Air trading [b] | Scenario 4: Kyoto-USA-Hot Air |
|---|---|---|---|---|
| 0% | 5.2 | 13.1 | -6.2 | 1.7 |
| 10% | 5.2 | 11.4 | -6.2 | 0.0 |
| 20% | 5.2 | 9.8 | -6.2 | -1.6 |
| 30% | 5.2 | 8.2 | -6.2 | -3.2 |

[a] Calculated using Data from Gusbin *et al*. (1999): Base line emissions of Annex B: 3851MtC, 5.2% reduction yields 3650.7MtC, in the 10% amount of Hot Air case, which equals 240.26MtC, emissions under Kyoto are 3410.5 compared to 3851 MtC yielding an "effective reduction" of 11.4%.

[b] Calculated using data from Barrett (1998a) and by assuming that the US increases emissions by 32% from 1990 to 2010 (Brandt and Svendsen, 2002).

The development in the 4 scenarios is also shown in figure 6. Which scenario is the most likely? Without the US, Russia has received tremendous bargaining power, which can be seen from figure 4. So the likely scenario is that a fully flexible trade system will be introduced, ironically without the US. Hence, scenario 3 could well come around, which implies a 6.2% increase in emissions of all Annex B countries (including the USA). If so, then the worst scenario in terms of emissions reduction will result, i.e. the situation where relatively low marginal costs will not yield high incentives for R&D. But, will increase emissions thus having serious long run implications.

***Figure 6: Scenarios showing the development in reduction in emissions in percentages compared to 1990 emissions levels (10% scenario from table 2)***



# 5. Are past performances linked to future developments in the climate change negotiations?

According to Barrett (1998b), a stage in the negotiation process can be split into 5 phases, a pre-negotiation phase, the actual negotiation, ratification, implementation, and finally, re-negotiation. Moreover, as already noted, in many international environmental agreements a distinct feature that can be identified is that progress is achieved stepwise by successive rounds of negotiations, where future demands are positively related to past performance.

When a major contributor in the process leaves the agreement, one of two things is likely to emerge: either the total reduction target will not be achieved, or there will be a re-negotiation resulting in a less ambitious overall target to include the country again.[15]

The successive build up is especially true for the negotiations over the climate change issue. Here the first negotiations in Rio in 1992 stipulated stabilization of emissions, whereas the Kyoto agreement stipulated a total 5.2% reduction by 2008-2012 compared to 1990 levels for most industrialized countries. A second round is expected to follow the Kyoto-agreement after 2012, where even more stringent reduction levels are to be expected. Moreover, Future demands are linked to positive performance in the Kyoto-negotiations. This has e.g. been identified by Barrett (1998a), who notes that in a second round that is expected to follow the Kyoto-agreement, a country might be able to negotiate an easier target for the next period if it invested less in reducing its abatement costs in the first control period.

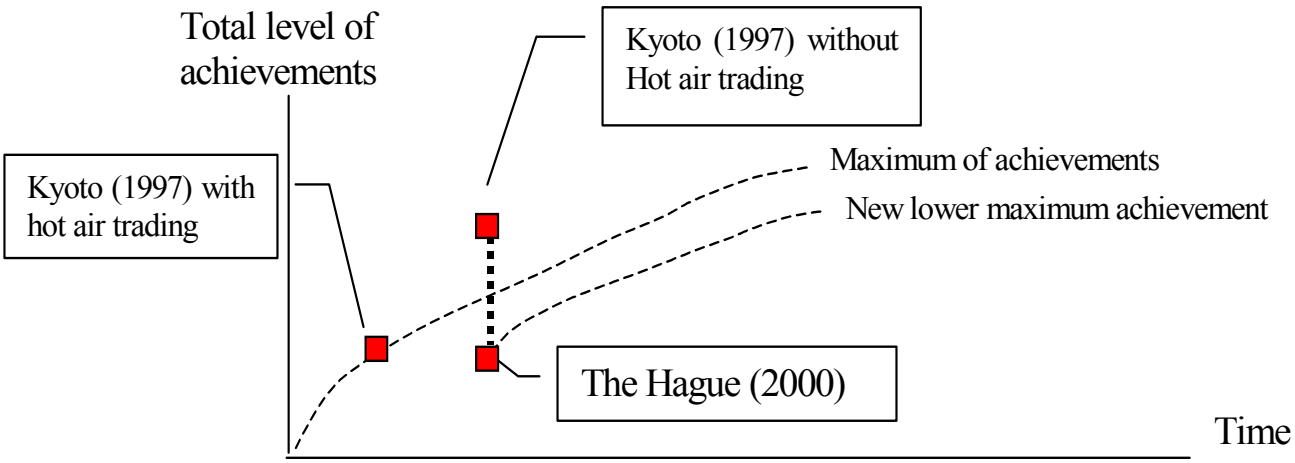
Considering all the evidence above, it might not be unreasonable to assume that once the negotiations break down, in any of the stages, the process has to start all over again and there will be a time-delay in the whole process. Such a situation is reproduced in figure 7.[16] The idea of this figure is that at any time there is an upper level of feasible achievements (regarding the level of total reduction possibilities), determined, on the one side, by the political and economic situa-

15 Of course, the remaining countries could agree to reduce more by themselves, but this would make them worse off, and the free riding country better off.

16 It is obvious that this is only a heuristic picture, but we think it contains much sound common sense.

tion, and on the other hand by physiological factors such as the present level of trust (in order to overcome the prisoners dilemma-like situation) between the affected countries. Once the total achievement exceeds the maximum level of achievements, then there will be a high risk of breakdown, which results in a delay until new negotiations take place. Once a new agreement is re-negotiated, the new upper level of feasible achievements is now at a lower level. The reason for this can be twofold; either because the level of trust has been diminished, or because simply because it takes time before the process can be re-started.

***Figure 7: A heuristic picture of the prospects for progress in climate negotiations***




As argued in Brandt and Svendsen (2002), the main reason for the collapse of the negotiations at The Hague were the increased costs of implementing the Kyoto Protocol, compared to the expectations that built the foundation for the Kyoto Protocol due to the restrictions on trade. As seen from table 2, such restrictions would have resulted in much higher reductions than in the original Kyoto protocol, due to restrictions on Hot Air trading. This is indicated in figure 1 by letting the reduction levels of the Kyoto Protocol be above what is sustainable politically. Instead of the high reduction scenario 1 from table 1, the climate change issue is likely to end in scenario 3, which contains less reduction than the original Kyoto protocol would have resulted in, in accordance with the picture in figure 7.

# 6. Conclusions

The purpose of this paper was to analyze whether the presence of Hot Air trading did jeopardize the environmental target of an international environmental agreement. We discussed the option of using Hot Air as an implicit side-payment mechanism which may actually bring about higher environmental protection compared to the situation without the trade option. Demonstrating how a fundamental trade-off exists between costs of compliance and the creation of dynamic incentives to develop cheaper reduction technologies, we argued that implicit side-payments, in terms of Hot Air provision, were needed in order to establish a compromise between these opposing demands. In this way, we identify the shortcomings and benefits of allowing fully flexible permit trading including grandfathering of permits.

The main conclusion is that pushing forward too ambitious reduction targets, (compared to the costs of meeting these targets), has pushed down the future possibilities of implementing increased reduction targets. Moreover, the argument that a high level of domestic reductions can encourage development of environmentally friendly reduction technologies fails to include the fact that such a strategy increases the risk of making the negotiations too costly. This results in less severe reduction obligations in the future, making this strategy less environmentally friendly than accepting that the low cost option, in some cases (e.g. in the climate change issue), are the main cause of success.

The main lesson from our analysis is that one has to consider the effect of short run policies on long run feasible achievements: If a dead-lock is the result of too low political acceptability, then the long run incentives will also be eroded, but the contrary is not true. In the case where progress to alleviate the internationally dispersed pollutant take place in a step by step manner and where future reduction requirements are linked to past performances, is it possible to identify situations where high short run political acceptability is a pre-requisite for the long run incentives to be achievable.

Regarding the Kyoto-agreement, we show that a very likely implication is that the EU proposal of restricting trade paradoxically may lead to lower permit prices than would have occurred if all actors had full free trade access in the first place. With the US withdrawal from the Kyoto protocol, two main effects

occurred in the market. First, Russia gained a large negotiating power and now has the power to demand full access to Hot Air trading. Second, since the largest buying country has left the negotiations, a decrease in the permit price can be expected. If the motivation for the proposed restriction on free trade was to encouraging research and development, this strategy has clearly failed, jeopardizing the Kyoto target level.

The development in the climate change negotiations after the Kyoto agreement shows that because the treaty implies costly action, the prospect of its success depends crucially on the ability to reach the stipulated targets at minimum costs. In this way, our main contribution is to argue that the conflict between the EU and the United States stems mainly from disagreement over the cost issue. If the cost implications following the EU proposal are ignored, the possibility of a total breakdown in future negotiations is severely increased and this will hamper joint efforts to improve the global environment.

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