The design and implementation of an international trading scheme for greenhouse gas emissions

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December 1998

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Abstract. The inclusion of emissions trading in the Kyoto Protocol reflects an important decision to address climate change issues through flexible market mechanisms. In this paper, we address a number of policy issues that must be considered in designing and implementing an international greenhouse gas (GHG) emissions trading scheme. These include how much of a Party's assigned amount of GHG emissions can be traded internationally; emissions trading models; competitiveness concerns in the allocation of emissions permits; banking and borrowing; the issue of liability for non-compliance; enlarging emissions trading system; and bubbles. Although our focus is exclusively on emissions trading, we discuss its relationship with the clean development mechanism, joint implementation and bubbles wherever necessary. By providing some new insights, the paper aims to contribute to the design and operationlization of an international emissions trading scheme.

Keywords: Bubbles, carbon tax, clean development mechanism, emissions trading, greenhouse gases, international competitiveness, joint implementation, Kyoto Protocol

JEL Classification: Q25, Q28, Q48

1. Introduction

In December 1997, 158 countries reached an historical agreement on limiting greenhouse gas emissions in Kyoto. While the United Nations Framework Convention on Climate Change (UNFCCC) signed at the Earth Summit in June 1992, committed Annex I countries (i.e., the OECD countries and countries with economies in transition. These countries have committed themselves to greenhouse gas emissions targets) to "aim" to stabilize emissions of carbon dioxide (CO_2) and other greenhouse gases at their 1990 levels by 2000, the so-called Kyoto Protocol goes further. It sets legally binding emissions targets and timetables for these countries. Together, Annex I countries must reduce their emissions of six greenhouse gases by 5.2% below 1990 levels over the commitment period 2008-2012, with the European Union (EU), the United States (US) and Japan required to reduce their emissions of such gases by 8%, 7% and 6% respectively (UNFCCC, 1997a). The Protocol will become effective once it is ratified by at least 55 parties whose CO_2 emissions represent at least 55% of the total from Annex I Parties in the year 1990.

Reflecting the underlying principles in Article 3.3 of the UNFCCC, which states "policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost", the Kyoto Protocol incorporates a variety of provisions for cooperative implementation mechanisms (see Box 1). It is generally acknowledged that the inclusion of cooperative implementation mechanisms in the Protocol reflects an important decision to address climate change issues through flexible market mechanisms. Article 6 authorizes the transfer or acquisition of "emission reduction units" (ERUs) from joint implementation (JI) projects among Annex I Parties. Article 12 establishes the so-called "clean development mechanism" (CDM). Through the mechanism, Annex I countries will be able to obtain the "certified emission reductions" (CERs) from jointly implemented projects with non-Annex I countries (i.e., developing countries), and use them to count towards meeting their commitments under the Kyoto Protocol. Pushed by the US, the Kyoto Protocol also accepts the concept of emissions trading in principle, under which one Annex B (an annex to the Kyoto Protocol that lists the quantified emission limitation or reduction commitment per Party) country or its sub-national entities (e.g., companies, non-governmental organizations) would be allowed to purchase the rights to emit greenhouse gases (GHG) from other Annex B countries or their regulated entities that are able to cut GHG emissions below their assigned amounts or their targets. Although

Annex B to the Kyoto Protocol and Annex I to the UNFCCC are now slightly different numerically, this change from Annex I into Annex B potentially allows a developing country to engage in emissions trading if it voluntarily adopts an emissions target and is inscribed in Annex B.[1] Because the emissions trading proposal was adopted at the very end of the Kyoto negotiations, designing "the relevant principles, modalities, rules and guidelines" governing emissions trading has been deferred to subsequent conferences. One year later, after two weeks of intense debate at the fourth Conference of the Parties (COP) to the UNFCCC held in November 1998, Buenos Aires, delegates adopted the Buenos Aires Plan of Action, an ambitious two-year work programme intended to make the Kyoto Protocol operative (UNFCCC, 1999). According to the Plan, decisions on rules governing cooperative implementation mechanisms, including emissions trading, are to be made in the year 2000 at the latest.

With the work programme in place, attention has since focused on how an international GHG emissions trading scheme would work. The market-based emissions trading approach, pioneered in the US SO_2 allowance trading program (cf. Ellerman *et al.*, 1997), can achieve significant cost reductions in cutting GHG emissions while also allowing flexibility for reaching compliance only if it is structured effectively. This has motivated us to address a number of policy issues that, although far from comprehensive, must be considered in designing and implementing such a trading scheme.[2] Taking environmental effectiveness, economic efficiency, equity and political acceptability as the guiding principles of designing and implementing an emissions trading scheme, we discuss: how much of a Party's assigned amount of GHG emissions can be traded internationally; inter-governmental emissions trading and inter-source trading; competitiveness concerns in the allocation of emissions permits; banking and borrowing; who should be held liable for non-compliance by the sellers; emissions trading system enlargement; and bubbles. These design and implementation issues are only partially on the climate negotiator's agenda but are very important because they

[1] The US proposed at Kyoto to allow developing countries to voluntarily adopt GHG controls so that developing countries would be able to opt in an international GHG emissions trading scheme. However, the group of 77 and China blocked the US proposal. At the fourth Conference of the Parties (COP) to the UNFCCC held in November 1998, Buenos Aires, the host country, Argentina, proposed the inclusion of voluntary commitments from developing countries on the conference agenda. Its proposal was rejected again by the group of 77 and China when delegates considered the agenda. In the end, during the second week of the COP, Argentina and Kazakstan stepped out from the ranks of the group of 77 and China and declared that they would undertake a voluntary commitment to abate their GHG emissions at the fifth COP to the UNFCCC in 1999.

are essential to the success of emissions trading. It seems unlikely that an international GHG emissions trading scheme will commence until these issues are seriously addressed. Although our focus is exclusively on emissions trading, we discuss its relationship with the CDM, JI and bubbles wherever necessary. By providing some new insights, this paper aims to contribute to the design and implementation of an international emissions trading scheme.

Box 1: Mechanisms of Cooperative Implementation under the Kyoto Protocol

Article 4.1
"Any Parties included in Annex I that have reached an agreement to fulfil their commitments under Article 3 jointly, shall be deemed to have met those commitments provided that their total combined aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of Article 3. The respective emission level allocated to each of the Parties to the agreement shall be set out in that agreement."

Article 6.1
"For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy..."

Article 12.2
"The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3."

Article 17
"The Conference of the Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading. The Parties included in Annex B may participate in emissions trading for the purpose of fulfilling their commitments under Article 3. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article."

Source: UNFCCC (1997a).

Before going into detail, we would like to emphasize that our discussion about these issues is based on, but is not limited to, the Kyoto Protocol. One obvious reason is that, as part of the overall climate policy debate, all the rules governing emissions trading still need to be established. So, we think that a broad discussion as proceeded in the paper could provide more useful inputs to the ongoing process of moving to

[2] A comprehensive discussion of all the design issues related to emissions trading well goes beyond the scope of the paper. We recommend readers to consult Grubb *et al.* (1998) in this regard.

decisions on rules governing emissions trading. As such, our discussion is analytical in nature, although it to the extent possible intends to enrich its policy relevance by taking some political concerns into consideration.

2. How Much Can Be Traded Internationally?

How much of a Party's assigned amount of greenhouse gas emissions can be traded internationally is a very important issue in the current international debate on emissions trading. In accordance with Article 17 of the Kyoto Protocol that specifies that emissions trading "be supplemental to domestic actions", some countries have called for imposing a concrete ceiling on the use of international emissions trading to meet one Annex I Party's Kyoto commitments (cf. United Kingdom, 1998).

Restricting trades interferes with the operation of an inter-source trading market. If Annex B governments elect to allocate the assigned amounts to individual sub-national legal entities and authorize them to trade on the international emissions permits market, no country would know up-front what a percentage of its obligations would have been fulfilled via emissions trading unless all transactions require to be pre-approved by the government or the endorsed agency. In the latter case, no legal entity is guaranteed up-front whether its transactions fall below the national threshold, although the government is sure that its allowed percentage limitation on the use of emissions trading is met. Clearly, this rule would raise transaction costs and inhibit trades, which would limit the effectiveness of emissions trading. Moreover, because the fundamental integrity of the Kyoto Protocol relies on the accountability of a Party for ultimately matching its actual GHG emissions with its assigned amounts, this approach to compliance explicitly suggests that no one means of meeting the emissions commitments is superior to, or more valid than, any others, provided that actual reductions in GHG emissions occur (Environmental Defense Fund, 1998).

It is important to bear in mind that incorporating the provision for trading to be supplemental to domestic actions reflects a variety of political concerns, such as preventing the trading in hot air[3] and urging

[3] When emissions trading were allowed, a country whose legally binding GHG emissions limits set by the Kyoto Protocol exceed its actual or anticipated emissions requirements would be able to trade these excess emissions, thus creating the hot air that would otherwise have not occurred. The hot air problem would be

Annex B countries to stimulate technical innovation domestically. Whatever the merits of these concerns, however, they are ultimately related to what targets levels should be set for Annex B countries, rather than emissions trading per se.[4] We believe that limiting the volume of trading is not an appropriate tool for responding to the concerns that advocates of supplementarity requirements express. From a political perspective, the more costly the compliance, the less likely it is that those who bear the high costs will be willing to commit to stringent emissions targets in the future. So, by increasing the overall costs of compliance, a ceiling on trading makes it even more difficult to set stringent emissions targets for some Annex B countries, if not all, for the subsequent commitment periods beyond 2012 in order to achieve the UNFCCC's ultimate objective of stabilizing GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.[5] It is the lack of the targets of post-2012 that is seen as a threat to the pace of technical innovation needed to make more stringent future emissions targets affordable. The lack of such long-term commitments also restricts the choice of the compliance mechanisms and tools and creates some divergence of views in assigning liability, which is discussed below. In addition, limits on trading will not get rid of any existing excess assigned amounts that would be found in some countries. These amounts will only be banked and will lower permits prices later, thus reducing incentives for technical change (Toman and Hourcade, 1998).

Instead of imposing a percentage limitation on the use of emissions trading, one possible resolution to the issue of hot air could be to require the Parties to demonstrate adequate domestic actions according to a set of criteria against which such actions can be measured. Such criteria should be defined by the Conference of the Parties to the UNFCCC. Unlike a ceiling on trading, this option refers to process rather than to outcomes. Note that the option differs from the EU approach at the pre-Kyoto negotiations. EU proposed to

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particularly acute in Russia whose emissions are not expected to rise to its 1990 level until 2010 (UNFCCC, 1997b).

4 The hot air forms a reservoir from which some advanced Western countries, if not all, can simply buy emissions permits to make up any shortfall, instead of taking any serious domestic actions. This is one of the reasons why some countries have called for imposing a percentage limitation on the use of emissions trading. However, it should be pointed out that although emission trading makes the hot air problem explicit, the problem is related to targets setting, not to emissions trading per se.

5 Stavins (1998) points out that the adoption of the US SO_2 allowance trading program is largely attributed to strong support from the Environmental Defense Fund that was able to make powerful arguments for tradeable permits on the grounds that the use of a cost-effective instrument would make it politically feasible to achieve

harmonize domestic policies and measures to comply with the commitments agreed on at Kyoto. By requiring all Parties with emissions targets to impose specific mandatory policies and measures, not surprisingly, the EU proposal was rejected at Kyoto.

Another option involves levying an annual fee on taxable traders or imposing a transaction tax on trades involving taxable allowances, with the fee or tax rate to be set by the Conference of the Parties to the UNFCCC (Zhang, 1998). Before going further, it is important to remember that Article 12.8 of the Kyoto Protocol stipulates that a share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing countries Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation. So, developing countries think that taking a share of proceeds only from CDM activities would put the mechanism at a disadvantage vis-à-vis JI and emissions trading, and therefore demand the fee of using JI and emissions trading as well (TERI, 1998). The second option we propose above is to some extent inspired by such a concern. But the underlying distinguishing features of why to raise and how to use proceeds make it different essentially from the developing countries' demand, which is discussed below.

Under this approach, a fee or tax could be imposed only on the buyer. If necessary, it could differ to reflect the direction of emissions trading flows, with a uniform zero or low fee/tax rate for transactions within the advanced OECD countries themselves but a uniform high fee/tax rate for transactions between them and countries with economies in transition. Setting a uniform low and uniform high fee or tax rate is to prevent countries from attracting more trades by setting an even lower fee or transaction tax rate of their own. Eventually, the differentiated fee or tax rate could become the uniform overall fee or tax rate until trading in hot air is no longer an issue.

Such a fee or transaction tax should be internationally imposed but nationally administered and collected by buyer countries. These countries could use the proceeds from the fee or tax to compensate those negatively affected businesses, workers or consumers. The proceeds could also be used to strengthen buyer countries' research, development and diffusion of low-cost climate friendly technologies, to subsidize the

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greater reductions in SO_2 emissions than would otherwise be possible. We believe that the arguments also hold for setting the post-2012 GHG emissions targets.

transfer of such technologies to non-Annex I countries, and/or to buy and retire a portion of their allowed emissions permits from the market.

Although imposing a fee or transaction tax raises Annex I countries' compliance costs of meeting their allowed emissions limits, it is much less trade-restrictive than imposing a percentage limitation on the use of emissions trading, because legal entities avoid the risk of being bumped over the national threshold. It alleviates to some extent the concern about hot air trading, because legal entities in the advanced OECD countries face higher fee or transaction tax rate when engaging in trading with their counterparts in (non-OECD) Annex I countries. It also provides the incentive to search for cleaner technologies, particularly when the proceeds from such a fee or tax are used by buyer countries' governments for R&D investments in climate friendly technologies and/or for their payments for buying and retiring a portion of their allowed emissions permits from the market.

Finally, it should be pointed out that a fee or transaction tax differs from a carbon tax. A carbon tax is a mandatory tax for firms emitting carbon emissions. Therefore, it is expected that in some countries there will be great political difficulties in introducing such a tax. By contrast, a fee or transaction tax leaves firms the freedom to determine how to meet their emissions limits. Firms that elect to meet their emissions limits only by taking domestic actions have no obligations to pay such a fee or tax.

3. Emissions Trading Models

In terms of whether sub-national entities are eligible for trading, two types of emissions trading models can be distinguished: 1) Inter-governmental emissions trading; and 2) Inter-source trading.

In the first model, governments elect not to allocate the assigned amounts to sub-national entities, and retain the sole right to trade. As such, inter-governmental emissions trading takes place on a government-to-government basis. The legal basis for such trading has been provided by Article 17, which unambiguously states that the Parties included in Annex B to the Kyoto Protocol are eligible for emissions trading. It should be pointed out that inter-governmental emissions trading differs from joint implementation (JI) as specified in Article 6 of the Kyoto Protocol, at least for two reasons. First, inter-governmental emissions trading separates

the issue of the financing from the source of generating allowances. By contrast, the initial ERUs to be transferred and acquired are always tied to specific JI projects, although ERUs could be incorporated into an international emissions trading scheme and afterwards be traded on the international market. Second, under normal conditions, no specific approval is needed to take the transactions in inter-governmental emissions trading, whereas any JI projects need the approval of both the host and investor Annex I countries. Moreover, inter-governmental emissions trading differs from the bubble approach as specified in Article 4 of the Kyoto Protocol. A bubble must be declared when the ratification is deposited. Once the terms of agreement have been registered with the UNFCCC Secretariat, the commitments agreed on cannot be revisited during the commitment period in question. As such, the bubble approach could pre-determine how much of a Party's assigned amount can be transferred and acquired within the voluntarily-formed group prior to the beginning of the commitment period, whereas inter-governmental emissions trading could take place anytime during the commitment period.

In the second model, governments elect to allocate the assigned amounts to individual sub-national entities, and authorize them to trade on the international emissions permits market. The great advantage over the first model is that it limits the governments to setting the rules rather than undertaking emissions trading themselves, and leaves individual companies the freedom to choose how to comply with their limits. By incorporating sub-national entities into an international emissions trading scheme, the companies that actually have control over emissions would be able to profit directly from emissions reduction activities, thus providing them with strong incentives to exploit cost-effective abatement opportunities. This would potentially increase the total amount of transactions in the international scheme, meaning greater capital flows to selling participants and greater cost reductions for buying participants. By increasing the number of trades, it would also improve market liquidity and reduce the potential for abuse of market power. The latter might occur under inter-governmental trading if one country or bloc holds a significant proportion of the total number of permits. Moreover, in comparison with national governments, individual companies are in the best position to posses information about their emissions reduction options and the corresponding marginal cost and thus to determine their efficient emissions level. Although we argue here that sub-national legal entities are the best entities to trade emissions permits, it is important to bear in mind that there are some potential drawbacks of including private companies in the trading scheme. One is increased administrative complexity; another is that

because inter-source trading would impact the assigned amounts of the Parties, the Parties might feel a loss of control over the level of their assigned amounts and thus their ability to meet their Kyoto obligations (CCAP, 1998).

If emissions trading among sub-national entities is authorized, the next issue is how these governments allocate the assigned amounts within their countries. The allocation of permits depends on the structure of national emissions trading systems. Such systems could be modelled as either *upstream* or *downstream* or *hybrid* systems (Zhang, 1998). An *upstream* trading system would target fossil fuel producers and importers as regulated entities, thereby reducing the number of allowance holders to oil refineries and importers, natural gas pipelines, natural gas processing plants, coal mines and processing plants (Hargrave, 1998). For example, if such a system would be implemented in the US, the total number of allowance holders would be restricted to about 1900 as shown in Table 1. Even with such a relatively small number of regulated sources, market power would not be an issue. In the above upstream system for the US, the largest firm has only a 5.6 percent market allowance share. Firms, with each having less than one percent share, would hold the lion's share of allowances (Cramton and Kerr, 1998).

Implemented effectively, an upstream system would capture virtually all fossil fuel use and carbon emissions in a national economy. Firms would raise fuel prices to offset the additional cost. In an upstream system the number of firms that has to be monitored for compliance is relatively small, thus it is easier to administer. Moreover, existing institutions for levying excises on fossil fuels, which exist in most industrialized countries, can be used to enforce the scheme (Zhang and Nentjes, 1998). However, one of the drawbacks of an upstream system is that it provides no incentive for energy end-users to develop disposal technologies, the aspect that is deemed critical in searching the long-term solutions to solving climate change problems.[6]

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6 The most efficient environmental policy needs to be targeted directly at the emissions, and policies that seek instead to indirectly regulate emissions through the control of inputs to production or consumption are less cost-effective (Fischer *et al.*, 1998). In the case of controlling SO_2 emissions, for example, a tax on the sulphur content of coal would encourage a switch to coal with a lower sulphur content, but it might not make the best use of fluidized bed combustion boilers or scrubbers if the latter options are less costly. However, this argument does not apply to CO_2 at this moment because large-scale technologies disposing of carbon are not economically available. This is the reason why we regulate CO_2 emissions by limiting the use of fossil fuels because there is a one-for-one relation between the carbon content of fossil fuels and the CO_2 emitted. However, this is by no means that we should give up our efforts to develop disposal technologies.

Table 1 Number of Regulated Entities in an Upstream Trading System in the US

Industry	Point of regulation	Number of regulated entities
Oil	Refinery	175
Oil	Refined product importers	200
Natural gas	Pipeline	150
Natural gas liquids	Processing plant	725
Coal	Preparation plant	550
Coal	Mine	100*
Total		1900

* Although there are approximately 2100 mines in the US, the number of mines actually required to hold allowance probably would be less than 100. This is because mines would be required to hold allowances only for coal not sent to preparation plants. This occurs at a relatively small number of mines, principally located in the West.

Source: Hargrave (1998).

In contrast, a *downstream* trading system would be applied at the point of emissions. As such, a large number of diverse energy users are included. This would offer greater competition and stimulate more robust trading, thus leading to increased innovation. However, such a system would be more difficult to administer, especially concerning emissions from the transportation sector and other small sources. On the other hand, it would avoid the potential problem that some energy users do not respond to the price signal, which might occur in an upstream system because of market imperfections such as high transaction costs, high discount rates and imperfect information, although the extent of responsiveness depends on the degree of competition and on whether price increases are actually passed on to the consumers (U.S. Office of the President, 1998).

To keep a downstream trading system at a manageable level, regulated sources could be limited to utilities and large industrial sources. Governments could then address uncapped sources through other regulatory means such as carbon taxes. In so doing, however, the governments need to establish additional programs. This would be administratively burdensome by virtue of the fact that it would require the establishment of additional programs as well as a trading system, let alone the political difficulties in introducing carbon taxes in some countries. Moreover, the actual achievements in reductions of CO_2 emissions by a proposed carbon tax remain uncertain because of imperfect knowledge of the price elasticities of demand and supply for fossil fuels, especially for the large price increases caused by carbon taxes for major emissions cutbacks (Cline, 1992). This would put the governments at risk of non-compliance with the emissions commitments. Furthermore, restricting trading to a subset of domestic emissions sources would pose serious efficiency and leakage problems.

Alternatively, national trading systems could be modelled as *hybrid* systems (Zhang and Nentjes, 1998). A hybrid system is similar to a downstream trading system in the sense that regulated sources at the levels of energy users are also limited to utilities and large industrial sources. On the other hand, like an upstream trading system, a hybrid system would require fuel distributors to hold allowances for small fuel users and to pass on their permit costs in a mark-up on the fuel price. As such, small fuel users are exempted from the necessity (and transaction costs) of holding allowances. This would avoid the establishment of a large and costly reporting system for small users. Yet the rise in fuel price will motivate them to reduce fuel consumption or to switch from high-carbon fuels, such as coal, to low-carbon fuels, such as natural gas.

Finally, it should be pointed out that fossil fuels sold on the domestic markets are supplied by importers as well as by domestic producers. The provisions in the World Trade Organization (WTO) do not allow unequal treatment of like products, be it domestic or foreign. In other words, imported products should be accorded no less favourable treatment than domestically produced products. So, no matter what national trading systems are adopted, domestic producers and importers of like products should be treated equally in obtaining emissions permits. Moreover, regardless of whether individual countries choose to empower inter-source trading, the ultimate responsibility for fulfilling the Kyoto Protocol commitments would, however, remain with the national government as a Party to the Protocol.

4. Competitiveness Concerns in the Allocation of Permits

The Kyoto Protocol has set the caps on aggregate GHG emissions for Annex I countries. If emissions trading among sub-national entities is authorized, the next issue is how these governments allocate the assigned amounts within their countries. The initial allocation process itself represents the establishment and distribution of private property rights over emissions, and therefore lies outside the mandate of the World Trade Organization (WTO) (Vaughan, 1997). Given the great concern about international competitiveness, however, the allocation of permits does have the potential to bring parties into conflict with the WTO provisions. Some fear, for example, that governments could allocate the permits in such a manner to favour domestic firms against foreign rivals. For example, a government of country X might allocate a generous amount of permits to a domestic firm, while a similar foreign firm also operating in the same industry of country X might get a tight emissions budget. This form of allocation will violate the WTO principle of non-discrimination. The allocation of permits could also be designed in such a manner to advantage certain sectors over others and further enhance their existing imperfect market competition. For example, a government might, to the extent possible, allow certain sectors to emit while imposing additional pressure on other emissions sources. The above ways to allocate permits make explicit an unequal treatment, a practice which can be much easier hidden from the general public under the conventional command-and-control regulations than under the above incentive-based policy instrument (Stavins, 1998). This treatment in turn will have a similar price distortion effect as a subsidy, and would be in conflict with the WTO rules that prohibit the use of export subsidies for such a purpose. All this clearly indicates that the manner in which countries allocate their assigned amounts should be compatible with these WTO principles and should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.[7]

However, it should be pointed out that although grandfathering is thought of as giving implicit subsidies to some sectors, grandfathering is less trade-distorted than the exemptions from carbon taxes. To understand their difference, it is important to bear in mind that grandfathering itself also implies an

opportunity cost for firms receiving permits: what matters here is not how you get your permits, but what you can sell them for - that is what determines opportunity cost. Thus, even if permits are awarded gratis, firms will value them at their market price. Accordingly, the prices of energy will adjust to reflect the increased scarcity of fossil fuels. This means that regardless of whether emissions permits are given out freely or are auctioned by the government, the effects on energy prices are expected to be the same, although the initial ownership of emissions permits differs among different allocation methods. As a result, relative prices of products will not be distorted relative to their pre-existing levels and switching of demands towards products of those firms whose permits are awarded gratis (the so-called substitution effect) will not be induced by grandfathering. This makes grandfathering different from the exemptions from carbon taxes. In the latter case, there exist substitution effects. For example, Commission of the European Communities (CEC) proposal for a mixed carbon and energy tax (Zhang, 1997) provides for exemptions for the six energy-intensive industries (i.e., iron and steel, non-ferrous metals, chemicals, cement, glass, and pulp and paper) from coverage of the CEC tax on grounds of competitiveness. This not only reduces effectiveness of the CEC tax in achieving its objective of reducing CO_2 emissions, but also makes the industries, which are exempt from paying the CEC tax, improve their competitive position in relation to those industries which are not. Therefore, there will be some switching of demand towards the products of these energy-intensive industries, which is precisely the reaction that such a tax should avoid (Zhang, 1997).

With the great concern that a government that grandfathers permits to a domestic firm could give it a competitive advantage over a similar firm in another country where permits are not awarded gratis, some believe that there is the need for the harmonization of allocation of permits. According to Article 17 of the Kyoto Protocol, the rules governing greenhouse gas emissions trading will be defined by the COP to the UNFCCC. This Article clearly indicates that the COP to the UNFCCC will determine all the rules relating to emissions trading, including decisions on whether to harmonize the allocation of permits, and if so on what basis.

Indeed, in order to facilitate trading and increase the environmental performance of an international emissions trading scheme, certain elements of domestic trading schemes operating within an international trading framework need to be comparable across countries, in particular with respect to monitoring and

[7] See Zhang (1998) for a detailed discussion on GHG emissions trading and the world trading system.

enforcement, although harmonization poses difficult coordination. However, the allocation of permits does not fall into the category of harmonization. We think that individual governments should be left free to devise their own ways of allocating permits on the following grounds.

First, we think that a firm that has to buy emissions permits is not necessarily at a competitive disadvantage, because even if it obtains permits by auction, if necessary, its government still can protect its international competitiveness by means of recycling the revenues raised through auctioned permits to lower other pre-existing distortionary taxes, such as taxes on labour and capital.

Second, although auctioning at least part of the assigned amounts to sub-national legal entities alleviates to some extent the concern about international competitiveness, any attempts to produce an agreement on a common rate are likely to run into concerns about national sovereignty and thus would encounter significant political difficulties. Take the above CEC proposal for a carbon/energy tax as an example. National sovereignty considerations to some extent explain why the CEC proposal for a carbon/energy tax failed to gain the unanimous support of its member states, partly because some member states (e.g., the UK) opposed an increase in the fiscal competence of the Community and thus opposed the introduction at a European level of a new tax on grounds of fiscal sovereignty (Bill, 1997). Besides, many existing national policies, including environmental policies, differ widely among countries and constantly affect trade patterns, and firms already compete internationally under very differing circumstances of corporate income tax rates, labour costs and energy prices. Even if existing policies that have already had competitiveness implications are not harmonized across countries, thus an argument for special treatment in the allocation of permits on grounds of competitiveness is unconvincing (OECD, 1997).

Third, given great differences in national circumstances, setting a uniform rule of allocation will restrict the rights of individual governments to select the option which is best suited to their own national circumstances. Indeed, the failure of the above CEC carbon/energy tax is to some extent because some member states are loath to restrict themselves to a common policy. With second-best considerations, it is conceivable that some countries whose economies are heavily distorted would decide to auction permits. The revenues generated through auctioned permits can then be used to reduce pre-existing distortionary taxes, thus generating overall efficiency gains. Parry *et al.* (1997), for example, show that the costs of reducing US carbon emissions by 10% in a second-best setting with pre-existing labour taxes are five times more costly

under a grandfathered carbon permits case than under an auctioned case. This is because the policy where the permits are auctioned raises revenues for the government that can be used to reduce pre-existing distortionary taxes. By contrast, in the former case no revenue-recycling effect occurs, since no revenues are raised for the government. However, the policy produces the same tax-interaction effect as under the latter case, which tends to reduce employment and investment and thus exacerbates the distortionary effects of pre-existing taxes.[8] Because the policy where the permits are given out freely under a grandfathered case does not produce the revenue-recycling effect to counteract the tax-interaction effect, it has a higher economic cost than a policy where the permits are auctioned under an auctioned case. The study of Parry *et al*. (1997) clearly indicates that if the harmonization of allocation of permits is in the form of imposing a uniform percentage limitation on the use of auctioning, this will restrict the US potential of exploiting the revenue-recycling effect to counteract the tax-interaction effect, thus leading to a higher economic cost than would otherwise have been the case.

Fourth and importantly, leaving individual governments the freedom to devise their own ways of allocating assigned amounts to sub-national entities would ensure that any individual government maintains its right to determine the domestic policies and measures that would be taken to meet its Kyoto obligations. For example, a government that wants to use taxes or regulations for domestic emissions control could retain the sole right to trade. As such, any effectuated trade would take place on an inter-governmental basis. Alternatively, a government could allocate its assigned amounts to private entities, and authorize them to trade on the international emissions permits market.

5. Banking and Borrowing

Banking and borrowing of permits offer a greater degree of intertemporal flexibility, thus lowering the cost of abating GHG emissions.

There has been heavy use of banking in the US SO_2 allowance trading program (cf. Ellerman *et al.*, 1997), which has led to early reductions and substantially lower overall costs of compliance. In an international

[8] See Oates (1995) and Goulder (1995) for a good discussion of the interactions between environmental taxes

GHG emissions trading scheme, three types of banking can be distinguished. The first type of banking is built into Article 12.10 of the Kyoto Protocol. It specifies that CERs obtained under the CDM during the period 2000-2008 can be banked for later use in meeting Annex I country's commitments during the first commitment period 2008-2012. This banking clause provides an incentive for private firms in Annex I countries to invest in emissions reductions in developing countries prior to the beginning of the first commitment period.

The second type is similar to the banking element built in the US SO_2 allowance trading program. It is derived from Article 3.13 of the Protocol, which authorizes Parties to carry forward their unused assigned amounts from one commitment period to subsequent periods. Once an emissions trading scheme, either domestic or international, is established among Annex B countries, permit holders are allowed to bank their unused permits to offset future emissions or to sell them to others. If property rights to permits during the commitment period are well defined, banking would encourage permit holders to reduce emissions below their required limits in early years if it were more cost-effective for them to do so.

The third type of banking extends the second mechanism by including emissions reductions achieved within the jurisdiction of Annex I countries prior to the beginning of the first commitment period as well. In comparison with the first type of banking under the CDM, it also provides a similar incentive for private firms within Annex I countries to take early actions at home rather than shop around abroad. Currently, this type of banking has not been an option under the Kyoto provisions but warrants special attention. We propose that potential use of the option is contingent on the following two conditions. The first is conditional on the ratification of the Kyoto Protocol (Kopp *et al*., 1998). The option might only be authorized from the year in which the Protocol is ratified onwards. This would provide a strong incentive for Annex I countries to ratify the Protocol earlier than what otherwise would be the case. The second is conditional on the stringency of overall assigned amounts of emissions. The countries that are supposed to sell hot air should be not allowed to use the option. Thus, it alleviates to some extent the concern about hot air trading, because it provides an incentive for legal entities in the advanced OECD countries to take abatement actions at home which in turn reduces their demand for hot air abroad. If authorized, the option will accelerate the process of implementing a domestic emissions trading scheme by dealing with all technical issues associated with it. However, triggering

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and the existing tax system.

the green light for the option requires an amendment to the Kyoto Protocol because the total emissions of one Annex I country during the commitment period will exceed its assigned amounts if pre-2008 emissions reductions banked are awarded to offset the post-2008 emissions targets. If such an amendment were made, the next question is that those countries that are eligible for pursuing the option have to negotiate internationally accepted national baselines for the pre-2008 period. As the negotiations leading up to the Kyoto Protocol have shown, this task will not be that easy.

An alternative option that would allow the banking of Annex I country's own early reductions is to draw any credits that one Annex I country awards its sub-national legal entities for pre-2008 reductions from the assigned amounts of the country in question. On the one hand, this option would give these first-movers a competitive advantage over those not undertaking early actions (Environmental Defense Fund, 1998). On the other hand, since the credits awarded to early movers would be otherwise allocated to those entities not undertaking early actions, with limited supply of early credits, the option amounts to government support for uneconomic rent-seeking (Fischer *et al.*, 1998). It might risk distributing too many credits for questionable early emissions reductions, particularly if they are not verified before credits are given to first movers.

No matter what degree of flexibility is allowed in banking, governments should not confiscate banked permits even if the latest scientific evidence suggests that further emission reductions are necessary. A more acceptable approach would be to reduce the issue of new permits proportionally from the year for which the stricter emissions cap applies. This suggests that an emissions trading scheme would have to be designed from the outset to be flexible enough to facilitate any changes that might be required in the overall emission limits.

If an Annex I country starts with a very strict limit on GHG emissions, bottlenecks could be prevented by allowing the borrowing of a limited amount of future permits provided that a premium is paid. A premium has to be paid, partly because the atmosphere is negatively affected by the additional amount of the borrowed permits by which a buyer exceeds its allowed levels when no borrowing is allowed, and partly because a delayed response will result in more GHG emissions being emitted into the atmosphere than would otherwise have occurred. By taking into account the turnover of capital stock, the prospect for low-carbon or carbon-free backstop technologies, and time discounting, borrowing would allow total abatement costs to be

minimized while keeping to an overall emissions budget. Therefore, as with banking, borrowing is another way to increase flexibility and lower the cost of abating GHG emissions (Richels *et al*., 1996).

Although banking is relatively uncontroversial, borrowing is much more controversial (cf. Matsuo, 1997; Mullins and Baron, 1997; Zhang and Nentjes, 1998). The US proposed borrowing with a penalty, but negotiators at Kyoto blocked the only compliance mechanism on the table. Opponents fear that borrowing would not bring any additional pressure to bear on a country that simply continues to disregard its commitments. Borrowing would make it more difficult to check whether emission sources are in compliance with their emission limits. If borrowing is allowed, firms facing bankruptcy have an incentive to borrow without being able to meet their future commitments. Borrowing could conceivably even discourage trading among individual emission sources, thus reducing market liquidity. Borrowing could also undermine the incentive to search for cleaner technologies.

As of now, no emissions targets beyond the first commitment period have been set, but it is generally acknowledged that the targets would become more and more stringent over time in order to achieve the UNFCCC's ultimate objective of stabilizing GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Given this, and because the potential cost savings from providing increased intertemporal flexibility are so great, therefore it is important to continue to investigate the ways that such flexibility might be credibly implemented in practice (Fischer *et al.*, 1998), which could serve as a complement to other compliance mechanisms. In case the Conference of the Parties to the UNFCCC deems it desirable to allow some but not complete borrowing, some safeguards could be developed to allow borrowing in such a way that it does not undermine the environmental objectives. Such safeguards could include:

- limiting the contribution of borrowing to meeting an emission target;
- restricting borrowed permits to own use, rather than sale to others;
- restricting borrowing to special circumstances, such as insufficient availability of allowances on the international market;

- making borrowing of the allowance contingent on the stringency of overall emission limits (perhaps postponing its adoption until more stringent limits for the subsequent commitment periods are agreed). In any case, borrowing should not be allowed for the countries that are supposed to sell the hot air; and
- restricting how far into the future permits can be borrowed. For example, borrowing in the current period should not go beyond the subsequent commitment period.

6. The Rules for Accountability

The question of which party - the buyer, the seller or both - is liable for non-compliance by the seller who over-sells its permits and then fails to comply with its commitments is one of the most important issues in designing a workable emissions trading scheme. Given the fact that Article 12 authorizes Annex I countries to acquire the certified credits obtained from the CDM projects with non-Annex I countries, the issue of liability for the validity of the credits is of less concern in the CDM case when the credits have been certified.[9] Thus some analysts suggest that the transfers and acquisitions of allowances in an international emissions trading scheme could be envisioned along this line. Any extra allowances to be sold first have to be verified and certified prior to trading. Other analysts even suggest that in order to ensure that the seller only sells those assigned amounts surplus to its compliance requirements, any extra allowances are allowed to be sold only after compliance has been established. This would increase the environmental performance of the scheme by reducing uncertainty surrounding the validity of acquired allowances. In the meantime, however, it would restrict legitimate trading activities during the commitment period. This could significantly increase the costs of participating in emissions trading and thus reduce the volume of trades. Moreover, it still does not eliminate the risk of over-selling, since the surplus assigned amounts from the first commitment period might be needed by the seller during the subsequent commitment periods. Thus, rules that address the risk more effectively and

[9] If the credits were to be used in advance of certification, we advocate that buyers should be primarily held liable for the compliance of CDM projects, because buyers in Annex I countries have their domestic emissions limitation commitments, and have the direct access to information and the leverage necessary for project oversight. In comparison with sellers, buyers have a financial stake in CDM projects.

allow trading during the first commitment period need to be established. They are essential to the success of emissions trading.

Because Article 3 refers to the transfers of allowable emissions from one nation to another without suggesting that transfers could be invalidated, some observers think that Article 17 implicitly means that trading rests on the so-called seller-only liability or seller beware liability (Rolfe, 1998). Under a seller beware regime, any permits acquired by the buyer are valid regardless of whether the seller is in compliance with its commitments under the Protocol, and all permits would be worth the same no matter where they originated. Because buyers bear no risk under the seller beware liability, they are more likely to become active in the market. This would stimulate the development of a more robust trading market. This is essential to the successful function of emissions trading, particularly in the initial start-up stage when few potential buyers, if any, have any trading experiences.

Seller beware works well in domestic emissions trading scheme, such as the US SO_2 allowance trading program whose built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. However, an international seller beware trading scheme will be problematic, given the fact that enforcement at the international level often proves to be more difficult and less likely to be effective than at the national level because of the absence of an institution with the international jurisdiction to enforce policy. As such, the seller beware liability could lead to a regime of weak compliance because the lack of strong enforcement at the international level would provide few disincentive for buyers to acquire from sellers who take a lax attitude to compliance.

To remove the built-in flaws, one option is to use eligibility to trade as an enforcement mechanism. The approach reflects the view that in some cases prevention of non-compliance is more effective than *ex post* reward or punishment (Mitchell, 1994). It assumes that trading is a privilege, not a right. Initially, trading is only allowed to those eligible parties whose domestic monitoring, tracking and enforcement systems have met certain minimum quality criteria (Zhang and Nentjes, 1998).[10] The eligibility requirement would be

10 The European Union environmental ministers insisted until recently on the need to set a concrete ceiling on the use of emissions trading to ensure that substantial efforts to cut GHG emissions be achieved through domestic actions. According to the EU Commissioner for the Environment, Ritt Bjerregaard, however, both present and prospective EU nations are now more interested in strict rules for emissions trading than a percentage limit (Reuters, 15 September 1998). Some EU officials think that such rules should stipulate, among

particularly important if *ex post* penalties for non-compliance were weak or unavailable in practice. By precluding those Annex B countries that do not meet the criteria from engaging in emissions trading until such time as they bring their domestic monitoring and enforcement systems up to the threshold eligible for trading, the eligibility criteria would ensure that there is no significant risk to buyers. The more stringent are the criteria, the greater is the assurance that traded tons of emissions represent real reductions, the less risk there is to buyers, and hence the more likely buyers become active in the market. From the environmental perspective, the more stringent criteria are preferred. On the other hand, this would lead to reduced scope of participation in the trading market than do the less stringent ones, thus undermining the effectiveness of emissions trading in lowering the cost of abating GHG emissions. Clearly, there is a tradeoff between the desirability of assigning the seller responsibility for the validity of acquired allowances and the "appropriate" eligibility threshold.

Another option to provide an incentive to sell only assigned amounts surplus to the compliance needs of the seller could rest on the seller beware liability with an escrow account (Haites, 1998). It requires that the proceeds from the initial sales of assigned amounts be deposited in an escrow account until compliance has been established. The money in the escrow account is used to compensate the buyers for the loss of the assigned amounts that they purchased in case the seller is found in non-compliance with its commitments, namely, the fraction required to bring the seller into compliance with its commitments. Because the seller does not receive the proceeds until after the end of the commitment period, it is conceivable that most trading will take place near the end of the commitment period. The reluctance to trade early in the commitment period could significantly reduce the volume of trades, thus undermining the effectiveness of emissions trading. Such a restriction might be relaxed by means of requiring only part of the proceeds from the initial sales of assigned amounts be deposited in an escrow account.

Instead of only the seller being held liable, the buyers could be assigned to hold the responsibility for the validity of acquired allowances. The so-called shared liability or buyer beware liability stipulates that the buyer, be it a country or a firm, shares the responsibility for non-compliance by the sellers. In this case, the allowances acquired by the buyers become invalidated or are discounted if the sellers are found not in

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other things, that only those countries capable of monitoring and tracking their emissions should be allowed to engage in trading.

compliance with their commitments. This would provide the strong incentive for risk-averse buyers to ensure that any allowances acquired are valid.

If, at the end of the commitment period, it turns out that the seller has exceeded its assigned amounts, then the allowances acquired by the buyers could either be discounted in proportion to the degree of the seller's overage or become invalidated on a last-in, first out (LIFO) basis. Use of the LIFO system could track the sales of allowances so that the last allowances acquired could be identified. In so doing, the Parties that wished to trade are required to serialize their allowances at least by their country of origin and year of origin, with the transfers and acquisitions of allowances being mandated to start with lower numbers. In the event of non-compliance by the seller, the allowances, which have been acquired by the buyers but are to become voided, is on the basis of the last that has been acquired would be the first to become voided. The process of taking back the seller's overage continues until the seller is brought into compliance, if non-compliance by the seller is due only to over-selling.

In our view, the LIFO approach is preferred to the simple discounting approach at least for three reasons. First, the LIFO approach can distinguish buyers who acquire allowances from sellers when no implementation problems are on the horizon from those buyers who do so when serious implementation problems have arisen in the seller country (Goldberg *et al*., 1998). Second, it minimizes the number of transactions affected and creates an incentive to register transactions quickly because earlier sales have a lower probability of being invalidated than later sales. Third, it corrects the serious drawback of discounting that is unable to decide who, all buyers or just the marginal buyer, is liable for non-compliance by the seller whose allowances are sold to several countries.

However, one drawback of including a buyer beware liability is that the allowances are not fungible, with each one representing a unit with reference to the country where it originated. As a result, the allowances would have different risks and thus have different prices eventually depending on the seller's credibility. Although there is some merit of increasing the environmental performance of the regime, the buyer beware liability might complicate the transfer and acquisition process[11] and could add substantial transaction costs. Another major drawback of assigning a buyer beware liability is that it erodes the commodity nature of

allowances by allowing them to be retroactively devalued, thus creating uncertainty over their value until the end of commitment period (Tietenberg *et al.*, 1998). This drawback becomes even more serious because in this Protocol there is only one very long commitment period. The long length means that compliance is not determined until the end of the commitment period because, in principle, both the seller and buyer responsibility regimes do not require any interim evaluation of implementation before the end of the commitment period. As a result, whether the seller is in compliance is ascertained only at the end of the commitment period. At that time, it might be too late to bring the seller back into compliance, although a true-up period of several months at the end of the commitment period is allowed for the seller finding itself in non-compliance to acquire additional allowances to cover its excess tons of emissions.

To prevent that unwanted outcomes from arising from an early date, it is desirable to assign the buyer-seller hybrid responsibility by introducing a process of evaluating Parties' efforts towards implementation during the commitment period. This includes annual reporting of the progress of each Party in meeting its assigned amounts. If in a given year a Party's actual emissions did not exceed by a certain margin its annualized assigned amounts, the tons sold to the buyers would not be affected (namely, the seller's tons acquired by the buyers would be valid). After the year when the seller is found to go beyond that tolerance margin, however, the buyers become liable for potential non-compliance by the seller. As such, the allowances acquired prior to that year would not be discounted, thus avoiding the imposition of retroactive liability for the buyer. The hybrid approach is superior to suspending trading rights for those sellers during the remaining commitment period, whose actual emissions in a given year exceed by a certain margin their annualized assigned amounts, because the latter restricts the legitimate rights of those sellers that might, in principle, sell all their entire assigned amounts early during the commitment period and then buy them back before the end of the commitment period.

Finally, it should be pointed out that buyer beware liability is effective only to the extent that it puts additional pressure on sellers to comply with their commitments because after all, sellers exercise great, if not complete, control over whether or not they comply with their commitments. As such, the above rules for accountability should not be understood as mutually exclusive. In fact, they should be complementary.

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11 With modern information technology, however, a regime of the buyer beware liability is probably not as complicated as it sounds.

7. Emissions Trading System Enlargement

Given the fact that the costs of abating GHG emissions differ significantly among countries and there are a great deal of low-cost abatement options in developing countries (cf. IPCC, 1996), it is generally acknowledged that broadening an international emissions trading scheme to include developing countries creates a source of obtaining low-cost abatement options, thus increasing potential of efficiency gains. This is one of the reasons why some OECD countries insist on bringing non-Annex I countries into an emissions trading scheme. On the other hand, those current Annex B countries that are widely regarded as the sellers of emissions permits once emissions trading takes place would not welcome the addition of non-Annex I countries to the scheme because these new entrants would raise the supply of overall permits on the market and depress the prices of those permits held by the current Annex B sellers. Although these are just speculations, they underline the importance of establishing clear rules of procedure about admitting new entrants before emissions trading begins.

The admittance of new Parties to Annex B has to be done through an amendment of the Annex to the Protocol. Two avenues are available to facilitate the process of admitting new entrants to Annex B. One is based on voting to admit new entrants. So far any decisions made by the Conference of the Parties to the UNFCCC have been generally adopted by consensus. If admitting new entrants requires consensus by all current Annex B countries eligible for emissions trading, this confers on any Annex B Party a *de facto* power of veto. Thus, if avenue to admit new entrants rests on voting, a three-fourth majority vote of the current Annex B countries present and voting at the meeting could be adopted to prevent exploitation of market power.

The second avenue involves introducing an automatic phase-in once one prospective country meets pre-determined criteria. In our view, the second is superior to the first avenue. Such criteria should include the conditions under which any new entrant could be incorporated into the emissions trading scheme. Once such criteria are set, they should remain stable in the short-run, although in the long-run adjustments in the criteria might be normal as greater information and experience is gained.

By the same token, broadening an emissions trading scheme to cover all the greenhouse gases under Annex A to the Kyoto Protocol would provide maximum opportunity for trading to find those sources where the costs of abating greenhouse gases are lowest, thus maximizing the cost savings. On the other hand, a workable emissions trading scheme requires that emissions of whatever a pollutant to be included have to be measured with reasonable accuracy. This requirement implicitly precludes including all gases in the initial trading scheme (Victor, 1991). However, limiting trading to a subset of gases is not likely to be effective unless the Protocol is further amended to partition the assigned amounts into two categories -- tradable and non-tradable gases with separate goals being assigned for each (Tietenberg *et al*., 1998). Without a separation of categories, it seems to be lack of a legal basis to reject the legitimate claim from those countries that use the flexibility inherent in the equivalence process to substitute freely among the gases, because Article 5.3 of the Protocol has authorized that the global warming potentials are used to translate non-CO_2 greenhouse gases into carbon equivalent units in determining each Annex I Party's compliance with its assigned amounts.

8. Bubbles

In addition to Article 17, on the insistence of the EU, the Kyoto Protocol incorporates the bubble concept into the final text (Article 4). It allows a group of Annex I countries to jointly fulfil their commitments under Article 3, provided that their total combined aggregate GHG emissions do not exceed their assigned amounts. A bubble must be declared when the ratification of the Protocol is deposited. The bubble approach is often termed as trading without rules because it sets few restrictions on trading between Parties. This makes it a potentially attractive instrument. Given great differences in environmental monitoring and enforcement infrastructures among Annex I countries, if it turns out to be too difficult to agree on the common rules and guidelines for a full-fledged emissions trading scheme, the bubble approach at least opens the possibility of trading emissions permits within the voluntarily-formed group. In addition to the current EU bubble, the US has reached a conceptual agreement with Australia, Canada, Japan, New Zealand, Russia and Ukraine to

pursue an umbrella group to trade emissions permits (USDOS, 1998).[12] However, the approach presents some drawbacks.

First, it requires to set a cap on overall emissions for the group as a whole and to work out a specific cap for each member country within the group in an agreement, the terms of which must be notified to the UNFCCC Secretariat at the time of ratification of the Protocol. Once the agreement has been registered with the Secretariat, the commitments agreed on cannot be revisited during the commitment period in question.

Second, it narrows the scope of efficiency gains in comparison with inter-source trading, because it restricts the location where firms or countries comply with their caps and because it is likely to have frightening transaction costs.

Third, in the case of the current EU bubble, because the European Community (EC) itself is a Party to the Protocol, it has the legitimate responsibility for reporting on the performance of the EU as a whole and ensuring its declared targets as a whole under the notified agreement are met. However, the potential advantages of offering double coverage of reporting obligations and double assurance for abatement obligations could be hindered by the need to have complete and early information from individual member states (OECD, 1998). In the event that the EU as a whole would fail to meet its own targets and if a non-compliance procedure would be established, the EC, together with those individual member states that have not achieved their own targets set out in the agreement, would thus be faced with sanctions under Article 4.6. In this case, the question is who bears the responsibility of the EC itself? So, in the case where a regional economic integration organization itself were a party to the Protocol, some clarification for the division of responsibility in the terms of that agreement would be needed.

Fourth, although originally conceived as a way of allowing the EU as a regional economic integration organization (REIO) to accommodate the internal burden sharing of the Kyoto commitments among its member states, the final wording under Article 4 is framed in general terms. This might create potential loopholes in meeting the Kyoto obligations. In the case of a REIO bubble, each REIO member and the organization itself are held accountable for the failure to achieve the required reductions for the REIO

[12] This umbrella group differs from one at the international climate change negotiations. The latter is not intended to form a bubble, but simply meets daily during the international climate change negotiations to exchange information and discuss substance/strategy on issues where there is a common ground.

member. Under the terms of the agreement notified to the UNFCCC Secretariat, the incentive for non-compliance is offset by the joint responsibility of both the individual members and the regional organization. In contrast, in the case of a non-REIO bubble, the absence of a formal regional organization with enforcement powers means that the seller countries are solely responsible for their own non-compliance. As discussed in Article 17 trading, these countries may have an incentive to fall short of compliance. To ensure the environmental integrity of the Kyoto Protocol, it is thus desirable to assign some form of joint responsibility for non-REIO bubbles too. However, the countries concerned within a non-REIO bubble should be left free to work out an arrangement to bring the whole group into compliance.[13]

Finally, the bubble approach raises a number of co-ordination issues with emissions trading. Within a bubble, should compliance, banking, eligibility, liability and supplementarity provisions be applied to the individual members of a bubble or to a bubble as a whole? For example, in case the group complies with its aggregate commitments but some members exceed their revised commitments, if the banking provisions are applied to individual members, then the sum of the surplus AAUs for individual members exceeds the quantity of AAUs surplus to the group commitments. By contrast, if the banking provisions are applied to the group, the quantity of AAUs banked is limited to those AAUs surplus to the group commitments. From the environmental integrity's perspective, Haites and Aslam (2000) think that the application of the banking provisions to individual members is preferred.[14] But this may be considered to conflict with the philosophy underlying Article 4 bubbles.

9. Concluding Remarks

The Kyoto Protocol is the first international environmental agreement that sets legally binding GHG emissions targets and timetables for Annex I countries. Article 17 authorizes emissions trading among Annex B

[13] Goldberg *et al.* (1998), for example, suggest that one possible approach to assigning the joint responsibility within a non-REIO bubble would be to hold the economically stronger members accountable, in part, for the failure of the weaker members to meet their agreed emissions targets.

[14] Haites and Aslam (2000) also think that the application of eligibility, liability and supplementarity provisions to individual members is preferred to the application to the group.

countries. If properly designed, emissions trading can effectively reduce their abatement costs while assisting Annex I countries in achieving their Kyoto obligations.

Aimed at contributing to the design and operationlization of an international GHG emissions trading scheme, this paper has discussed how much of a Party's assigned amount of GHG emissions can be traded internationally; emissions trading models; competitiveness concerns in the allocation of emissions permits; banking and borrowing; the issue of liability for non-compliance by the sellers; emissions trading system enlargement; and bubbles. The following conclusions emerge from the discussion.

First, no ceiling on the use of international emissions trading should be imposed on countries eligible for emissions trading, on grounds of both economic efficiency and environmental effectiveness. We think that setting a ceiling on trading on the arbitrary basis interferes with the development of financial markets for allowances, and makes it even more difficult to set more stringent emissions targets for the subsequent commitment periods beyond 2012.

Second, we propose to levy an annual fee on taxable traders or impose a transaction tax on trades involving taxable allowances as one possible resolution to the issue of hot air trading that motivated the placement of supplemental norm in the Kyoto Protocol. Such a fee or tax differs from a carbon tax because firms that elect to meet their emissions limits only by taking domestic actions have no obligations to pay such a fee or transaction tax. It could be imposed only on the buyer and could differ to reflect the direction of emissions trading flows. Another approach to addressing the supplemental norm requirement would be to require the Parties to demonstrate adequate domestic actions according to a set of criteria to be defined by the Conference of the Parties to the UNFCCC.

Third, companies are the best entities to trade emissions permits. Allocating permits to individual sub-national legal entities will facilitate private participation in emissions trading. Such an allocation depends on the structure of national emissions trading systems. Such systems could be modelled as either *upstream* or *downstream* or *hybrid* systems, depending on national circumstances. The principal differences among the three approaches relate to the coverage and administrative efficiency of an emissions trading system. The distinguishing features of broad coverage and administrative simplicity would make an *upstream* system the more attractive approach.

Fourth, the allocation of permits has the potential to bring parties into conflict with the WTO provisions, raising concerns about international competitiveness. Although such concerns are not limited to trading where allowance allocation can make unequal treatment explicit, they can be much more easily hidden from the general public if conventional command-and-control regulations are used. Auctioning at least part of the assigned amounts to sub-national legal entities alleviates to some extent the concern about international competitiveness. However, any attempts to produce an agreement on a common rate are likely to run into concerns about national sovereignty and thus would encounter significant political difficulties. With this in mind, we argue that individual governments should be left free to devise their own ways of allocating assigned amounts. This would ensure that any individual governments maintain their right to determine the domestic policies and measures that would be taken to meet their Kyoto obligations.

Fifth, permit banking offers a greater degree of intertemporal flexibility, thus lowering the cost of abating GHG emissions. The Protocol allows CERs obtained under the CDM prior to the beginning of the first commitment period to be credited for later use, and seems to place no restrictions on the use of banking during the post-2008 commitment periods. However, banking of Annex I country's own early reductions prior to the beginning of the first commitment period has not been an option under the Kyoto provisions. If authorized, this type of banking would provide a strong incentive for Annex I countries to ratify the Protocol earlier than what otherwise would be the case. It alleviates to some extent the concern about hot air trading, because it provides the incentive for legal entities in the advanced OECD countries to take abatement actions at home. As with banking, borrowing is another way to increase flexibility and lower the cost of abatement. However, borrowing is much more controversial. If allowed, a number of safeguards should be added to avoid possible abuses of the option.

Sixth, the rules for accountability are essential to the success of emissions trading. In general, a seller beware liability works well in a strong enforcement environment where the built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. In the Kyoto Protocol, however, a seller beware liability may not always work because there is only one very long commitment period and, as of now, no subsequent commitment periods have been defined, and because enforcement at the international level has proved to be less likely to be effective than at the national level. The eligibility requirement and the seller beware liability with an escrow account could to some extent effectuate compliance by the sellers, but may not

be considered sufficient. As a result, this may create a need for some form of a buyer beware liability under which acquired allowances that are tainted could not be used to satisfy the buyer's assigned amount requirements. This would provide a strong incentive for risk-averse buyers not to acquire allowances from sellers who appear to be headed towards non-compliance. If the Parties decide that buyer beware liability is needed to complement traditional compliance procedures, in our view, the last in, first out approach is preferred to the simple discounting approach in taking back the seller's overage, partly because the former can distinguish buyers who acquire allowances from sellers when no implementation problems are on the horizon from those buyers who do so when serious implementation problems have arisen in the seller country, and partly because it minimizes the number of transactions affected and creates an incentive to register transactions quickly. Furthermore, we argue that, in order to prevent non-compliance from arising at an early date, it is desirable to assign the buyer-seller hybrid responsibility by introducing a process of evaluating Parties' efforts towards implementation during the commitment period. If in a given year a Party's actual emissions did not exceed by a certain margin its annualized assigned amounts, the seller's tons acquired by the buyers would be valid. After the year when the seller is found to go beyond that tolerance margin, however, the buyers become liable for potential non-compliance by the seller. As such, the allowances acquired prior to that year would not be discounted, thus avoiding the imposition of retroactive liability for the buyer. We think that the hybrid approach is superior to suspending trading rights for those sellers during the remaining commitment period, whose actual emissions in a given year exceed by a certain margin their annualized assigned amounts.

Seventh, the Protocol itself, the eligibility criteria and the measurement capability considerations initially preclude including all the countries and greenhouse gases in an international emissions trading scheme. However, broadening a coverage of such a scheme will induce more cost-effective abatement options and further increase the cost savings. Therefore, it is very important to establish clear rules of procedure to facilitate admitting new entrants and including gases that are not covered initially before emissions trading begins.

Finally, although originally conceived as a way of allowing a REIO to accommodate the internal burden sharing of the Kyoto commitments among its member states, the final wording of joint fulfilment under Article 4 is framed in general terms. If it turns out to be too difficult to agree on the common rules and guidelines for a full-fledged emissions trading scheme, the bubble approach at least opens the possibility of

trading emissions permits within the voluntarily-formed group. However, in order to ensure the environmental integrity of the Kyoto Protocol, just as a REIO bubble has built-in joint responsibility of both the individual members and the regional organization, it is desirable to assign some form of joint responsibility in the case of non-REIO bubbles, although the countries concerned within a non-REIO bubble are left free to work out an arrangement to bring the whole group into compliance.

Acknowledgements

This paper was part of the presentations at the United Nations Conference on Trade and Development Workshop on International Greenhouse Gas Emissions Trading, a Side-Event of the Eighth Sessions of the Subsidiary Bodies of the UNFCCC, 8 June 1998, Bonn; the World Congress of Environmental and Resource Economists, 25-27 June 1998, Venice; the European Union Workshop on Domestic Tradeable Quotas, 1-2 July 1998, Brussels; and the IX Pacific Science Inter-Congress, S-III-2 Economics of Sustainable Development, 16-18 November 1998, Taipei; as well as at seminar at Renmin University of China, 9 December 1998, Beijing. We would like to thank participants in the above Workshops and Congress, three anonymous referees, one co-editor, Daniel Dudek, Frank Jushua, and Tom Tietenberg for useful discussions and comments on an earlier version of the paper. Financial support from the Netherlands Organization for Scientific Research is gratefully acknowledged. The usual caveat applies.

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