Using emissions trading to regulate global greenhouse gas emissions

Zhang, ZhongXiang

University of Groningen, The Netherlands

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ZhongXiang Zhang
Faculty of Law and Faculty of Economics
University of Groningen
The Netherlands

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Contents

Glossary of terms, abbreviations, etc

AAUs	Assigned amounts units
BTU	British thermal unit
CDM	Clean development mechanism
CEC	Commission of the European Communities
CERs	Certified emission reductions
CO_2	Carbon dioxide
COP	Conference of the Parties to the UNFCCC
CTO	Certified tradable offsets
EC	European Community
ERUs	Emission reduction units
EU	European Union
GHG	Greenhouse gases
LIFO	Last-in, first out
JI	Joint implementation
OECD	Organisation for Economic Co-operation and Development
REIO	Regional economic integration organization

UNFCCC United Nations Framework Convention on Climate Change
WTO World Trade Organization

Summary

The inclusion of emissions trading in the Kyoto Protocol reflects an important decision to address climate change issues through flexible market mechanisms. This Article addresses a number of policy issues that must be considered in designing and implementing an international greenhouse gases (GHG) emissions trading scheme. These include emissions trading models, the initial allocation of emissions permits and its competitiveness concerns, banking and borrowing, the liability rules for non-compliance, and bubbles. The following conclusions emerge from the discussion. First, although emissions trading could take place either on an inter-governmental basis or on an inter-source basis, sub-national legal entities are the best entities to trade emissions permits. Allocating permits to individual emissions sources will facilitate private participation in emissions trading. Moreover, it has been argued that individual governments should be left free to devise their own ways of allocating assigned amounts. Second, it has been pointed out that although national emissions trading systems could be modelled as either *upstream* or *downstream* or *hybrid* systems, the distinguishing features of broad coverage and administrative simplicity would make an *upstream* system the more attractive approach. Moreover, national emissions trading systems should incorporate the maximum degree of flexibility in banking. Third, the liability rules are essential to the success of an international GHG emissions trading scheme. In general, a seller beware liability works well in a strong enforcement environment. In the Kyoto Protocol, however, it may not always work. By contrast, a buyer beware liability could be an effective deterrent to non-compliance, but the costs of imposing it are expected to be very high. To strike a middle ground, it has been suggested a combination of preventive measures with strong but feasible end-of-period punishments to ensure compliance with the Kyoto emissions commitments. Such measures aim to maximize efficiency gains from emissions trading and at the same time, to minimize over-selling risks.

1. Introduction

In December 1997, 158 countries reached a historical agreement on limiting greenhouse gas emissions in Kyoto. The so-called Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) sets legally binding emissions targets and timetables for Annex I countries (i.e., countries of the Organisation for Economic Co-operation and Development (OECD) and countries with economies in transition). Together, these countries must reduce their emissions of six greenhouse gases by 5.2% below 1990 levels over the commitment period 2008-2012. 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 principle 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. 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 of the Protocol 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 this 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. In addition to the two project-based mechanisms, the Kyoto Protocol 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 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. 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.

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, 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. Taking environmental effectiveness, economic efficiency, equity and political acceptability as the guiding principles of designing and implementing an emissions trading scheme, this Article discusses emissions trading models, the allocation of emissions permits and its competitiveness concerns, banking and borrowing, the liability rules for non-compliance, and bubbles. These design and implementation issues are only partially on the climate negotiator's agenda but are very important because they 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 the focus is exclusively on emissions trading, its relationship with the CDM, JI and bubbles wherever necessary is to be discussed. By providing some new insights, the Article aims to contribute to the design and implementation of an international emissions trading scheme.

Before going into detail, it should be emphasized that the discussion here 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, a broad discussion as proceeded in the present Article could provide more

useful inputs to the ongoing process of moving to decisions on rules governing emissions trading. As such, this 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. Emissions trading models

In principle, an emissions trading scheme could include all the greenhouse gases under Annex A to the Kyoto Protocol. The so-called comprehensive approach would provide maximum opportunity for trading to find those sources where the costs of abating greenhouse gases are lowest, thus maximizing the cost savings. In practice, 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. 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. 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.

2.1. Inter-governmental emissions trading versus inter-source trading

Once the coverage issue is set, emissions trading could take place either on an inter-governmental basis or on an inter-source basis. Under inter-governmental trading, 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 JI as specified in Article 6 of the Kyoto Protocol, at least for two reasons. First, inter-governmental emissions trading separates the issue of 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 under 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.

Under inter-source trading, 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. Increasing the number of trades 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 costs and thus to determine their efficient emissions level. Although it has been argued 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.

2.2. The structure of national emissions trading systems

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. An *upstream* trading system would target fossil fuel producers and importers as regulated entities, thereby reducing the number of permit holders to oil refineries and importers, natural gas pipelines, natural gas processing plants, coal mines and processing plants.

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. 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.

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.

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. 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. 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 permits 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 permits. 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 of the World Trade Organization (WTO) do not allow unequal treatment of like products, be they 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.

3. The Initial allocation of permits and its competitiveness concerns

The Kyoto Protocol has set the caps on aggregate GHG emissions for Annex B countries. If emissions trading among sub-national entities is authorized, the next issue is how Annex B governments allocate the assigned amounts to sub-national entities within their countries. This decision is the first step towards trading among emissions sources as well as trading among countries. This raises the competitiveness concern in the initial allocation of permits.

3.1. The initial allocation of permits: grandfathering versus auctioning

The allocation of permits to emissions sources is a politically contentious issue because, given economic value of the permits, the choice has distributional implications and, in the presence of transaction costs, has efficiency implications as well. Individual emissions sources can benefit greatly depending on the allocation methods chosen.

One often-discussed allocation method is a form of grandfathering, whereby the permits are given out freely to existing regulated entities in proportion to their historical emissions or fossil fuel sales. For example, in the US SO_2 allowance trading program mandated in Title IV of the Clean Air Act Amendments of 1990, the basic allocation formula has been free distribution of available allowances among generating units within the regulated plants in proportion to their average fossil fuel consumption during the baseline period 1985-1987 multiplied by 2.5 pounds of SO_2 emissions per million British thermal unit (BTU) for Phase I and by 1.2 pounds of SO_2 emissions per million BTU for Phase II. Grandfathering would have the advantage of minimizing the disruption of current production of the regulated entities. With grandfathering, emissions sources could also save considerable expenditures, because they only have to pay for additional permits as needed. Therefore, it increases the political acceptability of an emissions trading scheme. However, like stringent command-and-control standards for new sources, grandfathering gives rise to entry barriers for new sources to enter the market, because they must buy their emissions permits while existing sources obtain theirs for free.

The alternative to grandfathering is that the government would require prospective permits buyers to bid for permits in an auction. The adopted annual auction of SO_2 allowances in the US SO_2 allowance trading program, which represents less than 2% of the total allowance allocation and thus is a trivial part of the overall program, is structured as a sealed-bid auction with pay-your-bid-pricing. Potential buyers are required to simultaneously send bids in sealed orders, stating the number of the permits they are willing to buy at a stated maximum price. The auctioneer then supplies permits beginning with the highest bidder until the excess supply is zero. Unlike in a stock market where there is one single price at any time, this form of auction creates many different settlement prices. Alternatively, a sealed-bid auction could be designed in such a manner that all winners pay the price of the marginal buyer, that is, the clearing price for each permit. Unlike in a sealed-bid auction with pay-your-bid-pricing where the bidders attempt to guess where the clearing price is likely to be, predicting the clearing price is less important in an auction with uniform pricing, since every winner pays the same price no matter how high it bids.

This form of auction also encourages participation by small bidders, since it is strategically simple.

Auctioning permits is aimed to serve two purposes. One is to ensure that permits are available for small and new sources. The second purpose is to deliver signals on permit prices. Many analysts often argue that auctioning is superior to grandfathering in the initial allocation of permits on the following grounds. First, as further discussed in the next section, auctioning generates revenues that could be used to reduce pre-existing distortionary taxes, thus generating overall efficiency gains. Second, it provides a stronger incentive for technical innovation. Third, auctioning eliminates the need to establish historical baselines for the regulated entities and helps to ease political contention in the allocation of scarcity rents, which occurs if the permits are grandfathered. Fourth, revenues raised from auctioning could be used to directly compensate those affected workers and consumers, and thus the equity goal could be better achieved under auctioning than under grandfathering. Despite all these advantages of auctioning, however, all the existing trading programs have initially allocated the permits through grandfathering, partly because it provides greater political control over the distributional effects of regulation.

3.2. Competitiveness concerns in the allocation of permits

The initial allocation process itself represents the establishment and distribution of private property rights over emissions, and therefore lies outside the mandate of the WTO. 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. 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.

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, the proposal of the Commission of the European Communities (CEC) for a mixed carbon and energy tax 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 this CEC tax on the 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 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.

3.3. The harmonisation of allocation of permits?

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 a need for the harmonisation of allocation of permits. According to Article 17 of the Kyoto Protocol, the rules governing GHG 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 harmonise 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 enforcement, although harmonisation poses difficult coordination. However, the allocation of permits does not fall into the category of harmonisation, and individual governments should be left free to devise their own ways of allocating permits on the following grounds.

First, 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 the grounds of fiscal sovereignty. 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 harmonised across countries, thus an argument for special treatment in the allocation of permits on the grounds of competitiveness is unconvincing.

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 due to the fact that 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. One study, 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. 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 above study clearly indicates that if the harmonisation 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.

4. 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, which has led to early reductions and substantially lower overall costs of compliance. In an international 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 from the CDM projects 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 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. It can be proposed that potential use of the option is contingent on the following two conditions. The first is conditional on the ratification of the Kyoto Protocol. 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[1] should not be 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

[1] 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 particularly acute in Russia whose emissions are not expected to rise to its 1990 level until 2010.

option will accelerate the process of implementing a domestic emissions trading scheme by dealing with all technical issues associated with it. However, triggering 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. 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. It might risk distributing too many credits for questionable early emissions reductions, particularly if they are not verified before credits are given to these 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.

Although banking is relatively uncontroversial, borrowing is much more controversial. 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, it is therefore important to continue to investigate the ways that such a flexibility might be credibly implemented in practice, which could serve as a complement to other compliance mechanisms. In case the COP 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.

5. The liability rules for non-compliance

Emissions trading would promote buyers' compliance with their emission limitation and reduction commitments by reducing their costs of compliance. Because selling parts of assigned amounts is likely to prove highly profitable, trading would also provide an economic incentive for Parties to sell their assigned amount units (AAUs) that are ultimately needed at the end of the commitment period for their own compliance purposes and would thus create the possibility that a Party could find itself in a situation of non-compliance as a result of its own excessive over-selling. Over-selling could occur unintentionally, wilfully or inadvertently. Wilful over-selling would occur where a Party transfers AAUs calculating that the gains of such transfers are likely to outweigh the consequences of its own non-compliance, and inadvertent over-selling would occur where a Party fails to anticipate correctly how much of assigned amounts will be needed ultimately to meet its own compliance needs. Although the exceptions to compliance rules could be made for unintentional over-selling that could occur if emissions increased late in the commitment period as a result of unpredictable events or events beyond the control of the government concerned, no exceptions should be allowed for both wilful over-selling and inadvertent over-selling. The question then arises of which Party - the buyer, the seller or both - is liable for non-compliance by the seller who either inadvertently or wilfully over-sells its permits and then fails to comply with its commitment. This problem of over-selling is one of the most challenging issues in designing a workable international emissions trading scheme. Given the fact that Article 12 of the Kyoto Protocol authorises 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. Thus, some Party suggests that the transfers of AAUs in an international emissions trading scheme could be envisioned along this line. Each year, any excess AAUs to be sold first have to be verified and certified prior to trading. Although the so-called post-verification trading model eliminates the risk of over-selling, there is no guarantee that the Parties who comply until the end of the fourth year of the commitment period will be in compliance with their commitments at the end of the

commitment period because they could sell more than their remaining AAUs available in the last, namely, fifth year of the commitment period. Other Party even suggests that in order to ensure that Parties only sell those assigned amounts surplus to their compliance requirements, any excess AAUs 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 permits. In the mean time, 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 allow trading during the first commitment period need to be established. They are essential to the success of emissions trading. By providing some new insights, this section aims to contribute to the in-depth discussion on the liability rules that are intended to define clearly where the responsibility lies for a Party in case it is out of compliance because of over-selling its AAUs, thus contributing to the design and implementation of an international GHG emissions trading scheme.

It should be pointed out that a Party could be in non-compliance with its commitments, whether or not it trades. Non-compliance could also occur because a Party fails to undertake sufficient domestic abatement policies and measures or to purchase enough AAUs or certified credits from the Kyoto mechanisms. Here, the focus is on the risk of over-selling just because it arises from emissions trading. It is by no means that over-selling deserves greater punishment than other reasons for non-compliance. Indeed, from the atmosphere's perspective, no matter how a Party is out of compliance, the damages to the atmosphere are the same. This suggests that all the reasons for non-compliance should be treated equally.

5.1. Seller beware liability

Because Article 3 of the Kyoto Protocol 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. 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 on 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 schemes, such as the US SO_2 allowance trading program mandated in Title IV of the 1990 Clean Air Act Amendments whose built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. However, in an international trading scheme, the efficacy of seller beware liability depends heavily on the non-compliance regime under Article 18 of the Kyoto Protocol. Unless financial penalties are much higher than the potential gains from over-

selling AAUs, there is an economic incentive for sellers to sell AAUs not surplus to their compliance needs. If, as past experience has suggested 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, the non-compliance regime under Article 18 provides weak sanctions for such a behaviour, the seller beware liability is unlikely to exert sufficient pressure on sellers' over-selling. 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.

5.1.1. Eligibility to participate in emissions trading

To remove the built-in flaws, one option is to use eligibility to trade as an enforcement mechanism. This approach reflects the view that in some cases prevention of non-compliance is more effective than *ex post* reward or punishment. 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. The criteria include, but are not limited to, compliance with inventory and reporting obligations of Articles 5 and 7 of the Kyoto Protocol, and establishment and maintenance of a satisfactory national registry that accurately records all holdings, transfers and acquisitions of AAUs by the Party and all the legal entities that it authorises to trade. The eligibility requirements would be 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, thus giving the credibility of the emissions trading system. 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 on the market. From the environmental perspective, the more stringent criteria are preferred. On the other hand, less developed Annex B countries or new entrants to Annex B are less likely to have well-developed monitoring and enforcement systems in place, but are most likely to have surplus emissions permits to sell. The more stringent eligibility requirements would preclude these potential sellers of emissions permits and increase buyers' costs of compliance, thus undermining the effectiveness of emissions trading in lowering the cost of abating GHG emissions. Clearly, there is a trade-off between the desirability of assigning the seller responsibility for the validity of acquired permits and the "appropriate" eligibility threshold. In addition to using eligibility to determine which Parties could be eligible for trading, the eligibility requirements could demand the suspension of valuable trading rights of those Parties that are not in compliance with their targets in the previous commitment period once subsequent commitment periods begin to take effect. If adopted, this would promote continuing compliance.

5.1.2. An escrow account

Another option to provide an incentive for sellers to sell only assigned amounts surplus to their compliance needs could rest on the seller beware liability with an escrow account. It requires that the proceeds from the initial sales of AAUs be deposited in an escrow account until compliance has been established. Any subsequent resale is unaffected by the escrow requirement, with the proceeds going to the seller. The money in the escrow account is used to compensate the buyers (that need not to be the initial buyers) for a loss of the assigned amounts that they purchased in case the seller is found to be in non-compliance with its commitments, namely, the fraction up to the quantity the seller over-sells. 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 AAUs be deposited in an escrow account.

5.1.3. A compliance reserve

The proceeds from sales of assigned amount in the early stage of the commitment period may be used to finance the development and deployment of an advanced emissions reduction technology. Under an escrow account option, the seller would refrain from using the early sales as a financing tool. An alternative would be to set a compliance reserve. It requires that, when any effectuated trades take place, the seller puts a percentage of AAUs to be sold into an account. A compliance reserve could be designed in such a way that at the end of the commitment period, if the Party were in compliance with its commitments, the AAUs in its reserve would be returned and could be sold during the "true-up" period or be banked for its use in the subsequent commitment period. If it were out of compliance, the reserve would be used to bring it into compliance. If some AAUs remained afterwards, a portion of them could be returned to the initial non-complier, with the portion related to the level of initial non-compliance. Alternatively, they could be distributed to compliers as a reward. Because how much of AAUs in the reserve will be returned depends on the level of compliance by the seller, the individual compliance reserve offers some prevention of over-selling.[2]

The environmental integrity of this option depends on the size of the reserve requirement. The more stringent the reserve requirement, the lower is the risk of over-selling. But if the reserve requirement were too stringent, it would unnecessarily reduce the number of AAUs available for trades, thus lowering the economic efficiency. Moreover, the compliance reserve discourages low-level non-compliance but not large-scale non-compliance, because when the seller chose to non-comply, it would lose at most the number of AAUs in the compliance reserve. Furthermore, it requires administrative oversight of registries to ensure that the right number of AAUs amounts were set aside for each international transfer.

[2] An alternative to an individual compliance reserve is a common pool reserve. Because the common pool would only raise compliance costs but have no effect on flagrant non-compliers, some analysts believe that a common pool reserve has less potential as a compliance instrument.

5.1.4. Annual retirement

Under this option, Parties could be annually required to retire or surrender the number of their AAUs to cover their GHG emissions in that year. Because such retired units would not be able to be further used or transferred, forcing the retirement of AAUs would leave the Parties with less of their assigned amounts available for sales. To operationalize the option, emissions in each year of the commitment period are needed. Under Article 5 of the Kyoto Protocol, Parties are already required to submit their emissions inventories annually, and the information on their emissions in each year could be obtained from emissions inventories. But the problem is that emissions inventories for a given year would not be available at least until the end of the subsequent year. Thus, the preliminary amounts of AAUs that need to be retired would have to be based on estimates of emissions in that year. They would be then adjusted once inventories are produced. These adjustments would be added to or subtracted from the subsequent year's retirements. Moreover, in order to prevent the retired AAUs from re-entering into the market, Parties are required to keep and record all their retired AAUs in their registries.

Annual retirement would reduce the risk of over-selling. But there is no guarantee that the Parties who comply until the end of the fourth year of the commitment period will be in compliance with their commitments at the end of the commitment period because they could sell more than their remaining AAUs available in the last, namely, fifth year of the commitment period.[3] Moreover, the option would reduce the volume of trading and market liquidity, and thus increase the potential for abuse of market power.

5.1.5. Compulsory insurance

Another option to address non-compliance due to the over-selling of AAUs is to require the seller to acquire insurance from internationally accredited insurance agencies. Such an insurance would be compulsory. The insurance premium will rise with the risk of non-compliance. The seller perceived to be reliable will be charged a lower premium, whereas the seller perceived to be at risk of non-compliance potentially in advance of any formal findings of non-compliance by the Protocol's compliance process will face a higher premium. If some sellers are perceived to be too risky, they may even be unable to obtain insurance at a reasonable premium. In this case, they will be precluded from emissions trading.

Once the seller had acquired insurance, the AAUs traded would be homogeneous and their price would be the same regardless of the country of origin and the date of first sale. Thus, for each unit of the AAUs traded, the revenues to the sellers perceived as unreliable are smaller than to those sellers perceived to be reliable, because the former pay higher premiums than the latter. This would encourage the sellers to improve their likelihood of

[3] This rogue trader type problem can be to some extent prevented by requiring each Party to put a portion of its assigned amounts into the permanent reserve over the whole commitment period (for this reason, the permanent reserve is also called the commitment period reserve). However, because the permanent reserve requirement is much more stringent than the annual retirement, it could significantly increase the costs of compliance by restricting the amount of the transfers within the commitment period by *bona fide* traders.

compliance so as to lower their insurance premiums and increase the revenues from the sales of AAUs.

However, higher compliance of the sellers under this option is without costs. Requiring insurance coverage drives up overall compliance costs by increasing transaction costs and excluding trades that seem risky but in fact are not. Most critically, it is unclear whether insurance companies would like to offer insurance to cover invalid AAUs on a large scale. One reason is that this kind of risk differs from those commonly insured risks that are beyond the control of the insurance holders. Another reason is that the potential level of moral hazard is much higher than with most coverage that they insure.

5.2. Buyer beware liability

Instead of the seller or insurance company being held liable, the buyers could be assigned to hold the responsibility for the validity of acquired permits.[4] The so-called buyer beware liability stipulates that the buyer, be it a country or a firm, holds the responsibility for non-compliance by the sellers as a result of over-selling. In this case, the AAU acquired by the buyers become invalidated or are discounted if the sellers are found to be in non-compliance with their commitments at the end of the commitment period. This would provide the strong incentive for risk-averse buyers to ensure that any AAUs acquired are valid.

If, at the end of the commitment period, it turns out that the seller has exceeded its assigned amounts, then the AAUs 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 AAUs so that the last AAUs acquired could be identified. In so doing, the Parties that wished to trade are required to serialize their AAUs at least by their country of origin and year of origin, with the transfers and acquisitions of AAUs being mandated to start with lower numbers. In the event of non-compliance by the seller, the acquired permits to be 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 the over-selling of AAUs.

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 AAUs 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. Second, it minimises 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

[4] Alternatively, the buyer and the seller could be assigned to jointly hold the responsibility for the validity of acquired permits. This shared liability stipulates that only a portion of the AAUs over-sold shall be invalidated and returned to the seller. This shall impose a heavier burden on the seller because after all the seller exercises great control over whether or not it intends to comply with its emissions commitments.

who, all buyers or just the marginal buyer, is liable for non-compliance by the seller whose permits are sold to several countries.

However, one drawback of including a buyer beware liability is that the AAUs are not fungible, with each one representing a unit with reference to the country where it originated. As a result, the AAUs 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 and could add substantial transaction costs. This would reduce the volume of trades, thus leading to a loss of potential gains from trading. Another major drawback of assigning a buyer beware liability is that it erodes the commodity nature of AAUs by allowing them to be retroactively devalued, thus creating uncertainty over their value until the end of the commitment period. This could result in non-compliance by many Parties who have each held some of the defaulting Party's over-sold AAUs (the so-called domino effect of repatriating the AAUs over-sold to the seller) and further complicates the Protocol's non-compliance regime. 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 no longer than six months at the end of the commitment period is allowed for the seller finding itself in non-compliance to acquire additional AAUs to cover its excess tons of emissions.

In order to prevent that unwanted outcomes from arising at an early date, it is desirable to assign the buyer-seller hybrid responsibility (the so-called traffic light option) by introducing a process of evaluating Parties' efforts towards implementation during the commitment period. This includes annual review of the progress of each Party in meeting its assigned amounts. In a given year, if a Party's actual emissions did not exceed by a certain margin its annualized assigned amounts, or if annual transfers by a Party did not exceed a specified percentage of its 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 or specified percentage, however, the buyers become liable for potential non-compliance by the seller. If a Party is found to go well beyond the allowed level, no further transfers by that Party are allowed. As such, the AAUs 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 or whose annual transfers in a given year exceed a specified percentage. This is 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. If a Party is found to be in non-compliance with its commitments at the end of the commitment period, a buyer beware liability should be imposed on all its sales in the subsequent commitment period. Because such a Party has

an unreliable reputation in the previous commitment period, the buyers would become wary of purchasing AAUs from such a Party. So, its AAUs would be automatically devalued in the subsequent commitment period, thus putting pressure on such a Party to strengthen its compliance and avoid over-selling its AAUs.

It should be pointed out that the effective functioning of the above traffic light option depends very much on how early the non-compliance problem is raised and on how quickly the decision is made to switch on the yellow light for transfers from the Party. If addressed inappropriately, the time lag between the two moves could severely undermine the effectiveness of this option.

6. Bubbles

In addition to Article 17, on the insistence of the European Union (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. 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. 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 (REIO) 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 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 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.

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, some analysts think that the application of the banking provisions to individual members is preferred. But this may be considered to conflict with the philosophy underlying Article 4 bubbles.

7. 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 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 operationalization of an international GHG emissions trading scheme, this Article has discussed emissions trading models, the initial allocation of emissions permits and its competitiveness concerns, banking and borrowing, the liability rules for non-compliance, and bubbles. The following conclusions emerge from the discussion.

Although emissions trading could take place either on an inter-governmental basis or on an inter-source basis, sub-national legal entities are the best entities to trade emissions permits.

Allocating permits to individual emissions sources will facilitate private participation in emissions trading. However, the allocation of permits to emissions sources is a politically contentious issue. It also 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 the allocation of permits 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, it has been argued 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.

If emissions trading is adopted as a climate policy instrument, how Parties allocate their assigned amounts 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. Moreover, national emissions trading systems should incorporate the maximum degree of flexibility in banking. This will offer a greater degree of intertemporal flexibility and lower the cost of abating GHG emissions. In its current form, the Kyoto Protocol allows CERs obtained from the CDM projects 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.

It has been suggested that the liability rules are essential to the success of emission 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. In contrast, a buyer beware liability could be an effective deterrent to non-compliance, but the costs of imposing it are expected to be very high. To strike a middle ground, a combination of a variety of the

approaches discussed earlier to ensure compliance with the Kyoto emissions commitments is summarized below. Such a combination seeks to combine preventive measures with strong but feasible end-of-period punishments.

First, only those Parties that comply with inventory and reporting obligations of Articles 5 and 7 of the Kyoto Protocol, and that establish and maintain a satisfactory national registry are allowed to participate in trading.

Second, part or all of the proceeds from the initial sales of AAUs would be deposited in an escrow account until compliance has been established, or the initial seller of AAUs would be required to acquire insurance from internationally accredited insurance agencies, or all eligible Parties would be annually required to retire the number of their AAUs to cover their GHG emissions in that year.

Third, if a Party is found to be in non-compliance with its commitments at the end of the commitment period, it should be required to acquire additional AAUs to cover its excess tons of emissions during a "true-up" period of no longer than six months. In case it does not acquire enough AAUs to cover its shortfall, its assigned amounts in the subsequent commitment period should be reduced by the amount more than an amount by which its actual emissions exceed its assigned amounts in the previous commitment period. As such, this punishment signals Parties that an "emit now, pay later" strategy for controlling their GHG emissions over time would be inevitably expensive and potentially risky, thus operating as a strong deterrent to non-compliance. It implicitly requires that the assigned amounts in the subsequent commitment period be negotiated well before the previous commitment period commences so that those Parties that are found to be in non-compliance with their commitments at the end of the previous commitment period are unable to strategically use non-compliance to affect negotiations about their assigned amounts in the subsequent commitment period. Moreover, given the fact that Parties can always choose to withdraw from the Kyoto Protocol, the credibility of the punishment could be enhanced if a non-exit provision to prevent Parties from leaving the treaty could be assigned.

Fourth, at the end of the commitment period, if a Party's emissions have exceeded its initial assigned amounts by a certain margin, a compliance reserve requirement would be imposed on all its sales in the subsequent commitment period. Such a reserve requirement could be linked to the level of non-compliance, with a larger compliance reserve in the case of serious non-compliance. If a Party has seriously violated the emissions caps, a buyer beware liability should be imposed on all its sales in the subsequent commitment period on a "last in, first out" basis. Because such a Party has an unreliable reputation in the previous commitment period, the buyers would become wary of purchasing AAUs from such a Party. So, its AAUs would be automatically devalued in the subsequent commitment period, thus putting pressure on such a Party to strengthen its compliance and avoid over-selling its AAUs.

Fifth, at the end of the commitment period, if a Party's emissions have exceeded its initial assigned amounts by an intolerant margin, it would be suspended from selling until it had

made up all of its shortfall in the first commitment period and were on track towards reaching compliance in the second commitment period.

Finally, it should be pointed out that although the focus in the Article has been exclusively on Article 17 trading, Article 4 bubble also raises an accountability issue. Although originally conceived as a way of allowing the EC as a 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 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.

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