



institut du développement durable et des relations internationales – 6, rue du Général Clergerie – 75116 Paris – France – Tél. : 01 53 70 22 35 – iddri@iddri.org – www.iddri.org

idées
POUR LE DÉBAT

N° 03/2003 | CHANGEMENT CLIMATIQUE

(ex-Les séminaires de l'Iddri n° 5)

Improving cost-effectiveness and facilitating participation of developing countries in international emissions trading

Peter Bohm (Stockholm University, Sweden)

Peter Bohm a présenté cette communication lors de la conférence qu'il a donnée, le 17 septembre 2002 à Paris,

dans le cadre du séminaire Economie de l'environnement et développement durable, co-organisé par l'Iddri et le

MEDD. Ce texte n'engage que son auteur.

Tous droits réservés

Les séminaires de l'Iddri, n° 5

Improving
cost-effectiveness and
facilitating participation
of developing countries
in international
emissions trading

Peter Bohm
Stockholm University, Sweden

*Conférence donnée à Paris le 17 septembre 2002,
dans le cadre du séminaire Economie de l'environnement et
du développement durable, coorganisé par l'Iddri et le Medd.*

© Iddri, 2003.

Diffusion : 6, rue du Général Clergerie - 75116 Paris - France
Téléphone : 01 53 70 22 35 - iddri@iddri.org - www.iddri.org

Conception : Ulys communication. Montpellier.

Contents

Avant-propos	5
Introduction	9
Attracting more countries to international emission trading	11
CDM: the imperfect flexibility mechanism	15
The Commitment Period Reserve's implications for international emissions trading	18
Borrowing and cost-effectiveness	21
Notes	25
References	29

Avant-propos

A la suite à la conférence de Marrakech, la Convention cadre sur le changement climatique est entrée dans une période charnière : il s'agit pour la communauté réunie au sein du Protocole de Kyoto de démontrer la faisabilité et la pertinence du protocole et, dans le même temps, d'engager le débat qui doit préparer l'étape ultérieure. Le séminaire, organisé par l'Iddri et le Cired en juillet 2002, sur l'association des pays en développement à l'effort international de lutte contre le changement climatique nous avait amenés à retenir deux axes de travail : mieux comprendre les dynamiques de développement économique et leur interface avec le changement climatique, pour progresser sur les motivations possibles d'une action coordonnée ; réévaluer la nature des engagements réciproques qui permettraient de progresser vers une meilleure acceptabilité de l'offre faite à cet ensemble très hétérogène de pays. C'est sur ce dernier point que Peter Bohm a axé la conférence qu'il a donnée le 17 septembre 2002 dans le cadre du séminaire Economie de l'environnement et du développement durable.

Dans un contexte marqué par le retrait américain, par la difficulté d'associer les pays en développement à cette réflexion, mais aussi par les premiers retours des expérien-

ces de mise en œuvre concrète des instruments adoptés à Kyoto, la communauté académique, les institutions internationales (OCDE, AIE) et les grandes ONG proposent de nouvelles pistes de travail allant de l'adaptation marginale des instruments du protocole à des évolutions architecturales plus radicales. Ces propositions sont essentiellement motivées par deux objectifs : offrir un cadre instrumental moins rigide face aux incertitudes qui continueront de peser tant sur le coût des dommages que sur ceux des politiques de réponse ; proposer des formules d'association répondant mieux aux spécificités des contraintes des différentes parties prenantes. L'analyse de Peter Bohm met tout particulièrement l'accent sur les possibilités d'améliorer l'efficacité économique des instruments de coordination internationale, condition essentielle selon lui pour convaincre les Etats-Unis de revenir dans la négociation et les pays en développement d'accepter le principe même d'engagements contraignants sur leurs émissions.

Partant de l'idée que l'attractivité du marché international de droits d'émissions qui doit se mettre en place au sein de l'annexe I est le facteur clé pour réussir l'intégration des pays en développement, Peter Bohm fait quatre propositions. La première porte sur la forme des compensations à accorder aux nouveaux entrants : plutôt que de générer des transferts par l'attribution de quotas « excessifs » de droits (comme cela a été fait dans le cas des pays à économie en transition), il suggère qu'une compensation monétaire directe fondée sur une appréciation différente des risques entre pays développés et pays en développement s'avérerait *in fine* moins coûteuse. La seconde concerne le Mécanisme de développement propre, incitation adverse selon lui à une entrée effective des pays en développement dans le système international de marché de droits. Il suggère donc de renoncer au plus vite à ce mécanisme, ainsi qu'à la « réserve de la période d'engagement » (*Commitment Period Reserve*), créée pour limiter les risques de survente en cours de période d'engagement. Outre que cette disposition réduit l'efficacité globale du marché d'échange, il la juge particulièrement défavorable aux pays en développement les plus pauvres, qui seraient les principaux offreurs de droits sur un marché global. Il réengage enfin le débat sur la possibilité d'emprunts inter-périodes d'engagement, à laquelle les Parties avaient

renoncé à Kyoto. Sa proposition part du constat qu'une telle possibilité a finalement été ouverte par les formules de sanction adoptées à Marrakech, sans pour autant permettre une utilisation optimale de cette flexibilité par les Parties.

Par ces propositions, Peter Bohm se fait l'avocat d'un marché international de droits très libéral, la restriction des contraintes aux échanges devant permettre de minimiser les coûts de mise en œuvre de l'accord et de favoriser le retour des Etats-Unis à la table de négociation. Au cours du débat, la discussion des options présentées par Peter Bohm a d'abord porté sur le diagnostic qui sous-tend ses propositions. Les difficultés rencontrées dans la négociation internationale tiennent-elles d'abord à l'importance des coûts associés à la mise en œuvre de l'accord, ou sont-elles plutôt le reflet des incertitudes qui pèsent sur ces coûts, par rapport auxquelles les anticipations des différentes Parties se sont révélées très divergentes ? Si l'on privilégie cette seconde approche, l'enjeu tient moins à la minimisation des coûts dans l'absolu qu'à la possibilité de développer des mécanismes de gestion de l'incertitude. L'accent doit alors être mis sur la nature des engagements (engagements dynamiques, système de prix plafonnés, engagements non-contraignants) plus que sur la libéralisation des règles de marché.

Suivant la même logique, Peter Bohm défend l'idée d'une allocation initiale des permis par le biais d'enchères. C'est pour lui la seule façon efficace et transparente de gérer l'allocation des droits. A l'inverse, une attribution sur la base des émissions historiques (*grandfathering*), privilégie les rentes acquises au détriment des nouveaux entrants et de l'efficacité globale. Il faut sans doute introduire les notions d'apprentissage et d'information du marché dans ce débat sur les modes d'allocation des droits d'émission. En effet, l'incertitude qui pèse sur les coûts ne permet pas de faire fonctionner d'emblée un marché d'allocations de façon efficace. L'introduction progressive des enchères, le complément étant attribué gratuitement sur une base historique, peut permettre au contraire de réduire ces incertitudes.

Michel Colombier

Improving cost-effectiveness and facilitating participation of developing countries in international emissions trading

Introduction

Cost-effectiveness is a crucial requirement for meaningful agreements on international climate change policy. This is also borne out in the wording of the Framework Convention of Climate Change and, in particular, the Kyoto Protocol (KP), see UNFCCC (1992) and UN (1997). However, the KP—as it stands after COP7 in Marrakech—is not fully cost-effective, although it may eventually turn out to be the only politically feasible, ‘most cost-effective’, first step in international climate change policy. The successor to the COP7 version of the KP may be a renegotiated protocol, if the COP7 version fails to be ratified by enough countries to enter into force, or it may be the treaty to be designed for a second commitment period.

Four dimensions in which cost-effectiveness may be improved in a treaty that succeeds the KP are discussed here. They all relate to international emissions trading (IET) which is likely to be the most significant instrument for attaining cost-effective reductions in aggregate greenhouse gas (GHG) emissions.

It is important for a climate treaty to be able to attract as many developing countries to IET as possible and achieve this as soon as possible. This would have to occur at essentially no cost to them. Only with developing countries onboard can the world community get full access to their low-cost options for emission reductions. A first aspect to be discussed here is related to identifying a cost-effective approach to attain that goal (Section 1). Another aspect concerns the role of the Clean Development Mechanism (CDM) in this context (Section 2). A third issue is to evaluate the consequences for cost-effectiveness of introducing a Commitment Period Reserve to limit 'overselling' (Section 3). A final one deals with the increase in flexibility that would follow from allowing not only banking but also borrowing of Assigned Amount Units (AAUs) (Section 4). While the first two issues refer directly to developing countries, the last two will be of particularly interest to them once they get involved in IET, since (a) these countries then typically would be sellers of AAUs, and (b) some room for borrowing may be important especially for risk-averse developing countries.

The main conclusions can be briefly stated as follows.

- It is likely that there exist more cost-effective ways to attract non-Annex I countries to IET than simply to 'offer' them large enough Assigned Amounts (AAs), as is the approach taken in the KP with respect to economies in transition. One such alternative involves replacing part of an AA allocation by financial transfers.
- The CDM is an imperfect flexibility mechanism that would disappear for developing countries that join IET/JI as an Annex B Party or otherwise. But it is also an instrument that makes it costlier to have such countries join IET. Applying stringent rules for 'certifying' emission reductions would reduce these costs, in addition to reducing the particular kind of 'hot air' that the acceptance of sanguine (or standardized) project baselines would tend to create. The choice here may be seen as one of giving up possible short-term CDM benefits for long-term cost-effectiveness in climate change policy.
- To reduce the risk that sales of AAUs exceed what a Party is entitled to sell the Party is required to hold a Com-

mitment Period Reserve. As is true for all (binding) constraints on trade, this requirement causes inefficiency. In addition, the constraint on AAU sales punishes primarily the poorer trader countries, all likely to be AAU sellers.

- The strong opposition from many Parties to allowing borrowing in IET does not seem to have taken into account that realistic sanctions against Parties in non-compliance would amount to just that. However, the particular sanctions agreed on will hardly represent the most cost-effective conditions for borrowing. Introducing (constrained) regular borrowing at a rate of interest (in addition to possibly reinforced sanctions against non-compliance) adds flexibility likely to be particularly important for risk-averse poorer countries that consider joining IET. Furthermore, this additional flexibility would emerge as somewhat of a substitute for the hybrid-price cap ('safety valve')-approach proposed to reduce the risk that AAU prices reach disturbingly high levels. Just as the hybrid approach would do, borrowing reduces the expected costs of a given Protocol, which reduces the reservation AAs of the pre-existing set of Parties, at least those who are net buyers of AAUs, and thus facilitates a further reduction in their AAs.

Attracting more countries to international emissions trading: a win-win option

The cost-effectiveness of the Kyoto Protocol or any similar form of international climate change policy would be enhanced by attracting as many new countries as possible to IET and achieving these additions as soon as possible (see e.g. Zhang, 2001). Adding more participants in IET would make their low-cost abatement options available for international emission reductions. In addition, it would reduce the scope for 'carbon (or greenhouse gas-GHG-) leakage', *i.e.*, for movements of GHG emitting production to countries that are not committed to emission constraints¹. Both the new and the pre-existing trader countries stand to gain from the increased cost-effectiveness of increasing the number of participants in IET².

It is obvious, but still important to note, that if the set of participating countries is not expanded at the earliest possible occasion, part of the potential gains in cost-effectiveness is lost forever. Efficient low-cost abatement options made available to international emissions abatement as a result of the participation of additional countries in the first commitment period can be used then and not only in later periods (if still relevant).

Another potential cost-effectiveness reason why non-Annex I countries should join IET as early as possible concerns the fear that dominant trader countries might try to distort trade to their advantage. Increasing the number of (large) trader countries would tend to reduce such risks. Furthermore, additional traders and larger transaction volumes would make it more likely that an efficient AAU exchange is introduced to replace a system of bilateral trading where market power risks and transaction costs are higher and market transparency lower (Bohm, 2000).

In principle, the gain in cost-effectiveness from adding countries to IET could be used either to try to achieve a given cap on total emissions at a lower cost or to reduce this cap, given some aggregate compliance cost already established, or some combination thereof. However, new participants can be expected to be unwilling to join an agreement that is certain to let pre-existing (rich) signatories get away with a reduction in their commitment costs. Therefore, a more interesting target for a near-term cost-effective policy agreement might be one of minimizing aggregate emissions given that (a) total costs, all borne by the pre-existing signatories, are kept at the level implied by, say, the KP, and (b) the additional countries are apportioned AAs that keep them fully, but barely, compensated. This target, which is assumed here, would identify the maximum potential reduction in climate change risks for the case where all Parties were kept compensated (net of their perceived benefits from the resulting reduction of the risks for global warming).

Different ways to keep new IET Parties fully compensated

Compensation to attract poor countries to participate in IET is typically taken to be in terms of sufficiently large

AAs, as was the case in the KP for economies in transition. However, the cost-effectiveness of other forms of compensation needs to be evaluated. We take a step in that direction here, assuming that developing countries are typically more risk averse than developed countries.

Bohm and Carlén (2002) show that compensating a developing country partly in terms of a financial transfer from pre-existing Annex-B Parties is more cost-effective than a compensation in terms of assigned amounts only. More specifically, the two options were compared for a case where a basic AA volume to the prospective developing trader country is given and—initially—equal to that where the country's expected value of revenue from future sales of AAUs *minus* abatement costs is zero. This is an AA at which a risk-neutral Party would be barely compensated. To attain the reservation AA of a risk-averse party, additional compensation is required, either in terms of extra AAUs (= X units) or as a financial transfer (= \$M)³. For simplicity, the new trader country is assumed to obtain the additional compensation only after having been found to be in compliance at the end of the (first) commitment period. This could mean that the sales revenue up to that point is kept in escrow until that date and that (the present value of) the financial transfer is deposited by the collective of pre-existing Annex-B countries prior to the start of the commitment period (see further below). Keeping all sales revenue in escrow until the Parties concerned are found to be in compliance is a safeguard against overselling that is compatible with seller liability, the *ceteris paribus* most efficient form of liability.

The cost-effectiveness of the financial M option emerges from the fact that the compensation in terms of the X AAUs, the value of which is uncertain, is worth less to the more risk-averse new trader country than to less risk-averse pre-existing Annex-B Parties. More specifically, the gain in cost-effectiveness—or the gain from using the increase in cost-effectiveness to reduce aggregate AAs—is obtained as follows:

- The outcome of a minimum X for the new Party to join IET is compared to that of a minimum M, both options evaluated at the expected new equilibrium.

- The group of pre-existing Annex-B Parties are kept at the same total cost level as implied by the case where the new Party would not join IET. This allows reducing their aggregate AAs to balance the gain they otherwise would have made from lower AAU prices.
- Keeping the new trader Party as well as the pre-existing group of Annex-B Parties indifferent, the M option will imply lower aggregate emissions than the X option⁴.

As shown in Bohm and Carlén (2002), the most cost-effective financial transfer (M) is strictly positive, and hence the AA part (the 'basic' AA) smaller than otherwise assumed. This contributes to making the aggregate emissions even lower. Intuitively, this follows from the fact that, instead of being allocated a large AA and exporting a substantial part of it to the pre-existing Annex-B Parties, the new trader country would be paid a large financial transfer for agreeing to a much smaller AA. Thus, the implication of the M approach resembles a long-term contract for a large part of the new trader's emission abatement and amounts to an efficient shifting of risks to the party with the lowest costs of risk bearing⁵.

There are aspects of the compensation issue that may speak against the political realism of using any significant amount of financial transfers. As suggested above, the M transfer must be made credible to the new trader country before it starts operating as an AAU trader. Thus, it was suggested that the financial transfer be deposited prior to the commitment period, hence made certain to be available for being paid out at the end of the commitment period, or some other solution to the same effect. If the pre-existing Annex-B countries, for political reasons, cannot agree to secure the feasibility of financial transfers in this way, they have in fact revealed that they do not consider it worthwhile to increase cost-effectiveness by using such transfers.

To conclude, there is a need to investigate the cost-effectiveness of various designs for compensating developing countries to join IET as compared to that of just finding the minimum AA volumes required⁶. An increase in cost-effectiveness in this respect would facilitate a further reduction in global GHG emissions.

CDM: the imperfect flexibility mechanism

When a non-Annex I Party joins IET, its involvement in the CDM is discontinued and the Party becomes eligible for joint implementation (JI) instead. Whatever the CDM can achieve in terms of project-related benefits to the Party the same could now be obtained from JI, e.g., technology transfers, assuming the benefits are calculated in the same way. However, replacing the CDM by JI fundamentally reduces the role of the baseline problem (see further below) since there would no longer be any incentives in common for investor and host countries/firms to exaggerate the emission reductions attained by the project. The host country has no reason to help make the emission reduction units (ERUs) of JI as large as possible, in contrast to what is true for the CDM's certified emission reductions (CERs). Rather, giving away ERUs will be costly to the host country since it requires either increased domestic abatement or selling fewer AAUs. Thus, the environmental effectiveness of the ERUs tends to exceed that of the CERs. However, if the host country finds that the way the CERs are calculated gives it more benefits than those provided by joining IET and JI, the country may prefer to stay with the CDM. The primary benefits of joining IET consist of having more emission reductions available for AAU sales than those arising from feasible, large CDM projects. The additional emission reductions include those that result from the introduction of domestic policies such as carbon taxes or carbon tariffs (e.g., reduced emission from transportation, heating and cooling)⁷.

The reservation AA of a non-Annex I country is given by the AA at which the potential benefits of IET (and JI) are considered equal to those of the CDM. Thus, the higher the estimated benefits of the CDM, the higher the Party's reservation AA—hence the cost for compensating it to join IET—and possibly the longer its delay to enter into IET.

The benefits in terms of increased cost-effectiveness from a new Party joining IET are two-fold. First, more low-cost abatement options will be made available. Second, the incentives that lead to inflated estimates of project-related emission reductions will effectively disappear.

Below, we check possible ways to reduce the risks that the global community won't be able to collect the increase in cost-effectiveness from having more countries join IET. Before doing so, however, we will take a look at the extent of the CDM baseline problems and the verifiability of emission reductions from CDM *vs.* IET.

Baseline problems and verifiability

IET is cap and trade while the CDM is baseline and offset trading. Fraud is possible in both cases, but the major difference between the two is the role of the fundamental uncertainty in estimating project baselines and the high likelihood of a systematic bias towards exaggerated emission reductions from the CDM⁸. As already noted, this is the result of investor and host parties having an interest in common to do what they can to convince the CDM executive board or its operational entities that their project has a high emission baseline (see e.g., Bohm, 1994, Wirl *et al.*, 1998). This may, but need not, involve explicit planning by the parties to try to fool the authorities. The fundamental and well-known reason for the problem is simply that the baseline is unobservable.

An important illustration of these risks may be the following. The least costly CDM projects are those which are near to being profitable on their own, say, projects that might well be carried out in the near future, say, with expected funding from conventional international organizations. The prospect of having such projects funded *via* the CDM would be particularly valuable for the host firm or country. Given these prospects, it is too much to expect that the firm or country would reveal a baseline suggesting that this or a similar project would soon have been carried out without any CDM funding. Specifically, the existence of the CDM institution may have a systematic effect on development plans, leaving out projects that directly or indirectly might qualify for the CDM, hence probably distorting the reported baseline.

Here, we will focus on a couple of other—less often highlighted—reasons for the risk that CDM projects would end up with exaggerated CERs.

- Given that firms involved in risky CDM projects need compensation for being risk-averse, there is reason for them to report what amounts to a higher estimate of the expected emission reductions of the projects. This is attained by underreporting (the expected value of) their baseline emissions. However, the true expected value of the baseline emissions is the relevant estimate for the CDM authorities who can pool the risks for a large number of CDM projects, if sufficiently independent of one another. Thus, even without any attempt by the contract parties to intentionally distort their reported baseline estimates, these reports would tend to imply an overstatement of the baseline emissions.
- Monitoring GHG emissions under IET is not designed to observe all that is, strictly speaking, relevant to include. For example, it will not take into account that emission reductions caused by policy actions in an Annex I country may give rise to more emissions in non-Annex I countries. In this respect, the case of CDM is far worse. While correct national inventories cover all changes in emissions in the country, even unbiased estimates of a host firm's emission reductions of a CDM project would not take into account what changes in emissions the project may give rise to elsewhere in the domestic economy⁹. In an economy with available capacity, economic activity and hence emissions elsewhere may increase. The CDM project may raise input prices that would crowd out other activities but also increase aggregate output of intermediary inputs and the transports connected to that increase. Similarly, if the project implies an increase in the output of the host firm, equilibrium output prices may be reduced and give rise to increased activities and emissions elsewhere. Or such price changes may eliminate an emissions-reducing project similar to the CDM project that otherwise would have occurred. As a result, nation-wide emission reductions due to a CDM project may be smaller than the reported project-wide estimates.

To be sure, the nation-wide GHG emission reductions of a CDM project could be larger than the project-wide ones. However, if so, it is likely that the CDM parties would do what they can to call such indications to the attention of the CDM authorities. This is not likely for

CDM projects where the nation-wide reductions are smaller than the project-wide ones. Thus, the risk for an overestimate of the baseline emissions of CDM projects would be further enhanced.

Improving the prospects of IET/JI being more attractive to developing countries than the CDM

Given that the CERs are more likely than the ERUs and the AAUs to result in an exaggeration of the emission reductions, the question arises what can be done with respect to the fact that the CDM reduces the prospects of non-Annex I Parties joining IET. To be more certain that reported CERs are not overblown, the CDM authorities could be instructed to be conservative in their evaluation of the CDM projects' emission reductions. As a result, joining IET would be more attractive¹⁰.

Another option to facilitate involvement of non-Annex I Parties in IET is to put an end to CDM operations as early as possible, perhaps already in the commitment period after 2012. An early elimination of CDM would be certain to meet strong opposition from Parties that now have a vested interest in the survival of this mechanism. However, if no date is set for a cessation of the CDM, it will continue to delay the enlargement of IET. The remaining option to speed up as much as possible the increase in cost-effectiveness that follows from this enlargement would be to attract non-Annex I countries to IET by offering them a higher level of compensation—e.g., extra AAUs or financial transfers.

The Commitment Period Reserve's implications for international emissions trading

There has been considerable concern with respect to the risk that the KP would allow sales of AAUs that do not represent any real emission reductions. To begin with, this concern was related to the fact that some Annex-B countries such as Russia and the Ukraine had received AAs that are likely to exceed their BAU emissions in the first commitment period. This would allow them to sell AAUs that

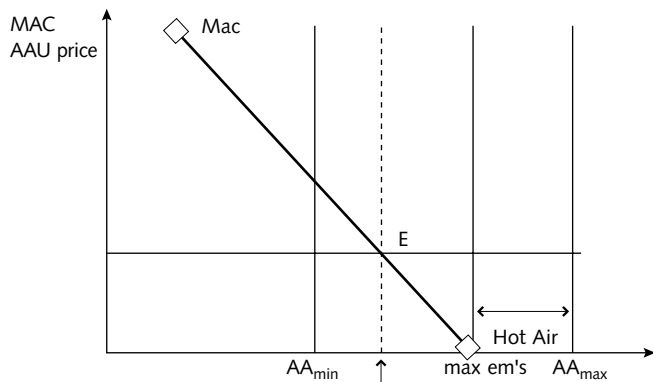
do not reflect actual emission reductions, so-called hot air. Soon after Kyoto, explicit rules for limiting hot-air sales were proposed by the EU, in spite of the fact that, like other (binding) trade constraints, such rules would clearly reduce cost-effectiveness. These ideas were eventually shelved before COP6bis in July 2001. Instead, rules have now been introduced to limit another form of 'overselling', namely that when Parties sell more AAUs than they are expected to have available for sales while remaining in compliance. These rules require that each Annex I Party shall maintain in its national registry a Commitment Period Reserve (CPR) that should not drop below 90% of the Party's AA or 100% of five times its most recently reviewed inventory, whichever is lower¹¹.

The effects of the CPR can be illustrated by a case where a Party wants to sell a large volume of AAUs at some point before or during (in particular, the early part of) the commitment period. Even if the Party is confident that its total emissions during the period will end up below 90% of its AA, e.g. because of abatement measures near completion or reliable abatement decisions already made, it would still not be able to sell more than 10% of its AA, if this part of the CPR rule is the binding one. In a case where the second part of the rule is binding, problems may arise partly as a result of the time lag in the reviews of its inventories. Here, the Party may not be able to sell a surplus of emission reductions that the Party knows has been or will be established, say, during the last year of the commitment period, because emissions according to the most recently reviewed inventory, say, one or two years earlier, exceeds expected actual emissions for the final year.

'Overselling' in the sense that the CPR requirement is violated is a real problem only to the extent that sales are not covered by emission reductions that would rule out an eventual non-compliance, i.e. $AA \text{ minus net sales minus emissions} < 0$. Non-compliance means that net sales *plus* emissions are too large. Except for 'last-minute' sales that unavoidably result in emissions in excess of the seller's AAU holdings, selling does not prohibit a Party from counting on later effects of actions already taken or taking actions later that would allow it to end up in compliance. This means that sales, which are ruled out by the CPR but

which the seller Party, controlled by sanctions against non-compliance, would like to carry out, represent a loss of cost-effectiveness¹².

Fig. 1 Optimal in-compliance level of emissions



The purpose of the CPR is obviously to avoid having (net) seller Parties sell and emit more than they are allowed, presupposing that such countries cannot be effectively or sufficiently controlled by sanctions against non-compliance. However, it must be noted that equally strong monetary incentives to end up in non-compliance exist also for buyer countries. This follows from the fact that the incentives and their strength must be gauged at the Parties' optimal in-compliance level of emissions for Parties. In Fig. 1, this level is located at point E where the marginal abatement cost (MAC) equals the AAU price (p). In order to compare a seller and a buyer (with the same MAC curve), the seller is defined by an AA level to the right of point E, e.g., AA_{max} , and the buyer by an AA level to the left of E, e.g., AA_{min} . Both have to make decisions about (i) emission abatement and (ii) trading. (i) Regardless of whether it is a seller or a buyer that considers abstaining from a certain amount of abatement from point E, gross savings would be the same, of course, and equal to the avoided abatement costs. (ii) Similarly, the gross gains of a seller that considers selling AAUs beyond point E are the

same as those of a buyer that considers buying less than enough to cover emissions up to point E, in both cases p times the marginal trade volume.

The often heard statement that a Party, given the chance to sell AAUs at a profit, will have a particularly strong incentive to end up in non-compliance, i.e. ‘oversell’/‘underabate’, is therefore not correct. What is correct, although hardly relevant here, is that the *introduction of IET* increases incentives to end up in non-compliance for those who will emerge as net sellers but reduce them for those who will emerge as net buyers. In the absence of IET, the former type of Parties have lower MACs, and in that sense lower incentives to end up in non-compliance, than those of the latter type¹³.

Net buyer Parties to the KP are regulated by sanctions against non-compliance, i.e. against emissions *minus* net purchases of AAUs exceeding their AAs. The introduction of the CPR means that such sanctions are not considered to be a deterrent enough with respect to overemissions by seller Parties. In other words, compliance is controlled by two deterrents for seller Parties but by only one for other Parties that violate the same rules and face the same incentives to do so. A parallel second deterrent for non-seller countries could be to require that they buy a reserve of AAUs to reduce the risk that they eventually have bought too little. But such a ‘fair’ set of rules would, of course, further reduce cost-effectiveness.

To sum up, if effective, the CPR reduces cost-effectiveness¹⁴. In addition, the CPR has distributional effects. It hits net seller countries, typically poorer countries¹⁵, but not buyer countries, which are all wealthier countries.

Borrowing and cost-effectiveness

Banking is accepted in the KP and provides cost-reducing opportunities to transfer AAUs between periods for Parties that expect discounted AAU prices to be higher in the next period. But those with the opposite expectations do not have access to any similar kind of inter-period flex-

ibility. In the negotiations leading up to the KP, there was strong opposition to the principle of permitting a Party to borrow AAUs from its AA in the next period¹⁶. The sentiments seem to have been that, given an agreement on a modest cap of (Annex B) emissions in a first commitment period, it should not be allowed to let emissions increase by borrowing, regardless of whether aggregate borrowing would exceed or fall short of aggregate banking. Moreover, allowing Parties to borrow might tempt them to let emissions exceed their AAs to an extent that in a later period might force them to defect from the agreement.

However, the increase in cost-effectiveness that follows from allowing also borrowing would increase the Parties' willingness to accept more stringent AAs and hence speed up the process of reducing the aggregate emissions. The increased 'when' flexibility would also help attract, in particular risk-averse, developing countries to join IET. For example, if a developing country, towards the end of the period, unexpectedly finds it (a) needs to buy back some AAUs to remain in compliance and (b) faces high final AAU prices, it could now count on the borrowing option for protection against large losses¹⁷.

Earlier studies analyzing the social efficiency of borrowing seem to be limited to the case where marginal environmental damages are known and where systems of banking and borrowing are introduced at the same time. Leiby and Rubin (2000) address the case of stock pollutants, i.e., where the environmental effects are caused by the accumulated stock of pollutants, such as carbon in the atmosphere. They show that full intertemporal trading is socially efficient, where the banking/borrowing interest rate is equal to the ratio of the current marginal stock damages to the discounted future value of marginal stock damages less the decay rate of emissions in the atmosphere. However, in the case of climate change policy, little is known about any relevant global (or national) marginal damage function. The agreed sum of AAs and its distribution over countries—and, eventually, over time—will likely represent political compromises that, at least for the time being, do not reflect any global, or Annex B, damage estimate. Moreover, in the KP, the banking rate of interest is set at zero and the borrowing rate, so to speak, at a rate that precludes any borrowing.

Not quite. Sanctions against a Party in non-compliance, as agreed on at COP6bis, imply that the Party will have its AA for the next period reduced by 1.3 time the AAUs lacking at the end of the preceding period. (Note that the AA allocations for the second period will have to be determined prior to the start of the first period.) This implies that borrowing *de facto* can take place, at an annual rate of interest of about five percent—or 30 percent per commitment period of five years. Thus, the Party may choose to borrow by choosing not to make enough emission reductions or buy enough AAUs.

Now, the formal sanctions agreed on have two additional components, none of which seems to be fully specified as yet. One is that an *action plan* that is deemed to take the Party back to compliance will have to be determined. Thus, the Party in non-compliance will have to commit to a plan of abatement actions that may differ from its preferred option to return to compliance. To provide an incentive for the Party to follow that plan, there is a second additional sanction component in that *the Party's eligibility to sell AAUs is suspended*, presumably until the Party is found to be 'faithfully' following its action plan. This amounts to an additional cost for Parties in non-compliance that would be sellers in the next period, hurting in particular those Parties for whom selling AAUs would be an important source of revenue. By contrast, Parties in non-compliance that will likely remain buyers in the next period will not be punished by this rule.

This means that the total costs of being in non-compliance will not be known at the time a Party completes its AAU transactions in the first commitment period, even if future AAU prices and MACs were known. In this sense, the consequences of borrowing by being in non-compliance differ from those of regular borrowing at a given rate of interest. These consequences are particularly unfavorable to seller Parties, to which are the poorer Parties belong, and unattractive to the developing countries that have not yet joined international emissions trading. Given whatever rules are selected to combat non-compliance, a step in the direction of increased cost-effectiveness would be to introduce a right to borrow AAUs up to some limit at a rate of interest at, or below, that of the non-compliance rate, but without any additional conditions¹⁸.

Allowing regular borrowing would have another potentially important effect. It can partly or wholly replace the hybrid-price cap ('safety valve')-approach suggested in particular by a number of US economists to avoid having AAU prices exceed a certain level. Also borrowing would tend to reduce high AAU prices although their maximum level then could not be known in advance. Both approaches tend to endanger the environmental integrity of the KP, although probably little as compared to having Parties like the US drop out from the Protocol on account of the risk for high AAU prices, if that were a dominant reason. Furthermore, since both approaches reduce the expected costs of the Protocol for present Annex B countries, their reservation AAs are reduced, which facilitates negotiating additional early AA reductions. The borrowing option has an additional advantage in that it could make developing countries more interested in joining IET, which at least indirectly could lead to further reductions in the global emissions level via reductions in the AAs of developed countries. By contrast, being prospective net sellers, developing countries would not fancy having a cap placed on AAU prices.

To conclude, the initial opposition to borrowing obviously did not realize that sanctions against Parties in non-compliance eventually would come to require some conditions for repayment of the exceeding amount of emissions and that this would imply a form of borrowing. However, the implications of the total set of conditions now agreed on are difficult for Parties to predict beforehand. As indicated here, regular borrowing with clearly specified rules can be inserted to precede a contingent state of non-compliance. This will increase the 'when' flexibility of IET, hence making it more attractive for new countries to join and, in principle, reducing the reservation AAs for all Parties. In contrast to the implications of the existing non-compliance rules, such regular borrowing in kind would not discriminate between seller and buyer Parties. In addition, borrowing could meet the need that some Parties otherwise would have for putting a cap on AAU prices.

Notes

I have benefited from helpful comments by Bjorn Carlén, Erik Haites, No Ho Park and the two referees. A grant from the Swedish Energy Agency is gratefully acknowledged.

1. Adding more participants in IET is likely to affect ordinary trade and hence, the countries' terms of trade. In this section, we abstract from effects on GHG leakage and terms of trade.

2. The pre-existing trader countries are here and below regarded as a group. Individually these countries differ; pre-existing would-be sellers would lose from AAU prices falling as a result of new countries joining IET. Therefore, it is presupposed that measures (such as higher AAs in the next commitment period) are taken to redistribute the group's net gains so that no countries would lose.

3. See Wiener (1999) for a discussion of a similar set of options. The primary reason why he ends up in favor of an AA-only approach is due to "the difference in compensation currencies" ...where the financial transfer "would involve cash flows from donor government to recipient government, while /the alternative compensation payment in terms of extra AAUs/ would involve the investment by industrialized emitters in the transfer of low-emissions technologies to firms in host countries in return for some of the /AAUs/ freed up by the attendant emissions reduction" (p. 766). In the approach discussed below, the 'extra AAU' option (X) is not assumed to take that form. The government in the new trader country obtains either a financial transfer or extra AAUs as a result of an international agreement and may, if it so wishes, devolve

IET to firms. The pre-existing trader countries' governments agree to a specific set of AAs or a set of larger AAs plus a financial commitment and may or may not devolve IET to legal entities. In other words, in the present analysis it is altogether a negotiation issue between governments and whether IET takes place between legal entities or governments or a combination of both is of no concern here.

4. An experiment that let 32 PhD students in Economics face a decision similar to that which is here taken to confront governments of developing countries is reported in Bohm and Carlén (2002). The results show that risk-averse subjects behaved essentially in accordance with the prediction suggested here. The hypothesis of equal X and M asks under the two mechanisms was rejected in favor of lower compensation asks under M at p-values below 1 percent.

5. Substituting the basic AA + M for the AA-only approach also reduces the risk that the AA allocation includes 'hot air', i.e., exceeds the business-as-usual level of emissions. Such allocations have raised political demands to place binding constraints on IET, which would reduce the cost-effectiveness of the policy (see further Section 3).

6. Other options include commitments by the pre-existing Annex-B Parties to stabilize AAU prices for the X component. Or new countries may be allowed to make early, preliminary commitments to join IET and be allowed to opt out later, at a cost. See Bohm and Carlén (2002) for a discussion and an experimental test of the latter approach.

7. It is sometimes argued that domestic policies such as the introduction of a carbon tax could constitute an eligible CDM project. However, this is unlikely since there is no way to prohibit a sovereign host country from introducing other policies that offset the effects of the carbon tax.

8. Note also that there are ways to *check* serious underreporting in a Party's national emissions inventory (e.g., by way of checking imports of fossil fuel), but no ways to *check* reasonably-looking but exaggerated baselines.

9. This creates some perverse incentives for large firms or conglomerates. Say, a CDM energy-transformation project would involve considerable construction activities with large emissions from construction and transportation equipment. If these activities normally would be handled by the conglomerate's construction department, it may now pay the firm to first sell off this department.

10. It has been argued that experience from CDM operations would make DC Parties more acquainted with the emissions trading idea and hence help making such Parties more interested in joining full-fledged international emissions trading. This is hardly credible given that the IET itself is straightforward and verifiable in a way that the CDM is not.

11. For an in-depth analysis of the percentages selected, with respect to the liquidity of the markets for emissions trading, the effectiveness in

limiting non-compliance due to overselling and constrained sales of surplus AAUs, see Missfeldt and Haites, 2002. For additional comments on the CPR, see IEA, 2001.

12. For a discussion of the complete set of mechanisms of compliance rules, see Nentjes and Klaassen (2002). The set discussed there includes, in addition to the explicit sanctions (restoration rate, compliance action plan and suspended eligibility to sell AAUs), reputation protection, the flexibility instruments and the CPR. Nentjes' and Klaassen's conclusion about the efficiency implications of the CPR differs from that reached here essentially because they assume that seller countries, so to speak, care less about their reputation than buyer countries do about theirs.

13. Whether or not this is taken to mean that the introduction of IET will increase the risk for overemissions is essentially a question of how sensitive the different groups of countries are to such incentives. However, this perspective is relevant only for those who wish to consider abolishing IET as a step towards a better climate change policy.

14. That the CPR would help eliminate eventual non-compliance cannot be determined. Compliance or non-compliance is the result of a number of factors, two of which are additional emissions abatement and repurchases of AAUs late in the commitment period.

15. As discussed above, developing countries are taken to accept, for the time being, only AAs that they feel would keep them fully compensated. Hence, as traders, they are put in a seller position.

16. In an IET system proposed by the US State Department (US DOS, 1997) prior to the COP3 meeting in Kyoto, both banking and borrowing were included. The US has large experience of some 25 years of emissions trading that, in some cases, have allowed borrowing.

17. The California Cap and Trade system, RECLAIM NO_x, in which intertemporal trading is prohibited, may be a good illustration of such risks of exceptional price hikes. There, NO_x prices which stayed on a fairly constant level for a number of years rose sixty-fold at the end of year 2000 (based on information provided by Denny Ellerman).

18. For a recent overview of issues related to non-compliance, see Hargrave *et al.* (2000).

References

Bohm, P., 1994. On the feasibility of joint implementation of carbon emissions reductions, *in* *Climate Change: Policy instruments and their Implications*. Proceedings of the Tsukuba Workshop of IPCC Working Group III (ed. A. Amano). Center for Global Environmental Research, Environment Agency of Japan, Tsukuba, Japan.

Bohm, P., 2000. International Greenhouse Gas Emission Trading—with special reference to the Kyoto Protocol. *In* *Efficiency and equity of climate change policy*, ed. C. Carraro, Kluwer, Dordrecht.

Bohm, P. and B. Carlén, 2002. Cost-effective approaches to attracting low-income countries to international emissions trading: theory and experiments. *Environmental and Resource Economics*, 22 (4), August.

Hargrave, T., S. Kerr, N. Helme and T. Denne, 2000. Treaty compliance as background for an effective trading program. *In* *Global emissions trading: key issues for industrialized countries* (ed. S. Kerr). Elgar, Cheltenham, 43-82.

Missfeldt, F. and E. Haites, 2002. Analysis of a Commitment Period Reserve at national and global levels. *Climate Change*, 2, 1, May.

Nentjes, A. and E. Woerdman, 2000. The EU proposal on supplementarity in international climate change negotiations: assessment and alternative, memorandum. Department of Economics, University of Groningen.

Nentjes, A. and G. Klaassen, 2002. On the quality of compliance mechanisms in the Kyoto Protocol. Paper presented at the second World

Congress of Environmental and Resource Economists, Monterey 24-27, June.

International Energy Agency (IEA), 2001. International emissions trading: from concept to reality. OECD, Paris.

Leiby, P. and J. Rubin, 2001. Intertemporal permit trading for the control of greenhouse gas emissions. *Environmental and Resource Economics*, 19(3), July.

Rose, A. and B. Stevens, 2000. A dynamic analysis of the efficiency and equity of tradeable greenhouse gas emission permits. *In Efficiency and equity of climate change policy* (ed. C. Carraro), Kluwer, Dordrecht, 247-71.

UN, 1997. Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations, Kyoto.

UNFCCC, Framework Convention on Climate Change. United Nations 1992.

Wiener, J.B., 1999. Global environmental regulation: instrument choice in legal context. *The Yale Law Journal*, 108, 4, January.

Wirl, F., C. Huber and I.O. Walker, 1998. Joint implementation: strategic reactions and possible remedies. *Environmental and Resource Economics*, 12, 2, September.

Zhang, Z.X., 2001. Meeting the Kyoto targets: the importance of developing country participation. Working Paper 30.2001. Feem, Milano.

