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TOWARDS INTERNATIONAL EMISSIONS TRADING: DESIGN IMPLICATIONS FOR LINKAGES

INFORMATION PAPER

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FOREWORD

This document was prepared in October 2002 by the OECD and IEA Secretariats at the request of the Annex I Expert Group on the United Nations Framework Convention on Climate Change. The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

The Annex I Parties or countries referred to in this document refer to those listed in Annex I to the UNFCCC (as amended at the 3rd Conference of the Parties in December 1997): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Where this document refers to "countries" or "governments" it is also intended to include "regional economic organisations", if appropriate.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Executive Summary

The Kyoto Protocol under the United Nations Framework Convention on Climate Change sets legally-binding quantified greenhouse gas (GHG) emission commitments on industrialised country Parties listed in its Annex B. Article 17 of the Protocol allows these Parties to achieve emission objectives through emissions trading. Parties that emit less than their target levels (known as assigned amounts) would be allowed to sell the surplus emission allowances, or assigned amount units (AAUs), to other Parties that need them to cover emissions above their targets. In preparation for this broad international regime, a number of domestic and regional greenhouse gas trading systems are being developed. Some are already in operation or, pending approval, will start soon. It is therefore useful to assess how the international trading regime could grow from a set of domestic trading systems into an international architecture.

There are a number of benefits to linking emissions trading schemes, including enhanced abatement options, market liquidity, and reduced compliance costs. This paper discusses: how GHG trading schemes with different design options may be linked in order to take advantage of these benefits; possible barriers to linking; and solutions. It also notes potential issues that may arise even when systems are not linked, referred to as compatibility issues. It seeks to help answer the question: can these domestic systems be merged over time into a larger trading system under Kyoto?

The main design elements considered in this paper include: allocation modes (grandfathering vs. auctioning, absolute or relative targets); system coverage (including upstream and downstream, direct and indirect); banking and borrowing provisions; incentives and enforcement systems. The integration of project-based activities is also briefly discussed.

The analysis in this paper suggests that there are few technical barriers to linking, and where barriers do exist, solutions can be designed. However, some design options may undermine the environmental integrity of emission trading systems, and implementing solutions may lead to an increase in administrative and monitoring costs.

The choice of allocation mode is a critical element of the design of domestic emissions trading schemes. The co-existence of different allocation modes can create competitive distortions as soon as a source can produce in one country and sell its products in another. However, it is not clear that linking would worsen such situations. Whether linking a grandfathering system (gratis allocation) with an auctioning system would further diminish the competitiveness amongst like sources depends on the individual design of each system, including the recycling of auction revenues to various segments of society, and possibly to sources. In all, linking should improve the economic performance of the system.

Linking systems with relative and absolute targets can lead to a loss of environmental integrity and concomitant increases in output and emissions. There may also be competitiveness concerns for entities operating in different systems. Design solutions such as a gateway could minimise these concerns, though they involve increased administrative costs.

Upstream and downstream designs are compatible provided a common unit of measurement (e.g., tonnes CO_2 equivalent) is used and as long as fuels are not used interchangeably between upstream and downstream systems. An appropriate design solution to avoid double coverage when linking national systems is to exempt exports of fuels from the upstream system to any other system. Double counting issues can also arise when linking direct and indirect systems. In some cases, linking can result in emissions not being covered by allowances. Adjustments could be necessary when linking up to a system with indirect coverage, depending on which sectors are covered if their products are traded internationally.

Systems with different coverage (activities and gases) can lead to fragmented markets in the short term, although this is unlikely to be an issue under Kyoto where AAUs are not specific to activity or gas and are fungible units. Adequate monitoring, reporting and verification (MRV) systems are essential to maintain environmental performance when linking systems with different coverage. A system with more restricted coverage as a result of difficulties in monitoring and reporting for certain gases and activities might consider limiting its links to other systems with broader coverage unless those other systems were also based on better monitoring. If not, linking could lead to more emissions than allowed by the system's total cap. Similarly, emissions trading schemes with different incentives for compliance could lead to export of non-compliance to the system where enforcement measures are not implemented systematically and undermine the environmental integrity of trading.

Linking systems with different conditions for banking pre-2008 allowances into the Kyoto commitment period could be problematic. A country where banking is available without limits would attract pre-Kyoto allowances from other systems. These would be temporarily transferred by sources for the purpose of creating AAUs that they could then buy back and use in 2008-2012. This country may therefore end up transferring its AAUs to sources outside its territory. This might lead to a shortage of AAUs available for other sources in this country, and increase in-period compliance costs. One solution to this problem is to limit the amount of banked units from pre-Kyoto to Kyoto. While borrowing is not allowed under Kyoto, borrowing AAUs for compliance with pre-Kyoto emission objectives could improve the environmental outcome of the Protocol.

Systems that rely primarily on project-based activities could encounter technical problems if and when they decide to shift to a more systematic emission trading system and link with other trading regimes. The detailed agreements that are the necessary basis of projects may not be easily adjusted to a cap-and-trade system. For instance, the project baseline may be adjusted through time, whereas a cap may not. In the end, of course, project-based credits as agreed by the host government (and an international supervisory authority, if required), would be fungible with other traded units under the Kyoto Protocol.

As part of the analysis, the paper differentiates between questions which may be of a transitory nature (e.g., pre-Kyoto) and those of a more permanent nature – noting that the Kyoto Protocol framework could provide solutions in the former case. However, some concerns raised by linkages prior to 2008 could remain valid when trading under Kyoto starts.

2. Introduction

Upon entry into force, the Kyoto Protocol to the United Nations Framework Convention on Climate Change will impose legally binding quantified greenhouse gas emission commitments on industrialised country Parties listed in its Annex B[1]. Each Party must emit no more than its so-called "assigned amount" of greenhouse gas emissions between 2008 and 2012.

The Protocol established a number of innovative new mechanisms to reduce the cost of compliance with the targets. One of these, introduced under Article 17, allows Parties to achieve their emission objectives through emissions trading. The concept of trading is simple: Parties that wish to can sell a surplus in their assigned amounts to other Parties, as long as, at the end of the commitment period, Parties' cumulative 2008-2012 emissions remain below their assigned amount when acquired and transferred units are accounted for. The agreement also introduced the concept of project based credits, (through joint implementation projects that might be undertaken jointly with another developed country Party) or clean development mechanism projects, undertaken jointly with a developing country Party. In theory, the optimal use of these mechanisms would equalise the marginal cost of reducing GHG emissions among participants to the system, reduce the overall cost of GHG reductions, and generate a market and a price for assigned amount units (AAUs).

A number of national and international emissions trading schemes have emerged since the adoption of the Protocol. However, Parties with domestic trading systems, if acting in isolation, would see more limited efficiency gains than those that might be delivered through international emission trading. An international price would not emerge as rapidly, and would not reflect the actual marginal cost of abatement for all sources involved. Furthermore, the more sources that compete for transactions on the international market, the less likely the market will be prone to price manipulations, price volatility and resultant increases in compliance costs. It is therefore useful to assess how the international trading regime could grow from a set of domestic trading systems into an international architecture. This architecture alone does not preclude, but neither does it guarantee, the emergence of an efficient emission trading system at international level under the Kyoto Protocol.

The analysis focuses on emissions trading among private entities covered by different domestic emission trading systems (DET) and not on inter-governmental trading (although the latter is also integral to international emissions trading under the Kyoto Protocol). The paper examines issues related to linking individual country schemes, ultimately in anticipation of moving towards a common single system (e.g., under the Kyoto Protocol). It identifies technical impediments to linking systems with different designs and evaluates economic issues that arise from such linkages (including the extent to which trading designs may "lock-in" market participants, preventing the subsequent merger of systems). However, the paper does not make recommendations for an "optimal" design of a domestic emission trading (DET) system.

[1] Annex B Parties are: Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Both Australia and the United States have indicated that they will not ratify the Protocol.

The design elements considered include:

- Grand-fathering, auctioning and other modes of allocation of allowances;
- Upstream or downstream regimes;
- Coverage of participants (broad or restricted);
- Absolute or relative targets;
- Direct or indirect emissions;
- Banking and borrowing;
- Penalties and incentives;
- The integration of project-based mechanisms.

A number of additional elements (such as common trading units and compatible registries) are not discussed here. While they are essential for the workability of the international system, these two subjects have already been fully addressed through existing processes (e.g., the design of Parties' registries is now handled by the UNFCCC process).

The paper provides background descriptions of each of the elements listed, and then highlights how addressing these elements affects linkages between domestic schemes. Criteria used in the analysis include economic efficiency, impact on competitiveness, and institutional compatibility.

The paper then provides a broader discussion of the minimum requirements for functionality when domestic schemes are linked – with the linking model assumed to be that of the Kyoto Protocol. It focuses only on those combinations that are realistic, or at least are likely to be considered by Parties in their analysis of the issues. Another section provides insight into issues related to the transition between the pre-Kyoto and Kyoto regimes.

3. Individual design elements of domestic emission trading (DET) systems

There are a number of key design elements incorporated into all emissions trading regimes. Each element requires decisions by the implementing Party. Each can change the operational efficiency and ease of implementation of the regime; each can also affect the difficulty of linking that regime with others. Certain design choices may not be compatible with those of another regime and create problems even before these regimes are linked; other choices may affect the feasibility of linking several DET systems to each other. For reference purposes, a table in Appendix 1 provides a summary of existing and projected GHG emission trading systems.

3.1 Allocation modes: auctioning, grand-fathering, updating

The allocated amount of emission allowances sets the overall target for these entities – presumably lower than the current level of emissions. For example, the Kyoto Protocol targets are allocated at a country level, and the emissions trading provisions of the Protocol allow Annex B governments to transfer and acquire assigned amount units. The Protocol also allows participation by entities of Annex B Parties. At the end of the commitment period, each accountable entity must surrender "allowances" that correspond to its emissions in order to be in compliance.

A variety of mechanisms might be envisioned under which such activity might occur; this paper explores allocation options of existing DET systems. DET is in many ways similar (albeit at a national level) to the systems established under Kyoto. It requires that some entities (e.g. large sources of GHG) be allocated an emission target for which they are accountable. Entities with excess emissions will need to invest resources – physical or human capital – to reduce emissions and meet their cap. The cost incurred is defined as the *abatement cost.* How allowances are allocated also affects the total cost borne by sources, i.e. their *compliance cost* (the cost of abatement plus the net payment for allowances and administration cost), and by society more broadly.

3.1.1 Key allocation issues

Three main modes of allocation have been studied in the literature (e.g., Harrison and Radov, 2002, Cramton and Kerr, 2002, Burtraw et al. 2001, Fischer 2001):

1. Auctioning: the government sells allowances to accountable entities (and possibly other interested parties) through a competitive auction[2]. One of the advantages of auctioning allowances is that it avoids the difficult negotiation of source-by-source allocations. Instead, each source decides how many allowances it needs to purchase to cover its projected emissions, and bids for these allowances in the marketplace. Auctions or tenders have also been used to generate emission reduction projects or encourage entities to adopt emission caps, as in the UK, where an auction was used to allocate public funds[3].

2. Grandfathering: allowances are distributed free of charge (gratis) in proportion of sources' past emissions. The government can use emission levels in a given allocation year as the basis for

[2] Various types of auctions are available, e.g. to avoid gaming amongst market participants. See Harrison and Radov (2002).

[3] Japan recently announced a similar process to allocate subsidies totalling 1 billion yen (Yomihuri Shimbun, 2002)

distribution. Alternatively, the average over, or the highest/lowest of several years can also be used. Grandfathering is, generally speaking, less costly for accountable entities, as they only need to buy allowances for emissions *in excess of* their initial, free, allocation. Compliance costs will be less than abatement costs for net sellers.

3. Updating: as with grandfathering, allowances are distributed free of charge to entities, but each entity's allocation is updated on the basis of its activity level – measured by a given metric such as industrial output (tonnes of cement, GWh of electricity, etc.). If a source has a higher output than others, its allocation will be higher in the next commitment period; symmetrically, a source with lower output would receive a lower allocation at the next round. Updating – in this paper – differs from intensity-based or relative targets: under updating, the total amount of emissions is fixed while relative objectives do not provide such certainty[4].

These options can of course be used simultaneously in a single trading framework: different sectors may be covered by different allocation modes, or two modes can be combined for all sources, with part of the allowances being grandfathered, another part being updated, and the final part being auctioned.

It is clear that differences in allocation modes could create potential problems if different systems were to be linked. Some allocation modes are more favourable to sources than other modes and, as is shown below, result in different allowance prices. Two separate systems producing different price levels for their domestic allowances may generate problems when linked – to the detriment of individuals or sectors in either or both of the regimes. It is not evident *a priori* that the broadening of the emissions trading systems through such linkages would necessarily compensate all sources for such problems. This section examines the possible choices on key issues related to allocation, e.g. regarding access to domestic auctions and the modality of participation by new entrants, and examines the consequences from linkages of systems making different choices.

3.1.2 Economic dimensions of various allocation modes

The economic implications of allocation regimes have been the subject of extensive literature, both theoretical and empirical[5]. It is not clear, at the outset, whether the choice of alternative modes in different countries would be a barrier to linking systems, but the importance of the economic dimension in the climate policy debate makes it worthwhile to briefly review existing literature on the subject.

Harrison and Radov (2002) list criteria to assess various allocation modes, distinguishing between efficiency and distributional elements[6]. On the efficiency side, cost criteria are:

- Compliance costs, i.e. the total cost of reaching the target;
- Administrative costs, borne by the government to operate the trading system;
- Transaction costs for participants (although Harrison and Radov conclude that all allocation modes do rather well in this respect);
- Product market distortions: does the allocation mode lead to a proper price signal on the product market given existing market conditions – i.e. are consumers being properly encouraged to substitute away from GHG-intensive goods or not[7]?

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[4] This is the case in the so-called "unit-based" sector under the UK emission trading scheme.

[5] OECD (1999) provides a thorough and extensive review of the literature on this subject, with a focus on the various effects of auctioning and grandfathering at sector and macro-economic levels. Since then, new research has provided additional insights on the effects of allocation modes on the value of firms.

[6] Appendix 2 reproduces a summary table on the above points from Harrison and Radov (2002), for all allocation options covered in their analysis, including the three main ones addressed in this section.

- Tax distortions: is the allocation mode conducive to more or fewer overall tax distortions?
- The potential for market power arising from allocation modes.

Criteria used to assess the distributional costs include:
- Sector burden: how are the various sources affected economically? Does the allocation mode allow compensating for these costs?
- Stranded costs: are existing sources compensated for the fact that their current physical capital is the result of investments that did not take the GHG constraint into account, and therefore leads to high abatement cost?
- Consumer/labour effects: how is the labour force affected by the allocation mode? This depends on the sources' ability to pass the cost to consumers, which in turn determines overall demand for the sources' product and impacts on employment.
- Taxpayer effects: is the overall tax burden improved by the chosen allocation mode?
- Rewards for early action.

Grandfathering and auctioning do equally well when it comes to reducing overall compliance costs[8]. Updating however, dilutes this key element of emission trading: because sources receive a higher share of the total "pie" if they reduce production less, each source would tend to produce more when compared to auctioning or grandfathering. In the latter cases, sources also adjust their activity level to minimise compliance cost.

Auctioning generally imposes greater costs on sources overall because they must buy an allowance for every emitted tonne; this is not the case for grandfathering or updating where allowances are distributed for free. For that reason, these two allocation modes are more favourable than auctioning when it comes to compensation for stranded costs. With a free allocation, sources are not credited (or held accountable) for their past investment in GHG intensive processes; they must abate emissions from now on, or pay a charge for *excess* emissions in the form of an allowance bought from the market[9].

Other studies have explored the effect of allocation modes on companies' equity or asset value[10] based on a detailed description of various sectors, technologies and fuel use. In a scenario where all US energy-related CO_2 emissions would be covered by a cap-and-trade system, Smith and Ross (2002) find that grandfathering CO_2 allowances would result in a 50% *increase* in the equity value of the power generation sector[11]. They also show that only 9% of all allowances would need to be grandfathered in order to compensate for the loss of equity value incurred by certain sectors (i.e., 91% of total allowances would be auctioned). Quirion (2002), using a simple model of the European iron and steel industry, finds that only

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[7] The analysis does not consider the case of an internationally traded product that would compete with similar products from an uncapped country. The ability to pass the compliance cost to consumers is likely to be more limited in that case.

[8] Harrison and Radov (2002) look at 7 different options, including different bases for grandfathering, and a combination of grand-fathering and auctioning. For the sake of brevity, we summarise results according to the three main categories.

[9] On the other hand, because auctioning requires sources to buy only the amount of allowances to cover their emissions in the commitment period, it rewards measures taken to reduce emissions in the past – so-called early action. Grandfathering only achieves this result if the base year for allocation is sufficiently far from the year when the cap becomes binding, assuming that sources receive an amount of allowances that is proportional to their emissions in the base year (Harrison and Radov, 2002).

[10] In theory, their value is equal to the discounted expected profits over the medium-long term.

[11] The assumption is that the price of carbon would be set internationally by trading among Annex B Parties, and reach $20/t$CO_2$.

1.7% of this sector's emissions would need to be grandfathered in order to maintain the sector's profit level, for emission reduction scenarios ranging from 12 to 21% - other allowances would be auctioned. With less favourable assumptions on overall iron and steel demand, a gratis allocation of up to 50% of total allowances would be necessary for to maintain profit levels. In a study of the power generation sector in the United States, Burtraw et al. (2001) confirm that full grandfathering would have a net positive effect on the asset value of existing power plants – including coal plants. But they also find that auctioning can – surprisingly – result in an increase in asset value for some regions: increased revenues from higher electricity prices more than offset the cost of controlling emissions and acquiring allowances[12].

A major difference between grandfathering and updating on the one hand, and auctioning on the other, relates to the total cost to society. A gratis distribution of allowances implies that the government transfers a rent to the capped sources. These sources reflect the price of allowances in their product prices. Cap-and-trade systems with binding emission constraints imply a cost for sources: the cost of investing in abatement and/or of purchasing allowances. But this cost is partly – or totally – passed on to consumers of these sources' goods through higher prices, meaning less demand on the one hand, but more revenues per product sold as well. Under an auctioning system, these revenues are captured by the government, since sources must pay the government for every tonne emitted. These revenues, however, can be used by government to offset existing taxes that have a negative effect on the economy[13]. Assuming that revenues are recycled by government, Burtraw et al. (2001) find that the social cost of reaching a cap with auctioning is roughly one-half of what it is with grandfathering/updating – a result that is robust over a range of reduction objectives and electricity regulatory regimes in the U.S. Moreover, they use the recycling mode that is known to be the least efficient: revenues are simply re-distributed to households, whereas they could be used to reduce tax rates that carry high economic cost. In spite of that, auctioning still fares better from a social cost perspective than the other two alternatives[14,15]. Turning to employment effects, Harrison and Radov find that updating is superior to the other two alternatives, as this mode affects product prices and demand the least. Auctioning would work better than grandfathering if revenues were used to lower existing taxes on labour.

To summarise, allocation modes affect the cost of meeting a set environmental goal. Updating – where the overall emission constraint is fixed i.e. not allowed to grow with overall output – also would not deliver a least-cost outcome. Grandfathering and auctioning respect the economic efficiency of trading systems, but they have different distributional impacts. Generally, grandfathering is more favourable in terms of the asset value of sources covered by the system, because sources are in a position to pass on the cost of emissions to consumers, whereas they received allowances for free. Under auctioning, they must also pay for allowances. However, auctioning is the most attractive when it comes to cost minimisation – including

[12] Because the total cost incurred by sources is highest with auctioning, electricity prices would increase more with auctioned allowances. In addition, generators in regions of the U.S. with regulated electricity prices might not be allowed to pass through the price of grandfathered allowances to their consumers, which also explains why the effect on electricity prices tends to be lower under the grandfathering scenario.

[13] The positive economic effect of recycling auction revenues (or carbon taxes) through a lowering of distortionary taxes is known as the "double dividend": an economic dividend is added to the environmental dividend. See Harrison and Radov (2002), Burtraw et al. (2001) for references and discussions of the double dividend issue.

[14] Burtraw et al. (2001) provide another striking illustration of the impact of allocation modes: the prices of CO_2 allowances would be \$25 and \$38 per tonne of CO_2 under auctioning and grandfathering, respectively.

[15] Auctioning also provides a stronger incentive for innovation than grandfathering. Under grandfathering, sources as a whole own the scarcity rent in the form of "free" allowances, and have less of an incentive to reduce its value through investments that would allow to reduce emissions more cheaply. Auctioning changes this because sources must pay for allowances in the first place and investment in lower emissions has a direct return in the form of less spending for allowances at the auction (Cramton and Kerr 2002).

the cost to society as a whole. In addition, auctioning revenues can be used to compensate sectors that may be most negatively affected by a cap on their emissions[16]. Empirical studies show, however, that the corporate competitiveness and profitability under various allocation modes depends on many external factors, including product pricing and how much they compete on international markets. In that respect, the above results do not take in consideration the economic loss and reduced environmental gain that may happen if a major country does not impose significant emissions constraints on its emitters while others do with a DET system. This factor would affect the political feasibility of various allocation modes.

Linking emissions trading systems does not seem to create a problem with respect to competitiveness. In fact, linking emissions trading systems together at least assures that the lowest compliance cost is available to all sources[17], and limits competitive distortions that could arise from different prices for allowances – i.e. different compliance costs – if systems were separate[18].

3.1.3 Allocation modes and new entrants

An allocation mode that facilitates the entry of new sources will attract more economic activity, if sources have the choice between different locations and are relatively mobile. The three allocation modes mentioned above handle new entrants very differently.

- Under auctioning, all sources are treated "equally" in that they must acquire allowances regardless of whether they are new, or pre-existing sources. New entrants that need allowances before the next auction can buy allowances from other sources, via the market.
- Updating, because it allocates allowances on the basis of the sources' activity – whether measured by its output, fuel input or emissions – does not create a barrier to entry for new sources.
- Grandfathering does not, in itself, define how new entrants are handled. The government may set aside allowances for new entrants, or new entrants may have to buy allowances from the market. A set-aside allocated for free to new entrants would be more favourable, as new entrants would otherwise incur direct additional cost to enter the market. Such a set-aside would be equivalent to auctioning allowances to new entrants[19].

The co-existence of different allocation modes in various countries (whether linked or not) creates competitive distortions once a source can produce in one country – presumably where the rule for new entrants is most favourable – and sell its products in the other. A company that has the choice of two locations will obviously favour the country with the more generous allocation rule. This may also influence

[16] See OECD (1999) and Johnstone (2001).

[17] One exception is suggested by Reilly (2002). If one assumes that countries introduce nation-wide emission trading systems, international trading may generate a net cost to some countries if it triggers an increase in fossil fuel prices that already bear a high tax level. The overall cost to the economy of a country in this situation may be higher with trading than without, even though it turns out to be a net seller on the market. It seems unlikely, however, that emission trading is likely to be the instrument of choice to curb GHG emissions from fossil fuel use in transport.

[18] Unfortunately, the literature does not shed light on the potential impacts on companies that would suddenly have their allowances exposed to a changing – higher or lower – price as a result of linking, in cases where sources are covered by different allocation modes. It seems likely that the period of transition could be disruptive to companies bearing a suddenly higher price.

[19] Harrison and Radov (2002) stress that this may not be unfair, since these new sources would know exactly the profitability of their activity, taking the cost of allowances into account. Investments could be shifted to less carbon-intensive activities if it turned out that the cost of carbon was too high – which is a desirable outcome for a country that seeks to lower its emissions. Pedersen (2000), in his presentation of the Danish CO_2 emissions trading system, also argues that grandfathering allowances only to existing producers is not necessarily discriminatory against new entrants. The European Commission, in approving the Danish plan, nevertheless specifically required the Danish government to provide new producers with emission allowances in a non-discriminatory fashion.

decisions taken during the planning of national systems, where entities that may be subject to a less favourable system object to it on the grounds that it is not compatible with systems adopted elsewhere, since it undermines their competitive position.

However, linking the two emission trading systems would not make this problem worse. In principle, sources under both systems would benefit from a wider emission trading system, as it allows them to achieve reductions at least cost through access to more abatement options than if they were limited to their own national system.

3.1.4 Allocation modes and access issues

Auctions are most likely to be organised by governments for entities that reside and are accountable for emissions within their country. Two governments that both rely on auctioning and decide to link their domestic systems would presumably allow their entities to access both auctions – or even organise a single auction.

What happens if a regime based on auctioning and one based on grandfathering link up? We assume that entities previously subject to auctioning would now have access to the allowances market of the grandfathering country; similarly, sources with grandfathered allowances could purchase allowances, if needed, at the auction.

If there is a shortage of allowances in the grandfathering regime before linking, with a price that is higher than that of allowances sold at the auction, linking would inflate the price of allowances at the next auction. The resulting price would be higher than the previous auction price and lower than the price under grandfathering. Sources under the original auction system would now pay more for each allowance. Entities with grandfathered emissions would face a lower cost of compliance given the lower allowance price, but the drop in price would negatively affect sellers in that system. Whether all accountable entities would be better off with or without linking depends again on the specific design of each regime (how auction revenues are used, whether the negative effects on sectors are compensated, etc.).

One critical question thus becomes whether, in such a scenario, linking an auctioning regime with another type of regime would mean granting sources in the latter regime access to the auction. A government that intends to recycle auction revenues should encourage broad participation to assure a competitive auction and as much revenue as possible. Otherwise, the risk is that its own sources acquire allowances from other countries where linkages between the domestic systems exist, leaving the government with much smaller auction revenues, and correspondingly less margin to offset the negative economic effects of the cap. This may happen automatically once trading starts in the commitment period of the Kyoto Protocol: unless a government prohibits access to the international market, entities would have the choice between the relatively large international market for AAUs, CERs and ERUs or the acquisition of domestic units at the auction. At the same time, entities outside the countries where auctions are held may seek to access auctions as an additional source of allowances.

3.1.5 Allocation: some preliminary conclusions

Allocation of allowances is clearly the most complex and politically charged elements of the emission trading design, whether domestic or international. We find little evidence suggesting major problems when linking trading systems with different allocation modes. Of course, competitiveness issues arise as soon as sources subject to different allocation modes compete on the international market – but there may also be distortions of competition when similar allocation modes are used in different countries, with more or less generous allocations. Linking domestic systems, offers a step in the right direction toward alleviating this problem, as all participating sources would have broad access to the cheapest means of compliance.

How allocation modes accommodate new entrants could be a matter for critical concern for mobile activities (e.g. power generation where international transmission is not overly costly). But the fact that the emission trading regimes would be linked – as opposed to separated – seems of lesser importance than the direct cost imposed by a new cap on emissions. However, in the absence of research to the contrary, it would seem that the effect of merging two markets based on different allocation modes would, overall, still lead to improvements in the condition of all sources covered through an equalisation of marginal abatement costs.

3.2 Upstream and downstream allocations

The terms "upstream" and "downstream" allocations refer to the point of application of the overall limit on GHG emissions in the production and consumption chain and define both the type of product that is traded in the market and the market actors (KPMG 2002). In an upstream design, the point of application is at the level of the producers and importers of fossil energy (the entities accountable for meeting a cap)[20]. In a downstream design the point of application is the end-users of fossil fuel energy, i.e. the actual emitters of CO_2 and sources of other GHGs; the accountable entities are usually large fossil fuel consumers in industry[21]. The difference may also be characterised as follows: the upstream sector produces, imports or sells commodities or products that will release GHG once they are consumed; the downstream sector directly emits greenhouse gases (Government of Japan 2000).

In an upstream system, the accountable sectors pass on to fossil fuel markets the cost of holding allowances to comply with the emissions cap, resulting in price changes for consumers, eventually resulting in lower emissions. For this reason, upstream systems have been criticised as essentially converting a trading system into a carbon tax. The advantage of the upstream approach is that it provides wider coverage, including small consumers of refined oil products, natural gas, and coal (e.g. those in the transport, residential, and commercial sectors) that would only be able to be brought into a trading regime at high administrative and transaction costs. In a downstream system, accountable entities are direct emitters of GHG and undertake measures to manage their own emissions constraint. This incentive may be less strong if sources receive the signal through a simple price increase.

The point of application will also influence the product that is traded. In an upstream design, the product is the carbon content of fossil fuels. This can cover carbon content of fuel oil, natural gas and gasoline across the residential, commercial, small industrial and transportation sectors (Haites and Mullins 2001). In a downstream design, the products traded are greenhouse gas emissions or carbon dioxide.

Because there is virtually no difference between the carbon content of fuels and the corresponding emissions at the point of combustion, if a common unit is used – e.g. tonnes of CO_2 equivalent – upstream and downstream systems are essentially compatible. The domestic emissions trading scheme in Denmark is based on downstream emissions calculated from fuel consumption data from each electricity and heat-producing plant in the country. The UK emission trading system also largely follows a downstream approach.

[20] From a GHG inventory standpoint, this is possible because there is essentially a 1 to 1 relationship between the carbon content of a fuel and its actual CO_2 emissions once combusted.

[21] It is possible to have combinations of upstream and downstream designs; these are usually referred to as "hybrid systems" (Haites and Mullins 2001).

3.2.1 Number and type of market participants and implications for efficiency, equity and competitiveness.

There are significant differences between the number and type of market participants under an upstream and a downstream design. An upstream design will have far fewer and much bigger participants than a downstream design. In terms of the impact on administrative efficiency, fewer players in an upstream design will be easier to manage and monitor. A downstream design has the potential to become impractical, with potentially large numbers of participants including small businesses and domestic households, leading to high administration and monitoring costs (KPMG 2002). In an effort to improve administrative efficiency, thresholds for the numbers of sources/participants have been set in some schemes. The result is an implicit trade-off between administrative efficiency (the number of sources to be monitored) and economic efficiency (the more sources, the more cost savings the system brings).

A number of authors (e.g., Haites and Mullins 2001, Smith and Ross 2002) maintain that an upstream design will provide a more economically efficient and environmentally effective scheme, as more sources will be faced with the same marginal cost than under a downstream system. This may be partly true: as soon as a market price is established, a single marginal cost will emerge, the sources covered by the price may be fewer in a downstream system thus limiting economic efficiency (as well as limiting opportunities for recycling revenues through tax cuts and undermining the degree to which equity compensation could occur to individual sectors). On the other hand, with a larger number of participants in a downstream design, the system could be more liquid, and, as capped sources have more of an incentive to control their own emissions, could be more efficient in revealing the true marginal cost of reductions[22]. In contrast, the upstream system might simply pass through a price signal that may be blurred as it makes its way through market intermediaries[23]. There is also potential for larger cost savings from downstream systems encompassing more diverse and numerous participants (Haites and Mullins 2001)[24].

Two different emissions trading systems – one with an upstream design and the other with a downstream design – could show significant differences in terms of the size of their respective market participants. There may be a concern, once systems are linked, that larger entities could exert market power in the more diffuse market. However, they are likely to have less opportunity to do so than under their original system where they were not challenged by smaller entities. Ultimately, participation by different players in the two markets will not prevent trading between those entities, and therefore not likely be a barrier to linking the two systems.

3.2.2 Implications for coverage of emissions

Choosing between upstream and downstream designs will have implications for the extent of coverage of emissions in the market. Studies (e.g., Smith and Ross 2002) suggest that upstream systems result in broader coverage: downstream designs will generally cover only half of emissions covered by upstream designs. Upstream emissions can cover up to 90% of emissions (Haites and Mullins 2001) and could be designed to cover almost all energy related CO_2 emissions in some schemes. Conversely, downstream

[22] KPMG (2002), Harrison and Radov (2002).

[23] Assuming that there are market imperfections which result in imperfect transmission of price signals.

[24] One approach could be to have a phased approach with increasing number of participants over time with the residential and transport sectors included in the final phases (KPMG 2002).

systems would probably cover only large facilities in major energy-intensive industries (electricity generation, refining, iron and steel, building materials, pulp and paper) (Smith and Ross 2002)[25].

3.2.3 Linking an upstream domestic emission trading scheme with a downstream emissions trading scheme

The co-existence of upstream and downstream designs has been examined by Zapfel and Vainio (2002), both within national trading schemes with different designs and between sectors. They examine the viability of a national scheme where the transport sector is covered upstream (refineries hold allowances for the embedded carbon in their fuel products) while the downstream power and industrial sectors are obliged to hold allowances to burn fossil fuels. They conclude that it is possible for the different designs to co-exist in the two sectors as long as the fuels are not used interchangeably (i.e., petrol, diesel, LPG, CNG etc could be added to the trading scheme as long as other fossil fuels used in power generation – for example, coal – cannot be used in the transport sector.

While Zapfel and Vainio (2002) point out the complexities involved in linking national schemes that mix upstream and downstream designs, they conclude that there are no problems with cross border trade in secondary energy products (in their hypothetical case, in electricity and heat). Provided that accounting methods for the export and import of emissions from primary energy products (oil, coal, natural gas) are consistent across regimes (as would be the case if both were participants in the Kyoto Protocol), there should also be no problems with double counting of emissions[26]. Hargrave (2000) examines the feasibility of combining an upstream system with a downstream system within a national emissions trading scheme; his study considers extending coverage under a simple downstream system. He identifies a significant technical challenge in accounting for each tonne of carbon[27], noting that this is primarily an issue of distinguishing those fuels that are consumed by downstream sources from those that are not. Hargrave suggests that this is mainly a problem for oil and natural gas rather than coal[28]. He points to the example where large point sources are covered downstream while emissions from small industrial sources, residential and commercial direct combustion, and the transportation sector are covered at the processing and bulk transport stages (refineries and major gas pipelines), and where fuels may change hands many times.

Hargrave explores three options for dealing with this issue:

1. exempting fuel producers from surrendering allowances for fuel transferred to wholesalers;

2. requiring upstream facilities to surrender allowances for all fuel sold to wholesalers;

[25] Note that other sources have been proposed for inclusion.

[26] Under the Protocol, Parties are accountable for the carbon content of the fuels they produce / import, but not for the carbon content of fossil fuels that they export, as these are combusted and release emissions in another country. To be consistent with the Kyoto framework, in the upstream system, a producer must surrender allowances for the carbon content of the fuel sold in the country, but does not need to surrender allowances for oil, coal or natural gas that is exported and is not accountable for emissions resulting from the consumption of that fuel in another country.

[27] Whilst noting that double counting is not an environmental problem, Hargrave (2000) observes that there are economic implications as the effective tightening of the cap leads to higher compliance costs.

[28] Most coal burned in industrial countries is used by the power sector and large industrial facilities, not by downstream users.

3. requiring allowances for all fuel transferred from fuel producers to wholesalers, unless the producer can provide evidence showing that the fuel was ultimately consumed by fuel users regulated downstream.

As Option 1 would lead to incentives for producers to avoid carbon obligations by selling fuel to wholesalers, and Option 2 could lead to double-counting of fuel consumed by entities regulated downstream, Option 3 is Hargrave's preferred approach. However, this option would likely lead to additional administrative costs for government, fuel producers / importers and sources.

In an international context, with one country following the upstream approach and another downstream, this need not be so complicated. Simply, fuel exports from the upstream system to any other country should not be covered, since they will not lead to emissions in the country.

Hargrave (2000) also outlines issues relating to the compatibility of upstream and downstream measurement systems, particularly the measurement of emissions from upstream facilities from the combustion of fuels they sell. He notes the problems caused by using different measurement systems and methodologies across different emissions trading systems. However, if linkages between systems were largely accommodated under the measurement and monitoring rules adopted under the Kyoto Protocol, this problem may be minimal.

3.2.4 Conclusions

Decisions around upstream and downstream emissions will be influenced by political considerations, and the exposure of particular sectors in international markets. While it is technically feasible to combine an upstream sector with a downstream sector within a national emissions trading scheme, monitoring emissions from upstream and downstream sources will involve additional administrative costs. On the other hand, linking two domestic regimes, one with upstream and another with downstream, only requires the exemption of fossil fuel exports from the upstream system to avoid double coverage of emissions. In fact, upstream systems would require such adjustment whether or not they are linked, as they would otherwise penalise their fuel exports. Ultimately, linkages between two disparate regimes need not pose insurmountable problems.

3.3 Accounting for direct or indirect emissions

Emissions trading systems can be designed to cap emissions at the source level – a cap on direct emissions – or designed so that entities are held accountable for emissions embedded in a good that they consume – so-called indirect emissions. An electricity consumer could therefore be held accountable (and should surrender allowances) for the carbon content of the volume of electricity consumed. The Kyoto Protocol does not take into account the indirect emissions of Parties: they are responsible for emissions on their territory only. Thus, emissions that took place in the manufacturing process of a good that is exported are the responsibility of the manufacturing country, not of the consuming country. However, coverage of indirect emissions has been envisioned and implemented at domestic level, and raises questions both with regard to linkages and to problems that arise even if DET systems are not linked (referred to as "compatibility" hereafter).

3.3.1 Are direct and indirect coverage compatible – without linking?

For some sectors, indirect coverage in one country may create price distortions when compared with direct coverage in another, even without linking the two systems. Linking the two systems could add further complications. For example, the United Kingdom emissions trading scheme handles CO_2 emissions from the power sector in an indirect mode: electricity users, not generators, are accountable for emissions linked to electricity use. A standard CO_2 content per unit of electricity consumed is applied to all consumers – except for those who consume electricity that they generate on site, in which case direct emissions are recorded. In this case, if electricity is imported from a country where the generator's emissions are also capped, the end-user will carry twice the cost of reductions.

In the case of the UK system, one can downplay this potential problem to the extent that electricity imports originate from France, where the carbon content is virtually nil[29]. However, a carbon constraint may result in an upward shift in overall electricity prices – including that of carbon-free electricity, if fossil-fuel plants compete with carbon-free plants[30]. Growing electricity trade and market intermediaries make it virtually impossible to determine whether electricity consumed at any point in the system is imported – i.e. already carries a carbon cost – or is domestically produced.

Zapfel and Vainio (2002) show that another problem would occur if a generator covered by an indirect regime exported to a country under a direct regime. The generator's emissions would not be covered by allowances in its country of origin since its output was not sold domestically, nor in the country where the electricity is consumed, where only direct emissions are recorded. The country of origin would therefore be left with fewer allowances than it would need to cover its emissions. The above issue would not be a problem if the commodity were only produced and consumed domestically – e.g. Australia, Japan and New Zealand do not import electricity from other countries. However, when electricity is traded internationally, direct and indirect systems could only co-exist without a number of adjustments for cross-border electricity trades – e.g. imports would have to be exempted to avoid double-counting.

Problems may also arise if a system allows the creation of new allowances for certain activities that might be considered to substitute for higher GHG intensity activities – e.g. energy savings, renewable energy, or natural gas production. Haites and Mullins (2001) give the example of an energy-efficiency or renewable energy project that would generate emission credits, while the actual source where emissions are displaced, e.g. a power generator, may also participate in a cap-and-trade programme. Reductions in the generator's emissions would free allowances that could be sold on the market. Hence both the project and the source would "record" and obtain credits: two allowances would be generated for every tonne of avoided emissions. This seems to trigger mostly a domestic problem: the government would need to find GHG reductions in other sectors in order to offset the double-counting of allowances made possible by this policy design[31]. Linking this regime with that of another country would not change this picture. It may happen that the displaced emissions occur in the partner country, increasing the availability of allowances in that country and not in the country where the project is hosted, but the problem for the government hosting the project remains the same.

[29] France's exports to the UK are largely based on nuclear generation.

[30] Participants in the Baltic Sea region electricity and CO_2 trading simulation have pointed out the significant increase in revenues from electricity sales stemming from the inclusion of the carbon cost on the electricity price, especially for generators operating with carbon-free sources (IEA, 2002).

[31] Haites and Mullins (2001) identify this double-counting problem as an issue for linking because they do not consider that sources would be covered by a country-wide cap, our assumption here.

3.3.2 Linkages between direct and indirect systems

Two direct systems could link without any obvious problem: each source would be accountable to its host country government for its own emissions. In the case of a country with a direct system opening to a country with an indirect system, as long as countries do not trade products that are indirectly covered, there is no issue. However, if such trade does occur, problems may indeed arise. For example, assume that two countries trade electricity. Consumers in the country with a direct coverage (in this example, the electricity importer) would not need to surrender allowances for their consumed electricity. In addition, because the exporting country has an indirect coverage, emissions related to the exported volume of electricity would not be covered. Unless consumers of imported electricity surrender allowances to the government of the country where the electricity was produced (likely to be impractical – and perhaps infeasible) there would be a clear gap in coverage.

The less probable case, where two countries with an indirect coverage trade indirectly-covered products and decide to link regimes, potentially creates equally difficult problems. Either the countries would need to adjust their carbon flows (unless they have balancing trade flows and an equivalent carbon content for their indirectly-covered products, which is unlikely[32]), or they would need to harmonise their systems. Such harmonisation may entail several elements:

- a unique carbon coefficient would be used for a given product, regardless of its origin, reflecting the average carbon content for this set of countries;
- consumers would surrender allowances for any product that is covered indirectly (e.g. electricity) to their respective governments;
- governments could transfer allowances to each other based on the inventories in the indirect sector. If a country had more allowances to cover its indirect emissions than indicated in its inventory, the other country should be in the opposite situation. A simple transfer of allowances between governments would balance the whole system.

This discussion makes clear that the type of approach (indirect or direct) adopted by a country could make linking difficult and in some cases (two indirect systems linked together) require cumbersome arrangements to ensure that all emissions are properly accounted for in the combined regime. In reality, however, this problem may not be significant in the overall context, as currently only the United Kingdom has implemented a system with indirect coverage.

3.4 Coverage

Coverage refers to the <u>sources or categories of emitters</u> that are included in an emission trading scheme as well as the <u>gases</u> that are incorporated. Coverage will vary from country to country as each will have different emissions profiles, and may already have in place policies and measures to cover specific sectors which therefore may not need to be covered under an emissions trading scheme. There are also different political motivations for covering certain sectors. Limiting a scheme to certain sectors and gases will protect certain industries, whether this is deliberate or not (Diringer 2002). Countries often make decisions on policy coverage around sectors that have different exposure to international competition – discussions of a possible Dutch trading system referred to sectors that are "exposed" and those that are "sheltered" (KPMG 2002).

[32] Otherwise, a country that imports more than its counterpart would require its consumers to surrender more allowances than needed – since the sources are in the exporting country.

There is not necessarily a relationship between the number of sectors covered and the proportion of emissions that are covered under a trading scheme, although this will depend on the sources covered under a particular system. For example, greenhouse gas emissions in OECD countries are mostly highest in the energy and transport sectors so that even a system covering just these sectors could capture a high proportion of emissions.

It should also be noted that there are quite different definitions for sectors[33] across countries (Zapfel and Vainio 2002), so that even if one sector is included in multiple domestic emissions trading schemes, in practice this will result in varying sectoral coverage.

In terms of currently implemented trading schemes, there are significant differences in the degree of coverage. The UK system is broad-based, covering most of industry, and involving more than 4,000 companies (although the electricity sector, producing a significant share of emissions, is only covered indirectly). In contrast, the Danish program is targeted at power-sector CO_2 emissions – and while it ostensibly covers all electricity producers in Denmark, neither generators emitting less than 100,000 tonnes CO_2 per year nor renewable energy generators are covered.

The proposed EU system would cover energy combustion installations with a rated thermal input greater than 20MW, as well as oil refineries, coke ovens, metal production and processing, and producers of cement, glass, ceramics pulp from timber and paper products. These sectors are projected to cover around 46% of European Union CO_2 emissions in 2010, and include 4,000 – 5,000 installations (European Commission, 2001). The Norwegian system covers sectors currently exempt from the existing carbon tax, such as energy- and emissions-intensive manufacturing industries (e.g. metals and chemicals).

The variability in the coverage of gases is less broad than that in sectors: most regimes cover only CO_2, and while additional gases are envisaged, they are not the current priority. The Danish system covers CO_2 only. The trading scheme being designed for the European Union currently covers only CO_2 emissions (Rosenzweig et al 2000) – although coverage can be expanded beyond CO_2 at the request of a Member State or the initiation of the Commission (expansion beyond CO_2 is dependent on the existence of adequate monitoring, reporting and verification mechanisms, see European Commission 2001). The UK scheme provides the broadest flexibility: participating firms can choose whether emissions cover all greenhouse gases or CO_2 only (Rosewell 2001).

Perhaps the most critical problem for multiple gases is accountability and regime credibility. Thus, for example, in terms of linkages, one country with an inadequate MRV system for CH_4 monitoring for agriculture may not want to link up with a country where CH_4 is a large source of emissions, and is included in trading, as it could undermine the integrity of its own trading system, especially if it is mostly a buyer from the other system.

3.4.1 Coverage: implications for effective markets

In principle there should be enough sources covered in a trading scheme to create an active market for allowances (Benkovic and Kruger 2000), and to allow participants a greater number of abatement opportunities and range of options for responding to the market and meeting their obligations (ERM 2002).

Generally speaking, the more sectors and gases that are covered in an emissions trading scheme, the greater the potential for liquidity and market efficiency[34]. The higher the number of sources covered the lower the

[33] For example, one country might include transport in the energy sector while another may not.

total cost of compliance. Thus, linking different systems with different coverage leads to potential cost savings, as there are different control costs among participants (ERM 2002).

The same is also true for gases covered in national trading schemes. A system that covers all six GHGs will generate lower compliance costs than a system covering just CO_2 emissions. ERM modelling results indicated cost increases from a system covering just CO_2 range from 3% (Latest Guess scenario) to 27% (No Trading scenario) higher than a scheme covering all six GHGs (ERM 2002)[35]. However, the modelling indicates very little difference in costs from including the three F-gases (HFCs, PFCs and SF_6). Modelling by ERM does not include low cost CH_4 and N_2O options in the offshore oil industry, reduced coal mining, and options in the waste and agriculture sectors, which could lead to a further reduction in system compliance costs (ERM, 2002). There are significant connections between the coverage of sectors in a domestic trading scheme and coverage of gases. For example, covering the agricultural sector would allow much broader coverage of N_2O and CH_4 sources[36].

In terms of linkages between various national emission trading schemes, differences in coverage across schemes may lead to fragmented markets (Rosenzweig, Varilek and Janssen 2002), as one system will cover one sector, whereas other systems may cover quite different sectors, with potentially different accounting for each gas or activity. However, this is only likely to be an issue in the shorter term. If many Parties become eligible to trade emissions under the Kyoto Protocol, Parties' assigned amounts, once defined, will generate AAUs that are not specific to any gas or activity; instead they would become fungible units in the set of the country's allowances[37]. Also, a patchwork of schemes with varying sector and gas coverage should not technically prevent trading between schemes with different sectoral coverage nor result in higher transaction costs provided the transaction unit (tonne of CO_2 equivalent) is consistent and emissions are well monitored and verified (Zapfel and Vainio 2002)[38].

However, linking systems with different coverage could have consequences for environmental integrity, subject to the quality of MRV systems across different emissions trading schemes. For example, a government may be reluctant, to link up with a system that covers six gases, when there is only an adequate MRV system for CO_2 as this could result in purchasing allowances that may not reflect real reductions, thereby undermining the environmental integrity of its own system.

This raises the importance of high-quality MRV systems for cross-country trading with different coverage. High quality MRV systems will not only be a minimum requirement to open sectors to the trading system, but will also give trading parties confidence in the emission reductions associated with particular sectors (Cappelen 2002). The emphasis put by Parties on compliance with Articles 5, 7 and 8 in the eligibility requirements for emissions trading testifies to the importance of a minimum standard in the creation of a transparent trading regime.

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[34] It is relatively easy to add new sectors and new gases over time (Zapfel and Vainio 2002), providing there are adequate monitoring and verification systems in place.

[35] This is reflected in the discussion by Zapfel and Vainio (2002), who indicate that the design of the EU trading scheme would ideally cover all gases to allow for greatest opportunity for cost minimisation.

[36] For this reason, the inclusion of non-CO_2 gases may have little impact on overall costs, subject to the coverage of individual sectors (ERM, 2002).

[37] However, in the development of the EU trading scheme, some have proposed that no access be granted to AAUs for industry.

[38] However, the same group of participants can be an advantage (Cappelen 2002), even though this is not a pre-condition to cross country trading.

3.4.2 Implications for competitiveness and equity issues

Different coverage in the variety of national schemes will lead to competitiveness issues if different companies are exposed to different costs (Haites and Mullins 2001)[39]. Sectoral coverage of a trading scheme will also influence the size of companies that will participate, and smaller companies will not have the same capacity to manage administrative costs as larger companies (Cappelen 2002), creating additional competitiveness issues. To reduce the potential impacts, (Zapfel and Vainio 2002) have suggested that it could be preferable to have a co-ordinated core of sectors across systems. Others have also suggested an extension or expansion of coverage over time (KPMG 2002).

3.4.3 Coverage and allocation – interconnected design elements

There are some linking issues between the choice of allocation method and coverage under a domestic emissions trading system. If a system has an auctioning method of allocation, the number of market participants will influence the available revenue available to be recycled from the auction, including for the compensation of affected parties by the trading scheme. Hence, decisions around coverage may be important here. Smith and Ross (2002) indicate that coverage of a small number of sectors will result in a smaller pool available for compensation of affected parties. However, this will also depend on the price for permits. For example, even if there are a large number of market participants, a low permit price may generate only a small level of revenues once they are distributed.

Another issue worth considering are the potential benefits for those sectors covered under an emissions trading scheme from a grandfathering method of allocation. Grandfathering allowances to sectors can result in reverse discrimination or favourable treatment (Zapfel and Vainio 2002), as discussed in section 2.1 on Allocation.

3.4.4 Conclusions

Differences in coverage will have an impact on the costs of implementing national emissions trading schemes. Linking systems with different coverage will maximise opportunities for abatement across sectors, and for cost minimisation. However, linking could also change the environmental performance of systems if the quality of MRV systems differ across emissions trading schemes.

Different coverage could lead to fragmented markets in the pre Kyoto period if countries do not trust the accuracy of each others' MRV systems and do not wish to link up with systems that would undermine the environmental integrity of their own. However, there does not appear to be any technical barriers to linking systems with different coverage, provided there is a common transaction unit and monitoring and measurement systems in place that are deemed adequate by all participants. The main concerns relate to competitiveness if some sources are covered in one domestic system and not another. However, this is more of a compatibility issue and will remain whether or not the emission trading systems are linked.

[39] Although sectors not covered under an emissions trading scheme will not be exposed to the same costs as those sectors covered under the trading system, it is also true to say the excluded sectors will not be able to take advantage of benefits from trading (ERM 2002).

3.5 Absolute or relative (rate-based) targets

Countries under the Kyoto Protocol have committed to absolute reductions in greenhouse gas emissions. However, the Protocol does not define how a country is to meet its target, and many have chosen to implement portions of their commitments through both absolute and relative targets. An absolute target is expressed as total emissions during a specified period. A relative target is expressed as an emissions rate per unit of output or activity such as GDP or energy consumption, or per unit of input[40].

Both the Danish and the proposed EU systems have absolute targets. The UK emissions trading system allows for both absolute and rate-based targets, depending on the participant. Direct participants[41] have absolute targets whereas Agreement participants[42] can choose absolute or relative targets. If companies have absolute targets, they are referred to as "absolute sector" participants, and if they have relative targets they are referred to as "unit sector" participants. Most of the Agreement participants have targets defined in terms of energy use or emissions per unit of output (Gielen et al 2002).

3.5.1 Advantages and disadvantages

Relative targets are generally more attractive to industry as they allow greater flexibility for individual firms in meeting their target, but also, because relative targets imply gratis allocation[43], so that firms essentially have free access to the market. In addition, relative targets can be more acceptable from a policy perspective as they can be combined easily with other existing policy instruments such as voluntary agreements (Gielen et al 2002). Relative targets allow for entry and expansion at no extra costs to the source as long as the emissions per unit of output or input are below the target, and costs can also more clearly controlled with a relative target (Gielen et al 2002)[44].

However, relative targets can lead to increased administrative costs both to determine the appropriate metric – unit of output, value added, energy input or other – and to monitor this metric, in addition to GHG emissions. Most of all, relative targets give less certainty to governments about the future emission level of sources covered by their regime and may require adjustments to policies covering other sectors in order to achieve compliance with fixed, absolute national targets[45]. It will also raise equity concerns for competing companies if some are subject to absolute caps and have to compete with companies that have the flexibility allowed by relative targets (not a problem if companies are not exposed to international competition).

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[40] For this reason, Gielen et al (2002) describe a rate based cap as a combination of a price on emissions and a production subsidy.

[41] Direct participants are those who can trade emissions not covered by other UK government targets and are not covered by a Climate Change Levy Agreement.

[42] Agreement participants are those that have signed a Climate Change Levy Agreement.

[43] Auctioning will only be possible with a fixed level of emissions – i.e. under an absolute target.

[44] At the same time, under the regime of fixed, absolute targets adopted under Kyoto, any increase in emissions by one sector will need to be compensated by more aggressive and costly reductions in another activity of the country. This discussion must therefore be cast in equity terms looking beyond the sector at stake.

[45] This would also depend on the stringency of the allocation factors set by government.

3.5.2 Incentives for increased output and emissions under either scheme

A number of authors (Burtraw et *al.* 2001, Haites and Mullins 2001, Harrison and Radov 2002, Gielen et al 2002, Rosenzweig et al 2002) note the economic incentive to increase output under a relative target compared to an absolute target, as well as the lower stringency of relative targets. Economic analysis by Gielen et al (2002) indicates that both production and permit prices are higher using relative targets, though in a global market this would depend on the share of total emissions covered by relative targets.

One option to address potential increases in output is through updating, described in section 2.1 on allocation. Updating effectively combines a rate-based approach with an absolute cap: if a source's output and therefore its emissions are higher than that allowed for a particular period, it receives a greater share of total distributed allowances in the next allocation. A source with lower output would be distributed a lower amount of allowances: the total remains fixed and can be ratcheted down every time a new allocation is done. However, although total output remains fixed, this option would in fact not achieve the target at minimum cost: environmental certainty is secured at the expense of the system's economic efficiency.

3.5.3 Transaction costs and administrative efficiency

Relative targets create problems of measurement and tracking emissions reductions across companies with different outputs, or within a company that changes its product mix or has varying degrees of vertical integration (Fischer 2001, Rosenzweig et al 2002). Problems will also be created through different production processes. This leads to methodological challenges, and additional administrative and monitoring requirements[46].

Solutions include measuring company outputs in terms of dollar value of goods sold (Rosenzweig et al 2002). Others include use of a "Carbon-Intensity-Adjusted-Tons" target where each company's target is formulated in terms of tons rather than carbon intensity and the tons target is adjusted periodically to reflect the national carbon intensity target (Rosenzweig et al 2002). A company's emissions target could then be ratcheted down over the long term if the carbon intensity target were stringent enough. However, as any individual company does not know its target for a particular compliance period until the end of that period, there are resulting impacts on flexibility and potential for banking.

There are clear differences in the costs of administering a scheme with absolute targets as opposed to administering a scheme with relative targets – not to mention the complexity of defining an appropriate metric for sectors that sometimes generate products of very different nature. Under an absolute target, only the emissions need to be monitored to ensure participants have achieved their requirements. However, with a relative approach, and depending on the methodologies adopted, input or output must also be monitored. This ultimately will result in higher costs of monitoring, and may lead to a number of separate databases being required, especially where a firm produces many different products (Gielen et al 2002).

This leads to the situation where relative targets are more complicated both for government and business. The use of relative targets essentially creates the need for two sets of measurement, verification and reporting systems. In addition, under the Kyoto Protocol, governments are committed to a fixed target whereas sectors under a relative cap would not be. While governments will need to ensure that their absolute country emissions target is met, there are risks for business that governments may need to introduce additional regulation at a later stage in order to meet their Kyoto targets which are defined in

[46] Where there is a homogenous product or output such as electricity, this is not as much of a concern (Rosenzweig et al 2002).

absolute terms[47]. This is the source of significant uncertainty in the market for emission permits, in many ways offsetting some of the perceived "flexibility" advantages of relative targets. Governments may also have to acquire AAUs on the international market to offset higher emissions from industry, while industry in other countries would face that cost themselves, which would also raise competitiveness concerns.

3.5.4 Implications for competitiveness

The main concern about the compatibility between absolute and rate-based systems arises when competing firms are covered by different systems, with one perceived as less constraining than the other. The incentives created in each system are quite different, leading to varying relative competitive positions of companies and sectors operating across the two systems (Gielen et al 2002). The sector in the country with the relative target has an incentive to increase output, becoming an attractive location for industries operating in both environments[48]. All other things equal, companies with relative targets should face lower marginal costs (Gielen et al 2002), increasing the competitiveness of those firms operating in a country with a relative target, while the sector in the country with the absolute target charges higher output prices. The resulting increase in output in the country with the relative target leads to an increase in emissions (assuming no counterbalancing offset from a different sector) whilst there is a reduction in emissions from the country with the absolute target. Depending on the degree of mobility of firms operating across the two different environments, this has the potential to lead to some movement of production and investment across countries.

If these systems are linked and those in a rate-based system can sell allowances to participants in the absolute system, the possible increase in output leads to more allowances and inflates the total quantity of allowances available to participants with absolute targets (Haites and Mullins 2001). If the country with relative targets is not ultimately in compliance with its Kyoto target, this outcome could thus diminish the environmental performance of the absolute target system. This could be a significant barrier to linking two systems if one relies on relative targets.

Generally speaking, relative targets will be beneficial for those firms that are included under that target, but a disadvantage for all competing firms subject to an absolute regime. This has implications both within sectors and across countries, and will create distortions across markets.

3.5.5 Potential solutions – the "gateway" approach

Any solution to resolving the competitiveness issues raised when an absolute program is linked with a rate-based program needs to remove incentives for an increase in activity and therefore emissions (Haites and Mullins 2001). The trading system in the United Kingdom has dealt with this issue by creating a so-called "gateway" between the absolute and rate-based "unit" sectors (see Figure 1). The primary aim of the gateway is to ensure that net transfers from the unit sector to the absolute sector do not occur, and so prevent inflation of the absolute sector from the unit based sector (Haites and Mullins 2001). Transfers of allowances to the absolute sector can only occur when there has been a net flow of allowances into the unit sector[49]. The system only allows for the sale of permits from the relative target sector to the absolute target

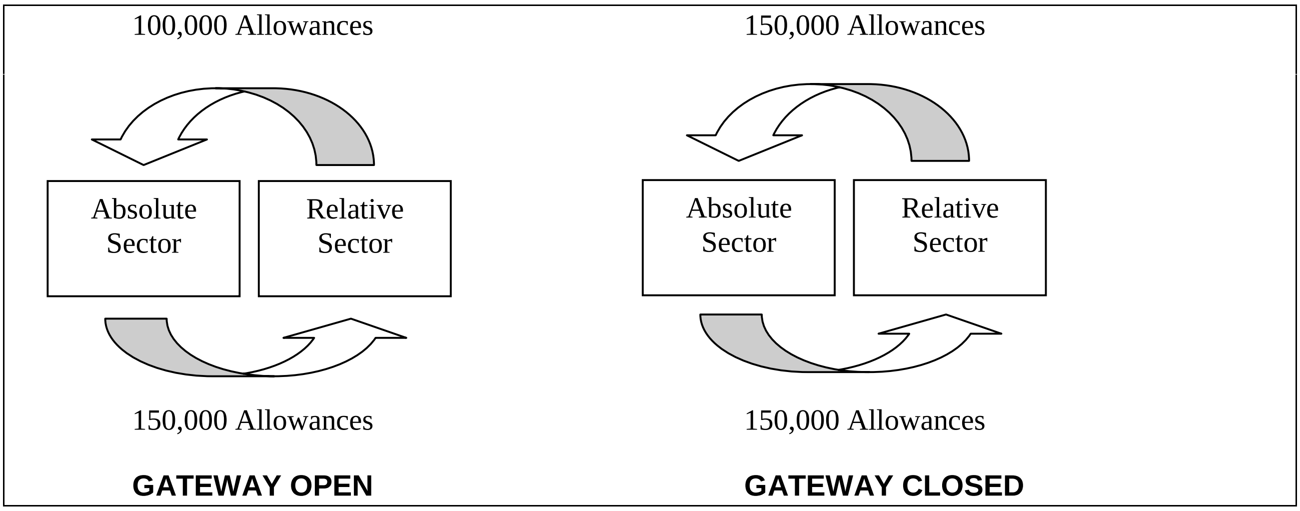
[47] Zapfel and Vainio 2002

[48] But this creates a compliance problem for that country as a whole if this becomes a widespread phenomenon.

[49] Verification and validation of emission levels are also required before transfers can take place (Haites and Mullins 2001).

sector, and only when total allowances from the relative target sector are below a certain level (Gielen et al 2002).

Figure 1: Operation of the gateway in the UK emissions trading system



Legend: Here, the gateway is open when allowances in the relative sector are lower than allowances in the absolute sector (100,000 allowances vs. 150,000). Transfers effectively occur when the marginal cost of abatement is lower in the absolute sector than the unit based sector (Haites and Mullins 2001). The gateway is closed when allowances from the relative sector are greater than or equal to allowances in the absolute sector (150,000 allowances have been transferred in each direction).

Source: Natsource 2001.

A number of problems with the gateway approach are identified in the literature. Firstly, there are significant transaction costs, lowering the efficiency of the system. Also, the rate-based sector has a limited ability to sell allowances to the absolute sector, preventing some companies from realising trading opportunities (Zapfel and Vainio 2002) and leading to reduced market liquidity (Rosenzweig et al 2002).

3.5.6 Conclusions

Participants subject to an absolute cap, if they must compete with participants covered by relative objectives in another country, will argue that they are at a competitive disadvantage because of the more binding limit on their emissions. Yet this problem occurs whether or not the two systems are linked.

Linking an absolute system with a rate-based system could create technical problems. Linking can also lead to increases in emissions, as well as competitiveness issues in sectors dealing across the two environments, with potential movement of production or investment. Within a country there will be significant disadvantages for those firms covered by an absolute target as opposed to those covered by a relative target. The same case will apply when linking national systems with different designs. A gateway or similar mechanism that prevents inflation of allowances in the absolute sector is essential in addressing these concerns.

3.6 On timing of allocation, banking and borrowing

3.6.1 Timing of allocation

Allowances could be distributed – or auctioned – for one or several years / periods in advance[50]. Under the Kyoto Protocol as it currently stands, Annex B governments only have a clear idea of their assigned amount for 2008-2012, not beyond, so it would be difficult for them to commit to a precise allocation to their sources beyond that time horizon. But they could, as soon as they are eligible, allocate assigned amount units for the 2008-2012, or first commitment "vintage".

Different countries may have differing views on how frequently they will proceed with the allocation. Some entities may be granted their allocation for several years ahead – as is done under the US SO_2 allowances trading programme. Auctions could also cover allowances for more than one year ahead, although that would take away some of the flexibility granted to the government to adjust overall emission volume based on external factors. Entities with a longer time horizon would be best equipped to make investment decisions accordingly, and maybe develop more efficient cost-minimising strategies by entering transactions on their allowances for future vintages.

Linking two systems where entities have significantly different projections on future allocation may result in artificially distorting prices: entities with less certainty about their future allocation may put pressure on the market for future-vintage allowances held by sources that already own their future allocation. Alternatively, they could choose to buy allowances today for banking purposes, at a cost that other entities would not face because they already have their future allocation. Market intermediaries may be able to accommodate these situations, at a cost. Otherwise, different timings for allocations do not seem to create a technical barrier to linking various DET. They may however add to market uncertainty.

3.6.2 Banking

In principle, allowances would correspond to a vintage, i.e., carry identification of the year or period for which they were issued. Banking allows Parties (or entities) to use allowances from a previous vintage to cover emissions in a future year/period. By providing such flexibility, banking generally reduces cost. Experience under the US SO_2 allowances trading programme shows that sources benefit economically from being able to carry over unused allowances from one year to the next, while leaving the environment "whole".

The Kyoto Protocol does allow banking from one commitment period into the next[51], recognising that the global climate system is neutral when it comes to the precise date at which emissions are released in the atmosphere. The Danish system also offers the option to bank – albeit only if a source's emissions are below a pre-determined saving limit. The UK system allows banking too, including into the Kyoto Protocol commitment period, although banking is only allowed if sources have over-complied with their target – i.e. they cannot buy to bank[52]. The draft EC Directive also allows banking within its two

[50] That said, auctioning several years' worth of allowances at any point in time could imply a very significant expenditure for sources that would seek to protect their GHG emission needs as much into the future as possible. More likely, auctions would be annual.

[51] Article 3.13 of the Kyoto Protocol. The Marrakesh accords have limited the ability to bank reductions generated by forestry activities.

[52] But the UK government reserves the right to impose restrictions on banking (Haites and Mullins, 2001).

commitment periods (2005-2007 and the Kyoto period), but leaves it up to Member states to decide how much banking would be allowed across these periods.

Compatibility issues related to banking arise when considering linkages between domestic trading systems prior to 2008. A government may authorise its sources to bank pre-2008 allowances into the Kyoto commitment period, as a means to encourage earlier reductions. This implies that a portion of the Party's assigned amount would be used for the purpose of turning pre-Kyoto allowances into Kyoto allowances or AAUs – with the overall assigned amount remaining fixed. The government may have to acquire AAUs from the international market to make up for the difference, or to apply more pressure on other sources, including through a lower allocation level.

A problem could arise if a country were to link its pre-Kyoto trading regime with one in which banking were not allowed. It would be straightforward for entities in non-banking regimes to sell unused allowances to entities allowed to bank, with an agreement to purchase them back, with a premium, after 2008. However, in such a circumstance, the country allowing banking would record a significant inflow of allowances on its entities account, which would be turned into 2008-2012 allowances. When these were later sold back to entities in other countries, there could be fewer AAUs left to cover the banking country's emissions in the commitment period; the banking country could hence face higher compliance costs.

In brief, a trading system that allows *unlimited* banking of pre-Kyoto allowances would be at risk if it were to link with a system where this were not allowed. One solution may be to only allow some of the unused allowances to be banked into the Kyoto commitment period. The UK system proposes another solution to this problem: sources cannot bank allowances that they have bought, but only allowances corresponding to their own reductions. However, this may not be ideal, as it potentially removes a valuable hedging strategy for those sources that expect future increase in their emissions and manage to acquire cheap allowances early to offset them. That said, these sources may enter forward transactions to acquire these allowances for these years when they actually need them. The extra transaction cost would imply some – small? – loss in economic efficiency.

From this discussion, it appears that the only problem with banking, when linking systems, could come from the banking of pre-2008 allowances into the Kyoto Protocol commitment period. A number of possible solutions could solve this problem, e.g. a restriction on the number of allowances that entities would be entitled to bank.

3.6.3 Borrowing

Under borrowing, a source is allowed to use allowances from a future vintage to cover current emissions: it borrows from potential reductions that have not been realised yet, but are anticipated to occur in the future, presumably at lower cost than current reductions. There is therefore a risk with borrowing that the environmental goal is undermined if these reductions never materialise, or if a source could borrow indefinitely from its future allocations and never pay back its environmental debt.

In the Kyoto Protocol, Parties have explicitly rejected borrowing, although the penalty system adopted in case of non-compliance can be compared with a form of borrowing, with an automatic increase in cost equivalent to 30% of the borrowed unit. But a Party cannot declare that it will borrow from its future commitment. Non-compliance must firstly be determined, i.e., after 2012; only then would the penalty be imposed. On the other hand, if a Party is willing to bear the risk of having to surrender 30% more allowances in the next commitment period, it may decide at any time to use more allowances than it holds – i.e. emit above its assigned amount.

Turning to DET regimes, if two regimes with and without borrowing were linked, a source in a non-borrowing regime could buy allowances from a source that borrows them from its future allocation another regime. If the country without borrowing had rejected that option on environmental grounds – the risk of perpetual non-compliance if sources keep on borrowing – linking could be perceived as a problem as its sources would now have access to "borrowed" allowances, albeit from another country's sources.

In the end, the acceptability of borrowing depends on how enforceable targets really are in the system with borrowing. If a penalty rate – such as the 30% penalty included in the Kyoto Protocol – exists, borrowing may be limited even in countries where it is an option. If, however, there is a significant risk of abusive reliance on borrowing, varying approaches to borrowing may be a significant barrier to linking systems together.

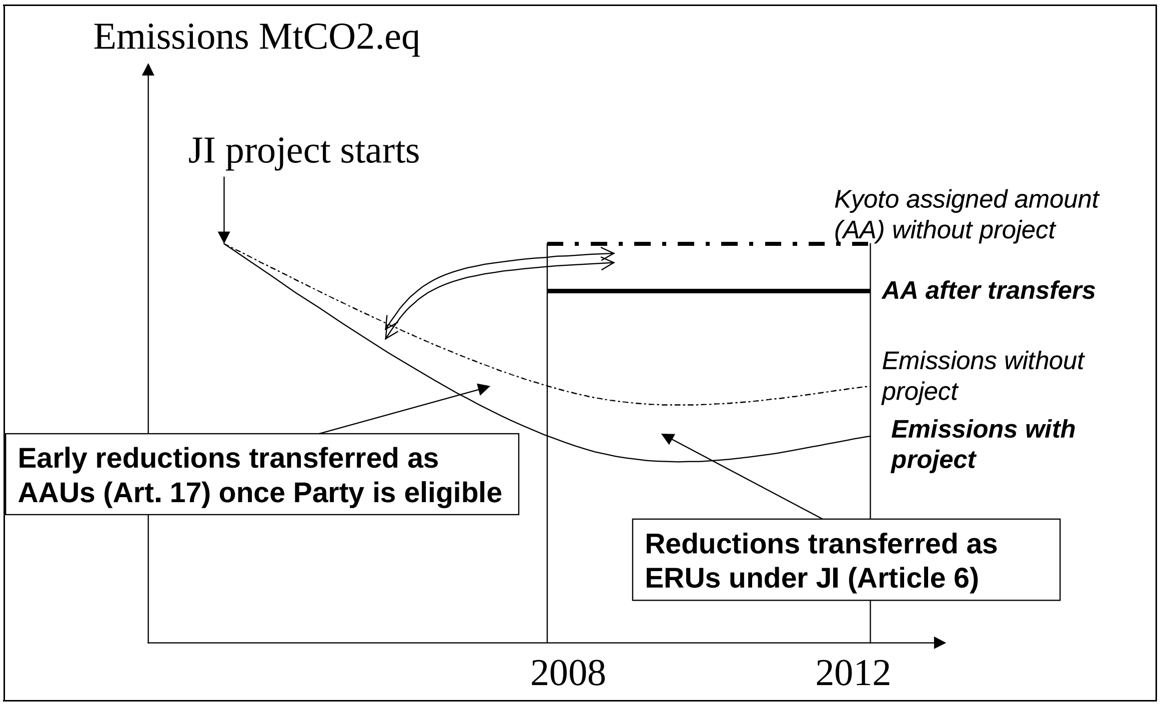
Several options are available to mitigate concerns of linkages between systems with borrowing. First, one could limit the amount that any source could borrow. Second, sources may only borrow for their own emission needs, i.e. only if they have emitted above their *initial* allocation and decided not to buy from the market. This would reduce the risk of these entities exporting borrowed allowances to others, but would require additional monitoring by governments.

While borrowing is implicitly allowed within each commitment period in the EC Directive[53] and other systems – including in the Protocol, where compliance is assessed over five years, and not annually – it is not likely to be a prominent feature of domestic trading systems. A restriction on the total amount that can be borrowed may be enough to address concerns raised by linking systems with and without borrowing.

There is one exceptional instance where borrowing combined with linking may be acceptable to Parties, if it meant borrowing AAUs for pre-2008 compliance. The Russian Federation has proposed the possibility to transfer AAUs (i.e. 2008-2012 Kyoto Protocol allowances) for projects that reduce emissions before 2008. The objective of such a measure is to encourage early investment in mitigation projects, which otherwise are only attractive starting 2008, when emission reduction units could be transferred via Article 6.

[53] Article 11.4 states that allowances would be issued each year of the period by 28 February that year, and Article 12.3 adds that allowances corresponding to the previous year's emissions – that are valid for the whole period regardless of which year they were issued – must be surrendered by 31 March. In effect, a source could surrender on 31 March 2006 some of the allowances received on 28 February 2006 to comply with its emission objective for 2005 (European Commission, 2001).

Figure 2: Borrowing from assigned amount to encourage early reductions



If another country wished to link its system with that of Russia on that basis, it would help reduce the so-called "hot air" with credits that do correspond to real reductions – pending appropriate verification of projects' achievements – and improve the environmental reach of the Kyoto Protocol. Indeed, part of the assigned amount of sellers could be "cancelled" by buyers as they use them to achieve their pre-Kyoto emissions objectives. These AAUs would be subtracted from the overall assigned amount available for 2008-2012 (labelled "AA after transfers" in the above). For such an option to become possible, both Parties to the transaction would need to be eligible to trade under Article 17.

3.7 Incentives, stringency and penalties

3.7.1 Incentives to join DET

Governments that are keen to rely on trading as a domestic tool will use a range of instruments to ensure broad participation in their systems and compliance with the agreed targets. In the UK, incentives to adopt legally-binding objectives include the auction of public funds (GBP 210 Million), as well as a rebate on the climate change levy. In Denmark, the existence of a carbon tax on other sources is an incentive for generators to enter the cap-and-trade system, as there is a possibility that taxation would follow if trading is not used[54]. Support to other measures that reduce GHG emissions also encourages sources to undertake emission goals.

A source that operates in a country with favourable conditions to join the domestic trading system would be at a competitive advantage against a source in a country where joining is mandatory, but where no additional incentive is provided. There is also a risk that emissions trading systems open to voluntary

[54] Norway also considers including those sources that have not been covered by its CO_2 tax in their proposed domestic emission trading system (Norwegian Government, 2002).

participants would mostly attract entities that have a clear economic advantage in joining, i.e. sellers, leading to inflation of the emission cap[55]. If sources in mandatory and voluntary programmes compete on the same international market, one is clearly better off than the other. From a pure economic standpoint, linking these two domestic systems would be neutral[56] – or positive, if it gives companies in the less favourable environment access to cheaper allowances, or allows them to sell theirs at a higher price. Yet emissions may be higher than would otherwise be the case.

However, incentives to join trading systems are likely to be of a transitory and temporary nature, bringing only a one-off advantage to their recipients. The overall impact on competitiveness and the location choices of firms that have such opportunities would be small, if sources were to quickly become subject to roughly equivalent regimes[57]. Haites and Mullins note nevertheless that countries with significant amounts of “hot air” could accrue significant windfall gains – including for their industry, a situation that would further distort competition. In addition, systems that contemplate linking with a country with “hot air” may fear that such links will undermine the environmental integrity of their own regimes. The EC proposed directive guides governments against allocating allowances too generously to their entities, an indication that “hot air” trading would not be allowed (EC 2001, Annex III.5). On the other hand, linking with a regime with excess allowances would lower compliance cost for all involved.

3.7.2 Monitoring and enforcement measures

Emission trading systems must rest on strong GHG monitoring, tracking of transactions and enforcement measures. A domestic system that does not include adequate monitoring and verification of emissions could undermine the environmental integrity of other systems that link to it. A source subject to inaccurate GHG monitoring could sell unqualified allowances to others resulting in a higher emission level overall. If this phenomenon were widespread, it could lower allowance prices, hence reducing the incentives for participants to undertake mitigation measures. Conversely, as Haites and Mullins (2001) explain, linking systems, if it were to lead to a higher price of allowances, would encourage sources with less accurate monitoring and verification procedures to understate emission levels in order to sell unused allowances or avoid having to acquire them to cover emissions.

The purpose of Articles 5, 7 and 8 as well as the eligibility requirements for the flexibility mechanisms of the Kyoto Protocol is to prevent such problems from arising. Yet significant uncertainties on inventories, especially for non-energy related emissions, raise concerns about the ability of Parties to appropriately monitor emissions, and therefore to quantify AAUs that they have available for sale, or must acquire in order to comply. As the environmental basis of the whole emissions trading architecture, the monitoring, reporting and review of Parties’ and entities emissions should draw increasing attention as potential markets start emerging. Yet there is no common standard in place to monitor and review emissions prior to 2008. Parties may decide to trade among themselves for pre-Kyoto compliance once they have passed the eligibility requirements of the Protocol, but as some systems are already operational, the timing may not be right. It seems that mutual recognition of each Party’s MRV systems would be needed prior to any linking.

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[55] Ellerman et al. (2000) show how the so-called opt-in clause of the US SO_2 allowances programme attracted a surprisingly large number of voluntary participants, resulting in an increase in the overall system cap.

[56] Unless it meant allowing sources in a country to receive the subsidy distributed by the government of another country, which is quite unlikely.

[57] The choice of a production site for a major industrial project involves a number of strategic elements but also going through many local administrative procedures with a lead-time that often spans several years. The cost savings would have to be significant for a company to shift its investment plans, once it had chosen a particular site.

Indicating the minimum requirements for domestic MRV systems prior to Kyoto is beyond the scope of this paper.

Enforcement measures must also be credible throughout the system: no source ought to be able to avoid consequences for non-compliance with its emission commitments. The argument is often made that there should be a uniform penalty rate for non-compliance across systems that link. If penalties are not comparable across linked trading systems, the argument goes, non-compliance could be "exported" to the country with the lowest penalty level[58], undermining the environmental integrity of linked systems. But this argument may only hold true with complementary assumptions about the compliance regimes[59]:

- All non-compliance would be caught and systematically penalised.

- The financial penalty would be the only sanction for non-compliance[60] and non-compliance does not lead to other legal charges and sanctions, including loss of access to the market.

- Firms or other entities would be comfortable with making profits on deliberate non-compliance with environmental objectives.

- Governments, through their registries, would let such transactions (over-selling) happen, in spite of the compliance implications at the country level.

Different assumptions about these factors suggest it is less evident that different penalty levels would lead to a systematic export of non-compliance to countries with low penalty levels. On the other hand, if a government were to set a "safety valve" – i.e. a fixed payment to acquire excess allowances – at a fairly low level, entities in other countries, subject to much higher penalty rates and a higher price of allowances would suffer a competitive disadvantage. The pressure towards harmonisation cannot be completely ignored, even if the penalty rate is not the only element in the enforcement toolkit of governments.

Turning to the linkage question, a domestic system with a relatively high penalty may not be inclined to accept merging with a system with lower penalties, precisely because of the potential non-compliance issue. Since sources in both regimes should gain from linkages, the governments involved could establish a penalty level that is acceptable to all and avoids the above risk. But there is no reason *a priori* why the lowest penalty should be what is agreed as the common penalty rate in the end. In fact, a country that wishes to link its system with others, but has a low penalty rate – and no other enforcement measures – should worry about this leading to non-compliance by its entities. Given the desirability of linking to other systems, a country with weak penalties or other provisions for non-compliance may indeed have the incentive to take measures to improve its own compliance.

[58] Haites and Mullins, 2001, page 58.

[59] We note that under the Renewable Obligation introduced in the UK in 2002 to promote the development of renewable energy sources, the price of Renewable Obligation Certificates (ROCs) is sometimes higher than the non-compliance penalty because the holder of a ROC is also exempted from the climate change levy on its electricity consumption. This illustrates, with another commodity, that penalty levels may not be a good indicator of the market's maximum willingness to pay for allowances.

[60] As soon as sources in non-compliance have to make up for their higher emissions in the next commitment period, the financial penalty would only be one part of the total cost borne sources for their non-compliance, the other part being the cost of meeting more stringent objectives in the future. Thus they may not transfer allowances just because the offered price is higher than the financial penalty.

3.7.3 Conclusions

Governments have an interest in bringing a large number of entities into their new DET systems. Thus, numerous measures are being taken to facilitate the transition from the current uncapped regime to a new DET cap-and-trade program. Current practice shows that these incentives and other measures may be very different from one country to the next; these differences have the potential to create distortions and competitive disadvantages for "exposed" industries. On the other hand, these measures may be of a transitional nature only. There is no reason why linking DET systems with different incentives for participation would exacerbate this situation: as stressed above, it is the competition between firms in their products' market that is where problems may surface. Once all relevant sources are appropriately covered, improving access to other markets for GHG allowances should benefit all.

A possible exception may arise if linking systems make it possible for some sources to record windfall profits, e.g. if they have been allocated allowances over and above their needs. This could happen if these sources had previously no demand for their allowances.

Monitoring verification and review of greenhouse gas emissions is an essential piece of DET; it guarantees its environmental integrity. It is therefore likely, as under the Kyoto Protocol, that Parties to a linked system will set a minimum standard for MRV. Similarly, enforcement and non-compliance measures also need careful examination, beyond the comparison of financial penalties for non-compliance, in order to ensure that linking several systems will not lead to a "race to the bottom" and trigger non-compliance.

3.8 Linkages issues between mechanisms: transition from JI projects to emissions trading

The majority of the focus in the current debate has been on the issue of linking – or even merging – domestic emissions trading programmes in two or more countries. However, the Kyoto protocol provides for two additional mechanisms through which emissions credits can be obtained – Joint Implementation and the Clean Development Mechanisms. While neither system is yet fully operational, both have adherents in national systems, and a debate is also underway as to how analogues to these Kyoto Mechanisms will be developed – and linked – at the national level.

This may soon become an issue within the European Union. Countries with economies in transition that are also accession countries to the European Union would normally adhere to a European framework for GHG emission trading within the EU. Because some of these countries have already launched projects under Joint Implementation, some of which in activities that would be covered by the EU scheme – as it stands in the current proposal – questions can be raised about the status of these JI projects under the emissions trading regime. Two options can be envisioned:

- The projected reductions under the JI project could be automatically eligible for transfer under emissions trading. The previously agreed baseline would then become the entity's cap;
- The JI projects – corresponding plants or sources – may be temporarily (or even permanently) excluded from the trading system. This may happen "automatically" if the projects cover activities or gases that are not included in the proposed emission trading system. ERUs would nevertheless be on the market for purchase by other entities or governments outside that regime.

Are there compatibility or linkages problems arising from these two scenarios? The generation of emission reduction units via projects may be indexed on the level of output of the identified plants, e.g. total electricity production in GWh. The potential problem arising from intensity-based, i.e. relative, targets combined with systems with absolute caps is addressed earlier. This issue would not arise if projects had adopted absolute targets.

A project that is left outside the cap of a new trading system may raise concerns about fairness, e.g. if its baseline is seen as less stringent than that adopted for other sources under the broader trading system. However, JI projects may also adopt targets that are *more* ambitious than those allowed under the trading system, in which case the host entity / source would suffer, through a higher abatement cost, from having entered a more ambitious agreement.

In brief, the transition from a project-based approach to a more systematic cap-and-trade system may require some adjustment, all the more so as projects are likely to be based on fairly detailed legal agreements between investors and hosts, and baselines are always particularly difficult to elaborate in a manner that is satisfactory to all stakeholders. Replacing a baseline by a new, absolute, cap may not be a straightforward operation. The forthcoming discussion in the context of accession of transition economies to the European Union will probably shed some light on this problem.

4. DET linkages and Kyoto compatibility: before and after 2008

The previous discussion examined various issues contributing to difficulties in linking multiple DET systems. However, the idea of such links cannot be considered in a vacuum: existing national and international agreements clearly provide a setting and context in which any such decisions will be taken. Perhaps most critical is the framework of the Kyoto Protocol. This framework requires decisions on two central elements (each of which in turn raises a host of implementation issues):

- Will linkages of domestic systems be undertaken prior to the commitment period set out in the Protocol – i.e., for years before 2008?
- Will linkages be set in the Kyoto Protocol context only, or will other frameworks (e.g., with non-Parties, with non-compliant Parties, or using different rules) also be undertaken?

Governments that seek to introduce emission trading with commitments prior to 2008 may be motivated by several factors:

- Their responsibility to reduce emissions as early as possible – without incurring undue economic cost. Linking with other systems can contribute to these objectives;
- The need to put their country on track to reach the legally-binding objectives of the Kyoto Protocol;
- The desire to experiment first with a system that represents a significant change in countries' policy approach to environmental problems before international GHG emission trading is launched under Article 17.

It is often assumed that linkage problems would disappear as soon as trading under Article 17 and other mechanisms, start operating. In fact, the Kyoto Protocol does not prescribe a unique set of features for domestic emission trading systems – with the exception of Articles 5 and 7 on monitoring and reporting and the possible agreement on a technical standard for communication across Parties' registries. There is therefore no reason why *a priori* the start of emissions trading under Article 17 would resolve linkage problems that existed before 2008. Furthermore, if the goal (for purposes of improving economic efficiency) is to encourage as broad a trading regime as possible, it is important to consider problems that may still exist during the Kyoto commitment and envision solutions early.

Previous sections have raised issues for domestic GHG emission trading systems both with and without linking. For example, some design features raise problems regarding competitiveness within a sector when two countries proceed along different paths – even before linking is envisioned (for example, indirect coverage of certain sectors' emissions). Turning to those concerns related to linkages more specifically, banking from the pre-Kyoto period into the Kyoto period and borrowing provisions may require some adjustments in order to maintain the environmental integrity of the linked systems. At least partial solutions to these problems are presented above.

Other differences in design may make systems harder to reconcile. One such situation is when links are made to a national system in which accountable entities have an allocation well above their needs. If linkages open access to the market for these entities, they are tantamount to providing significant financial transfers – without entailing equivalent mitigation efforts. The negotiation under Kyoto explicitly provided for this – and some analysts are of the view that the political and economic gains to be achieved through linking supersede the less ambitious environmental goal created by such links. But other political considerations may prevent governments from allowing such links in programmes currently in operation. Thus, for example, in the criteria for allocation presented in the EC Directive proposal, an allocation beyond entities' needs would not be acceptable, which suggests that linking with DET systems of countries with excess allowances would not be automatic.

It is not clear that this situation would change once emissions trading starts under the Kyoto Protocol, even assuming that all Parties are eligible to trade. Parties may still decide to set bilateral or multi-lateral agreements limiting transactions in spite of the existence of the wider opportunities to trade among Parties offered by the Kyoto Protocol, and the corresponding cost savings.

Another potential barrier to linking could be different quality standards for monitoring, reporting and review. This becomes even more critical a problem when different gases and sectors are covered, and Parties are inadequately prepared to assess the robustness of tonnes credited under each other's regimes – with the concomitant fear that the new link may undermine the environmental integrity of the existing domestic programme. The existence of a common standard for emission inventories and their review under Article 5, 7 and 8 of the Kyoto Protocol contributes to solving this problem. Similarly, ongoing discussions on registries among Parties may solve technical problems of communication before they arise. In that respect, a critical point in establishing an efficient international market is whether entities will be allocated AAUs and allowed to buy and sell these internationally or whether domestic / regional units will still be used for trading during the Kyoto Protocol commitment period. This question is not specifically addressed in this paper.

Entry into force of the Protocol and Parties' eligibility to trade may not automatically resolve linkages and compatibility questions highlighted earlier. . However, all of the design issues highlighted above could be accommodated under the Kyoto framework with some (albeit, in few cases, significant) adjustments to domestic policies. Table 1 provides an overview of linkage questions as they may arise before and discusses whether they could remain valid during the Kyoto commitment period.

Compatibility with Kyoto does not necessarily mean that the Kyoto structure alone will provide the greatest possible benefit for the international community. This paper does not look beyond the boundaries of the Kyoto Protocol, where greenhouse gas trading systems are also emerging. Linking enlarges the scope of reductions and brings lower compliance cost with any target. However, the sheer number of Parties (and the volume of emissions they represent) that are not covered in the Kyoto regime suggests that some independent schemes, possibly linked among themselves, may develop outside of the Kyoto process. For these, the issues discussed with regard to environmental integrity and regime compatibility are critical, and the solutions discussed above, even outside of the centralised Kyoto process, may have enormous importance.

Table 1: Compatibility and linkages questions – Pre and during Kyoto's first commitment period

Design feature	**Pre-Kyoto (trading outside Article 17)** based on domestic emissions trading systems	**During Kyoto (under Article 17)** assuming eligibility to participate in emissions trading
Allocation modes	Any competitiveness issues that may arise from countries' choices of different allocation modes are likely to remain valid before and during Kyoto. However, linking is likely to be beneficial to all sources involved, even if the transition from domestic to international system may affect the profitability of investment choices that were made prior to linking.	
- New entrants	**New entrants**: Concerns about more or less favourable treatment of new entrants remain valid whenever systems start operating, i.e., also before trading under Kyoto starts – but may be of a transitory nature only.	**New entrants**: Similar problems could remain during Kyoto.
- Access issues	**Access**: Auction-based systems will need to decide on whether and how to grant access to the auction to sources and other entities in linked systems.	**Access**: As soon as a broad market exists, access to countries' auctions may be less of an issue as sources can find AAUs and other units on the international market.
Upstream / downstream	Adjustments required for fuels that are used interchangeably and traded across systems (e.g., oil and gas). All systems must have a compatible measurement and monitoring system.	To avoid double counting under Kyoto, it will be necessary to exempt fuel exports from upstream systems. Eligibility requirements under Kyoto ensure compatibility of MRV.
Direct / indirect	Direct and indirect systems may require adjustments to be compatible – even without linking – depending on which sectors are covered indirectly and whether they export/import products from countries with direct coverage. Linkages would raise further problems. Linking two systems that cover the same sectors indirectly would also require adjustments.	The accounting of GHG emissions and AAUs under Kyoto is not compatible with an indirect coverage of sectors *if* these sectors export to other Parties. Each Party is responsible for emissions on its territory. Parties with some sectors covered indirectly may need to adjust their domestic system accordingly.
Coverage	DET systems will benefit from increased coverage. Fragmented markets possible in short term. Some potential issues if inadequate MRV systems.	Trading costs under Kyoto likely to be lower with increased coverage. Fragmented markets within Kyoto Parties unlikely, as AAUs cover all activities and gases. Minimum issues with linking as well-defined requirements for consistent MRV systems under the Protocol.
Absolute / relative	Relative and absolute targets possible. Gateways necessary to ensure environmental integrity. Possibility of competitiveness issues.	Kyoto is not amenable to relative targets although gateways could ensure the environmental integrity of international transactions. This would require additional administrative and monitoring costs for the government and/or entities.

Design feature	**Pre-Kyoto (trading outside Article 17)** based on domestic emissions trading systems	**During Kyoto (under Article 17)** assuming eligibility to participate in emissions trading
Banking	Banking pre-Kyoto allowances into Kyoto (turning them into AAUs), if unlimited, may be a problem for linkages if some countries do not allow this option.	Banking of AAUs (and other units, with some restrictions) from the first commitment period into future commitment periods is explicitly allowed (Article 3.13 of the Kyoto Protocol).
Borrowing	A system that excludes borrowing may not be inclined to link with a system that allows this option because of the possible repercussions on the environmental performance of the whole system. However, borrowing Kyoto Protocol AAUs for pre-Kyoto compliance would increase the environmental performance of the Protocol, especially – but not only – if "hot air" were to be used for that purpose.	Borrowing from the next commitment period is not allowed by the Kyoto Protocol, although it may be allowed by a county in a DET; in such a case, the country would need to ensure that sufficient tons to comply in the current period were provided by other sources..
Incentives	Possible distortions of competition if linking with a system with oversupply of allowances. Linking a system based on mandatory caps with a voluntary system may be problematic for that reason.	Potential problem if linking with system where sources have an overly generous allocation (i.e. "hot air").
Monitoring, reporting and review (MRV)	No common MRV standard exists for DET systems. Mutual recognition of MRV systems would probably be a prerequisite for linkages, as they ensure the environmental integrity of the trading system.	The Kyoto Protocol specifies eligibility requirements for international emissions trading, including MRV (Articles 5, 7 and 8).
Penalties	Linking may put pressure on systems to homogenise their enforcement systems, to avoid exporting non-compliance to the less stringent regime (note: penalties are only one element of enforcement systems).	This problem would remain under the Kyoto Protocol commitment period, as the Protocol does not prescribe an approach to non-compliance at domestic level.

5. Preliminary conclusions and issues for further work

There are significant benefits to linking national emissions trading systems, whether or not they use different features. Linking domestic emission trading systems together will broaden coverage of activities, increase abatement options available to sources, increase market efficiency and liquidity, lower compliance costs and provide an economic signal that is more relevant than if it relates to some countries only.

Generally speaking, there are few technical barriers to linking, though some modifications and design solutions are required to ensure effective linking of different designs. In fact, technical barriers may be fewer than expected given the multiple choices available to designers of trading programmes. Importantly, linking may reduce the environmental performance of trading systems, especially when linking a system with an absolute target with a system with a relative target. There may also be reluctance to link systems with very different levels of ambitions in environmental terms, even if emissions trading under the Kyoto Protocol allows for this through differentiated emission objectives for Parties.

Allocation modes, because of their impact on the cost of compliance of sources, will raise a number of questions relating to their impacts on competitiveness. However valid, these concerns are not directly affected by the linking of domestic systems, even if these systems rely on different allocation modes. Rather, they arise because companies within the same sector may face different compliance costs as a result of different allocation modes. Linking could contribute to reduce distortions of competition by giving access to the cheapest means of compliance to all sources covered. Access of new entrants to the emission trading market – whether they receive allowances for free or buy them from the market or at an auction – may also have implications on the location of companies. But there is no evidence that linking two systems with different allocation modes will have *permanent* and negative effects on sources, as all should benefit from a trading system with broader coverage.

Upstream and downstream systems influence the types of market participants, especially their relative weights: upstream systems will include fewer entities, each accountable for a larger proportion of the country's emissions than would be the case with a downstream allocation. Linking would hence reduce the risk of market power, as there will be a greater number of market participants in a linked trading system. There are few significant issues related to linking an upstream system with a downstream one. Linking national systems that mix upstream and downstream designs will require sound and consistent accounting methods, as well as a common unit of measurement (e.g. tonnes CO_2 equivalent, the unit adopted by the Kyoto Protocol). The easiest option to avoid double counting of emissions from fuels used in both upstream and downstream systems is to exempt fuel exports from a upstream national system to any other country.

As mentioned above, linking systems will give sources in each system access to abatement options in a broader range of sectors and gases, increasing the potential for cost minimisation. However, reaping the benefits of linking require effective monitoring, reporting and review systems (MRV). A system that excludes certain activities and gases because of the uncertainty surrounding emission levels may not readily link up with another in which these same activities are covered and allowed to trade. Incentives for countries to link will be reduced when MRV systems are not adequate, as they lead to uncertainty around the validity of allowances from individual systems. This should no longer be an issue under Kyoto's first commitment period, and once Parties are eligible (i.e., they have established proper MRV systems for their inventories of all six gases). Prior to that, some Parties may choose to limit the acquisition of allowances from Parties for which MRV systems are deemed inappropriate.

The most significant issue when linking systems with a mix of relative and absolute targets, is the potential for an increase in output and emissions, and the consequent reduction in environmental performance. There are also competitiveness issues for firms operating across systems – those firms covered by a relative target will be less constrained than those covered by an absolute target, and this could result in some movement of investment and production across countries. A "gateway" or similar mechanism is a possible solution to these concerns, though such a mechanism will involve increased transaction costs and could result in reduced market liquidity.

Some domestic systems rely partly on the indirect coverage of sources: consumers of the goods, not producers and actual GHG sources, are held accountable under the trading regime. Even before linking such a system with a system relying on the more straightforward "direct" approach, the co-existence of these different systems could lead to consumers paying twice the cost of compliance. This would occur if consumers are liable under an indirect regime and consume a good produced in a direct regime. Conversely, emissions could be left unaccounted for, if a producer in the indirect regime sells its product in the direct regime. However, consistency problems would only arise in fairly specific contexts.

Countries will rely on a range of incentives for entities to participate in their domestic emission trading schemes. In theory, entities and sources would seek to locate where they can obtain the most favourable regulatory conditions. However, the fact that a unique allowance price should emerge from linked systems should significantly reduce distortions coming from different compliance costs. Linking, in this case, is the solution rather than the problem. Of particular concern will be systems in which sources operate with a generous cap, possibly above their emission needs. Countries will need to balance environmental integrity with cost savings when deciding whether or not to link with these systems. This is one issue that may remain during the Kyoto commitment period.

A table is provided below, summarising compatibility issues as well as those arising from linkages. On the whole, serious technical problems arising from linkages are not many, and often have fairly straightforward solutions. In some cases one country may need to adjust its system to the design of the other with which it intends to link up. The expected benefits in terms of compliance cost and environmental effectiveness should provide strong incentives to do so.

Emissions trading as defined under the Kyoto Protocol framework may solve many potential problems but not all of them. Some barriers to linkages may well continue into the Kyoto Protocol timeframe (see Table 1).

Some questions would require more detailed analysis than was possible here:

- Allowance prices and tax treatment of capital gains in various domestic settings: this is likely to be an important driver of price differences across systems and may introduce distortions not highlighted in this overview.

- Registries and trading units. There is a possibility that different regimes will rely on different units, even for Parties to the Kyoto Protocol, making transfers across systems possibly more costly and less transparent. Implications for the implementation of the commitment period reserve rule could also be explored.

- Role of third parties (e.g., brokers, etc.) acting to provide market liquidity between regimes, and arbitraging on regime differences. How equipped are market intermediaries to bypass technical problems between DET systems[61]?

[61] See Baron and Pershing (2002) for a discussion of how trading between Kyoto Parties and non-Parties might be undertaken.

- What practical arrangements would be needed to move smoothly from project-based activities into cap-and-trade systems with broader coverage?

Table 2: Summary of Compatibility and Linkage Issues

Design Element	Allocation	Upstream and Downstream	Direct and Indirect	Coverage	Absolute and Relative Targets	Banking and borrowing	Incentives and Penalties	From project-based to emissions trading
Implications of Different Options and Compatibility*	Competitiveness concerns raised by potential differences in compliance costs caused by different allocation modes (auction vs. grandfathering) and different rules for new entrants.	Upstream and downstream systems can be compatible providing a common unit of measurement (e.g. tonnes CO_2-e) is used.	In some cases, inconsistent treatment of sectors across countries may cause "double capture" (consumers pay twice for reductions) and un-accounted for emissions.	Different systems will be compatible once Parties are eligible to trade under Kyoto Protocol – AAUs not specific to activity or gas.	Competitiveness issues between firms under relative and absolute targets. Relative targets not consistent with auctioning method of allocation.	No obvious problems if systems are not linked.	If given the possibility, sources will seek to operate where entities have best conditions to join. Maybe a temporary phenomenon.	No obvious compatibility problems between JI-based and DET approaches, as ERUs and AAUs are fungible for the most part under Kyoto. Possible concerns pre-Kyoto.
Linkage** Issues	Competitiveness concerns possibly more prominent *without* linked systems: in a broader system allowance prices are equal for all sources across countries. Temporary winners and losers as domestic prices move towards a single price.	Linking of upstream and downstream systems will require exemption of allowances from exported fuels from upstream system.	Linking direct w. indirect systems would require adjustments to avoid gaps in accountable sources. Linking two systems with indirect coverage of the same sectors also a problem.	Linking will broaden coverage of sectors and gases, increasing market efficiency and lowering costs. Inadequate MRV systems may be a barrier to linking different systems.	Linking creates incentives to increase output and emissions, reducing environmental performance of systems.	Allowing banking pre-Kyoto into Kyoto, if other Parties do not, could lead to increased compliance cost. Systems w/o borrowing may be reluctant to link with systems w. borrowing.	Linking with systems where allocations are too generous could be problematic from environmental standpoint.	Some adjustments may be needed if sources are covered by projects need to move to a sector-based allocation. May not be compatible with contractual arrangements under JI projects.
Remarks	This issue must be considered in practice, as sectors face different competitive pressures. Auctions make it possible to partly offset negative effects.		This issue may only apply to the power sector (covered indirectly in the UK), as power is easily traded across borders.	Grandfathering under restricted coverage could result in transfer of rents to small number of entities.	Gateway or similar mechanism will be important to ensure allowances are not inflated in absolute system.	Negative effects of Pre-Kyoto banking can be solved. Pre-Kyoto borrowing could be a plus environmentally.	Penalties are only one element of enforcement measures. Different penalty rates not necessarily a problem.	Investors in projects to obtain ERUs would need to envision scenarios in which sources become capped under a broader regime.

Notes:
* Compatibility issues refer to those arising from the coexistence of two different systems, even without linking.
** Barriers that may arise when linking systems.

6. Glossary

Absolute target – a target expressed as total emissions during a specified period.

Accountable entities – Sources or other economic agents that must surrender allowances to their government to establish compliance with their emission goals under an emissions trading system.

Allowances – tradeable units under emission trading programmes. Under the Kyoto Protocol, the allowances are assigned amount units, emission reduction units (under Joint Implementation) and Certified Emission Reductions (under the Clean Development Mechanism).

Allocation – Process whereby entities, sources or else, receive their emission goals (see Auction, Grandfathering, Updating).

AAUs (assigned amount units) – Allowances for the emissions trading system established by the Kyoto Protocol. Correspond to a permit granted to a Party to emit one tonne of CO_2 equivalent in the period between 2008 to 2012.

Auction – Allocation mode in which accountable entities (sources or else) can purchase allowances to cover their emissions needs.

Banking – Possibility to set aside unused allowances for use in the next commitment period.

Borrowing – Possibility to use allowances for a future commitment period to comply with objectives of an earlier commitment period.

Coverage – The sources or categories of emitters that are included in an emissions trading scheme as well as the gases that are included **.**

Credits – Allowances related to a project, corresponding to avoided emissions generated by the project.

Downstream - point of application in the production and consumption chain and defines which parties are required to surrender emission allowances. Parties responsible for the CO_2 emissions are the end-users of energy, usually fossil fuel generators and large industry. The products traded are greenhouse gas emissions or carbon dioxide.

Grandfathering – Allocation mode whereby sources are initially *given* a number of allowances that defines their emission goal, as opposed to auctioning which requires them to buy all allowances.

Indirect emissions – Emissions related to the production of a commodity. Refers to coverage of sectors under emission trading: consumers may be held accountable for their “indirect emissions”, as opposed to actual sources.

Relative target – A target expressed as an emissions rate, such as emissions per unit of output or activity such as GDP or energy savings, or emissions per unit of input.

Stranded costs – Cost incurred from operating physical capital under a regulatory constraint – e.g. CO_2 cap – that was not planned when investment was realised.

Updating – Allocation rule based on grandfathering whereby the total allocation is fixed, but the distribution among sources is re-done periodically to account for relative increases or decreases in a metric for each source. The metric can be physical output, input, or emissions. A source that produced / emitted more than its share in a given period would receive a higher share in the next period.

Upstream – point of application in the production and consumption chain and defines which parties are required to surrender emission allowances. Parties responsible for the CO_2 emissions are the producers and importers of fossil energy. The product that is usually traded is the carbon content of fossil fuels consumed in a country.

7. References

Baron R., Pershing J. (2002): *Trading Greenhouse Gases Outside Kyoto*, IEA Information Paper, October, http://www.iea.org/envissu/emis.htm

Benkovic S. and Kruger J., (2002): *To Trade or Not To Trade?* Clean Air Markets Update, Issue 2, United States Environmental Protection Agency, May

Burtraw D. Palmer K. Bharvirker R. and Paul A. (2001): *The Effect of Allowance Allocation on the Cost of Carbon Emission Trading*, Resources for the Future Discussion Paper 01-30, August. http://www.rff.org

Cappelen F. (2002): *Linking Domestic Emission Trading Schemes – a Perspective from the Private Sector*, IETA/IEA/EPRI Brainstorming Session on Convergence of GHG Regimes and Linking Trading Schemes, Montreal, April

Cramton P. and Kerr S. (2002): "Tradeable carbon permit auctions: How and why to auction and not grandfather", *Energy Policy* 30 (2002) p.333-345.

Diringer E. (2002): *Two Scenarios: Linking U.S. and International Climate Change Efforts*, IETA/IEA/EPRI Brainstorming Session on Convergence of GHG Regimes and Linking Trading Schemes, Montreal, April

Ellerman D., Joskow P.L., Schmalensee R., Bailey E. (2000): *Markets for Clean Air: the U.S. Acid Rain Programme*, Cambridge University Press, 362 pp.

Environmental Resources Management (2002): *GETS 3 - Greenhouse Gas and Energy Trading Simulations*, Final Report for Eurelectric, the Union of the Electricity Industry, March

European Commission (2001): *Proposal for a directive of the European Parliament and of the Council Establishing a Framework for Greenhouse Gas Emissions Trading within the European Community and Amending Council Directive 96/61/EC*, Directive of the European Parliament and of the Council, COM(2001)581, October.

Fischer C. (2001): *Rebating Environmental Policy Revenues: Output-Based Allocations and Tradable Performance Standards*, Resources for the Future, Discussion Paper 01-22, July. http://www.rff.org

Gielen A. M., Koutstaal P. R., and Vollebergh H. R. J. (2002): *Comparing Emission Trading with Absolute and Relative Targets*, paper presented for Netherlands Ministry of Finance, March

Government of Japan (2000): *Discussion Paper on Domestic Emissions Trading Regime for Greenhouse Gases in Japan*, Committee for Designing a Domestic Emissions Trading Regime, A study commissioned by the Environment Agency of Japan, June

Government of Norway (2002): *Amendment to Report No. 54 to the Storting (2000-2001) Norwegian climate policy*

Hagem C. (2002): *A Note on The Kyoto Protocol, Tradeable Quotas and Firm Survival*, Environmental and Resource Economics 22: 467-468, Kluwer, Netherlands

Haites E. and Mullins F. (2001): *Linking Domestic and Industry Greenhouse Gas Emission Trading Systems*, report prepared for Electric Power Research Institute, International Energy Agency and International Emissions Trading Association, October

Hargrave T. (1998): *US Carbon Emissions Trading: Description of an Upstream Approach*, Center for Clean Air Policy, March

Hargrave T. (2000): *An Upstream/Downstream Approach to Greenhouse Gas Emissions Trading*, Center for Clean Air Policy, June

Harrison D. and Radov D. B. (2002): *Evaluation of Alternative Initial Allocation Mechanisms in a European Union Greenhouse Gas Emissions Allowance Trading Scheme*, Report by National Economic Research Associates prepared for DG Environment, European Commission, March

IEA (2002): *Flexibility Mechanisms: Simulation of Electricity and CO_2 Permit Trading in the Baltic Sea Region*. International Energy Agency, Standing Group on Long-Term Co-operation, IEA/SLT(2002)27.

Johnstone, N. (2001): “The impacts of alternative permit allocation methods on international competitiveness.” Presented at the IEA-IETA-EPRI workshop: *Greenhouse gas emissions trading – Linkages between domestic systems*. Paris, 19-20 September 2001.

Kitamori, K. (2002): “Domestic GHG Emissions Trading Schemes: Recent Developments and Current Status in Selected OECD Countries”, In: OECD (2002): *Implementing Domestic Tradeable Permits – Recent Developments and Future Challenges*, OECD, Paris

KPMG (2002): *Trading for a better climate – Feasibility of a national system for CO_2 emission trading*, Summary of Final Recommendations of the Dutch CO_2 Trading Commission, January

Natsource (2001): *UK Creates First National GHG Trading Program*, AirTrends, 4(8):6, September

OECD (1999): *Permit allocation methods, greenhouse gases, and competitiveness.* OECD Environment Directorate, Environment Policy Committee. ENV/EPOC/GEEI(99)1/FINAL.

Pedersen S.L. (2000): “Danish CO_2 Emissions Trading System”. *RECIEL* 9:3.

Quirion P. (2002): “Can Europe afford non-global CO_2 emission trading? The iron and steel industry case”, 3rd CATEP workshop on *global trading*, 30 September – 1 October, Kiel, Germany.

Reilly J. (2002): “Is International Permit Trading Always Beneficial?” Presented at the XIXth MIT Global Change Forum: *Managing Fragmented Climate Regimes*. Paris, June 13.

Rosenzweig R., Varilek M. and Janssen J., (2002): *The Emerging International Greenhouse Gas Market*, prepared for the Pew Center on Global Climate Change, March

Rosenzweig R., Nordhaus R., and Danish K., (2002): *The Evolving National and Regional Emissions Trading Programs and Opportunities for Linkage*

Rosewell B. (2001): “GHG Trading: Easier than you think”, *Environmental Finance*, October 2001.

Smith A. E. and Ross M. T. (2002): *Allowance Allocation – Who Wins and Loses Under a Carbon Dioxide Control Program?* Paper by Charles River Associates prepared for the Center for Clean Air Policy, February

Yomiuri Shimbun Online (2002): "Govt eyes market for CO_2 credits". http://www.yomiuri.co.jp/newse/20020811wo11.htm

Zapfel P. and Vainio M. (2001): *Pathways to European Greenhouse Gas Emission Trading*, CATEP Workshop on Trading Scales – Linking Industry, Local/Regional, National and International Emissions Trading Schemes, Venice, December

Appendix 1: Summary of domestic greenhouse gas emissions trading schemes

Country	Coverage	Initial Permit Allocation	Interface with other instruments
Canada	Not yet certain. Both narrow and "broad as practical" coverage considered.	Both grandfathering and auctioning considered.	Transitional voluntary credit-trading scheme (for reduction beyond what is required by regulation) considered prior to mandatory cap-and-trade scheme.
Denmark	CO_2 from electricity production only, about 30% of 1997 CO_2 emissions.	Grandfathering	Trading covers electricity generation, supplementing the tax covering others.
EU	Initially CO_2 only (from 2005), then eventually all Kyoto gases after 2008. Approx. 46% of EU's estimated CO_2 emissions, covering 4,000 – 5,000 sites. Sectors include electricity and heat; iron and steel; refining, glass and building material; and pulp and paper. The chemical sector is not included for the most part.	During 2005-7, grandfathering of allowances by Member states, which will be required to apply common criteria for their national allocation.	Some discussion on the possibility to exempt certain sectors / companies from the Directive until 2007. Synergies with the IPPC Directive intended. Anticipated that future revisions or new directives will establish links with JI/CDM mechanisms.
France	Large industrial sources. All Kyoto gases. Possibly as early as 2003.	Based on voluntary agreements.	Linking to EC system and Kyoto mechanisms explicitly envisioned.
Norway	All Kyoto gases and all sectors possible; over 80% to be captured.	To be determined, partial auctioning, partial grandfathering.	In parallel with carbon tax, eventually to replace it after 2008.
Slovakia	Both mandatory and voluntary participants. Sources emitting CO_2. Expected start-up in 2006	To be determined.	
Switzerland	Large emitters, companies and energy intensive producers can exempt themselves from the CO_2 law by adopting absolute CO_2 limit, with possibility to trade. Pilot phase 2005 – 2007.	Based on voluntary agreements. Free allocation.	Tax on fossil fuels will be imposed from 2004 if voluntary measures insufficient.
UK	Emission Trading Scheme (ETS) on voluntary basis for any firms that commit to binding targets, with the choice of CO_2 only or all Kyoto gases. ETS launched in April 2002, and will run from 2002 until the end of 2006.	Free allocation of allowances. Direct participants bid for reduction commitments in an auction for incentive monies.	Firms that negotiate Climate Change Agreements qualify for 80% discount on Climate Change Levy and eligibility for baseline and credit trading. This is integrated into cap-and-trading by the direct participants in the ETS.

Source: adapted from Kitamori (2002).

Appendix 2: Economic effects of various allocation modes – Results from Harrison and Radov (2002)

See next page and section "Economic dimensions of various allocation modes" for details.

Key

- Best
- Good
- Fair
- Poor
- Worst

	Allocation Alternative	Efficiency: Compliance Costs	Efficiency: Administrative Costs	Efficiency: Transactions Costs	Efficiency: Product Market Distortions	Efficiency: Tax Distortions	Distributional: Sector Burden	Distributional: Stranded Costs	Distributional: Consumer/ Labor Effects	Distributional: Taxpayer Effects	Distributional: Rewards for Early Action
1	Auction [1]	Best	Good	Good	Best	Best	Worst	Worst	Good	Best	Best
2	Grandfathering (Emissions) [2,3]	Best	Good	Good	Best	Poor	Best	Best	Poor	Worst	Fair
3	Grandfathering (Input) [2,3]	Best	Good	Good	Best	Poor	Best	Best	Poor	Worst	Fair
4	Grandfathering (Production) [2,3]	Best	Good	Good	Best	Poor	Best	Best	Poor	Worst	Fair
5	Updating	Worst	Poor	Good	Worst	Worst	Worst	Poor	Best	Worst	Worst
6	Grandfathering (Direct and Indirect Emissions) [4]	Best	Fair	Good	Best	Poor	Good	Good	Poor	Worst	Fair
7	Grandfathering With Auction Phase-In [1,2,3]	Best	Fair	Good	Best	Good	Poor	Good	Fair	Fair	Good

Notes:

1. We assume that auction revenues are recycled both to reduce taxes and to reduce impacts on the affected labor force.
2. We assume that all sectors receiving grandfathered allocations are competitive or fully liberalized (e.g., that electricity is priced on the basis of marginal cost rather than average embedded cost) and thus that the opportunity costs of allowances are reflected in prices to customers. Efficiency and distributional impacts would differ if this assumption were not met.
3. The effect of grandfathering on "early action" (i.e. emission reductions before the trading program begins) depends on the allocation year. Under an early allocation year the treatment of early actions is equivalent to their treatment under an auction. However, a later allocation year would *penalise* early actions. To account for this latter possibility, grandfathering receives a lower rating than auctions for this criterion.
4. We assume that indirect *allocation* is *not* accompanied by indirect *accountability*, otherwise the efficiency of the programme would be reduced. Grandfathering based upon direct plus indirect emissions would reduce allocations to electricity and heat facilities, which as covered sources would need to purchase allowances for residual emissions (after controls). The sector burden and stranded cost evaluations reflect this negative effect on these facilities.