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**On Carbon Prices and Volumes in the Evolving
'Kyoto Market'**

by

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FOREWORD

This paper was prepared by Michael Grubb (Associated Director of Policy, Carbon Trust, London/Visiting Professor, Climate Change and Energy Policy, Imperial College/Senior Research Associate, Department of Applied Economics, Cambridge University) for the OECD Global Forum on Sustainable Development: Emissions Trading and Concerted Action on Tradeable Emissions Permits (CATEP) Country Forum, held at the OECD Headquarters in Paris on 17-18 March 2003. The aim of the Forum was to bring representatives from OECD and non-OECD country governments together with representatives from the research community, to identify and discuss key policy issues relating to greenhouse gas emissions trading and other project based mechanisms for GHG emission reduction, such as Joint Implementation and the Clean Development Mechanism. The Forum also aimed to promote dialogue between the various stakeholder groups, and discuss policy needs in the design and implementation of tradeable emissions schemes. Forum participants included representatives from OECD and non-OECD governments, as well as from the research community. Those from industry and other institutions involved with emissions trading, joint implementation and clean development mechanism projects such as the European Commission and the World Bank were also represented.

The OECD Global Forums are one of the two pillars of the new architecture of the Centre for Co-operation with Non-Members, agreed upon by the Committee on Co-operation with Non-Members. The Global Forum on Sustainable Development (GFSD) provides a mechanism for achieving the OECD Ministers' outreach objective and will complement other work on sustainable development. Within the organisational framework of OECD, the GFSD will aim to facilitate a constructive dialogue between non-member and OECD economies on key issues on the sustainable development agenda.

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The ideas expressed in the paper are those of the author and do not necessarily represent the views of the OECD or its Member Countries.

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1. INTRODUCTION AND OVERVIEW

Projections of international carbon prices under the Kyoto system, generated by economic models, have fluctuated wildly over time and between models. Now, however, most models project very low prices due to the US pullout, the carbon sink agreements at Marrakech, and revised (much lower) projections of emissions especially in Russia and Ukraine. These factors together imply a large surplus of available allowances, leading to price collapse if all allowances potentially available are freely and competitively traded.

The real international system will not behave in the way projected in such models. Ultimately, emission units under the Kyoto system only have economic value to the extent that supplying governments are willing to issue and transfer them, and the governments of receiving countries are willing to recognize and use those units for compliance assessment under Kyoto. The Kyoto registries system requires the source of all units to be registered by a unique identifier, so that governments have the potential to be selective about the units they are willing to issue or to accept.

Governments will use this capacity to meet strategic concerns, and this will make the Kyoto 'market' vary widely from least-cost 'market' behaviour:

- Economies in Transition, and in particular Russia and Ukraine as dominant exporters, have a clear interest to restrain supply so as to raise prices (potentially retaining allowances for 'banking'), and have some limited market power with which to do so;
- Potential importing governments (predominantly the EU, Japan and Canada) will use the mechanisms selectively and strategically to support their interests and the political legitimacy of the Kyoto system overall, whilst protecting existing domestic legislation.

This paper presents analysis based on these observations, and offers some estimates of the prices and volumes that may be implied.

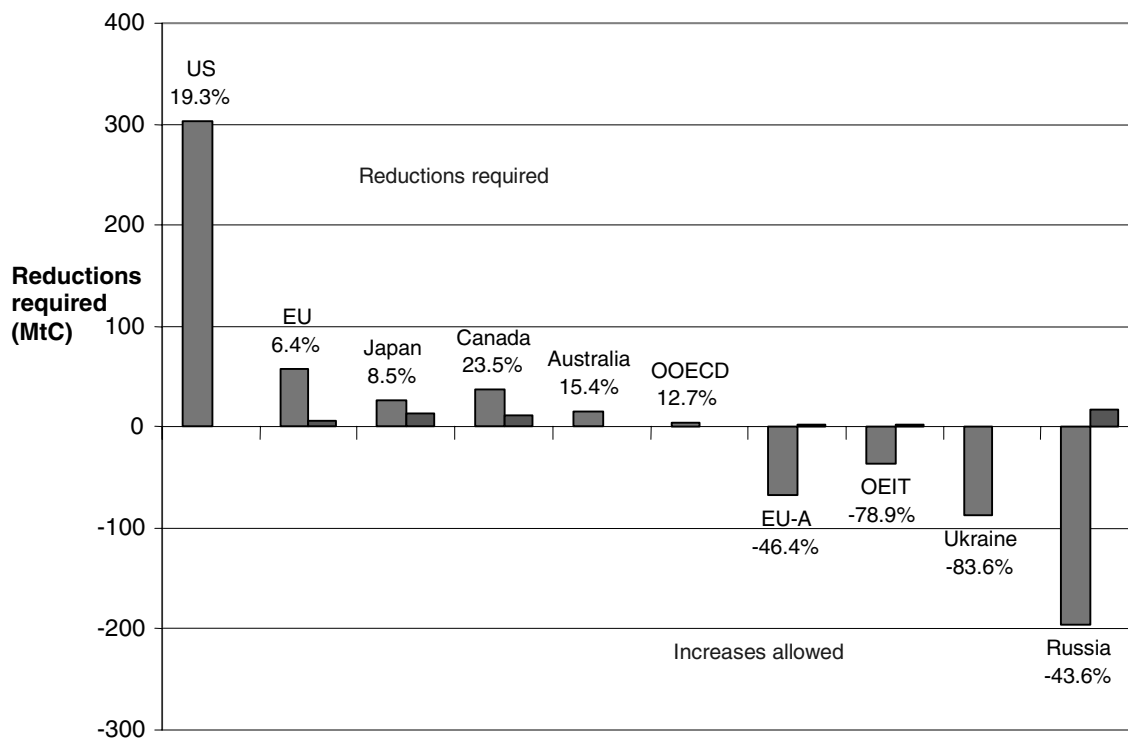
2. SURVEY OF ECONOMIC DETERMINANTS AND MODELING RESULTS

The underpinnings of confusion about carbon prices under the Kyoto Protocol stem from the attempt to model the system in terms of a top-down equilibrium balance of supply and demand. Figure 1 represents the nearest thing to observable data on the potential supply-demand balance, using the most recent emissions for which comprehensive data are available (year 2000 emissions of industrial CO₂)¹. The main

¹ Industrial CO₂ here refers to all CO₂ emissions from industrial activity, ie. energy-related activities. Kyoto commitments are defined in terms of the basket of six greenhouse gases, of which CO₂ accounts for about 80% across

bars show the gap between countries' emissions and their Kyoto allocation. For example, EU emissions had roughly stabilised at 1990 levels and the gap was 70MtC, whilst Canada faced a gap of c. 40MtC, the highest percentage of any due to its rapid growth since 1990.

Figure 1. Gap between present (yr 2000) emissions and Kyoto target, and managed forest allowances (MtC/yr)



Notes:

- The main (single or larger) bars show the gap between 2000 emissions and Kyoto commitments for the principal countries / groups in Annex I. The smaller bars show the maximum allowance that each can claim for carbon absorbed from managed forests under the Marrakech Accords (excluding the US which is not included in that agreement), which can in effect be deducted. % numbers show the percent cut required to get from current levels to the Kyoto targets (-ve numbers indicate the corresponding % growth from current levels for EITs).

- Key: EU-A = the 10 EU candidate countries heading for early accession. OEIT = the 5 other countries applying for EU membership. OECD = all other OECD countries. Data represents CO₂ total national emissions from industrial activity.

Source: 2000 emission data: Energy Information Administration. USA.

In stark contrast to the OECD, the bars on the right hand side of the graph illustrate that emissions in the Economies in Transition had declined since 1990 and are well below their Kyoto allowance. In particular, the EU Accession countries have a potential 'surplus' larger than the shortfall in the present EU countries: their emissions would have to rise 46% from current levels to reach their Kyoto allocation. Russia and

all Annex I, and allows various sink activities to be included. For Fig. 1 every effort has been made to set the base year and recent emissions on the same basis, to preserve comparability, and remaining discrepancies are too small to affect the main points of this analysis.

Ukraine have potential surpluses far larger than any of the individual ‘gaps’ of OECD countries other than the US (respectively, 240MtC and over 100MtC). In total, in fact, the sum of all these data indicate that the aggregate emissions of Annex I countries in 2000 were already below the aggregate Kyoto cap of – 5.2%, but with a huge east-west discrepancy in the distribution.

For two or three years after the Kyoto agreement, the usual economic perspective was that emissions in all these regions would rise substantially in the absence of strong action to limit domestic CO₂ emissions, so that models predicted that a high carbon price would be required if countries were to cut back emissions enough to comply, with the US and Japan facing the biggest gaps and bearing the biggest costs. Three factors have served to completely reverse this perspective:

- emissions of most countries, but especially the Economies in Transition, have failed to grow as many models predicted. The only exceptions were the New World economies (US, Canada, Australia). Emissions in Europe and Japan remain roughly static, as have emissions from most of the EITs (see Table 2 below).
- the Marrakech Accords granted countries a certain allowance of carbon sinks from ‘managed forests’, the smaller bars shown in Figure 1 – essentially a windfall gain, since many forests in industrialised countries are in practice managed in one way or another - and also allowed inclusion of afforestation and reforestation projects in the CDM.
- the Bush administration’s rejection of Kyoto removed by far the largest potential source of demand in the Kyoto system.

The result is to leave a large potential supply set against radically reduced demand. This has a dramatic impact on the results of economic models, as shown in Table 1 – in some cases, pushing the price close to zero (eg. as in the MIT model, one of the few to include non-CO₂ gases and carbon sinks (Babiker et al, 2002)). Buchner et al (2002) reviewed studies and found the impact of US withdrawal alone to result in more than a halving of the permit price in all studies except their own.²

Table 1: International carbon prices from Economic models of the Kyoto system without US: modelling results

Model / study	Includes		Equilibrium Carbon Price under Kyoto, \$/tCO ₂ e		Price impact of US withdrawal (% decline)
	Carbon Sinks (inc managed forests)	Non-CO ₂ gases	With US	Without US	
Hagem and Holtsmark (2001)	N	N	15	5	66%
Kemfert (2001)	Y	N	52	8	84%
Eymans et al. (2001)	N	N	22	10	55%
Den Elzen and Manders (2001)	Y	Y	37	13.6	63%
Bohringer (2001)	Y ?	N		‘Close to zero’	

² Buchner et al model includes both cartelisation of the market, and a feedback between prices and technological change, with lower prices slowing down technical change and leading to higher emissions in the rest of Annex B. It is hard to see how such an impact of induced technical change could really operate so substantially on a timescale of just a few years, though the point, taken more generally, is pertinent.

Furthermore, there are several reasons why even these models may over-predict 'equilibrium' prices. Most do not include the full set of Kyoto flexibilities including non-CO₂ gases and sinks (both managed forests, and others). Many neglect domestic abatement actions already being put in place, such as the European emissions trading system. And most still contain rather simplistic representations of the Economies in Transition, with built-in assumptions that economic recovery leads to emissions growth.

The latter point is important, because it is a source of considerable and genuine uncertainty. However, the most recent data on trends in the EITs – including those that have experienced rapid economic growth since the late 1990s - do not yet support the economy-emissions linkage that is implicit in most economic models (Table 2). Up to 2000 at least, there is no evidence of significant emissions growth in the region: economic recovery has instead been reflected in (and indeed been partly driven by) increased efficiency.

Table 2: Emissions from Economies in Transition: base year and recent trends

EIT Countries		Industrial CO ₂ emissions, MtC			
		Base year*	(1998)	(1999)	(2000)
EU Accession countries	Czech Republic	44.7	29.3	27.0	28.4
	Estonia	10.4	2.3	2.0	1.9
	Hungary (1985-7)*	22.2	16.0	15.8	14.9
	Latvia	6.4	2.1	1.8	1.9
	Lithuania	10.8	4.8	3.4	3.6
	Poland (1988)*	115.7	84.9	81.7	81.4
	Slovakia	16.3	10.4	10.7	10.4
	Slovenia	3.8	4.7	4.2	4.2
	Malta**	-	-	-	-
	Cyprus**	-	-	-	-
Total Accession		230.3	154.5	146.6	146.7
Other EU candidates	Bulgaria (1988)*	28.3	15.3	13.7	15.0
	Croatia	6.4	5.3	5.4	5.7
	Romania (1989)*	53.4	27.2	24.0	24.7
	Turkey**	-	-	-	-
Other Annex I EITs	Ukraine	191.9	100.0	105.0	104.5
	Russia	647.0	395.8	440.0	450.7
<p>Note: Accession countries = the 10 countries officially accepted for EU Accession in 2004. * Base year emissions are 1990 unless otherwise indicated. The data show the emissions of industrial CO₂ emissions in the base year for comparability, not the full GHG emissions. Emissions of the other GHGs collectively have generally declined by at least as much as CO₂ emissions, but full data for recent years are not available. ** Countries not in Kyoto Protocol Annex B, ie. without emission targets, indicated by italics: no emissions data shown as these countries are not relevant to the Kyoto first-period trading system.</p>					
<p>Source: (1) Base year emissions, UNFCCC (EIA for those with base years different to 1990) (2) Other emission years, Energy Information Administration, US DOE, Washington.</p>					

So from a perspective of supply-demand balance, the ‘carbon price’ under Kyoto might be projected to be virtually zero. There are three broad reasons why the reality of the carbon price facing companies is likely to be considerably more complex than this suggests:

- a) **The prioritization of domestic action.** Most countries are concentrating first on domestic action. For example, the EU and its member countries are taking a range of measures in all sectors to limit GHG emissions, and even its emissions trading directive is carefully confined to domestic action: whilst states retain the right to international trade under Kyoto, the Directive is clear that companies cannot themselves engage in international trading under the Directive. Climate mitigation policy in the EU already forms a patchwork of measures implicitly at widely divergent marginal costs, and existing policies in many areas (notably transport, in which existing excise duties already typically equate to over Euros 50/tCO₂) will be insulated from competition with international carbon trading.
- b) **Market power and other constraints on the operation of Kyoto as a fully competitive international market.** The international carbon price could be considerably higher because Kyoto will not operate as a fully competitive market. The project-based mechanisms will be inhibited by transaction costs, and international trading may be affected by the potential for major exporters to withhold supply so as to raise prices; they also have the option for holding any unused allowances over for use in the subsequent period through Kyoto’s banking provisions.
- c) **Buyer sovereignty.** Countries looking to import allowances have a sovereign right to choose from whom they buy and on what basis. For a whole variety of political and strategic reasons, elaborated below, countries are unlikely to seek to acquire allowances at least carbon cost.

These factors all involve considerations of political economy, concerning the likely behaviour of sovereign states engaged in the Kyoto system to which we now turn.

3. THE SELLERS

Russia and Ukraine will have a large surplus of allowances during the Kyoto period. However, executing their interest in Kyoto will be more complex than it appears, for the following reasons:

- The relationship between supply and price means that their revenue will be maximised not by selling as much as possible, but rather by holding back a substantial part of their allowances to raise the price.³
- Russia and Ukrainian energy projections are still very diverse and selling is likely to be cautious to avoid any possibility of having to buy back allowances if emissions growth is high.
- Many individual actors in these countries are more concerned with where the money goes than with the overall flows. Of most direct relevance here, the Ministries of Energy and of Economy

³ Many different models have now been applied to show this. Estimates of the % sales that would maximize revenues are highly scenario dependent, but typically in the range 10-50% of their total surplus.

in Russia are concerned to see that money flows into real investment to improve energy infrastructure.

- Related to this, the reduced volume of money without US participation increases the appeal of using the mechanisms primarily to try and leverage potentially much larger private sector flows.

The relationship between Ukraine and Russia, as the countries with by far the largest potential volumes of surplus to sell, may be particularly important. Clearly, this relationship is already complex not least because of the ongoing struggle over gas supplies and payments. Cartels are notoriously difficult to hold together. In this case, close collaboration between EU Accession countries and other EITs seems implausible because of the former's close ties to the EU and the likelihood that they will be included in an EU-wide emissions trading scheme. However notwithstanding their fractious relationship, the incentives may be big enough for some EITs to collaborate in some mutual restraint of sales.

This also sets the context for the Russian proposal on a 'Green Investment Scheme', whereby revenues from emissions trading would be invested in environmentally-oriented projects, principally aimed at improving the efficiency of the energy sector, an idea explored in considerable depth by a recent international study (Tangen et al., 2002).

The developing countries do not have a ready 'surplus' available to sell, but they can generate emission credits through CDM projects. However, very low carbon prices are simply not big enough to make much difference to the economics of real projects; prices need to be several tens of \$/tC before they are likely to make material difference to investors decisions on whether to proceed with complex, potentially difficult and risky projects in developing countries.

4. THE BUYERS

The European Union

EU reservation about unlimited use of the international mechanisms has a long history. In addition to this, at least three other factors will shape the EU's approach to the international carbon market under Kyoto:

- The politics of EU enlargement.** Economic and political considerations smoothing the path of Accession are likely to take precedence, so the 'price' in intra-Europe trading is unlikely to be allowed to fall to near zero.
- The EU-Russia energy dialogue.** Engagement with Russia and Ukraine will be set in an explicit context seeking political cooperation based largely around energy trade, and in particular east-west gas trade and the EU-Russia energy dialogue. Kyoto units are likely to be seen as a tool to be used in the context of this dialogue and its associated efforts to secure a stable basis for foreign investment in the Russian energy system.
- Political investment in Kyoto.** The EU was at the centre of political efforts to rescue the Kyoto Protocol. This involved convincing both developing countries and the EITs not only that it was the 'right' thing to do, but that they stood to benefit from the system. In addition, the EU has relatively strong ties with many developing countries, partly through ex-colonial links. The result

is that the EU is bound (in both senses of the word) to factor political and strategic considerations in to any international trading under the Protocol.

All this will take expression in a diverse willingness to pay. For example, the EU might be willing to pay 'over the odds' to encourage CDM project in Africa, as compared to countries that are perceived to be less 'in need', or which are already attracting foreign investment. Indeed, the promise of international money flows form the glue behind the political consensus underpinning Kyoto. This implies a political need to do some international trading, but to avoid a price collapse. The EU may be a buyer, but it cannot aim to be a least cost / lowest price buyer.

Japan

Japan has been ideologically even further from regarding Kyoto as a 'free market' than was Europe. Japan needs the flexibility, but at the same time the mechanisms are regarded as an instrument, at the sovereign disposal of 'Japan inc.', not a market 'free for all.' As such, perhaps to an even greater extent than the EU, Japan will exercise buyer sovereignty over whom it wishes to trade with, and on what terms.

Against this background, the deep-rooted difficulties of Japanese relations with Russia – sustained since WWII by the continuing dispute over the Kurile Islands – are highly relevant. When in 1998 MITI announced 20 'AIJ projects' with Russia it was seen as a breakthrough; the subsequent failure of any of these projects to materialise has reinforced Japanese scepticism about Russia being a reliable source of supply, and Japanese plans do not formally include any use of Russian allowances. Japanese NGOs are also likely to demand, with influence, that emissions trading should be tied to environmentally legitimate investments – the only way in which transferring money to an old adversary is likely to be politically acceptable. Any Japan-Russia deals on JI or emissions trading will proceed cautiously, hesitantly, with conditions requiring monitorable environmental investments, and at a small scale as pilot programmes in building trust (Tangen et al, 2002).

Insofar as Japan needs emission units, therefore, it is likely to seek the bulk in the form of CDM credits from developing countries, and it may be willing to pay substantial prices, using this in part as a political instrument for maintaining good relations with its Asian developing country neighbors – a far cry from a global least-cost market.

Canada

Of all the countries in Kyoto, Canada probably has both an interest and an ideology inclined to treat Kyoto as a competitive international carbon market. In percentage terms, Canada probably faces an 'emissions gap' larger than Japan; and it may have far less resistance to large-scale emissions trading with Russia.

Yet even for Canada, it is becoming apparent that reality will differ markedly from the models, for two big reasons. One is that environmental and international NGOs, which have a large influence in Canada (and the wider public), object strongly to the idea of giving Russia money for 'doing nothing', as indeed does the general public. In addition, Canadian industry has mixed interests. Those companies that have opposed Kyoto would nevertheless like to seek ways of benefiting from it, if Canada does go ahead. And the most obvious way they can do so is if foreign expenditure for emission units is directed primarily towards investments that involve Canadian companies – perhaps particularly for Russia, where the similar range of climatic conditions makes Canadian expertise potentially valuable. Albertan companies, which have so fiercely opposed Kyoto, could be the first to line up in favour of linking emissions trading with Russia to real investments in the Russian energy systems – and at as high a price as possible, if they have prospects of being the main contractors.

5. ANALOGIES WITH THE OIL MARKET

How exceptional is the Kyoto 'market'? The above discussion suggests, at first sight, that it will be so far from the economic ideal of a least-cost market as to scarcely justify the term 'market', and that little insight could be gained from expertise with other market operations. Whilst Kyoto undoubtedly has many unique features, the behaviour sketched is not really so exceptional.

Consider the oil markets. Despite a century of evolution, international oil prices are generally maintained well above \$20/bbl, despite the fact that the marginal production cost in Saudi Arabia is probably less than \$5/bbl. Saudi Arabia's main influence is wielded through the OPEC alliance of exporting countries, yet even OPEC overall does not exert anything like monopoly control on supplies, whilst its members themselves have widely divergent interests according to their fiscal and reserve situations.

For Kyoto's first period, it is not hard to see Russia as the Saudi Arabia of carbon permits, and the EITs overall, as OPEC. Nor is it hard to paint analogies with the 1980s oil price collapse, envisioning Russia trying to hold back supplies whilst the carbon price sinks lower and lower until it loses patience and threatens to flood the market. One potential feature of such markets certainly is their price instability, and dependence on political decisions and negotiations amongst suppliers. Similar features would hardly be surprising in the Kyoto first period system.

Yet a view of oil markets that focuses only on supply is also fundamentally misguided, or at least extremely dated. The oil price is maintained so far above its marginal production cost through processes that are to a large degree collaborative between producing and consuming nations and in collaboration with industry. To a large degree these are not formal collaborations, though the producer-consumer dialogue has made progress towards some common understandings – but even that is only possible because of a perceived common interest in maintaining prices that are stable, and at 'reasonable' levels, which is generally understood to mean in the range c. \$20-25/bbl. Importing countries acquiesce (or even actively collaborate) to maintain prices an order of magnitude higher than marginal production costs, for a variety of complex reasons. These include the internal politics of their own oil industries, and long-term strategic calculations that oil is, ultimately, a highly valuable and (on strategic timescales) scarce resource. Higher prices do not only protect domestic investments in frontier non-OPEC production, and keep high-cost domestic oil companies in business; they also underpin efforts to reduce long-term dependence on imports through efficiency and diversification. Again, analogies with the carbon markets are not hard to draw.

Finally, much as the oil markets involve a high degree of government-industry interaction (though now somewhat less than formerly), the Kyoto system is bound to involve the same. Some governments at least wish to protect and support emergent industries that can deliver, and profit from, lower carbon futures.

6. DIFFERENTIATION AMONG THE KYOTO UNITS

The Protocol itself places no significant restrictions on the fungibility of the different units defined under Kyoto;⁴ all can be added to bring a country into compliance.⁵ Despite this effective lack of formal restrictions, the implication of this paper is that there will be considerable price discrimination. Some of this will come directly from the private sector in this nascent market. Especially in this formative stage, the value accorded to emission units by the private sector is strongly affected by both reputational and political risk considerations. Reputational considerations will make companies averse to large scale and potentially controversial projects, such as large scale agroforestry where land rights are disputed. Political risk considerations will include the risks associated with uncertainty about what kind of units home governments will ultimately accept.

With the Marrakech Accords establishing the fundamentals of project eligibility, the major governmental distinctions are likely to depend upon region – and corresponding mechanisms – but with important subdivisions according to project type (see Box 1).

Traded AAUs appear subject to the greatest political risk, and consequently the greatest discounting. Conversely however, AAU trading is likely to be an essential component of the compliance portfolio at least for Japan and Canada, simply because it is probably the only source large enough to ensure their compliance given the real-world constraints on project volumes. Within AAU trading, one can distinguish four possible components:

- ‘Greened’ trading, probably through something like the Russian Green Investment Scheme proposals, are likely to be the most widely favoured and attract the highest premium;
- trading from OECD countries that have exceeded their targets demonstrably due to domestic action may be considered next, and would provide a sense of diversity in the portfolio. The UK is one of few OECD countries likely to surpass its target, and international availability of such AAUs may depend in large measure upon the EU’s wider progress towards compliance including Accession countries;
- AAUs could also be made available from EITs in a controlled manner through non-GIS-type routes: for example, EIT governments could develop some domestic trading schemes with allocation that is seen to have some degree of environmental credibility;

⁴ Namely Annex I carbon sink projects (**RMUs**); CDM projects (**CERs**, from investments in developing countries under Art. 12); JI projects (**ERUs**, from investments in other Annex I countries under Article 6); Trading of Assigned Amount Units (**AAUs**, acquired from another Annex I country through trading under Article 17).

⁵ There are restrictions on the volume of RMUs allowable (1% of initial Assigned Amounts), though Jotso and Forner (2002) make a persuasive case that this cap could not be reached anyway. RMUs cannot be banked for use in subsequent periods, but their allowable and likely volume is sufficiently small that they can readily be used in the first period for compliance and other units banked instead. Similar remarks apply to ERUs and CERs, of which a maximum of 2.5% of initial Assigned Amounts each can be banked.

- Finally, wholesale transfers of AAUs without any such linkage would be legal under the Marrakech Accords, but for all the reasons discussed earlier in this report is likely to be the most heavily discounted.

Box 1 : Differentiation among the Kyoto project mechanisms

Project mechanisms. Credits from project mechanisms may attract a premium over AAUs from trading, principally because they can be seen on all sides to be associated with real project investments – real action and measured environmental gain – as opposed to paper trading. Supplementary reasons include the interests of domestic actors (eg. within Russia) to use project credits to attract and leverage much larger overall investment investment to specific sectors and projects, as well as the sheer political difficulty of developing domestic corporate emission trading systems. However there is likely to be discrimination even within the project mechanisms.

CERs may attract a premium over ERUs for three reasons: they are more likely to be perceived as contributing to developmental needs in poor regions; the crediting can begin immediately (as opposed to being a forward transfer of credits projected from 2008); and they will pass through a more rigorous international procedure for accreditation. Amongst CERs, there may be preference for those generated from small-scale, renewable energy projects under the ‘fast track’ procedures agreed at COP8, because of the general perception that renewable energy promotion is a good end in itself and because the COP8 decision removes much political risk.⁶ Detailed rules for accrediting other CDM project types have yet to be determined by the Executive Board. Discounting may be particularly large for some forestry projects, given both greater potential land-use conflicts, and the longer timescales likely to be involved in resolving rules for these (which are not scheduled to be resolved until COP10, in 2004).

ERUs may be somewhat more homogenous, in part because of the smaller geographic and economic range of the source countries. However, there could clearly be a distinction between the ‘mainstream’ and ‘track two’ JI procedures. The former, for projects in countries that have fulfilled all relevant eligibility criteria, might give greater legal security about the credits, but for many EITs, full eligibility may imply a long delay, and the detailed project supervision is slight compared to CDM projects. ‘Track two’ procedures in principle could come onstream quicker, but uncertainty still exists about the exact form and functioning of the Supervisory Committee.

RMUs are perhaps more difficult to locate in the spectrum. However, the perception (to an important degree correct) that land-use projects are often somewhat more questionable in their quantification of incremental emission savings, and that they provide a temporary palliative rather than promise of strategic solutions, they may be seen as inherently less valuable than CERs and ERUs, especially those derived from energy sector investments (note however, that the perception that energy-sector investments are inherently more valuable than land-use projects is disputed as a general principal).⁷

⁶ FCCC/CP/2002/L.5, Report of the Executive Board of the CDM, Decision CP8, Annex A: ‘Draft simplified modalities and procedures for small-scale clean development mechanism project activities’. Such projects are defined as (i) renewable energy project activities with maximum output capacity equivalent of up to 15 megawatts; (ii) energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 gigawatt hours per year; and (iii) other project activities that both reduce anthropogenic emission by source and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually.

⁷ eg. Chomitz (2002) argues that from a carbon perspective the differences between energy and land-use projects are far less clear and systematic than often supposed, and Pandey (2002) makes a strong case that agroforestry in developing countries could have large ancillary benefits for host countries.

All this of course makes price prediction extremely difficult. However, various approaches, or influences, can be considered.

- Expert prediction of those already engaged in real trading; these confirm strongly the hypothesis of wide price differentiation between projects and mechanisms;
- Sufficiency, ie. prices required to significantly affect investment behaviour; this implies prices around \$/Euros 10-20/tCO₂ to be relevant in project economics;
- Political constraints arising from the desire to protect existing domestic policies on the one hand, but to constrain intergovernmental transfers on the other.

The last of these relates mostly to Canada, because of its likely high demand. Table 3 shows implications for Japan and Canada under combinations of extreme cases. If the need for allowance imports is low, and it is considered acceptable for international carbon allowance expenditure to reach 20% of ODA expenditure, then Japan might accept international carbon prices about \$20/tCO₂e, compatible with the other measures. Canada however, with a much higher proportion of carbon import needs relative to ODA expenditure, may find it hard to tolerate international AAU prices much above \$5/tCO₂ even under relatively favourable conditions. Much more likely is that Canada will seek large volume international transfers of AAUs at prices well below this, and perhaps as low as \$1/tCO₂e. Prices much above this are likely to run into varied political constraints: from the same domestic pressures that have curtailed ODA expenditure to the present levels; from domestic development aid constituencies, arguing that development is a far more pressing need for such large expenditures – and, indeed, from developing countries themselves, on the same grounds.

Table 3: International revenue flow constraints on carbon prices

	Current ODA expenditure (1998 data)		Likely volume of imports, MtCO ₂ e/yr		Price required for allowance trade to equal x% of ODA	
	US \$bn/yr	% GNP	Low	High	20%	5%
Japan	10640	0.28	100	200	21.28	2.66
Canada	1691	0.29	50	100	6.76	0.85

These considerations underline why price differentiation is probably inevitable in the Kyoto system. Prices for project-mechanism credits that are high enough to be effective, in terms of influence on discrete projects, are likely to lead to unacceptably high resource transfers if applied to wholesale AAU transfers. AAU transfers will generally be at much lower prices - but to avoid undermining the basic purpose of Kyoto and of domestic measures already in train, they will be contained in application to those cases where such transfers are deemed necessary and acceptable to enable countries to comply.

Table 4 summarises the specific price predictions derived from these varied perspectives. It suggests a wide range of prices, differentiated according to the nature of the source, project and mechanism. Prices for companies engaging in Kyoto-compliant projects in developing countries and EITs will be in the range £10-25 / tCO₂ for the smaller-scale, widely-approved projects such as renewable energy investments, and £5-15 / tCO₂ for more potentially controversial (and lower cost) projects including land-use, but also for

example for large-scale boiler retrofitting or gas conversion. Prices for allowances themselves (AAUs) may be lower, but they may be seen as having lower value, and little or no co-benefits, except where they are visibly linked to environmental investments at prices that may push towards the level of project credits.

In turn, the prices for large-scale transfers of AAUs between governments may be lower still; but the private sector will not be given access to these. The reason for this, fundamentally, is that although emissions trading under Kyoto has been analysed as one instrument, in reality it will be used to fulfil two quite different functions. One is the traditional role of providing market flexibility and efficiency at the margin of project investments. The other is fundamentally a redistributive function, correcting the excessively lop-sided nature of the original Kyoto allocations. The cost of making such transfers at the 'market' price that would be required to sustain action effective action on climate change is politically tenable. Neither 'east nor west' has the market power to exact such a price, nor could the fledgling Kyoto institutions withstand the political pressures such transfers would generate. So, large-scale intergovernmental transfers, most notably for Canada, will occur at much lower prices – and domestic programmes, and the private sector, will be shielded from the malign influence that such low prices would otherwise exert on international efforts to initiate some real action under Kyoto.

Kyoto may evolve towards greater price consistency over time, but price instability and discrimination between different kinds of emission units may be fundamental features of the early stages especially. For Kyoto's first period, price convergence, stability and greater homogeneity could only realistically be expected if and when the US were to rejoin the system.

Table 4: Probable prices ranges for different Kyoto-related units

Type of Unit	Location / mechanism	Project / source / procedure	Like price range, £ / MtCO ₂
(A) Kyoto compliance units available to private sector	Developing country projects: Certified Emission Reductions (CERS verified through the Clean Development Mechanism procedures)	(i) Renewable energy and energy efficiency projects under CDM fast-track procedures for small scale projects	10 – 25
		(ii) Land use and other CDM projects	5-15
	‘Joint Implementation’ projects in EITs: Emission Reduction Units (ERUs verified under Article 6).	(i) ‘Track 1’ projects from countries with full eligibility (reduced additionality governance)	5-15
		(ii) ‘Track 2’ projects under Supervisory Committee - Small scale, renewables - Larger conversion projects	10-20 5-15
	Assigned Amount Units transferred from EITs (Article 17)	(i) Accession country transfers within context of EU trading system	7-10
		(ii) Transfers from other EITs verified under ‘green investment scheme’ approach or approved domestic trading schemes	5-10
(b) Kyoto compliance units exchanged directly between governments	Assigned Amount Units transferred from EITs (Article 17)	(i) Accession country transfers to EU Cohesion countries within enlargement ‘trading bubble’	3-8
		(ii) EIT transfers to other OECD countries (eg. Canada)	2-8
		(iii) Large-scale possible Russia/Ukrainian transfer in context of hypothetical US re-entry	1-3
c) Compliance against domestic energy/power sector trading systems / levies		EU trading system	5-12
d) compliance or credits for transport sector projects – carbon component		EU -	20-50
		Other -	5-35
Source: Authors estimates			

7. VOLUME FLOWS AND POTENTIAL CARRY-OVER OF KYOTO UNITS

The previous analysis has emphasized that the international flexibility in Kyoto is unlikely to undermine the general impetus to domestic action in Kyoto countries. This differs from economic modeling assumptions where the slack nature of the international market leads to reduction (or complete loss) of incentives to domestic action. The fact that countries importing under Kyoto will still be taking domestic action has implications for the balance of supply and demand.

Table 5 shows two scenarios of the potential volumes of demand and supply, that probably represent limiting high and low cases for the degree of surplus. These are constructed in terms of emission trends from the latest year's data, the year 2000, and taking account of underlying trends (such as high population and economic growth rates in Canada).

Under a 'low surplus' scenario that combines high demand with low supply, gross CO₂ emissions in the EU-15 might be about 120MtC above its Kyoto allocation, and those from Japan and Canada might each be about half that (60MtC/yr) in absolute terms. Assuming that Australia and the US remain outside the Protocol, and after taking account of other greenhouse gases and the managed forest allowance, the total demand from OECD countries might be about 220MtC/yr. Under 'low supply' assumptions, in which emissions from the EITs grow 20-25% from their levels in year 2000, the total supply from EITs might be about 330MtC/yr, to which a minimum level of CDM investment might add the equivalent of about 15MtC/yr. The result is a surplus of 100MtC/yr – or a total over the 5-year period of 500MtC presumably 'banked' into subsequent commitment periods. Under the 'high surplus' scenario, in which emissions from the EU and Japan decline 3% below current (2000) levels and Canada stabilizes at 2000 levels, the potential demand (after taking account of the Marrakech forest allowances) is shrunk to only just over 50MtC/yr. If emissions in the EITs follow their emission trend of the last three years – essentially flat at current levels in which economic growth is matched by equivalent gains in energy efficiency – then total availability of allowances from the EITs is likely to exceed 500MtC/yr. If there is also greater take-up of the CDM, then the potential net surplus could itself exceed 500MtC/yr.

These are limiting scenarios, that combine extremes in opposite directions, particularly concerning the 'low surplus'. Far more likely is something more central; the actual surplus will probably be in the range 200-400MtC/yr, or 1000-2000MtC total unused from the first Kyoto period. For comparison, US CO₂ emissions in 2000 (and in 2001, in which emissions fell slightly) exceeded the US' original Kyoto allowance by about 300MtC/yr.

Table 5: Supply-demand balance in Kyoto system (MtCeq./yr): limit scenarios

	Historical emissions		Low surplus (High demand, low supply)		High surplus (Low demand, high supply)	
	1990	2000	% change	Carbon balance	% change	Carbon balance
Gross Demand				220		53
EU Carbon	911.4	895.5	7%	120	-3%	30
Japan carbon	305.3	313.7	10%	58	-3%	17
Canada carbon	128.6	158.0	15%	61	0%	37
+ Net other GHGs (+5, -5%)				12		-2
- Managed forest allowance				-30		-30
Supply				331		587
Russia carbon	647	450.7	20%	106	0%	196
Ukraine carbon	191.9	104.5	20%	67	0%	87
Accession 10 carbon	245.2	146.6	25%	45	5%	75
Other EITs	87.8	45.4	25%	24	0%	36
Other GHGs (10, 20%)				24		79
+ Managed forest allowance				40		40
CDM (MtC/yr equiv in Kyoto period)				15		50
Net surplus				101		509

8. CONCLUSIONS

The over-arching role of governments in the 'Kyoto market', and the varied interests and mechanisms as sketched, have several implications.

First, in reality, there will be not be one uniform 'price of carbon', but many diverse prices at least in terms of implications for actual project economics. It may be that international trading facilities develop a marker 'carbon price' for Kyoto units, but not all sellers will make their units available at a flat price, nor will all governments will recognize all types of Kyoto units without discrimination. Consequently, some units will trade at a discount, some at a premium, because their value to companies for complying with domestic legislation will vary correspondingly.

This is an observed characteristic of the nascent private sector carbon market at present. Companies are more willing to pay for emission credits from projects that are perceived as very high quality and uncontroversial – projects to which hardly anyone is likely to object, and which seem likely to attract the approval of both governments and NGOs. Emission units from other sources may be traded, but at a discount. The relationship of government interests to corporate investment will become more important, and more complex.

The implication is that the Kyoto Protocol, as elaborated in the Marrakech Accords, will not in itself define 'the standard'. It may do so for CDM project credits (CERs), though even for this, credits from renewable energy projects in the poorer countries may well be given a premium compared, for example, to forestry projects in some others. The COP8 decision on expedited procedures for small-scale CDM projects, indeed, could help to define the first real international carbon market component, and renewable energy credits generated under the CDM fast track procedures could emerge to be the 'marker' commodity in the carbon market. The Marrakech Accords may also set market standards for JI project credits (ERUs), though differentiation is likely between the two tracks for JI.

In contrast, the Marrakech Accords simply cannot in themselves set a definitive standard for the international trading of all the AAUs potentially available, for the simple reason that this would lead the whole Kyoto system to collapse under a sea of meaningless paper transactions.

The surplus will not eclipse domestic action, but offers a strategic level for engaging supplier countries and a backstop of prices. The size of the surplus remains uncertain, and aggregated models with a price-equilibrium are too unrealistic to be useful in this respect. Scenarios sketched suggest that the overall surplus, averaged over the Kyoto period, is most likely to be in the range 200-400MtC/yr.

Given the reality of such numbers, the only circumstances in which a free and competitive market could emerge would be if the US rejoined Kyoto, with its original allocation (and probably in the context of a US-Russia deal on 'hot air' allowances) so as to bring back some semblance of balance between supply and demand - not a prospect that seems likely. Barring this, the Kyoto system will have to deal with carry forward of huge volumes into subsequent periods.

Finally, these observations are not so surprising in a historical context. No global markets have been created in one massive act. Most markets have evolved, starting with domestic trading, and expanding slowly as trading links build up and buyers gain confidence in the quality and 'legitimacy' of imports. Albeit within the context of a global system, the carbon market is likely similarly to evolve.

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