The Kyoto-Marrakech System: a Strategic Assessment
Module 1:

The real-world economics of the Kyoto-Marrakech system and implications for AAU availability

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Executive Summary

Economic models of the Kyoto system generally assume that the international mechanisms will function as a competitive market. Projections of international carbon prices under the Kyoto system, generated by such 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 wish 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 (which would be untenable given the supply-demand imbalance):

- 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.

Importing countries are likely to focus first upon domestic programmes, and shield many of these from direct unfettered competition from international units. Beyond this, different countries are likely to approach international units with differing emphasis, though with some common themes.

The EU may preferentially trade with EU Accession countries, and ensure that imports from other region are demonstrably linked to investments it considers both environmentally and developmentally desirable; JI projects and trades with Russia are likely to be closely linked to the EU-Russia energy dialogue and gas sector developments. Japan is likely to be wary of extensive reliance on Russian supplies and will tend to deal more with east Asian countries. Canada may import significantly from Russia, but will also want to see environmentally legitimate use of revenues, in at least some cases linked to projects that involve Canadian companies.

Combined with this will be concerns of companies that engage with international permit trading, to protect against reputational and political risks.

All these factors mean that there will be wide divergence in prices depending upon the source, nature of the project (if any), and the user. This also implies substantial price discrimination between the various Kyoto mechanisms, and different applications of them. Expert prediction of those already engaged in real trading; these confirm strongly the hypothesis of wide price differentiation between projects and mechanisms;

Renewable energy projects, many of which could qualify under the CDM rules on small-scale projects expected to be agreed at COP8 in Delhi, may form amongst the highest-value credits. This, combined with the fact that this will be the first market to come into effective legal operation under Kyoto, implies that it may perform a role as providing an initial 'marker price' despite the probably small (in volume terms) size of this market overall. To provide an economically significant incentive, prices up to £25/tCO2 might be supported. Some European governments may also seek to protect existing domestic programmes, with implicit carbon prices in the range £10-20/tCO2, from direct competition from lower price international credits. In most cases, other kinds of CDM and Joint Implementation projects, are likely to attract lower prices at least for some time. Removal Units, generated from land-use projects within industrialized countries, will probably attract unit prices below those from CDM and JI if they are traded internationally, though in certain circumstances governments may protect domestic prices to support land-use projects.

Emissions trading is the most complex to analyse. In most cases it may attract the lowest unit price, though ultimately, it may be the only mechanism able to generate the scale of emission transfers required to secure compliance for Japan and Canada. Political constraints on international financial transfers raise the possibility of direct intergovernmental exchanges of AAUs, especially for Canada, at far lower prices than the private market (perhaps below £5/tCO2), shielded from private sector exchanges and linked to reinvestment of the revenues for mutually acceptable purposes.

This is possible because 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 private sector investments. The other is fundamentally a redistributional 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 effective action on climate change may be politically untenable. If this is the case, large-scale intergovernmental transfers could be made, shielded from the malign influence that such low prices would otherwise exert on international efforts to initiate real action under Kyoto.

Kyoto may evolve towards greater price consistency over time, but price instability and discrimination between different kinds of emission credits may be fundamental features of the early stages especially. The international trading market, in other words, will be built form the 'bottom up', step-by-step – like, indeed, the historical evolution of most other markets.

In the present circumstances, a substantial surplus of allowances in the Kyoto system seems inevitable. Table E1 sets out scenarios that span the plausible range, taking account of the conclusion that countries will engage in some domestic action and real project investments with an overlay of AAU transfers. These scenarios indicated that the surplus of supply over demand is likely to be in the range 100-500MtC/yr, i.e. 500-2500 MtC total surplus over the Kyoto period. Dealing with this surplus is likely to be one of the principal challenges facing the future evolution of the system.

Table E1 Supply-demand balance in Kyoto system (MtCeq./yr): two scenarios

	Historical emissions		Low surplus (High demand, low supply)		High surplus (Low demand, high supply)	
	1990	2000	% change 2000-2010	Carbon balance	% change 2000-2010	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**

1. Introduction

From an economic standpoint, the aim of the Kyoto Protocol is to tackle the threat of climate change by establishing an efficient regulatory framework that sets an international 'price' on emissions of CO2 and other greenhouse gases. The core mechanism for achieving this is quantified emission commitments (established for industrialised countries in Kyoto's first period of 2008-12), which are given market-based flexibility through the use of emissions trading and other international economic instruments.

The legacy of the negotiations and the US withdrawal have left a complex situation regarding the 'real economic' of the commitments, by which I refer to the way in which the flexibilities may be used in practice to enable participating countries to meet their legal obligations, factoring in various political considerations; this contrasts with modeling studies, which generally rely assumptions that, as this module discusses, are probably some way from reality.

In the aftermath of initial agreement on the Kyoto Protocol, many economic modeling studies of the commitments, conducted under a programme of the Stanford-based Energy Modeling Forum, suggested that carbon prices could be several hundred dollars per tonne of carbon ($/tC) if trading were impeded, or on the order of $100/tC (= 27.3 $/tCO2, c.£18/tCO2) even with unrestricted trading amongst the industrialised countries (Energy Journal, 1999).[2] Figure 1 shows results from the set of models covered in these studies, for the US and EU, for four cases: no trading (giving the marginal costs of achieving Kyoto targets domestically); full Annex I trading; a 'double bubble' in which there is no trade between the EU and the rest of Annex I but each bloc trades within itself; and full global trading, taken as crude approximation to maximal use of the CDM. Generally, increasing flexibility reduces prices as expected, but there is a huge range of prices across the models.

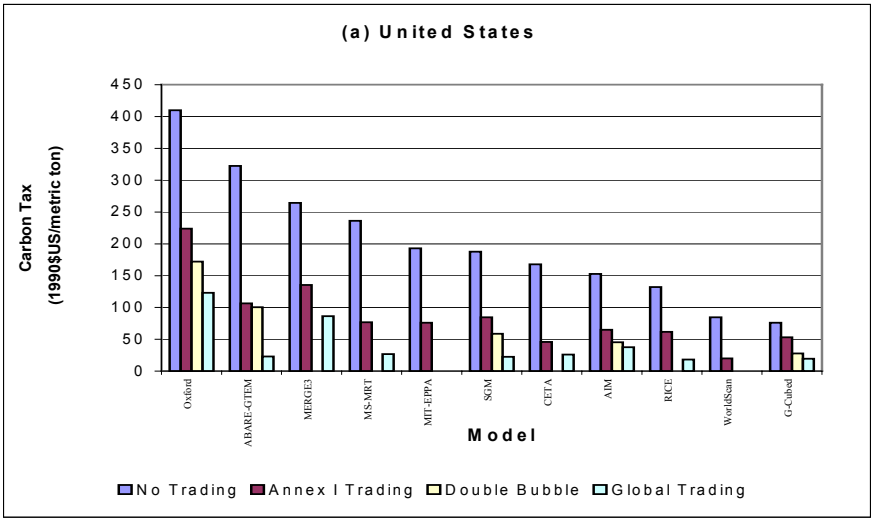
The IPCC Third Assessment figures on the costs of Kyoto drew heavily on this set of studies, whilst noting that the models generally 'do not include carbon sinks, non-CO2 gases, the CDM, negative cost options, ancillary benefits, or targeted revenue recycling'[3] – a rather serious set of limitations, which go some way to explaining the gulf between many of these modeling studies and the claims of some others even at that time that the Kyoto targets might be met at extremely low cost.

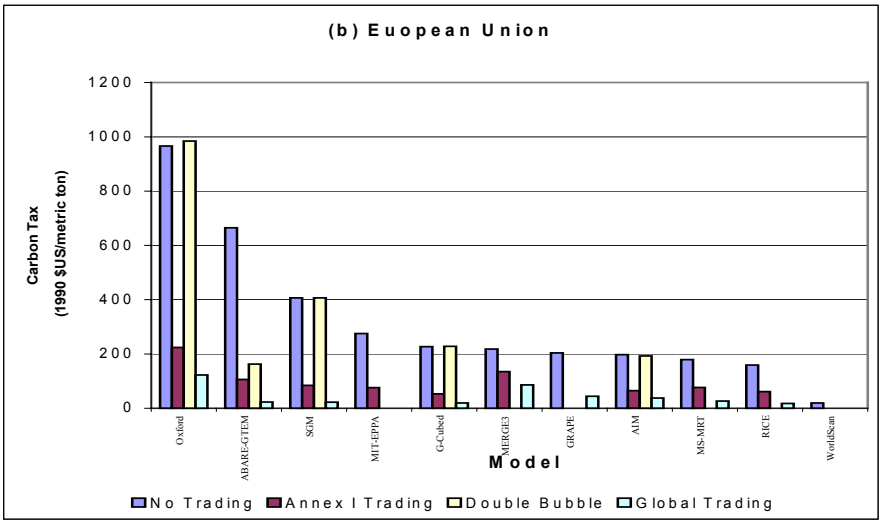
[2] To conform with the emerging standard in the UNFCCC and the private sector, prices in this report are given per unit MtCO2. The conversion factor between tC and tCO2 is 44/12.

[3] Negative cost options, such as efficiency gains that do no involve extra net costs; ancillary benefits, benefits associated with greenhouse gas abatement that are not captured in prices (e.g. reduction in other pollutants or congestion); revenue recycling, the use of carbon tax revenues to offset other distortionary taxes such as corporate or labour taxes.

Figure 1 Impact of international trading on abatement costs (EMF-16 studies)

(a) US, (b) EU.





Notes: 'Double bubble' = trading separately within EU and within rest of Annex B countries. 'Global trading' is modeled as giving developing countries allowances equal to their business-as-usual emissions, but can also be considered as reflecting an economically highly idealized operation of the Protocol's Clean Development Mechanism

The tumultuous events of 2001 transformed the economic situation further due to at least three major factors explored further below: the withdrawal of the US, by far the largest source of potential 'demand' in the system; official revision of Russian energy projections which greatly increased their projected allowance surplus; and the subsequent Bonn/Marrakech deal on carbon sinks. As a result, projections of the price plummeted. Indeed, some modeling studies now suggest a net surplus of supply even in the absence of mitigation action, implying a price collapse to close to zero.

A gulf away from modeling studies, a few nascent and speculative market trades did occur. In stark contrast to the projections of the EMF models, most such trades – discounted heavily by the uncertainty about future developments, and representing the first trades at the margin - were at a price of just a few $/tC.

Innumerable model studies now exist that take a theoretical perspective of the carbon price based upon the balance of supply and demand and marginal abatement costs. In addition, many international companies are becoming familiar with the (very different) features of the actual nascent CO2 trading market and its characteristics in terms of product differentiation and risk discounting. What is missing from both these respective world-views is any appreciation of the political realities that underpin the Kyoto system, and the impact this will have on the operation and prices of the 'international carbon market' once Kyoto comes into effect. The purpose of this report is to develop an understanding of how the international flexibilities might be used in practice, and to explore the implications for both price and volumes.

2. Survey of economic determinants and modeling results

The underpinnings of confusion about carbon prices under the Kyoto Protocol can be represented in terms of one diagram. Figure 2 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)[4] which. The main (green) bars show the gap between countries' emissions and their Kyoto allocation. Thus, US emissions in 2000 were 300 MtC above their Kyoto allowance, and would have to reduce by 19.3% to get down to their original Kyoto allocation (7% below 1990 levels). EU emissions had roughly stabilised at 1990 levels and the gap was only 70MtC, whilst Canada faced a gap of c. 40MtC, the highest percentage of any due to its rapid growth since 1990.

[4] Industrial CO2 here in principle refers to all CO2 emissions from industrial activity, i.e. energy-related activities. In practice, there are minor differences between different sources, eg. with respect to accounting of long-lived petrochemical products, and direct emissions from cement manufacture. Sources are not always clear on the exact definition. In addition, the Kyoto commitments are defined in terms of the basket of six greenhouse gases, of which CO2 accounts for about 80% across all Annex I, and allows various sink activities to be included. Every effort has been made to set the base year on the same basis as the recent emissions, and remaining discrepancies are too small to affect the main points of this analysis out here.

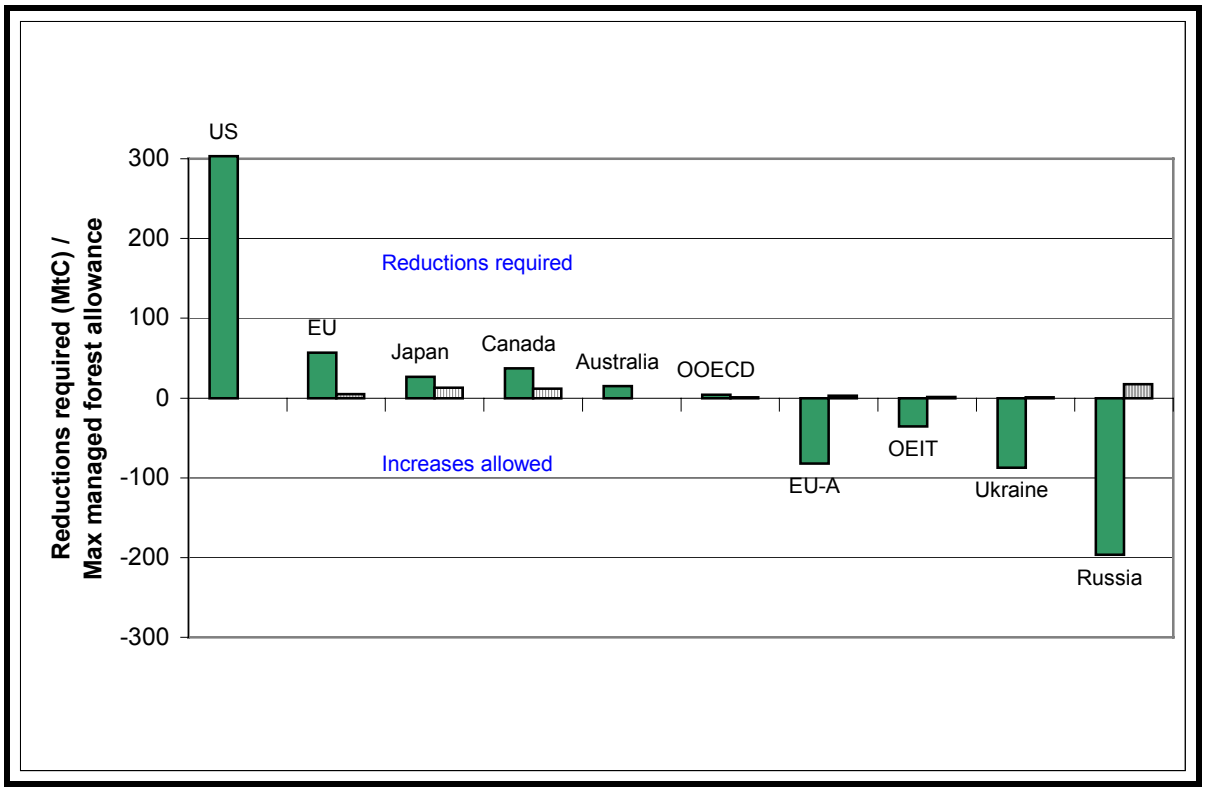


Figure 2 The precursor supply-demand balance in the Kyoto system

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. OOECD = all other OECD countries. Data represents CO2 total national emissions.
Source: 2000 emission data: Energy Information Administration. USA.

In stark contrast, the bars on the right hand side of the graph illustrate that emissions in the Economies in Transition had declined since 1990 and were well below their Kyoto allowance. In particular, the EU Accession countries have a potential 'surplus' larger than 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 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 1998 were

already below the *aggregate* Kyoto cap of –5.2%, but with a huge east-west discrepancy in the distribution. Detailed data for EITs, with recent trends are given in the net section.

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: growth of US and Japanese emissions would continue apace, the EU would 'recover' from the transitional effects of German reunification, the UK dash-for-gas, and its sluggish economy; and the emissions from the EITs would rise sharply as their economies and recovered and began to grow apace. Consequently, economic models at that time mostly 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. Thus was set the context for the battles of The Hague conference (COP6, November 2000), in which the US and other 'Umbrella Group' countries fought for provisions that would reduce the effective carbon price and degree of international transfers.

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, and (even more significant) so did emissions from most of the EITs, where economic recovery was generally reflected in increased efficiency rather than emissions growth (see Table 3 below).
- the Marrakech Accords granted countries a certain allowance of carbon sinks from 'managed forests' as shown in Figure 2 – 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. One of the more modest results found that on its own, 'the withdrawal of the US results in the permit price falling from US$15/tCO2 to only US $5/tCO2' (Hagem and Hotsmark, 2001, p.4). Table 1 summarises the results of various economic modeling studies conducted since the US withdrawal from Kyoto. Without exception, US withdrawal has a big impact in these models, which mostly assume a freely operating international trade in allowances – in some cases, pushing the price close to zero. 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.[5] The conclusions do not only apply to European studies: the MIT group estimated a carbon price at about US $10/tCO2 in the pre-COP6

[5] This is due to the fact that the Buchner et al model includes both cartelisation of the market, and a feedback between prices and technological change. They argue that the low prices in the absence of the US will slow down technical change and lead to higher emissions in the rest of Annex B. In reality, 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.

circumstances, and found this fell to a negligible level under the Marrakech agreement (*sans* US) with free international trade (Babiker et al, 2002).

Table 1. International carbon prices from Economic models of the Kyoto system: impact of US withdrawal

Model / study	Includes		Equilibrium Carbon Price under Kyoto, $/tCO2e		Price impact of US withdrawal (% decline)
	Carbon Sinks (inc managed forests)	Non-CO2 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'	
Note. For reference, see end of the report. The absolute numbers from different studies are not directly comparable as they may refer to different currency base years, as well as embodying different assumptions and base year emissions data used for 'reference' projections. However the impact of different currency and emission base years is small in relation to the impact of US withdrawal.					

The relative influence of the three different factors varies between studies, and indeed the impact of revised emission projections is rarely carried out, presumably because the modelers are not so keen to illustrate just how wrong they were concerning past forecasts. Nevertheless, the withdrawal of the US is clearly an extremely big factor.

The main purpose of this report, however, is to explain why these revised analyses are likely to be almost as misleading as the earlier studies regarding the 'carbon price' facing business. There are three broad types of reason for this:

i) **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 competitions with international carbon trading.

ii) **Market power and other constraints on the operation of Kyoto as a fully competitive international market.** the international carbon price could be considerably higher than the residual supply-demand balance might seem to imply 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.

iii) **Buyer sovereignty.** This reflects the fact that 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.

To understand the importance of these factors and how they may work, the next section explores the recent trends, interests and policies of the major countries engaged in the Kyoto Protocol.

3. Interests of different countries

3.1 The sellers

The biggest potential sellers in the international 'Kyoto market' are the Economies in Transition. Table 2 shows emissions from the individual EITs, including recent trends. It shows that for all the EITs, with the single exception of Slovenia, emissions by 2000 were well below their base year levels, implying potential for a substantial surplus under Kyoto.

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

EIT Countries		Industrial CO2 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

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.*

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.

Accession and Candidate countries

In total, emissions of the ten Accession countries which have been accepted for EU membership in principle from May 2004, were in 2000 more than 80MtC below their collective allowance under Kyoto – larger than the EU shortfall.

The Accession countries are for the most part more advanced in the transition process. It was widely predicted that their emissions would start rising as their economies recovered. As yet, there is little sign of this happening, though there is evidence of a 'bottoming out' by the year 2000. Resumed emissions growth cannot be ruled out, but there remain substantial inefficiencies in these countries and the Accession process (which requires *inter alia* removal of various subsidies, including many of those on coal) may accelerate this.

The Russian fear is that the EU will trade preferentially with its Accession partners, leaving little demand left over for other countries. Certainly, there is likely to be substantially more trade between the EU and its Accession countries. However, it is not certain that all the countries will join; it is possible that they will not meet the formal requirements by the due date, it is also quite possible that not all will pass referenda on joining, given the political pain of some of the policy reforms currently being pushed through in the name of Accession. Furthermore, there is nothing to stop the Accession countries seeking to sell on the international market. On balance, it is likely that the EU will meet most of its emission requirements under Kyoto through domestic action and the Accession process, but not all.

Russia and Ukraine

Russia and Ukraine almost certainly will have a large surplus of allowances during the Kyoto period. However, executing the Russian interest in Kyoto will be more complex than it appears. The supply-demand balance shown in section 2 above is so large that, as

indicated, the international price could fall close to zero if Russia seeks to sell all of its surplus. There are many reasons why this is unlikely:

- The relationship between supply and price means that Russian 'rent' will be maximised not by selling as much as possible, but rather by holding back allowances to raise the price; specific results are discussed in the next section.
- Russian 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 Russia 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 are concerned to see that money flows into real investment to improve Russian 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.

Similar remarks could apply to Ukraine; it has been less engaged in the Kyoto process, but there are signs that this is changing. 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; however, speculation on how this may evolve and interract with trading under Kyoto is beyond the scope of this report.

Non-Annex I sellers: developing countries and the CDM

The developing countries do not have a ready 'surplus' available to sell, but they can generate emission credits through CDM projects. The Bonn-Marrakech Accords established that these could include afforestation and reforestation projects, but limited this to a cap of 1% of total Annex I allowances.

Views on the potential supply of credits from the CDM take one of two fundamental approaches. One consists of 'top down' assessments of potential, based on estimated marginal supply curves of the costs of the limiting GHG emissions in developing countries. Depending in part upon the price projections, the resulting estimates of CDM supply spanned a huge range, up to more than 500MtC/yr (Table 3).

Table 3 'Top-down' estimates of the size of the CDM

Study	Cost ($billion)	Emission credits (cumulative MtC)	Implied Annex I emissions (% of 1990)
Haites[a,e]	1–21	27–572	- 4.7 – + 6.9
MIT[b,e]	2.5–26	273–723	+ 0.5 – + 10.0
Austin[c]	5.2–13	397–503	+ 3.2 – + 5.4
US administration[d]	4.2–7.9	100–188	- 3.1 – - 1.3
ITEA[f]	3.3–3.9	67–141	- 3.8 – - 2.3

Source: M.Grubb, C. Vrolijk, D.Brack, 'The Kyoto Protocol – a Guide and Assessment', RIIA/Earthscan, Chapter 5.

[a] Erik Haites, *Estimate of the Potential Market for Cooperative Mechanisms in 2010*, Toronto, 11 September 1998.
[b] US Administration, *The Kyoto Protocol and the President's Policies to Address Climate Change*, Washington, July 1998.
[c] Duncan Austin et al., *Opportunities for Financing Sustainable Development via the CDM: a Discussion Draft*, 7 November 1998.
[d] A.D. Ellerman, H.D. Jacoby and A. Decaux, 'The Effects on Developing Countries of the Kyoto Protocol and CO_2 Emissions Trading', *MIT Joint Program on the Science and Policy of Global Change Report No. 41*, November 1998, Cambridge, MA.
[e] The low values in these estimate ranges are for scenarios with supplementarity restrictions.
[f] Here the annual costs with domestic action only for Annex B Parties is assumed to be $120 billion, as in the MIT study.

The other approach focuses upon the nature of CDM projects, the various institutional and other obstacles, and the sheer number of projects that would be required. This approach results in far lower estimates of the CDM potential. Assessments of the scope for forestry similarly cast doubt on whether the volume of such projects in reality could ever reach even close to the 1% cap in the time available.

The pricing aspect of the CDM is similarly complex. 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.

There are many other complexities to the CDM. The need for 'counterfactual' baselines leads to the fear that credits will be generated spuriously (the additionality problem): one study suggests that such 'free riding' in the developing country power sector could lead to as much as 250-600MtC of spurious credits over the first Kyoto period (Bernow et al., 2001).

The politics of the CDM amongst developing countries complicate this further. Assessments have indicated that investment flows under the CDM are likely to go disproportionately to just a few major developing countries that already offer a stable context and big market for foreign investment. The distribution of investment flows under the CDM is therefore a politicised issue, and there will be significant efforts to ensure some degree of equity - which must imply differentiated prices in some form, in a way that interacts with the concerns of potential investors and investing countries – to which we now turn.

3.2 The buyers

European Union

With the partial exception of the UK and the Netherlands, EU negotiators have never regarded the aim of Kyoto's mechanisms as being to create a free and fully competitive global market in emission credits. Their dominant concern was that such a market would undermine the pressure for domestic action in industrialised countries, and also would undermine important policy measures already adopted in the EU, for example with

respect to the transport sector. Whereas the US and some other Umbrella Group countries in principle regarded the Kyoto targets as initial allocations in a trading system, the EU regarded the targets as the core, with scope for 'topping up' through the mechanisms if domestic actions proved insufficient; hence the EU's infamous attempt to impose a 'concrete ceiling' on the use of international mechanisms.

Whilst the Marrakech Accords dropped any such reference, major European countries retain a perspective focused upon trying to deliver its Kyoto targets domestically, with the international mechanisms reserved to make up the balance if some countries fall short.

At least three other factors determine the EU's approach to the international market under Kyoto:

i) The politics of EU enlargement. Economic and political considerations smoothing the path of accession are likely to take precedence over all else; and this may well include giving preferential treatment to emissions trading with Accession countries as compared to other Annex I countries.

ii) 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 credits 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.

iii) 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

Western commentators have consistently tended to underestimate the Japanese stake in the Kyoto Protocol, and misunderstand the nature of its concerns and strategy. There is no question that Japan faces a relatively tough target: at Kyoto, it was pushed to a much stronger target than it had been prepared for. Despite this, its official national plan relies

heavily upon domestic emission reductions spearheaded by nuclear expansion (now unachievable), with only 2% set aside for international trading. Yet internationally, Japan has always tended to be dependent upon the US, and it backed the US position in the negotiations. Many observers expected that Japan would take the US rejection of Kyoto as the perfect excuse to get out of a 'tight corner', and Japanese comments on the importance of having the US involved were widely misinterpreted as making Japanese participation conditional on the US.

Instead Japan continued with the negotiations. It struggled to weaken the compliance provisions in the Protocol, but was rebuffed on this. Confounding the sceptics, and over the opposition of much of its own industry, Japan nevertheless ratified in June 2002. Its commitment to the Protocol stems not only from the fact that it is by far the most important international agreement ever signed on Japanese soil. It also became a symbol of the Japanese search for a cooperative international identity – its *Kokusai Koken*, contribution to the modern world – after the catastrophe of World War II and the American dominance of the subsequent half century. Japanese NGOs furthermore gained a huge boost from the Kyoto process and continue to watch progress like a hawk. Japanese pride also rests with its technological capacity for tackling major challenges, such as the oil price shocks – as well as Japanese honour, now that they have commited to Kyoto. The efforts that Japan will make to comply with its Kyoto comittment, consequently, could eclipse anything delivered in the West.

At the same time, Japan has been ideologically even further from regarding Kyoto as a 'free market' than was Europe. They need the flexibiltiy, but at the same time the mechanisms are regarded as an instrument, at the disposal of 'Japan inc', to ensure that it can comply, not a free 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 credits, therefore, it is likely to seek the bulk of credits from developing countries through the CDM, 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

Canadian participation in Kyoto has fundamental implications both for the Kyoto market and the wider regime prospects. The Johanessburg announcement by Prime Minister Cretian that he intends to present Kyoto to the Canadian Parliament for ratification is therefore supremely important: despite the fierce opposition from much (though by no means all) Canadian industry, his Party's dominance is likely to ensure that it passes.

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'. Indeed, the Canadian's relatively internationalist outlook plays against this, making Canada willing to condone foreign transfers if it is linked to good purposes, but more reluctant to condone 'money for nothing'.

Second, 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 credits 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. One of the greatest ironies at present is the increasingly transparent fact that Albertan companies, which have so fiercely opposed Kyoto, will 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.

Non-Parties: the US

At present, Australia is the only country other than the US to have declared opposition to Kyoto. Yet, quite apart from being small in comparison, Australia has also stated that it intends to comply with its Kyoto target, and because of its special allowances, it is indeed in a position to come very close without resort to any international mechanisms. Whatever the future political developments, therefore, Australia is likely to have minimal impact on the 'Kyoto market'.

The role of the US itself is in some ways perhaps the most difficult to judge. The current administration is clearly not going to change its fundamental opposition to the Protocol. Yet despite – or in part, because of – this, there is significant action, both at state level

and by some companies. This includes some target-setting initiatives, and corporate trading.

For the present, trading activity by US corporations mostly reflects a combination of public relations and hedging activity, in the face of considerable uncertainty about future prospects. The lack of any mandatory basis makes it unlikely that any international buying will be large-scale, or at high prices At the same time however, it means that trading from the US is likely to be dominated by companies that are concerned about environmental issues and issues of 'corporate responsibilty'; as such, companies may seek to ensure that trades are at a high standard of integrity. Some may choose to adopt Kyoto rules as the 'standard setter' for project investments; some may seek even 'higher' standards. Given the drivers mentioned, it is hard to see that any US companies would wish to engage in trading from the EIT surplus; their interest will be in projects which are seen to be delivering good outcomes.

4. Modalities for restraining international emissions trading and raising prices

4.1 The government-corporate interface

The above discussion indicates that hardly any of the direct government participants in the Kyoto system wish, in reality, to have a fully competitive international market that would levelise prices and compliance costs to almost zero given the preponderance of 'hot air' in the system. Nor will any of the potentially active US companies seek this. This section explores the mechanisms by which higher prices would be maintained, and the impact this may have.

There are two key points of context. First, although international trades are already occurring in private markets, these are all initiatives taken in expectation of future legislation, or for other reasons; the legal architecture is not in place until Kyoto enters into force and, indeed, a number of other conditions (for example with respect to inventories, reporting and registries) set out in the Marrakech accords are achieved.

Second, Kyoto is an intergovernmental agreement and the only entities that can be bound by it *directly* are governments. Value under Kyoto can only be accorded to private sector trades to the extent that these are endorsed, in one way or another, by governments. 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 for trading, or to accept and use for their compliance assessment.

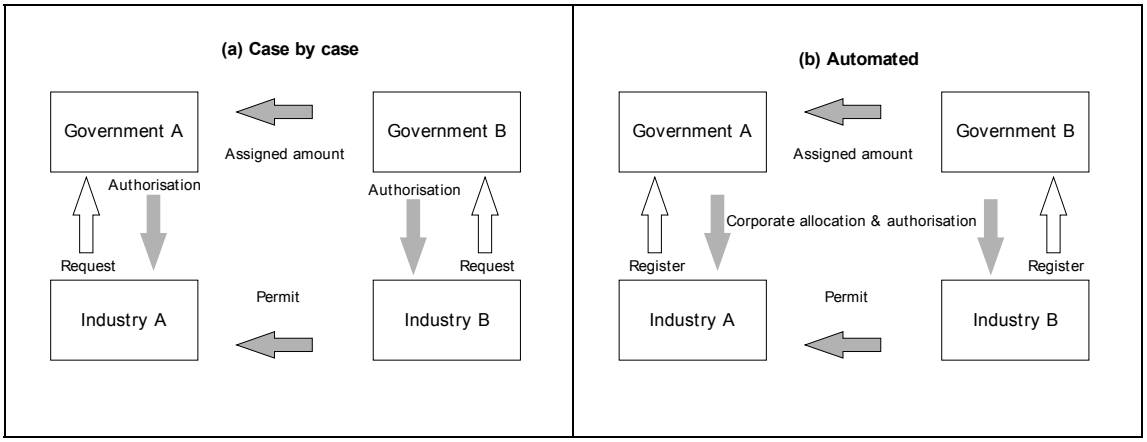
Consequently the driving force behind corporate involvement in emissions trading must be domestic legislation. Though this could take many forms, the simplest to consider is

when governments establish a domestic emissions permit system. The question is then how this might interface with intergovernmental exchanges under Kyoto.

At one extreme, governments might simply transfer title deeds for part of their assigned amount to corporations and authorize them to trade these internationally subject to government tracking of trades. Another approach, similar in its implications, would be to create discrete domestic systems for trading governmentally defined emission permits, but to enable companies to 'cash these in' with governments in exchange for parts of assigned amounts specifically for international exchanges. For various reasons - including those of monitoring, but also the need to 'manage' the market in the present circumstances - this may not be attractive to governments at least for the present.

A third option would be to authorize companies to trade between national systems subject to such trade being reported and approved by the governments concerned; the governments would simultaneously register a directly equivalent trade of assigned amount between the countries concerned, which then assume responsibility for it under the Protocol. As illustrated in Figure 3, this can take one of two forms. The simpler but more bureaucratic approach (a) is to require direct case-by-case authorization of any such trades. Alternatively, (b) two governments could in principle agree to mutual recognition of domestic systems and sign an agreement governing automatic recognition of trades between the two systems. Parallels with financial and other markets are obvious.

Figure 3 Government-industry interface in international emissions trading



Source: Author, as set out in Grubb et al (1999).

The point is that on these models, governments retain direct control over the recognition or acceptance of international trades, which is essential before any private sector trade can assume value under the Kyoto (for which, it ultimately needs to alter a countries allowed emissions). This fundamentally is why governments in principal have the tools to control the Kyoto market as they wish. There are then various ways in which governments could exert this capacity.

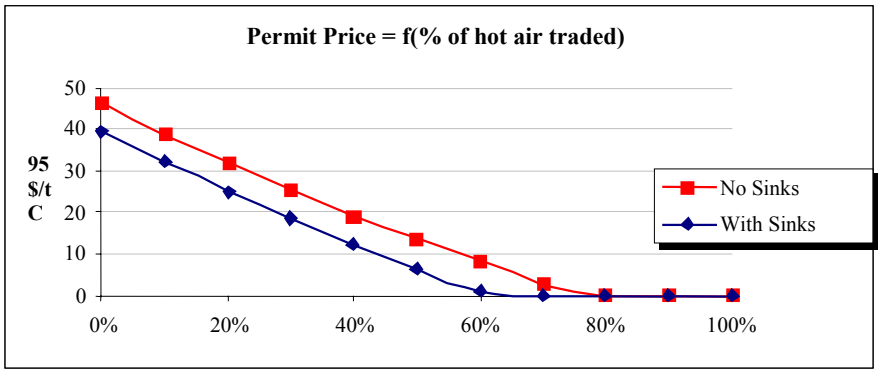
4.2 Seller cartels

The most obvious way is that the seller countries could collaborate to sell only that amount of AAUs that will maximise their revenue during the first commitment period.

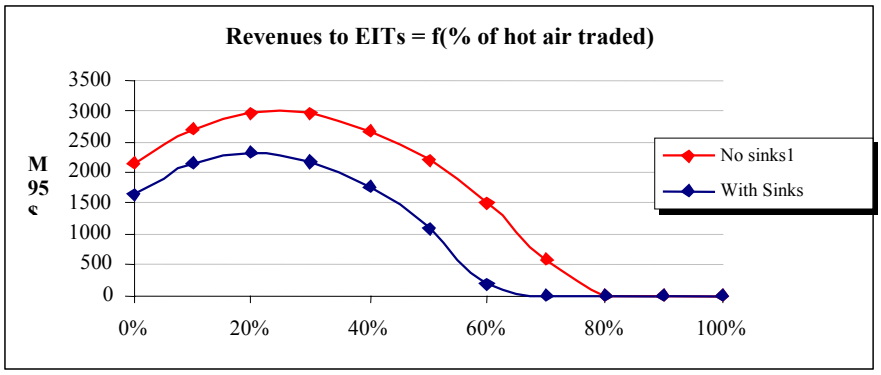
Figure 4 shows one estimate of the impact on permit prices and revenues to the EITs, as a function of the amount of their *surplus* allowances (relative to the 'business-as-usual' emissions in this projection), more colloquially known as 'hot air'. In this study, the revenues to EITs would be maximised by trading only 20% of their overall surplus, at a price in the region of $20-30/tC (c. $5-7/tCO2) which would yield somewhat over US$2bn/yr; if more is traded, the collapse of price outweighs the increasing volumes.

Figure 4 Impact of trading EIT emission surplus ('hot air') on permit price and EIT revenues

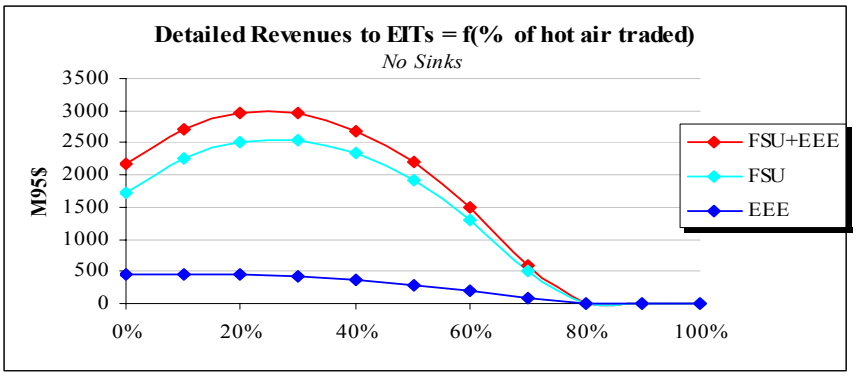
a) Permit price as a function of the traded EIT surplus



b) Revenues of FSU and EEE as a function of the traded EIT surplus



c) Division between Former Soviet Union and other EITs



Price Units: millions of US$/tC, at $1995. To express equivalent prices in current $ per tonne of CO2, divide by about 3.5.
Source: Criqui and Kitous (2001)

Other models give other results, but all concur that revenues would be maximised if the EITs withhold a substantial part of their surplus.

In practice of course, cartels are notoriously difficult to hold together. In this case, effective collaboration between EU Accession countries and other EITs seems particularly 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.

It is apparent from Figures 2 and 4c that what really matters however is whether Russia and Ukraine collaborate or compete. If the Accession countries sell primarily to the EU, then indeed, the CDM apart, Russia and Ukraine may come close to being duopoly suppliers to the rest of Annex I. Notwithstanding their fractious relationship, the incentives may be big enough for them to collaborate in mutual restraint of sales. If there is no collaboration, then Russia would be left in the position of being 'swing supplier', trying to maintain price by withholding sales, but watching its potential revenue disappear to rivals. Analogies with the oil market are touched upon in section 5.

The only other alternative is to develop a mechanism that would have the effect of restraining sales automatically, in a way that was seen to be fair amongst the different EIT suppliers, as discussed at the end of this section.

The developing countries in themselves may have little influence on this situation. Although the total volume of sales through the CDM could in principle be substantial, it is necessarily at higher marginal costs because the credits need to be generated through specific projects and passed through complex verification procedures to ensure additionality (depending in part on the stringency of these rules). And although CDM credits will be far from evenly dispersed amongst the 120+ developing countries, nevertheless no single country is going to dominate that supply. Indeed despite the political collaboration of developing countries in the G77, it is hard to see even the three biggest (China, India, Brazil) collaborating effectively in a bid to raise the price – which anyway would be just as likely to leak revenues to the EITs as it would be to help the poorer developing countries.

Thus the developing countries can only bring market power to bear if it is in collaboration with suppliers, justified by a mutual desire to secure investment in some of the poorer developing countries, and to secure overall G77 backing for the maintenance of the Kyoto regime overall.

4.3 Exercising buyer sovereignty

The mechanisms through which the EU might exercise 'buyer sovereignty' are strongly influenced by the success of the Emissions Trading Scheme (ETS) directive, and will to an important degree be expressed through its successor Directive on project accreditation. This to an important degree raises the political competence to the level of the EU rather than the member states. Once these rules are in place, there will be little scope for

member states individually to exercise buyer sovereignty because the major part of their industries will be able to access international credits on agreed terms.

The emerging struggle in the Projects directive is over how tightly the rules will be drawn, and will to some extent be a struggle between member states that face a shortfall, and EU-level institutions (both Commission and Parliament) looking at the overall international supply-demand balance. What is clear however is that no-one is seeking to floodgates to unlimited imports of AAUs into the ETS.

Member states would retain the right to import AAUs at the national level. For the most part, this option is likely to remain in reserve, as the 'backstop' to ensure both national-level and EU-wide Kyoto compliance. This implies that significant large-scale trades of AAUs may only occur towards the end of the Kyoto commitment period. Earlier AAU trades would almost certainly be restricted to politically-oriented deals to help secure Russian engagement, linked to environmental reinvestment or perhaps gas infrastructure and trade.

In sharp contrast to the EU (when combined with Accession countries), Japan may be looking for substantial imports. As indicated above however, it is no more likely than the EU to want a fully competitive market with all prospective sellers. However Japan is far more likely to consider something approaching a competitive market in CDM credits, allowing Japanese companies to invest in developing countries and claim emission credits that, subject to Kyoto procedures, would be automatically accepted by their governments. Possibly this might extend also to JI projects. Emissions trading itself however is likely to be approached with great caution, as a possible reservoir to fall back upon in case the project mechanisms and domestic action do not yield enough, and then only when implemented with clear and acceptable governance in the seller countries regarding the use of the revenues.

Canada, as noted, is perhaps closest to wanting a free market in emission allowances, but even this is constrained by the factors noted above, notably the dual resistance of the Canadian political system to untied transfers. Perhaps the strongest feature of the Canadian approach may be to negotiate with Russia on procedures relating to the kinds of investment that could qualify for emissions trading. This brings us to an important specific element likely to emerge as a mechanism for price management in the international system.

4.4 The Russian 'Green Investment Scheme'

The idea of the GIS is, broadly, that revenues from emissions trading would be earmarked for environment-related purposes. Several Russian government officials floated the concept and endorsed by the head of the Russian delegation in a statement at the Hague conference (COP6), who said that Russia 'was willing to consider the targeted use of revenues..'. The proposal is suppoted by the Ministry of Energy and the Ministry of Economy, who expect the economy to benefit from such targeted revenue flows, particularly as a natural direction would be towards improving the efficiency of the Russian energy and industrial sectors. The conclusions of a major government-funded

collaborative project engaging Russian, Japanese and Canadian as well as European researchers are set out in Box 1.

'A Russian Green Investment Scheme' (Tangen et al., 2002)

- EXECUTIVE SUMMARY

The concept of a Green Investment Scheme (GIS) refers to ways of using revenues generated from trading Assigned Amount Units (AAUs), under Article 17 of the Kyoto Protocol, for environmentally-related purposes. A GIS may finance a range of activities: from capacity building in respect of developing appropriate statistical collection and reporting methods, to large scale emission reduction projects.

A GIS can include projects which are quantifiable - for which emission reductions can be estimated - or non-quantifiable. Two approaches can be adopted for GIS projects: a program approach where a number of smaller projects are bundled together; and a project approach, where each project is treated individually. A programme approach would give priority to small and simple projects for which emission reductions are easy to monitor and verify such as: energy efficiency, fuel switching, renewable energy and improvement of gas and heat networks. A project approach would favour large (perhaps very large) projects which may be more complex to organise requiring longer time horizons.

The current institutional framework for project investments in Russia has been inadequate even for the Activities Implemented Jointly pilot phase and will need to be changed if GIS projects are to succeed. A single ministry or inter-governmental commission with support from the highest levels of government, should be put in charge of Russian climate policy and implementation of GIS.

All the major potential buyers of AAUs under a GIS will require the funds to be used for credible environmental purposes and subject to high levels of governance. The views of potential buyers differ on the merits of quantifiable versus non-quantifiable projects and the stringency of requirements such as additionality and verification.

Although the European Union (EU) may not have a substantial demand for Russian AAUs, it is likely to play a significant role in the development of a GIS. There are substantial complementarities of interest between climate and energy policy on the one hand, and the compatibility of the GIS with European ambitions for the international climate regime on the other. The EU has a general interest in the architecture of the Kyoto Protocol and will want to be engaged in the development of such an important new policy instrument, particularly one that provides additional interest for Russia to ratify. The EU, and individual member states, are likely to invest only in quantifiable projects with relatively strict verification and additionality requirements.

Japan is likely to be the largest buyer of Russian AAUs. The Japanese approach is that GIS should include all activities – quantifiable and non-quantifiable, with investors free to decide their degree of "greenness". There is a spectrum of opinion which ranges from those requiring strict quantification including additionality requirements, to those who see no need to incorporate such complexities but values good governance and non-quantifiable activities such as capacity building.

Canada may require significant purchases of Russian AAUs. As far as criteria for GIS investments are concerned, the Canadian position falls somewhere between those of the EU and Japan. Potential Canadian investors are prepared to consider non-quantifiable GIS projects, but with strict verification and monitoring.

A GIS has the potential to bring real environmental benefits and meet profound concerns from several of the key actors in the Kyoto regime. However, establishing a well-functioning GIS will require the removal of many of the current barriers that have held back investments. Many of these problems have to be resolved by Russians themselves but foreign involvement backed by concrete assistance programmes can play significant role.

The GIS proposal seems credible because it offers a way of meeting several needs simultaneously. Providing that the approach can be implemented effectively, it would help to maintain prices and attract revenues to productive investments in the Russian energy sector; if similar requirements were extended to trade with Ukraine, it would furthermore meet Russian needs for a mechanism to control sales that would require similar discipline of the other major Annex I seller. For Europe, GIS offers a channel to bring climate into the mainstream of the EU-Russian energy dialogue. For Japan, it offers a more secure investment environment with oversight in the context of a multilateral regime, reducing their difficulties concerning direct engagement with the Russians. For Canada (and the others), it offers a way to make potentially significant transfers to Russia politically acceptable by linking expenditures to environmental investments, potentially also involving Canadian companies.

Of course, the GIS approach is not the only way of 'managing' international emissions trading. Private sector actors in Russia would prefer direct allocation of AAUs to the private sector, so that they could then trade directly with western companies. In practice, however, such AAUs would only be deemed acceptable for compliance by governments of the countries purchasing if they could be assured that the internal allocation did not simply represent a funneling of the 'hot air' – which could also in this context have competitiveness / subsidy connotations. The net conclusion is the same: the transfer of truly 'surplus' allowances from Russia and Ukraine is likely to be severely constrained in practice.

Whilst much detail still needs to be worked out between the relevant players, this does seem likely to emerge as an important feature of the way forward. In effect, the EIT surplus, and the agreements developed to govern the circumstances in which it may trade, will form the control valve on the economics of carbon pricing Kyoto system, maintaining prices within a mutually 'acceptable' range.

5. Analogies with oil and other markets

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 at $20-25/bbl, despite the fact that the marginal production cost in Saudi Arabia is probably less than $5/bbl. Saudi Arabia has not only low production costs, but huge reserves, and as the 'swing producer' has a huge influence on the market. On occasion it has exerted that influence directly, notably in the mid 1980s, threatening price collapse and ruin to some of its competitors. Yet it is far from having monopoly control, and such unilateral action has been rare. Its 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 anologies 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. With the partial exception of the US, most OECD governments accept that the atmospheric capacity to absorb CO2 without dangerous consequences is limited, and will rapidly become more scarce. Hence, they have embarked on domestic programmes to support efficiency and diversification, and they do not want these efforts undermined by a collapse of the international carbon price to near zero. Nor, for that matter, do they want the efforts of 10 years of negotiations to be rendered irrelevant by such an outcome.

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.

Of course, the analogy can be overstretched. Carbon permits are an artificial construct developed with the intent of using market forces to protect our atmosphere. Under Kyoto, allocations for the first period were agreed in the context of politicized negotiations based on inadequate information. The integrity of the product (which will be determined ultimately by compliance & compliance procedures) is contingent upon institutions that are still being developed. Allocations for subsequent periods have yet to

be determined. The Kyoto system is unique, in its very early stages, and still subject to rapid evolution and experimentation. Even so, a brief look at oil markets is sufficient to illustrate the fundamental point that a market in which prices vary widely from the apparent marginal / least cost, in which consumers as well as producers collaborate to maintain this situation, and in which intimate relations between the private and public sector participants are central, is nothing new.

6. Differentiation among the Kyoto units

The Kyoto system itself defines four types of transferrable emission units, resulting from:

- 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).

The Protocol itself places no significant restrictions on the fungibility of these different credits, and all can be added to bring a country into compliance. 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.

Despite this effective lack of formal restrictions, the implication of this study 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 credits 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.

There will be some special cases. The most notable will be those pertaining to the relationship between the EU and its Accession countries. This may imply a premium price within the EU market if demand is large enough within that 'expanded bubble' (but this would not apply for countries outside the EU). Furthermore it is possible that full use of all Accession country credits, combined with the domestic actions already in train in EU countries, would lead to over-compliance; in this case, EU countries may offer premiums for credits from outside so as to meet some of the other needs of the Kyoto system, as indicated.

Box: 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, however, the 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 fulfiled all relevant eligibility criteria, might give greater legal security about the credits, but for many EITs, full eligibity 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]

Traded AAUs. Traded AAUs appear subject to the greatest political risk, and consequently the greatest discounting. Conversely however, AAU trading is likely to be

[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 e3fficiency 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 the from a carbon perspective the differences between energy and land-use projects are far less clear and systematic than often supposed, and Pandy (2002) makes a strong case that agroforestry in developing countries could have large ancillary benefits for host countries.

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 and Germany appear to be the most likely contenders for generating such AAUs, and 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.
- 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.

One potential political constraint in the international context is likely to be that of international financial transfers. Because Europe is likely to have relatively small demand for carbon allowance imports, this is likely to be a more significant issue for Japan and Canada. Table 4 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. Under these conditions, there may not be a pressing need to import AAUs at lower prices than the project mechanisms.

Table 4. International revenue flow constraints on carbon prices

	Current ODA expenditure (1998 data)		Likely volume of imports, MtCO2e/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

This may be the exceptional case, however. Canada, 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.

Whilst Canada is the most obvious case, the same basic mechanism is also possible within Europe, as the Cohesion countries seek to make good their shortfall, most likely through trading with some of the Accession countries.

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.

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 illustrative scenarios of the potential volumes of demand and supply. These are contructed 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.

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

	Historical emissions		Low surplus (High demand, low supply)		High surplus (Low demand, high supply)	
	1990	2000	% change 2000-2010	Carbon balance	% change 2000-2010	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				**111**		**534**

Under a '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 – implying a massive carry-forward (from the full period) of up to 2500MtC.

For comparison, US CO2 emissions in 2000 (and in 2001, in which emissions fell slightly) exceeded their Kyoto allowance by about 300MtC/yr.

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 (such as CO2e.com) develop a '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 in on observed characteristic of the nascent private sector 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 credits or allowances 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 well 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 likely to be in the range 100-500MtC/yr.

Given the reality of such numbers, the only circumstances in which a free and competitive market could be tolerated 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.

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GLOSSARY

AAU	Assigned Amount Units, the basic emission allowance for the industrialised countries as listed in **Annex B** of the Kyoto Protocol. An AAU corresponds to one metric tonne of CO2e which can be emitted any time during the first commitment period (2008-12), or banked for subsequent use.
Accession countries	CEECs expected to become members of the EU.
AIJ	Activities Implemented Jointly, pilot phase of JI and the CDM.
Annex I	Annex to the UN FCCC, listing industrialised country and economy in transition Parties to the UN FCCC that assume specific commitments. Almost synonymous to the countries in Annex B of the Kyoto Protocol, which defines emission allowances of Annex I countries for Kyoto's first commitment period.
Article 6	Article of the Kyoto Protocol defining Joint Implementation.
Article 17	Article of the Kyoto Protocol defining Emissions Trading.
Base year	AAUs are defined relative to GHG emissions in the base year - 1990 for industrialised countries, EITs have some flexibility and some EITs subsequently declared different base years.
Baseline	Projection of emissions that would occur in the absence of an abatement project. Used to calculate emission reductions generated by JI and CDM projects.
CDM	The Clean Development Mechanism, defined by Article 12 of the Kyoto Protocol. Refers to the emission reduction activities implemented in Non-Annex I, mainly developing, countries that create CERs, which can then be used by Annex B countries to fulfill their commitments.
CEEC	Central and Eastern European Countries - former socialistic economies countries in Europe.
CER	Certified Emission Reduction, a unit issued pursuant to Article 12 of the Kyoto Protocol (the CDM).
CIS	Commonwealth of the Independent States: a broad cooperative framework comprising most of the countries which were formerly part of the Soviet Union, excluding the Baltic states.
COP	Conference of Parties of the UN FCCC.
EITs	Economies in Transition, refers to both CEECs and Former Soviet Union countries.

ERU	Emission Reduction Units, a unit issued pursuant to Article 6 of the Kyoto Protocol (Joint Implementation).
EU-bubble	Internal agreement between the EU countries to redistribute the common Union level emission reduction target between member states. Allowed under Article 4 of the Kyoto Protocol.
GIS	Green Investment Scheme, the idea of recycling revenues from emissions trading to further GHG emission reductions or other environmental purposes in EITs.
JI	Joint Implementation, defined by the Article 6 of the Kyoto Protocol. Refers to the emission reduction activities implemented jointly between industrialised countries and EITs.
Marrakech Accords	Detailed rules for implementing the Kyoto Protocol agreed at COP-7 in Marrakech in November 2001.
MtCO2(e)	million tonnes of carbon dioxide (equivalent - basket of greenhouse gases with radiative impact equivalent to one MtCO2)
Non-Annex I	Parties to the UN FCCC not listed in the Annex I of the Kyoto Protocol, mostly developing countries but also several countries of the former Soviet Union.
ODA	Official Development Assistance.
PCF	Prototype Carbon Fund of the World Bank
RAO UES	Russian Joint Stock Company 'United Energy Systems'.
RMU	Removal Unit, defined by the Marrakesh Accords (FCCC/CP/2001/13/Add.2) in Annex of Decision CMP.1. Represents sink credits created by Annex I countries and can only be used during the commitment period in which they have been generated.
Roshydromet	The Russian Federal Service for Hydrometeorology and Environmental Monitoring.
Sink	Ecosystems absorbing CO2, such as young forests.
Track two JI	A procedure for approving JI projects for host countries that do not fulfil the general reporting requirements of the Marrakesh Accords (more complex than is otherwise required). It can also voluntarily be used by proponents of projects in host countries fulfilling the requirements.
UN FCCC	United Nations Framework Convention on Climate Change.
VER	Verified emission reduction – verified emission saving from project, without any particular reference to Kyoto or other legal crediting system