Insights for climate policy in Europe

Frank J. Convery

Environmental Institute, University College, Dublin, Ireland

In this paper, the following key issues are addressed: the so-called "South" – the Group of 77 and China – and how to engage their interest and commitment; the purported savings if the flexible mechanisms are availed of, and the macro-economic impacts of meeting the Kyoto objectives; the associated issues of narrowing the extent and scope for such trading by setting a limit on how much can be traded, and "hot air" – the surplus quota above their own projected needs which Russia and most of the old Soviet Union have to offer; operational issues, including units to be traded, monitoring and enforcement, allocation of permits, competitiveness and risk management; in the case of emissions trading, the initial allocation of permits.

1. Introduction

The focus of this paper is on the key themes that the policy process must deal with if effective climate change policies are to be successfully integrated into development strategies.

The primary audience for this paper is presumed to be those in the policy system who are charged with making Kyoto "work" as it stands at present (2000) in the short run, and to give them some concepts and ideas as to how to improve it over the medium to long term. Many of the arguments presented are based on the implicit assumption that the Kyoto Protocol will be ratified and come into force. If it does not do so, then much of what follows has diminished relevance.

The paper comprises an attempt to distil the lessons which some leading economics researchers have to offer the policy process. The criteria of static efficiency (minimum cost achievement of objectives, or maximising of welfare), dynamic efficiency (engendering of cost reducing and/or performance enhancing innovation), equity, and administrative and political viability or feasibility underlie much of the discussion. Inevitably, a review such as this will be partial and will miss some key challenges and opportunities.

2. The context

The Kyoto Protocol to the Convention on Climate Change – referred to in this paper simply as "Kyoto" or "Kyoto Protocol" – was agreed in Kyoto in December 1997, and comes into effect when not less than 55 parties to the Convention have deposited instruments of ratification, acceptance, approval or accession, subject to conditions. Parties representing at least 55% of CO_2 emissions in 1990 must also ratify, so that without Russia and the US it cannot enter into force. There are two features that distinguish Kyoto from previous international aspirational commitments to good practice and process:

– For 38 industrialised countries – the OECD group and the many of the countries of the former Soviet Union (referred to hereafter as "Annex 1") – emission quotas have been agreed under article 3, to be achieved by 2008–2012, with "demonstrable progress" to be made by 2005. The OECD group agreed to achieve a 5% reduction below 1990 levels, while the former Soviet countries agreed to stabilise at 1990 levels over the same period.

– Secondly, flexible mechanisms are provided for, which allow some of a national target to be met by reduction of activity in another State.

- Under article 6, *joint implementation* is provided for, whereby any party in Annex 1 may acquire from, or transfer to, any other party emission reduction units resulting from projects aimed at reducing human induced emissions.
- Under article 12, provision is made for utilising a *clean development mechanism*, whereby parties not included in Annex 1 can benefit from projects which achieve certified emission reductions, and Annex 1 parties may use these reductions as a contribution to the meeting of their limitation and reduction commitments.
- Under article 17 the parties included in Annex B may participate in *emissions trading* for purposes of fulfilling their commitments, whereby a market in carbon equivalent emissions is created and those above their quota can buy from those who are achieving reductions in excess of their allowance, and, therefore, have a surplus.

But "any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments". The developing countries – the "Group of 77" and China – are not party to any ceilings on emissions.

Under the Kyoto Protocol, quotas have been allocated to the industrial countries, using 1990 as a base. The EU agreed to a quota comprising a reduction of 8% below 1990 levels for the 6 greenhouse gasses – CO_2, CH_4, N_2O, hy-

Table 1
Greenhouse gas quotas, by Member State, for the European Union.

Country	Reduction from 1990 (%)	Emissions 1990 (million tonnes of CO_2 equiv.)	Target or Quota, 2008–2012 (million tonnes of CO_2 equiv.)	Difference (million tonnes of CO_2 equiv.)	Per capita emissions, 1990 (tonnes of CO_2 equiv.)
Austria	−13.0	78	68	−10	9.2
Belgium	−7.0	139	129	−10	13.7
Denmark	−21.0	72	57	−15	13.7
Finland	0	65	65	0	14.2
France	0	546	546	0	11.0
Germany	−21.0	1208	955	−253	14.7
Greece	25.0	99	124	+25	9.9
Ireland	13.0	57	64	+7	16.0
Italy	−6.5	543	507	−36	9.5
Luxembourg	−28.0	14	10	−4	34.7
Netherlands	−6.0	217	204	−13	13.5
Portugal	27.0	69	87	+18	7.0
Spain	15.0	302	348	+46	7.6
Sweden	4.0	66	68	+2	7.9
UK	−12.5	790	691	−99	13.3
EU total	−8.0	4264	3922	−342	13.1

Source: CEC, 1999, Annex 1 [1], European Environment Agency, 1999, p. 86 [2].

drofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). In June 1998, a system of burden-sharing or target sharing was agreed for the EU Member States, to meet this aggregate target, allocated to Member States as detailed in table 1.

3. Key issues

The following are key issues which are addressed below: the so-called "South" – the Group of 77 and China – and how to engage their interest and commitment; the purported savings if the flexible mechanisms are availed of, and the macroeconomic impacts of meeting the Kyoto objectives; the associated issues of narrowing the extent and scope for such trading by setting a limit on how much can be traded, and "hot air" – the surplus quota above their own projected needs which Russia and most of the old Soviet Union have to offer; operational issues, including units to be traded, monitoring and enforcement, allocation of permits, competitiveness and risk management; in the case of emissions trading, the initial allocation of permits.

3.1. Globalisation of the agreement – issues in integrating "the South"

Within 25 years, the developing countries will account for over half of the global warming emissions and their share will continue to increase thereafter. If there is going to be any lasting achievement in regard to climate abatement it is clear that the agreement must extend beyond the Annex 1 countries to embrace the Group of 77 and China. Shogren [3], Former Senior Economist for environmental policy at the Council of Economic Advisers in the US, supports this view, pointing out that if developing countries do not alter their emissions path, global emission levels will continue to increase even if all the developed nations completely eliminate all their emissions: *developing countries sit on the sidelines uncommitted, serious in their refusal to stifle economic growth by controlling their swelling emissions*, their general philosophy being captured by the sentiment: *Rich nations got rich through carbon, poor nations want the same*. The same point is echoed by Manne and Richels [4]: *The Kyoto forever scenario will fail to stabilise global emissions and concentrations.*

How to address this fact was a source of contention in the Kyoto process between the US and the EU. The US pushed for a voluntary system embracing all countries, the so-called "broad, then deep" – "broad" referring to participation by both developed and developing countries, and a gradual emission reduction path to achieve a desired long-term concentration target – as contrasted with the "deep, then broad" strategy of the EU, who maintained that discussions on developing countries should only begin after the developed nations took the lead. The EU position prevailed in part because it was clear that there would be no substantive engagement by most developing countries in the process as regards commitments to action unless the developed world moved unilaterally first.

Shukla [5] argues that, from a Southern (developing) country perspective, the Kyoto Protocol is not a good start; it violates equity criteria, namely ability to pay, historical responsibility, proportionality, and "Rawlsian basic needs" principles. And that, specifically, "grandfathering" – benchmarking to a baseline year (1990), rather than, say, applying a per capita quota – equates with unfairness to the South. But Annex 1 countries would not have agreed anything close to the Rawlsian ideal, and so we are posed with the most fundamental challenge – how to operate and if neces-

sary modify the Protocol so as to simultaneously maintain the commitment of the developed world – and especially the former Soviet Union countries – and induce participation by the non Annex 1 majority. This is a crucial point: EU and US jousting about the extent to which trading will be allowed, refining the mechanisms for monitoring and enforcement, will all avail nothing if the Group of 77 and China do not "sign up".

A number of questions raised by the Group of 77 and China were addressed in a paper on behalf of the EU and Switzerland, during the UK Presidency [6]. These focus on: how to ensure that domestic actions by developed countries are the primary means of greenhouse gas limitation and reduction – it is proposed that a "concrete ceiling" be established on the use of flexible mechanisms; the mechanisms for ensuring transparency and accountability in regard to joint implementation (article 6 projects); how the Clean Development Mechanism (article 12) will operate; how to ensure that emissions trading will lead to real and verifiable reductions; and specifically how to address the "hot air" issue in this context. It is not clear why these are the priority issues for these countries. I can speculate that a lack of trust as to the long term intentions of the developed world, and a parallel concern that Kyoto represents a rich country attempt to take ownership of the global commons, are underlying factors. With regard to the hot air question, the challenge and possible solution are posed by the EU group [6] as follows: *If Parties' assigned amounts are higher than their expected emissions – so-called "hot air" trading may occur. This would lead to higher emissions than would be the case in the absence of a trading system. It is essential that the rules, modalities and guidelines that are developed for emissions trading should prevent this. For example, this could require that net transfers by a party shall not be greater than the amount of emissions reduced by that party as a result of domestic action*. (p. 10). I address this issue later on.

So what are we to conclude about the engagement of the Group of 77 and China? In spite of the fact that, at present, they favour strong domestic action and the implication that trade should somehow be minimised, it is my view that they will not engage seriously in global atmospheric management until they can see that there is real money on the table, that compensates them in part for their historic frugality, and that payment is not dependent on the whim of governments' contributions to a fund. In regard to the latter, according to the European Environment Agency, the example of the ozone policy in this regard is not reassuring; the size of the Multilateral Fund designed to assist developing countries to afford substitutes is too small to meet requirements, and is only funded by a few countries.

The allocation of a generous quota, at or above future emissions projections based on business as usual, in tandem with a global emissions market is likely to engage their interest, as they would control whether and to what extent to trade, and the revenues from such trading would simultaneously improve wellbeing and provide an incentive to conserve use of the atmospheric commons. The Clean Development Mechanism (CDM) – touched on below – will provide some transitional transfers between the year 2000 (when it becomes effective) and the potential expansion of emissions trading to include developing countries.

3.2. Flexible mechanisms and macro-economic impacts

Where markets are effectively mobilised to ration scarcity, the effect – compared to alternative rationing mechanisms – is to improve performance and reduce costs. This capacity to exchange for mutual gain is unique to our species. As Adam Smith remarked: *Man is the only animal that makes bargains; one dog does not change bones with another dog*.

In regard to the costs of complying with Kyoto, there is enormous variability in the cost of compliance estimates – see variability in US estimates below – but all agree that using the flexibility provisions – tradable permits, joint implementation, etc. – will reduce them substantially. Shogren notes that it is estimated that any agreement without the cost flexibility provided by trading will at least double the US costs, where flexibility can be measured as the ability to reduce carbon at the lowest cost, either domestically and internationally, including the so-called "when and where" flexibility; the key is to distribute emissions internationally so as to minimise the costs of climate policy. Manne and Richels agree. Their model indicates that: *losses in 2010 are two and one-half times higher with the constraint on the purchase of carbon emission rights – international co-operation through trade is essential if we are to reduce mitigation costs.*

Note however that all such estimates are based on models in which induced technical progress is not included, and the potential benefits therefrom are not incorporated. At the IIASA workshop on Induced Technological Change and the Environment in June 1999, following on Goulder and Mathai [7], a number of papers – see Kratena and Schleider [8] and Nordhaus [9] – highlighted the fact that implementation of emission reduction targets may provide incentives for induced technological change with positive spillover effects to many sectors of the economy, possibly even transforming the burden to an opportunity, the so-called "Porter" effect.

Bohm [10, p. 25] undertook a simulation of a permit market for the Nordic countries, and concluded as follows: *The estimated aggregate cost for Denmark, Finland, Norway and Sweden to stay on their 1990 carbon emission levels by the year 2000 (a "Rio" target) amounted to USD 713 million in the absence of trade, but was reduced to USD 368 as a result of (hypothetical) trading*.

In the US context, Shogren notes the contrast between the (in favour of Kyoto) President's Council of Economic advisers' estimate – implementation would result in a small drop of GDP of 0.5% ($10 billion) and a rise in petrol prices of 5 cents a gallon – and the US Congress (opposed) estimate prepared by WRI and WEFA – 3% drop in GDP

($250 billion) and gasoline prices to rise by 50 cents a gallon.

The variety of forecasts recalls the observation that: *An economic forecaster is like a cross-eyed javelin thrower; he does not win many accuracy contests, but he keeps the crowd's attention*.

So-called "carbon leakage" can occur whereby, firstly, carbon intensive products become more expensive in signatory countries, and imports increase from non-signatory countries, and secondly, firms using carbon emitting technologies in signatory countries move to non-signatory countries. The Kyoto Protocol does not contain any policies or measures to counteract carbon leakage. Michaelowa and Stronzik [11] point out that *leakage* arose in the US Acid Rain programme. *Since it is designed to be implemented in two phases some energy suppliers used the option of reduced utilisation (of the plant in phase 1) to cut back sulphur emissions of sources already regulated in the first phase. The problem was dealt with by including the sources used for displacement of emissions in the first phase .... Whether leakage will turn out to become a big issue depends crucially on coverage of relevant actors as well as on substitution options of a single company.*

Hoel [12], who has done the definitive work on this subject, makes the general point that actions taken by a particular country (or group of countries) will in general affect equilibrium prices of internationally traded goods. This in turn may affect the production and consumption decisions of other countries, and thus emissions from these countries.

Given the Kyoto agreement, it is only leakage to developing (non Annex B) countries that is of importance. Moreover, it is shown that differentiation of a carbon tax is not justified by a concern for CO_2 emissions in developing countries. It is more cost effective to induce these countries to reduce emissions through appropriate transfers. Ignoring the optimal tariff argument, an approximation of the optimal policy is thus to have a uniform carbon tax and no tariffs. The industrialised countries giving the developing countries transfers should take care of carbon leakage conditional on the developing countries implementing climate policies.

This is an important conclusion, as it provides an efficiency rationale for direct transfers, leaving open issues in implementation which are touched on later on. There may of course also be a political rationale for such action. Concerns about leakage may be misplaced, as there is very little evidence to support the hypothesis that there is much industry flight on the basis of the stringency or cost of environmentally related measures alone (Barker [13]).

These findings are consistent with the direction of change predicted in the econometric literature in the event of a carbon energy tax being imposed, and the proceeds re-cycled; most models indicate that, at least in the short run, it would yield a small aggregate net gain in output and employment, with losses in energy intensive sectors being more than compensated for by gains in less intensive sectors. (See Barker and Köhler [14].)

To the extent that positive technological change is induced by the greenhouse gas constraints, as discussed above, this will mitigate, and may even transcend, any leakage losses. Nevertheless, for those economies, e.g., Australia, with heavily energy dependent sectors such as aluminium smelting, the leakage issue is a real concern, as most of the competing sites for such activity are in non Annex 1 countries, and the profit margins are low; relatively small adjustments in real costs could, over the medium to long term, trigger some migration. If it happened that the industry that migrated was operated in a less energy efficient way in the non Annex country than it was in its original Annex 1 site, then the outcome would be a net increase in emissions.

The evidence to hand indicates that the prospects of seriously damaging leakage from Europe to non-signatory countries in the short run is low. In the long run, if the energy cost asymmetry continues between Annex 1 and non Annex 1 countries, and the latter improve competitiveness in other areas, then leakage may become a more significant factor. However, the technological optimists argue on the basis that innovation, driven by either pricing of quotas or other policy instruments, seems likely to induce technological change, and this will further narrow any potential advantage accruing to non-signatories. To the extent that leakage does become a problem, allocation of generous quotas to developing countries and inclusion in the trading scheme should simultaneously provide an automatic transfer and encourage limitation in the growth of emissions.

As noted above, the Clean Development Mechanism (CDM) provides for emission reducing investment by parties in Annex 1 countries to take place in developing (non Annex 1) countries, with the emission reductions achieved thereby attributed to the former. Action on this instrument is likely to be rapid, for the following reasons: it becomes effective from 1 January 2000, whereas attributable action on Joint Implementation and emissions trading only become effective later on; because Official Development Assistance (ODA) is falling, developing countries are very anxious to have that gap bridged by other funding; utilities and others with "carbon emission problems" in Annex 1 countries will be seeking out opportunities where they can secure substantial reductions in their likely commitments, by off-setting emission reductions achieved via CDM. There are many important issues to be addressed here: what is the counterfactual, or the business as usual (without the project) situation, i.e., how can we be sure that the investment would not have happened anyway?; given that the CDM is project based, even if it does achieve a net reduction in emissions, given that the host country does not have a ceiling on emissions, will there in fact be a net overall reduction? The transaction costs of administering a plethora of projects, both in terms of evaluating the proposals and in monitoring implementation, are likely to be high, especially since both the investor (Annex 1) and the host (non

Annex 1) will have an incentive to exaggerate the extent of the achievement. The Global Environment Facility (GEF) is a relatively small fund administered by the World Bank post Rio to identify and fund projects which meet global environmental objectives, including biodiversity conservation and greenhouse gas emission reductions. There is a wealth of experience there in addressing these issues, and this should be drawn upon in the design and implementation of policy. This instrument has achieved relatively low overt attention in Europe. Because it is literally happening now, and the incentives noted above indicate that there will be considerable pressure for rapid expansion, we need to move it up the list for sustained policy attention.

3.3. Restraints on carbon trade

Article 17 of the Protocol, which allows emissions trading, also calls for it to be only "supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under article 3". Given that a tonne of greenhouse gas reduction has the same effect wherever it is undertaken, it makes sense to use market mechanisms to distribute the costs to where abatement is cheapest. And it, therefore, does not make sense to require a fixed quantum of abatement domestically, whatever the cost. If quantitative constraints on imports of emission reductions are imposed, Bohm points out that this can be expected to *increase marginal costs or shadow prices of emission reductions in the importing countries* and that *forcing countries to produce more of the emission reduction quantity at home than they want to is like forcing cold Nordic countries to grow some minimum share of bananas before they are allowed to import bananas from countries that have a comparative advantage in banana production.*

And there are other potential costs: The negative effects spill over also to the countries likely to export carbon credits. If "imports" or demand from OECD countries are restricted, the equilibrium price they receive for units sold will drop. If sales are restricted, there is likely to be some upward movement in price, but the volume of their sales will fall.

All countries lose, and emission reduction commitments in subsequent periods will be made more expensive and, therefore, less likely to be significant. Since the gains from trade experienced by Russia and the Ukraine will be reduced, it will also reduce the prospects for trade gains from potential entrants from the developing countries in the future.

As Bohm notes: *Supplementarity will not only make present Annex B countries less likely to accept more stringent future commitments, it will also make it harder to get new countries to join the set of Annex B countries. Finally, in the more immediate time frame, the success of the Kyoto Protocol stands and falls with the US ratifying it* (and this will require maximum flexibility).

Bohm makes the point that "hot air" – the allocation to some countries, notably Russia and the Ukraine, which exceeds their likely emissions in 2008–2012 under the business as usual scenario – was a likely prerequisite to secure an agreement: *First, Russia and the Ukraine may not have accepted a reduction of their quotas to equal their most likely Business as Usual (BAU) levels, especially not given the time-pressed conclusion of the Kyoto negotiations. Instead, the risk would seem to have been significant that, confronted by such a quota offer, one or both of these countries would have dropped out of the agreement. And other Annex B countries would realise that their commitments then would have become more costly and, therefore, may have negotiated larger quotas themselves.* And there thus would have been an increased risk of carbon leakage.

3.4. The EU proposals for "concrete ceilings"

The EU is in the process of developing its proposals to implement the restrictions on the flexibility mechanisms. This action is driven in part by concerns that the US might fulfil 80% of its commitments by trading "hot air" with countries such as the Ukraine where the US is politically influential, and, therefore, in a position to negotiate a favourable deal.

The formulae proposed by the EU Council of Ministers to set the "concrete ceiling" on what can be traded are as follows (European Union [15]). Note that these proposals are in a state of evolution, and are likely to be amended over time. Box 1 shows the implications of these rules for Ireland, as they stood in March 1999.

Purchases (acquisitions)

(a) Net acquisitions by an Annex B Party for all three Kyoto mechanisms together must not exceed the higher of the two following alternatives: 5% of its base year emissions multiplied by 5 plus its assigned amount divided by 2, where the "assigned amount" is the total allowed in each of the five years 2008–2012 inclusive.

We can illustrate the practical implications by examining a hypothetical Member State, assigned an increase (13%) above the 1990 baseline.

If we take the base year (1990) as 100, then the annual quota in years 2008–2012 is 113. Net acquisitions allowed can be computed as follows:

$$\begin{aligned} &0.05 \times [(100 \times 5) + (113 \times 5)]/2 \\ &\quad = 0.05 \times [500 + 565]/2 = 0.05 \times 1065/2 \\ &\quad = 0.05 \times 532.5 = 26.625. \end{aligned}$$

Thus, the Member State under this formula would be allowed to trade 26.6% of its base year amount, or 23.6% of the annual allowed quota, over the 5 year commitment period, or 5.32% per annum.

50% of: the difference between its annual actual emissions in any year of the period 1994–2002, multiplied by 5, and its assigned amount.

Suppose that the hypothetical Member State (Base 1990 = 100) had a peak annual emission of 140 in the year 2001. Then it could compute its tradable quota as follows:

$$0.50 \times [(140 \times 5) - (113 \times 5)] = 0.50 \times [700 - 565] = 0.50 \times 135 = 67.5.$$

Under this formula, the Member State would be allowed to trade up to 67.5% of its base allowance, and 59.7% of its annual quota.

Sales (transfers)

(b) Net transfers by an Annex B party for all three Kyoto mechanisms together must not exceed: 5% of its base year emissions multiplied by 5 plus its assigned amount divided by 2: As in the first estimate of maximum allowable purchases, the formula for Ireland would be as follows.

For example, in the case of a Member State which was given an allowance 13% above the base year (1990), if we take the base year as 100, then the allowance per year is 113, net sales can be computed as follows:

$$0.05 \times [(100 \times 5) + (113 \times 5)]/2 = 0.05 \times [500 + 565]/2 = 0.05 \times 1065/2 = 0.05 \times 532.5 = 26.625,$$

or 26.625% of the initial allocation.

There is an incentive to take domestic action, expressed as follows: *However, this ceiling on net transfers can be increased to the extent that an Annex B party achieves emission reductions larger than this ceiling in the commitment period through domestic action undertaken after 1993, if demonstrated by the party in a verifiable manner and subject to the expert review process to be developed under article 8 of the Kyoto Protocol.*

This works as follows: Take the case of a Member State with a 1990 base = 100 that has (say) a "business as usual" projected of 131, which is estimated following agreed and verifiable procedures. If, between 1993 and the commitment period, it undertakes domestic action which reduce emissions by 30, then 3.325 million tonnes, being the difference between 30 and 26.625 (30 – 26.625 = 3.325) is a "bonus" which can be traded.

The Council recalls that the trading of so-called "hot air" should not lead to overall reductions being lower than would otherwise be the case. This issue may be further addressed through rules on trading.

With regard to the "hot air" issue, the Protocol would certainly be a relative failure *if* the relevant comparison for the Protocol were that the negotiations could have ended in no country being given a quota with "hot air", but it is clear that this is not the relevant comparison. And because hot air exists, and will, if not traded, be utilised post 2010 by the countries involved, it seems odd to imply that limitations on such trade are warranted.

If such cogent cases exist supporting maximum flexibility, why has the EU gone to such lengths to ensure that it is limited? A number of reasons suggest themselves:

- The first is moral and aesthetic, the view, that it can not be doing good unless it's hurting.
- The second is a rivalry between the US and the EU, with the latter viewing the former as lacking in commitment, looking to buy its way out of pain. Shogren quotes a spokesman of the EU as follows: *As the leading emitter of greenhouse gasses, the United States needs to take tough domestic measures. . . .[the US] is going to try and buy its way out of its Kyoto commitments and we are determined to prevent that from happening.* Apprehensions on the part of the EU have been fuelled from time to time by assertions that the US could meet up to 80% of its requirements by trading "hot air".
- A third is the view that the "Group of 77 and China" want to see real domestic action, so as to be convinced that the West is serious, and worth joining in this endeavour.
- The fourth is environmental, a conviction that buying hot air instead of "real" reduction through domestic action does not contribute to reduced global warming pressure. This issue has intensified since the Kyoto Protocol was agreed. It is reported in the newspaper *The Guardian*, 9 April 1999 (Brown [15]) that the collapse of the former Soviet block countries has exceeded anything foreseen as recently as a few months ago, such that all the countries in that block have vast quantities of "saved" carbon for sale – emissions in 2010 are projected to be 27% below 1990 emission levels. This contrasts with a 23% growth projected for the industrialised countries, providing great scope for the purchase of "hot air". Ute Collier of the Worldwide Fund for Nature is quoted as saying: *It means the Kyoto agreement is almost useless. Emission reductions that would have occurred anyway are being counted as something to bail out Americans, who are carrying on business as usual. We seem to have lost sight of the issue – how to save the world from global warming.* This argument indicates a lack of understanding of how markets work. If there is a strong market in emission permits, even if the price is low, the outlays of those purchasing these are real costs, and they will induce action in the purchasing States. However, in terms of EU response, this antagonistic view represents a real pressure point on Member States, some of whose governments depend on "Green" support to stay in power.
- The fifth is the induced innovation argument, the view that early movers will capture some advantage in terms of developing technologies which, in addition to giving economic advantage, will provide a capacity to meet more demanding limitations in the future.

Box 1
A worked example – the Irish case.

Base (1990) = 57.12 million tonnes of greenhouse gas emissions (CO_2 equivalents).

Annual quota for 2008–2010 = Base plus 13% = $57.12 \times 1.13 = 64.55$ million tonnes.

Assigned amount is the total allowed emissions over the 5 year 2008–2010 period, or the annual quota multiplied by five = $64.55 \times 5 = 322.75$ million tonnes.

Maximum purchases allowed

There are two formulae for computing net purchases, of which Ireland can choose the higher.

Option 1 5% of: its base year emissions multiplied by 5 plus its assigned amount divided by 2, where the "assigned amount" is the total allowed in each of the five years 2008–2012 inclusive.

Thus Ireland will be allowed to purchase up to 15.21 million tonnes over the 5 year commitment period, or an average of 3.04 million tonnes annually

Option 2 50% of: the difference between its annual actual emissions in any year of the period 1994–2002, multiplied by 5, and its assigned amount.

Suppose that Ireland (Base 1990 = 57.12 million tonnes) had a peak annual emission 40% in excess of this in the year 2001, i.e., an emission level of $57.12 \times 1.40 = 79.97$ million tonnes.

Then its maximum purchase allowance on this basis will be:
$0.50 \times [(79.97 \times 5) - (322.75)] = 0.50 \times [399.85 - 322.75] = 0.50 \times 77.1 = 38.55$ million tonnes over the 5 year period, or an average of 7.71 million tonnes annually.

Sales

(b) Net transfers by an Annex B party for all three Kyoto mechanisms together must not exceed:

5% of its base year emissions multiplied by 5 plus its assigned amount divided by two: As in the first estimate of maximum allowable purchases, the formula for Ireland would be as follows:

This is the same amount as the maximum amount which can be purchased under option 1, i.e.,
$0.05 \times [(57.12 \times 5) + 322.75]/2 = 0.05 \times [285.6 + 322.75]/2 = 0.05 \times 608.35/2 = 0.05 \times 304.175 = 15.21$ million tonnes, or 3.04 million annually.

Incentive for domestic action to expand sales quota
However, this ceiling on net transfers can be increased to the extent that an Annex B party achieves emission reductions larger than this ceiling in the commitment period through domestic action undertaken after 1993, if demonstrated by the party in a verifiable manner and subject to the expert review process to be developed under article 8 of the Kyoto Protocol.

Let us say that Ireland has a "business as usual" projected of 74.8 million tonnes, which is estimated following agreed and verifiable procedures. Between 1993 and the commitment period, it undertakes domestic actions which reduce emissions by 20 million tonnes, then 4.79 million tonnes – or 0.958 million annually – being the difference between 20 and 15.21 ($20 - 15.21 = 4.79$) is a "bonus" which can be traded.

3.5. Conclusions re concrete ceiling proposals

There is very strong political pressure amongst Member States for a concrete ceiling, and the Commission has had to reflect this pressure in its proposals. However, if the concrete ceiling policy as proposed by the EU were to be become Kyoto policy, I believe that there are a number of serious negative implications which in aggregate will perhaps yield a small short term gain, but at the cost of the collapse of the policy after the first commitment period.

– Unless the system can be simplified, it seems likely that there would be virtually no emissions trading. The baroqueness of the limitation mechanisms as they stand means that the trading mechanisms would fail the tests of simplicity and transparency needed to make markets work effectively (Sorrell and Skea [17]).

– There seems to be an incentive for EU Member States to achieve a "high emission year" before the year 2002 so as to maximise their tradable quota (see box 1, option 2).

- Relatively high costs of compliance in the OECD countries in the first commitment period induced by the "concrete ceiling" may result in diminished willingness to intensify reductions thereafter.
- The Newly Industrialising States (former Soviet Union) may become alienated from the process, as they see their potential for significant compensatory transfers from the West eviscerated; they may not sign up for the second commitment period.
- The Group of 77 and China will realise that there is no real prospect of significant transfers to them as part of a global climate change strategy; they will continue to in effect "opt out" post the first commitment period.

However, it is true that at present these countries do not express such fears, and in fact are very much in favour of strong domestic action rather than dependence on emissions trading. Their views are based – I suspect – on fears that Kyoto is the thin edge of a wedge that would see property rights to the global commons appropriated by the rich developed countries, and they would be locked in to quotas much smaller than would be justified on the basis of, say, per capita allocation of a global quota.

- There may be some modest gain in net abatement in the first commitment period relative to the situation which would obtain if a free market in all of the available "hot air" were permitted.
- There will be a gain for the economies that innovate most successfully and quickly in greenhouse gas reducing technologies. To the extent that such a gain is induced by requirements for domestic action, they will compensate in part for restrictions on trade; who and to what extent the 15 Member States will benefit is not certain.

How are we to proceed? We should test my propositions by working backwards by identifying what strategy is absolutely necessary if the Protocol is to succeed in the long term – namely the real engagement of the Group of 77 and China. What is their view of the restrictions on flexibility issue? Will they welcome the development of a vigorous emissions market for greenhouse gasses, with demand maximised so that price is higher than would be the case with restricted demand? In such a scenario, they might be attracted to join the Annex B list, on the basis that a bonus for joining would be an allocation of some "hot air" which can be used to generate income via permit sales. Will the existing hot air holders – the newly industrialising states (NIS), i.e., Russia, the Ukraine et al. – want to benefit substantially in financial terms, and will they resent attempts to in effect retroactively reduce their holdings by limiting demand? With such a view, maximum flexibility becomes the preferred choice. Conversely, if the priority of the NIS, the Group of 77 and China is not a future flow of potential revenue, but evidence that developed countries are suffering relatively high costs to limit emissions, then they will welcome restrictions on trade, which reduces the volume and (probably) the price of permits. This latter view seems to be that prevailing in the EU at present.

3.6. Timing of action – short versus longer term

Manne and Richels [4] argue that: *Rather than requiring sharp near-term reductions, it appears that a more sensible strategy would be to make the transition at the point of capital stock turnover – eliminate the need for premature retirement of an existing plant.* However, it should be noted that over the first target period, up to 2008–2012, at least 90% of the stock of cars will be replaced, 50% of power plants will need an upgrade, and 30% of buildings will need re-furbishment. This provides plenty of scope for incremental capital replacement.

Hope [18] notes that stabilisation of CO_2 concentrations at 550 ppm can be achieved either by starting to cut back emissions immediately, or by delaying cut-backs and then cutting back more, as in the scenario he cites proposed by Wigley, Richels and Edmonds (WRE). In the latter case, costs were estimated to be $6.8–2.7 trillion lower by the MERGE model. And the substantially lower costs of the WRE scenario led (in the US...) to calls for any cut-backs in emissions to be delayed, with the proviso that larger cut-backs could be made later if they were found to be necessary. But Hope makes the point that in neither case was there an incorporation of sulphate aerosols which, if higher under WRE, might partially offset the higher temperatures calculated for the WRE scenario, and, therefore, reduce the difference in impacts between the two scenarios. But the two calculations make *no estimate of the extra health and acid rain damage that the extra sulphates in the WRE scenario would cause up to 2080*.

This work illustrates simultaneously how important and how difficult it is to be inclusive of the key variables in drawing policy conclusions.

In a sense this debate on timing is for the moment beside the point, at least for those countries who have signed the Protocol and intend to implement it, since the time for the attainment of performance is specified.

3.7. Can global trading mechanisms be made to work effectively?

Bohm makes the point that carbon trading involves a homogeneous good with no transport, implying that *transaction costs per unit of trade will be small*; designing a market system should not be impossible. We can draw on the early experience with trading in the US, where there were unexpected implementation problems which relate to market imperfections problems of a thin market with few traders and, as it seems, unfortunate combinations with concurrent command and control policies. But these were effectively addressed. Transactions costs, both those that are directly market based, and those associated with institutional arrangements, are crucial in determining what happens, how, and to what extent. Burgenmeier [19] notes: *If bounded rationality shapes economic behaviour, transactions costs are an integrated part of the cost–benefit analysis. Explicitly taking transactions costs of each instrument into account, stakeholders are bound to the institutions which are necessary to implement the instrument.*

The transactions cost approach in the broader sense is not restricted to the market, but also takes account of the transactions that occur in public and private bureaucracies, and there is an important research agenda ahead, which has to carefully examine the institutional design of each instrument in the light of associated transactions costs. It seems clear that the concrete ceilings mechanisms proposed by the EU and discussed above, will increase the transactions

costs and uncertainties of trading, to the extent perhaps of stymieing the development of such markets entirely.

The units traded could be units of emissions reductions or units of national emissions quotas that can be used once during a five year commitment period, or banked for a subsequent period, using an *international emissions exchange* which never closes.

The *seller will be involved with a neutral international exchange – once the question of sanctions has been settled, this holds the seller responsible for its sales of emission reductions.*

Monitoring of national emission levels will be crucial for a reliable and well functioning tradable quota (TQ) system, and – at least for fossil fuel carbon – be relatively easy to measure performance.

Fuel use equals production plus imports minus exports (*plus* inventory changes) (costs of carbon removal are still prohibitively high).

Bohm points out that*: It is in the interest of every fossil-fuel exporting country to avoid underestimates of its export volume, and of every importing country to avoid overestimates of its import volume*. These twin incentives will encourage accurate reporting of transactions.

In the Kyoto protocol, only Annex B countries (Max of 36) that have ratified the Protocol can engage in emissions trading, so that special measures may be required for imports from non-signatory countries, to institute measures such as sample unannounced inspections of fossil-fuel transport.

The monitoring problem is not specific to the issue of emissions trading – it applies to all policy instruments.

Trading rules can be designed and defined to be effective and ensure competitive markets. As a minimum condition for acceptable bilateral transactions, it would seem to be necessary to make all transactions subject to a *transparency requirement* where the prices are made commonly known to all traders – no "side payments" implementing multilateral transactions systems, as on an exchange market, would make it possible to keep traders anonymous to one another – anonymity makes market transactions more efficient.

As regards market power – a *quota exchange* would help make market power inoperative.

Unless risk management strategies are part of the policy framework, the potential which joint implementation has is likely to remain largely unrealised. Janssen [20] makes the point that, in the case of joint implementation, difficulties of expected returns, and the probability of their realisation (risks) – requires the availability of instruments for the management of JI risks. These instruments include: integrate existing insurance institutions (e.g., Multilateral Investment Guarantee Agency), diversification – portfolio of uncorrelated projects – wide range of project types and host countries, carbon offset mutual funds.

3.8. Permit allocation

There is a case made in the literature for auctioning permits rather than "grandfathering" – giving them away free to existing polluters. Bohm puts the case as follows: Auctioning the whole volume of permits provides government revenue that allows a reduction of pre-existing distortionary taxes, a so-called double dividend. . . . the auction price reflects this environmental concern and emerges as a corrective rather than distortionary levy.

Grandfathering allows benefiting firms to (a) remain in business, when, in the absence of the free endowment of assets represented by grandfathering, a firm would have gone out of business (b) have more funds for risky investments, and (c) have cheaper access to bank loans and capital markets. . . giving away permits for free to existing firms can be expected to slow down productivity growth. Thus, the fear that countries using "grandfathering" (free quota allocations) will have a competitive edge is unlikely to be valid, at least in the medium term. And any advantage will be further undermined by revenue recycling, and neutrality towards new firms which imply that auctioning of permits provides some important efficiency benefits.

And if fuel producers and importers were "grandfathered" we would we need to tax them and subsidise the end users and this would impost transaction costs and be complex and inefficient.

Bohm notes that the US might be politically "forced" to use an approach ("grandfathering") which harms new firms, hence, productivity growth, and misses a chance to reform its tax system through revenue recycling. The recycling issue is also germane to the issue of equity. Energy taxes tend to be regressive in effect, unless the additional burden on the relatively poor is mitigated by recycling. But see the Resource for the Future Proposal ([21] and box 2).

And it is presumably this amongst other reasons which led the Resources for the Future Group to propose the auctioning of tradable permits in the US, with a $25 per tonne of carbon ceiling, and the revenues refunded to households (see box 2). Note however that Shogren is not optimistic about the prospects of such a system in the US: *But the political reality is that the odds of a tax or permit system that raises revenues to be recycled is as likely as seeing a Democratic Senator from Wyoming*.

3.9. Conclusions re trading mechanisms

The answer to the question: "Can global markets be made to work effectively?" is "yes, if certain conditions are met". Because greenhouse gasses are homogeneous, incur no transport costs, and the incentives facing importers and exporters of fuel encourage accurate reporting, there is a basis for concluding that an effective market can be created. But effective monitoring has to be in place (this is common to all control policies) as have effective sanc-

Box 2
A proposal for credible early action in US climate policy. (By Raymond Kopp, Richard Morgenstern, William Pizer, and Michael Toman, Resources for the Future.)

Features

- In place by 2002.
- Provide incentives for cost minimisation, and innovation.
- Administered "upstream" to obtain the broadest possible coverage – electric utilities, in the transportation sector, or elsewhere. focus on domestic energy producers (and importers) in order to obtain this broad coverage at the lowest possible administration and monitoring cost.
- Require energy producers to obtain permits equivalent to the volume of carbon dioxide eventually released by the fuels they sell, at the permit price specified below. Virtually all domestic emissions are covered by roughly two thousand collection points.
- Broaden as quickly as possible to include other greenhouse gases, sinks, and international joint implementation projects.
- To the extent practicable, these regulations should permit trading among all gases, sinks and joint implementation projects, and should be consistent with internationally accepted definitions.
- Proceed gradually while we undertake further research into climate change consequences, while the capital stock (both human and physical) adjusts to new incentives, and while other countries remain undecided about their own courses of action.
    - Deal with uncertainty by capping the price of permits in order to prevent the program from becoming too expensive. With a price ceiling – or safety valve – the government provides unlimited additional, above-target permits at a specified price.
    - An initial ceiling price of $25/ton carbon in 2002 which rises by 7% each year (above inflation) through 2007. In 2002, this ceiling price is equivalent to a six cent rise in gasoline prices.
    - Current analyses suggest that these prices would yield annual emissions of roughly 1,460 million tons of carbon (MtC) through 2007. We propose an initial distribution of permits equal to this estimated volume.
    - Although permits will be freely tradable, it is proposed that ordinary permits expire after two years and permits sold at the ceiling price expire after one year.

  Since future climate change goals are uncertain, we need to preserve the option of lowering emission targets in the future if it becomes warranted. To avoid this risk limits are placed on permit banking.
- permits to be auctioned and the revenues generated through permit sales to be returned to households via a tax refund.
    - quarterly permit auctions with 75% of all proceeds in the first year funding a direct payment to all US households based on legal residency.

Equity provision. In order to address special hardships, the remaining 25% would be given to states based on energy use by low income households and the vulnerability of industry (both owners and employees) to increased energy costs.

tions, so as to punish sellers who do not reduce their emissions in proportion to their permit sales; there needs to be a transparency rule, where prices are made known to all traders. Implementing multilateral transactions systems, as on an exchange market, would make it possible to keep traders anonymous to one another – anonymity makes market transactions more efficient. Unless market dominance is created thereby, how permits are allocated should not affect the effectiveness of the market *per se*. However, there is an efficiency loss if the permits are grandfathered rather than auctioned with recycling of revenues. This needs to be set against the fact that it may be politically infeasible to introduce trading in the absence of allocated free to the initial beneficiary.

There are transactions costs involved in setting up a trading system, as contrasted with, for example, imposing carbon energy taxes, where the infrastructure is already in place to collect VAT, excise duties etc., and the marginal costs of adding another responsibility are relatively small. The transaction costs of establishing and implementing an emissions trading scheme will be further added to if the concrete ceilings proposed by the EU require further monitoring and enforcement mechanisms.

3.9.1. Sectoral emissions trading?

There may be a case for "customising" tradable permits to address problems that are judged in need of serious incentivisation if they are to be effectively addressed, e.g., the transport sector. Albrecht [21] focuses on transport (see table 2) – the most dynamic growth sector in most countries – and comments that: *Current designs and proposals for tradable CO_2 emission systems do not provide incentives to stimulate cross-sectoral energy efficiency investments. Manufacturers should be "rewarded" for their products that make it possible for consumers to save energy during consumption.*

Table 2
Emissions of CO_2 in the transport sector under conventional and high performance (incentivised) conditions.

	Emission category	
	Per car	Per truck
	Conventional	
Emissions during production	1–2 tonnes CO_2	3–5 tonnes CO_2
Emissions during lifetime	37.5 tonnes (150,000 km)	1500 tonnes CO_2 (1.25 million km)
Rel. importance of consumption phase	$37.5/1.5 = 25$	$1500/4 = 375$
	High performance	
Emissions during lifetime	22.5 tonnes	1050
Savings	$37.5 - 22.5 = 15$	$1500 - 1050 = 450$

For each tonne of CO_2 emissions reduction below a baseline, the manufacturer is allocated a certificate. The value of these earned certificates is linked to price developments on the permit markets. Prices will depend on abatement costs for carbon producing industries. (Average abatement costs per tonne of CO_2 in the \$30–150 range are assumed.)

Focusing on a particular sector could impose substantial losses on the economy if the reductions achieved were much higher cost than could be achieved elsewhere in the economy. If for sake of argument, the costs of achieving mitigation in the transport sector turned out to be \$100 per tonne of CO_2, while reductions could be achieved in agriculture for \$10 per tonne, then in this case, overall wellbeing would be enhanced by reallocating effort from transport to agriculture. If however there were other anticipated gains from a sectoral focus, e.g., an innovation which would give European car manufacturers an advantage in global markets, then such a focus may be justified.

4. Overall conclusions

Implementing Kyoto represents a great challenge and opportunity for the global community. It lacks the unambiguous benefits, the clear "technical fix" and the incentives to conform which characterise the Montreal Protocol vis-à-vis stratospheric ozone depletion. But it's what we have got, and we must try to get it to work. The key challenge in this regard is to engage the interest and commitment of the developing countries. If this does not succeed, then there is little point in implementing Kyoto. Approved greenhouse gas gains from implementing the Clean Development Mechanism (CDM) are attributable from 1 January 2000, while joint implementation and emission trading only become effective in this sense in 2008. This asymmetry means that CDM will immediately be an active policy option, and this immediacy needs to be recognised. But the transactions costs involved in approving and monitoring CDMs will be such that they are unlikely on their own make a major contribution to reducing the climate change impact of developing countries. To get sustained and large scale action, will require that there is serious and continuing money on the table, and, from the point of view of the developed world, there is verifiable progress in stabilising the growth of emissions. Trading has to be a key part of that, but how is as yet unclear.

If implemented, the restraints on trade proposed by the European Commission may prove too baroque to make emissions trading market operational. If trading does take place with such constraints, then – because of the limit on trading in hot air – the net environmental results over the first commitment period may be better that would be the case without such constraints. However, if the constrained market results in costs which the OECD countries regard as onerous (relative to the free trade option), if Russia, the Ukraine, etc., are alienated as a result of (from their point of view) a re-writing of Kyoto to achieve a *de facto* reduction in their allocation, and if the Group of 77 and China do not see a substantive opportunity for automatic transfers based on trading emerging, it may prove to be a Pyhrric victory, as negotiations on a second commitment period founder.

In regard to leakage, the effects of implementing Kyoto are unlikely to be significant in the short run, but over time, if the energy price asymmetry were to continue, then very energy intensive sectors may see some movement out of Annex 1.

In regard to operational matters, there are a range of principles which should underlie any permit trading system if it is to work effectively, and to be sustainable across frontiers. If these are acted upon, there is reason to expect that global trading can succeed.

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