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The Kyoto Guys'
Thoughts on Designing an International Greenhouse Gas Trading System:
A Non-Paper on the Non-Papers

OUTLINE
(July 31, 1998)

Purpose: Identify the major issues in the design of an international tradable permit (ITP) system, synthesize what is known about those issues, provide conclusions where feasible, and identify further questions and research needs.

1. Introduction

1.1. Context – While we think there are many things wrong with the Kyoto Protocol (KP) (levels of reductions, focus on the short term, focus on emissions, etc.), we take the KP as our starting point. The goal is to identify issues (and conclusions where feasible) for the ITP system to be addressed for Buenos Aires (and beyond).

1.2. General description of alternative international policy instruments

TABLE 1: International Policy Mechanisms

1.3. Scope – examine those domestic issues which are directly relevant to the design of an international system; we do not want to specifically talk about other issues in the KP (JI, the time-path of reductions, etc.) except as they relate to the design of the ITP system.

TABLE 2: International Tradable Permit Proposals

1.4. Criteria – primarily cost-effectiveness, discuss motivation for this focus (believe climate change is a serious issue and that cost-effective policies will be more politically acceptable and environmentally effective).

1.5. Modus Operandi – For each section, discuss normative/first-best issues first, then political economy evaluation.

2. Permit Definition

2.1 Establishing Property Rights - Cap and Trade vs. Offset Systems

2.2 What is the tradable unit? (*Are emissions and sinks included? What gases?*)

2.2.1 What gases should be included? How should they be converted?

2.2.2 How to deal with Sinks?

2.2.3 Discounting sinks and some gases?

- 2.2.4. Permit Length (perpetuity, time-limited)? Concern about market decisions, market power, and flexibility of the system.
- 2.3 How should credits for early action be handled?
 - 2.3.1. How would domestic early action systems interact?
 - 2.3.2 What international early action systems should be developed?

3. Who Trades?

- 3.1. What nations should trade?
 - 3.1.1. What domestic institutions should be required for participation?
 - 3.1.2. Efficiency gains from trading regimes?
TABLE 3: Efficiency Gains from Broadening Trading Regime
 - 3.1.3. What is the appropriate role of non-Annex I nations?
Theoretical arguments for their involvement (Schmalensee, Stavins),
against (Hahn, Goulder)
 - 3.1.4 Leakage
TABLE 4: Estimates of Leakage
- 3.2. How are countries (developed and developing) added to the system?
 - 3.2.1 Reasons developing countries not eager to join
 - 3.2.2. Designs that provide incentives for non-Annex I to join.
- 3.3. What entities would be engaged in trade? (Country-to-country; firm-to-country, etc.)

4. How should permits be allocated initially?

- 4.1. For how many periods (as defined in 2.1.1) should permits be allocated?
- 4.2. What is the baseline?
- 4.3. How should national allocations be determined?
 - 4.3.1. Theoretical arguments: doesn't matter, but it does with transaction costs, market power, or non cost-minimizing actors.
 - 4.3.2. But they are determined by UNFCCC process.

- 4.3.3. If regime is expanding, new entrant allocation mechanism is important (see 3.2)
- 4.3.4. How much of a Party's allocation can be traded? (Hot-air debate; see 5.4.3.)

5. Market Design

- 5.1. Stylized criteria for efficient functioning of the market
- 5.2. What is the interaction between the system and various subsystems?
 - 5.2.1. Can domestic policy instruments (taxes, etc.) be incorporated into the ITP system?
 - 5.2.2. How are multiple markets handled? (i.e. the EU bubble)
 - 5.2.3. How should CDM exchanges be considered?
 - 5.2.4. How should JI credits be handled (between Ann. I)?
- 5.3. Intertemporal Trading
 - 5.3.1. Banking
 - 5.3.2. Borrowing
- 5.4. What are the rules for trading among Annex I countries?
 - 5.4.1. How is a trade executed?
 - 5.4.2. How, when, and who certifies credits and trades? (Different levels)
 - 5.4.3. Limits to Trade? ("Hot-Air" debate -- How much of a nation's commitment can be met through trading? See also 4.3.4)
- 5.5. Provision of adequate information
 - 5.5.1. What price information is needed for efficient markets?
 - 5.5.2. What is the role of international organizations, national governments, private brokers?
- 5.6. Monitoring
 - 5.6.1. How, when, and who monitors the system for compliance?
 - 5.6.2. Reporting Requirements
 - 5.6.3. Reporting in other Int. Agreements

TABLE 5: Approaches to Monitoring

5.7. Enforcement

5.7.1. Who is liable for the allowances traded? (Buyer vs. seller; countries, other dimensions?)

5.7.2. What are appropriate enforcement mechanisms (for international compliance)?

5.7.2.1 Levels of fines/sanctions?

5.7.2.2 Look at other international agreements [David Victor, Scott Barrett]

5.7.3. What are the limits of enforcement?

TABLE 6: Approaches to Enforcement

6. Conclusions/Synthesis

6.1. Future Research

6.1.1. What should the rules (similar to Nordhaus' voting mechanism) be for changing the system?

6.2. Lessons Learned:

6.2.1 Dealing with JI/CDM

6.2.2 Credibility

6.2.3. Time-path of Emissions

8. Appendix -- Relevant Sections of Kyoto Protocol Text

The Kyoto Guys'
Thoughts on Designing an International Greenhouse Gas Trading System:
A Non-Paper on the Non-Papers

Outline Report

Purpose: Identify the major issues in the design of an international tradable permit (ITP) system, synthesize what is known about those issues, provide conclusions where feasible, and identify further questions and research needs.

1. Intro

General rationale for looking at tradeable permits: P.188 "Economic-incentive policies in general, and emissions trading in particular, are well suited for the management of uniformly-mixed air pollution problems, such as acid rain and global climate change, because these policy mechanisms allow for *aggregate* pollution reductions at minimum cost to society at large. With essentially uniformly-mixed air pollutants,¹ ultimate concern is on aggregate pollution levels, as opposed to specific emissions from individual sources. It does not matter, for example, whether a reduction in carbon dioxide emission takes place in Thailand or the United States.

... An international tradeable-permit system would essentially implement a regulatory program that sets overall limits on emissions of carbon dioxide (CO₂) or limits on combustion of fossil fuel or deforestation. Nations would be assigned a baseline that would establish the initial emissions levels from which reductions would be assessed.² Each country would have to meet its minimum standard, but could do so either by controlling emissions or by purchasing reduction credits from nations that exceeded their own standard.

After establishing responsibility among nations (as in the Montreal Protocol in the case of CFCs), the permits could be transferred among nations, thus ensuring that emission reduction goals are cost-effectively distributed among participating nations.³ Individual countries could thus achieve their respective control obligations through any means chosen. For example, the United States and other nations might choose to meet their control targets through some combination of carbon charges, domestic tradeable permits, or other incentive-based and conventional regulatory policies. In this way, an international CO₂ or greenhouse gas trading program could accommodate a variety of separate national implementation strategies. Such an international, government-to-government trading system raises a number of legitimate concerns, which we discuss later. Among these are monitoring and enforcement problems and the likelihood that nations would not necessarily make cost-minimizing permit-trading decisions."

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

Theoretical Reasons for TP : * In theory, TP systems (Dales 68, Montgomery '72) will minimize aggregate costs of achieving a given environmental objective (Baumol and Oates, 1988), and provide dynamic incentives for adoption and diffusion of cheaper and better pollution control technologies (Milliman and Prince, 1989).

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

1.1 Context

While we think there are many things wrong with the Kyoto Protocol (KP) (levels of reductions, focus on the short term, focus on emissions, etc.), we take the KP as our starting point. The goal is to identify issues (and conclusions where feasible) for the ITP system to be addressed for Buenos Aires (and beyond).

HS: House analogy - someone has asked us to build this house, we are going to try to do it in the best way

possible. Some will argue this is the wrong foundation for the house and that we ought to start over...

Two sets of concerns with an ITP system: * There are a lot of concerns raised about ITP systems. They could be difficult to initiate, monitor and manage - concerns about free riding, leakage, baselines, and allocation of permits. But these relate to any emissions control policy, not strictly to ITP systems. And trading may actually ease these challenges. [BH - but trading can also make things worse under certain circumstances]

* A second set of concerns does relate specifically to ITP systems - concerns about market power, transaction costs, and the behaviour of national governments.

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

Trading is allowed under Kyoto: Art. 17 * "The Conference of the Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading. " * Should be "supplemental to domestic action", other parameters to be determined.

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

1.2 General Description of Alternative Int. Policy Instruments

Fisher, B, S. Barrett, M. Kuroda, J. Mubazi, A. Shah, and R. Stavins. (1996) An Economic Assessment of Policy Instruments for Combatting Climate Change.

404 * "Regulatory Instruments – It is conceivable that uniform standards could be established among countries. However, it will be difficult to achieve wide agreement about any large set of specific instruments. For example, individual countries may adopt standards for housing insulation, but it is most unlikely that the same standards would be applicable in both temperate and tropical countries. [or even nationally in a country with both temperate and tropical zones] Moreover, such an approach would limit the domestic policy choices of individual countries and, hence, their flexibility in adjusting their emissions under an international greenhouse gas reduction agreement. Another regulatory approach involves agreements by countries fixed national emission levels (nontradable emission quotas), in the tradition of the EU's Large Combustion Plants Directive, which specifies reductions in emissions of sulphur dioxide and oxides of nitrogen from plants with a thermal rating of 50 MW or larger. Such an approach would mean that marginal abatement costs among participating nations would tend to be different and, hence, total abatement costs, globally speaking, would be unnecessarily high.

* "International Taxes and harmonized domestic Taxes"

* Tradable quotas

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Two distinct categories of policy instruments need to be considered to address global climate change. First, there are fundamentally domestic policy instruments, intended to enable individual nations to achieve their specific targets or goals. Second, there are international (bilateral, multilateral, or global) instruments that can be employed jointly by groups of nations.

...it should be acknowledged at the outset that although there is abundant precedent for national environmental policy actions, there is much less experience with successful environmental initiatives at the international level. The "exceptions that may prove the rule" include the successful agreements for stratospheric ozone and the somewhat less successful international whaling agreements. In the case of global climate change, the challenges are significantly greater than either of those experiences might suggest.

It is most reasonable to anticipate that stringent climate change policies will be adopted by individual nations only to the degree that those nations perceive that positive net benefits — including international transfers — will be forthcoming (Carraro and Siniscalco 1993; Heal 1994). The general point has been made in the starkest terms by Nordhaus and Yang: “It is single nations, not the United Nations, that determine energy and environmental policy, so any grand design to slow global warming must be translated into national measures” (1996, p. 742). On the other hand, there is little doubt that successful policies to address this truly global environmental problem will require the adoption of international agreements. Hence, it is necessary to consider both domestic and international policy instruments.

Challenges for International Policy Instruments: Climate change is truly a global commons problem. The location of emissions of greenhouse gases has no effect on the global distribution of damages, and so free-riding problems plague unilateral or multilateral “solutions.” Further, nations will not benefit proportionately from greenhouse-gas abatement policies. In fact, some countries — such as Canada and Russia — might experience no benefits from control, since they actually stand to gain from global climate change (due to the effects of increased temperatures and precipitation on agricultural production). Thus, for some countries, costs of control may exceed benefits. This means that to be successful an international (voluntary) agreement needs to include a mechanism for transferring gains to countries that would otherwise not benefit from joining an agreement. This is a central challenge for any international policy instrument that is to allocate responsibility among nations.

Uniform Standards: It is at least conceivable that standards could be employed that are uniform among countries participating in an international emissions reduction agreement. It would be difficult, however, to achieve wide agreement about any large set of specific instruments, because such approaches would place severe limits on individual countries’ domestic policy choices. An alternative regulatory approach would involve countries agreeing on fixed national emission levels. But marginal abatement costs would then vary greatly among participating countries, and so total global abatement costs would be much greater than necessary.

Market Based Instruments Instead, some degree of aggregate cost effectiveness could be achieved if market-based instruments were employed internationally. Four possibilities stand out. First, if countries agreed to apply the same level of domestic greenhouse taxes (*harmonized domestic taxes*), marginal abatement costs would tend to be equalized among countries. Second, a *uniform international tax* on greenhouse emissions could be employed, with the total tax revenue being allocated among participating countries according to some set of rules.

International Tradeable Permits: A third potentially cost-effective approach would be a system of *international tradeable permits*, in particular, a system of tradeable carbon rights, the total allocation of which would reflect the overall emissions target. International permit trade would establish a market price — an implicit international tax rate — which would equate marginal abatement costs among countries, leading — in theory — to a cost-effective solution. Within the context of such an international tradeable permit scheme, participating countries could then use whatever domestic policy instruments they chose to achieve their permit-determined targets. They might employ domestic tradeable permits, domestic taxes, or conventional regulations.¹

¹As I discuss later, with a domestic tax there is uncertainty regarding the quantity of emissions reductions that will be induced. Given this caveat, any of a variety of price or quantity instruments can be used domestically if a tradeable

JI: A fourth market-based instrument, closely related to the concept of international tradeable permits, is *joint implementation*, essentially bilateral trading arranged on an ad hoc basis. This policy mechanism, which we also consider below, has received considerable attention from policy makers and others in the past few years.

4 * **Mandatory common policies and measures**, supported because they would alleviate competitiveness concerns and generate economies of scale for technologies, were rejected at KP. "Weight of national circumstances won out over need for harmonization."

* KP does still have a list of "priority policy areas", but on voluntary basis.

Baron, Richard and Lee Solsbery. (1998) *The Kyoto Protocol and Its Implications for Energy*.

References:

EU Coordinated Taxes: Barrett is sending citation for Commission of European Communities (CEC)

Schelling, Thomas. (1997) *Costs and Benefits of Greenhouse Gas Reduction*.

Agreed upon actions that can be monitored. OECD. China and India must be included soon.
Uses abatement actions, not abatement targets.

Cooper, Richard N.. (1998) *Toward a Real Global Warming Treaty*.

***There are generally two approaches to international treaties** - those that set agreed-upon national objectives but leave each party to achieve them as they see fit; and those that define mutually agreed-upon actions. Believes success will only come through latter approach.

* Proposes a common tax, tax would be levied by nations, and would be a uniform additional tax above those taxes nations already apply to energy

Nordhaus, William D.. (1997) *Climate Allowances Protocol (CAP): Comparison of Alternative Global Tradable Emissions Regimes*. [**Tradable Quotas**]

Environmental Defense Fund. (1998) *Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward*. [**Tradable Quotas**]

Peck, Stephen C. and Thomas Tiesberg. (1997) *A Property Rights Approach to Climate Change*

Tradable permit proposal wherein we agree on an ultimate concentration at some point in the future. Permits are allocated for emissions at any point up to that point. To reflect natural removal of CO₂, a permit would allow more emissions the closer to the terminal year. After this, permits would be allocated each year equal to the volume absorbed by the atmosphere.

Schmalensee, Richard (1996) *Greenhouse Policy Architectures and Institutions*.

+ **Broad, then deep approach, hybrid permit-ceiling policy.**

McKibbin and Wilcoxon. (1997) "A Better Way to Slow Global Climate Change"

+ **Hybrid permit w/ceiling policy.**

permit system is used to allocate targets internationally.

HS: Table one is in the conventional framework of using instruments to achieve a target. There is an alternative view (Cooper, 1998; Schelling, 1997; Hahn, 1997?) that says that such a framework is inappropriate in the Climate Change context and we should instead be focusing on actions that can be monitored that will help build the institutions necessary to deal with problem without necessarily specifically focusing on the targets yet.

[Q: Alternatively, the second approach can be seen as a system of internationally agreed on differentiated policies or measures.]

TABLE 1. International Policy Instruments

1.3. Scope

Examine those domestic issues which are directly relevant to the design of an international system; we do not want to specifically talk about other issues in the KP (JI, the time-path of reductions, etc.) except as they relate to the design of the ITP system.

[BH: We should make it clear that we are not necessarily talking about trading between private parties in different countries. May want to call this tradable Quotas instead of permits to signal this.]

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Caveats -- "With any of these international instruments, it is imperative to keep an important caveat in mind: there is no world government — or other institution — that appears to be immediately capable of administering, monitoring, and enforcing truly international instruments (Schmalensee 1996). We return to that critical issue later."

Commission of the European Communities. (1998) Communication from the Commission to the Council and the European Parliament: Climate Change - towards a post Kyoto Strategy.

23 **Caveat cont.** * There is no international experience with international trading instruments. If too much is done

too soon, the system may prove unworkable. An alternative would be to start with a subset of parties and gases, and expanding the system as we gain experience.

TABLE 2: International Tradable Permit Proposals

Pahauri, R.K.. (1998) The Clean Development Mechanism: Some Developing Country Perspectives.

18 **Brazilian Tradable Permit Proposal** Clean Development Fund proposal (proposed 6 months prior to Kyoto) included an ITP system:

* commitments would be defined in terms of "temperature increase ceilings" for each party

* Nations exceeding their ceiling would need to buy an equivalent temperature credit from another party.

1.4 Criteria

HS: Primary criteria is cost-effectiveness, discuss motivation for this focus (believe climate change is a serious issue and that cost-effective policies will be more politically acceptable and environmentally effective).

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

295 ...the first candidate criterion for instrument assessment should probably be relative *efficiency*, that is, the degree to which instruments are capable of maximizing net benefits.² But the efficiency criterion can be problematic, because it requires not only knowledge of the costs of abatement, but also knowledge of the benefits of abatement. And the latter requires both an understanding of the physical consequences of climate change and the economic valuation of those consequences. This information burden is overwhelming in many circumstances, as it surely is at present in the global climate context; and so frequently the less ambitious criterion of *cost effectiveness* has been used, that is, seeking a policy instrument that achieves a given target or goal (which may or may not represent the efficient level of control) at minimum aggregate cost of abatement.³

Other Criterion:

Fisher, B, S. Barrett, M. Kuroda, J. Mubazi, A. Shah, and R. Stavins. (1996) An Economic Assessment of Policy Instruments for Combatting Climate Change.

407 “Focus on cost-effectiveness should not be taken to mean that this single criterion is of exclusive or paramount importance. On the contrary, individual nations will inevitably choose their own criteria to distinguish between competing policy instruments. The specific criteria chosen will always be a function of the individual socio-economic and cultural context, but in many cases the following set of criteria will be among those considered:

- * probability that the environmental goal will be achieved
- * efficiency or cost-effectiveness
- * dynamic incentives for innovation and the diffusion of improved technologies
- * flexibility and adaptability to exogenous changes in technology, resource use, and consumer tastes
- * distributional equity
- * feasibility in terms of political implementation and administration.”

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P.178 “To assess whether trading of greenhouse gas reduction permits is likely to result in real advantages over alternative approaches, we consider the following criteria:⁴

- o Will the policy achieve stated environmental goals?
- o Will the policy approach be cost-effective? That is, will it achieve environmental goals at least cost to society at large?

²The “efficient” level of abatement is that level where the difference between (social) benefits and (social) costs is maximized. If the benefit and cost functions are shaped as they are typically believed to be, then this efficient level occurs at the (single) point where marginal benefits equal marginal costs (Baumol and Oates 1988).

³The “cost-effective” allocation of the pollution-control burden among sources is that allocation for which all sources are controlling at the same marginal abatement cost (Baumol and Oates 1988).

- o Will the strategy provide government agencies and private decision makers with information needed to implement the policy?
- o Will monitoring and enforcement costs be reasonable?
- o Will the policy be flexible in the face of changes in tastes, technology, resource use, and information?
- o Will the policy give private industry incentives to develop new environment-saving technologies, or will it encourage firms to retain existing inefficient plants?
- o Will the effects of the policy be equitably distributed?
- o Will the purpose and nature of the policy be broadly understandable to the general public?
- o Will the policy be feasible? That is, can it be enacted, and can it be implemented by appropriate international agencies?"

1.5. Modus Operandi

For each section, discuss normative/first-best issues first, then political economy evaluation.

HS - we aren't oblivious to politics, but we will discuss these issues at the end.

2. Permit Definition

HS: many factors affect how one should define the permits: damages(RS) or science(BH) - geographical and temporal aspects of damages (non linearities in damages in space and time); and economics - market power, gains from inter-gas/source trading.

2.1 Establishing Property Rights – Cap and Trade vs. Offset Systems

HS: the issue is whether entities (nations) have full control over their property right or not.

RH: Not sure this is true; issue is which is better defined (baseline clarity) and which is enforceable.

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 4 *** There have been two general types of permit trading systems** -- emissions caps with allowance trading, and credit trading. Experience in US and elsewhere is that the first perform relatively well whereas the second do not. For credit trading, there is a tradeoff between needing high levels of government oversight to ensure credits are legitimate and the high transaction costs this oversight entails. Therefore, credit systems typically have much lower levels of trading.

2.2 What is the Tradable Unit?

HS: Net emissions; we are concerned not with emissions, but concentrations, which are a function of emissions and sinks. Also, should not constrain domestic choices, net emissions leaves upstream/downstream issue up to the parties themselves.

- The issue is the currency of international trading. The system should keep the nations responsible for the net emissions, and leave other decisions up to the parties. For the international level, that could give also incentive to the nations to improve their monitoring/enforcement issues.
- Other option is to concentrate on CO2 now, and then add others later.
- As a practical matter, government policy will concentrate on CO2, so it may not be a big deal. Costs of abatement other gases will be larger so that dominant abatement will be from CO2.

[Q – On the other hand, on the margin, other gases and sinks may be important. Yellen testimony - cost savings could be as high as 10% if all gases are included. See next few sections]

HS are undecided between the option of defining net emissions (AAUs) and focusing first on CO2, with a gradual phase in of other gases.

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Determined partly in Art. 3 Art. 3 "Net reductions or increases in emissions from changes in land use and forestry since 1990 will count against national emissions commitments."

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

Some take this to mean trading unit is already defined: 30 EDF believes that the Kyoto Protocol language already specifies that trading will take place with "assigned amounts." This is because article 3.10-11 specifies that trades between nations will result in deductions/additions to party's assigned amounts, and because all party's compliance is determined by their net emissions relevant to their assigned amounts.

[Q: Even though national commitments are defined in KP, this need not necessarily mean that *trading* also has to be in the same units. The currency of trade could still be carbon content of fuels, and nations would trade a portion of their assigned amounts on these markets, reserving the rest to be used to cover other emissions.]

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 194 "...there are a variety of points in the "product cycle" at which tradeable permits can be assigned to regulated parties. ... a system of international trading among governments of "control responsibilities" or targets could conceivably be linked to emissions, although the monitoring and enforcement problems are likely to be massive."

P. 199 **System should be capable of responding appropriately to evolving scientific (and economic) understanding** of global climate change and its causes and consequences. Marketable permits are somewhat flexible in this regard. The authority issuing permits can make clear the conditions under which they will remain valid. But placing too many contingencies on permits is dangerous. Firms may no longer find it in their interest to participate in such a market. Governments have a reputation for not being able to make credible commitments honoring the value inherent in tradeable permits... Nations may want to consider two strategies. The first is to use markets for greenhouse gases where the science is "reasonably" certain and the problem can be measured with a reasonable degree of precision. This suggests that carbon dioxide may be the most promising candidate for applying some kind of incentive-based approach.⁵ A second constructive strategy that nations could pursue is to agree to revisit the issue at fixed intervals, modifying strategies to accord with the underlying science and economics. This approach would provide firms and nations with some guarantee about the value of their allowances over a specified time. At the same time, it would provide

nations with needed flexibility to adapt to the changing science.”

Input Permits: U.S. phaseout of leaded gasoline. The currency of that system was not lead oxide emissions from motor vehicles, but the lead content of gasoline. So too, in the case of global climate, great savings in monitoring and enforcement costs could be had by adopting *input* trading linked to the carbon content of fossil fuels. This is reasonable in the climate case, since — unlike in the SO₂ case — CO₂ emissions are roughly proportional to the carbon content of fossil fuels and scrubbing alternatives are largely unavailable, at least at present. On the other hand, natural sequestration of CO₂ from the atmosphere by expanding forested areas is available (even in the United States) at reasonable cost (Stavins 1997) and is explicitly counted toward compliance with the targets of the Kyoto Protocol. Hence, it will be important to combine any carbon trading (or carbon tax) program with a carbon sequestration program, possibly denominated by forested areas.

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

Parson, Edward and David Keith. (1998) Fossil Fuels Without CO₂ Emissions: Progress, Prospects and Policy Implications

Carbon Management (the separation, collection, and sequestration of carbon) has largely been ignored as too expensive. However, a new look at advances and innovation shows that total costs of using fossil fuels with carbon management may be cheaper than non-fossil fuel energy for “medium to high” levels of abatement. CM will play a small part in meeting targets now and will gain in importance in the future.

Proposals:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

10. The tradable unit would be parts of assigned amounts, (as defined under Article 3) which this paper will refer to as PAA units. Transfers and acquisitions of PAA units shall be denominated in metric tons of CO₂ equivalent, calculated using the global warming potentials defined by decisions 2/CP.3 or as subsequently revised in accordance with Article 5.3. One PAA unit would be equal to one metric tonne of CO₂ equivalent emissions.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

12. Assigned amount units (AAUs) would be the standardised unit of trade. AAUs would represent a tradable form of an Annex B Party's ‘assigned amount’. Parties who wished to trade would issue tradable AAUs from its ‘assigned amount’. Parties would be required to identify the AAUs that they issued with a unique serial number which identified the country of origin and the relevant commitment period. This would ensure that each AAU is unique internationally.

2.2.1 What gases should be included? How should they be converted?

RS: - CO₂ GWP equivalent -- 100 yr units as defined by IPCC; use point estimates of best scientific understanding, not considering the uncertainty of GWPs. Values would be fixed for each compliance period, and would be revised every 5 years by the IPCC. This means the IPCC would be making decisions affecting the allocation of all nations and that firms undertaking investments would have to take account of the risks GWPs will change.

RH: Issues - Do we risk toppling the system if gases are included and there are major changes e.g. CFC's

- How do we deal with banking and value changes?
- Is there any "uncertainty level" above which we would exclude a pollutant from being traded? (Either regarding measurement or estimating GWP's)
- KP includes all six gases according to global warming potentials
- Tradeoff between gains from adding gases (flexibility) and the increasing monitoring/enforcement costs associated with those gases [See Stavins, et al 1996 (IPCC) and Hahn and Stavins (1995) for language]

Proposals:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

10. Transfers and acquisitions of PAA units shall be denominated in metric tons of CO₂ equivalent, calculated using the global warming potentials defined by decisions 2/CP.3 or as subsequently revised in accordance with Article 5.3. One PAA unit would be equal to one metric tonne of CO₂ equivalent emissions.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

13. 'Assigned amounts' can be traded, whether they derive from, for example, Articles 3(7), 3(3), 6 and/or 12. there would be no differentiation of AAUs on the basis of data certainty for gases or sources.

14. Consistent with Article 3(1), AAUs would be denominated in 'CO₂ equivalent'. Consistent with Article 5(3), Global Warming Potentials (GWPs) would be used as the appropriate conversion factors to convert non-CO₂ gases into CO₂ equivalent terms and would be fixed for a commitment period. For the first commitment period, Parties should use the revised 1996 Guidelines for National Greenhouse Gas Inventories of the IPCC. GWPs used by Parties should be those provided by the IPCC in its Second Assessment Report based on the effects of the greenhouse gases over a 100 year time horizon, taking into account the inherent and complicated uncertainties involved in global warming potential estimates.

Determined in KP:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art.5(3) All six gases are covered -- CO₂, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, and sulphur hexafluoride; 100 yr Global Warming Potentials used to convert gases into common unit.

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 195 "If there were trading in all greenhouse gases, should there be trading across gases as well? Trading across gases adds an additional layer of complexity because it requires defining trading ratios.⁶

Tradeoffs: The advantage of the more comprehensive approach is the additional flexibility it introduces into the system, and hence the potential it creates for even greater cost-effectiveness.⁷ On the other hand, such a system would increase administrative burdens and require greater scientific understanding of the relative impacts of the suite of greenhouse gases. One option is gradually to introduce other gases into the trading framework, contingent upon increased scientific knowledge about these gases.⁸ Experience suggests that when there is significant profit potential and it is clear that regulatory action will be taken, firms or nations may cooperate in the development of baselines, budgets, and appropriate certification methods.⁹

Comprehensive approach not appropriate: Given current understanding of the causes and consequences of global climate change, and technological limitations, a "comprehensive" market-based approach for greenhouse gas emissions is probably not appropriate, even in the United States. This is not to suggest that all gases should not be considered in an agreement, but that there are significant limitations to markets when monitoring and enforcement are particularly costly and the science is highly uncertain."

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

11 * Want to include as many sources as possible, but this may not be practicable due to uncertainties in measurement for some sources, political constraints, etc. [written relating to a domestic program]

19 * **Limiting trading to a subset of gases will not be effective** unless the KP is amended to partition commitments into two categories (tradable and non tradable). Since GWP are used to determine compliance with the protocol, countries can freely substitute between gases already.

* Inter-country trading should be allowed only for that amount of a country's limit that is readily monitored gases.

Tradeoffs:

Cooper, Richard N.. (1998) Toward a Real Global Warming Treaty.

72 * All significant gases should be included, but given all the sources and actors involved, such broad coverage would be impossible to monitor and enforce. So main target "is usually" fossil fuel consumption which can be monitored.

Gains from Including All Gases:

Yellen, Janet. (1998) The Kyoto Protocol: Problems with U.S. Sovereignty and the Lack of Developing Country Participation.

* "Analysis indicates that a strategy of reducing non-CO2 GHG emissions by greater percentage than CO2 emissions could lower permit prices by as much as 10%."

Uncertainty in GWP Estimates:

Victor, David G. and Salt, Julian E.. (1995) Keeping the Climate Treaty Relevant.

282 * "Compliance with a target that includes all gases is very sensitive to how the component gases are summed."

* "There is little reason to believe that GWP values are stable. Options for managing these well-known problems include phasing different gases(Grubb, Victor, & Hope, 1991) over time or setting targets in terms of radiative forcing rather than emissions."

* Adopting global warming potentials to convert emisiosns of different gases into a common greenhouse unit can be used, but quantifying GWPs "is plagued with informational problems and arbitrary choices - the values calculated by IPCC have changed roughly 15% in 4 years!" (IPCC, 1990; IPCC, 1994)

2.2.3 Sinks

The Issue & Complications:

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P.194 “Should an international CO₂ trading program consider only changes in emissions of CO₂ or also changes in CO₂ sinks, such as expanding forests? Since growing forests remove carbon from the atmosphere and their burning or destruction contributes to global CO₂ loadings, one question is whether and how an international agreement might help retard deforestation and promote reforestation. With a tradeable-permit program for CO₂, countries like Brazil and Indonesia might find it economically attractive, as well as environmentally sound, to retard the depletion of their forests or to implement reforestation programs in order to earn CO₂ credits which their own industries could use or which they could sell to foreign governments.¹⁰

There are many complications with including sinks, however. First and foremost is the issue of establishing a relevant baseline. How many trees are out there now and who should get the credits for these trees? Second, there is the issue of how to measure changes in greenhouse gas emissions associated with various sinks. It is not a simple matter to measure the carbon sequestered in trees and how it varies over time.¹¹ Moreover, should individuals get credit for planting trees in their back yard? Suffice it to note that sinks frequently pose formidable measurement problems and are often owned or managed by governments. While they can be included in a market-based approach in principle, one should be very cautious about including them on a large scale, at least in the short term.”

Benefits of including sinks: Although there are significant challenges to implementing a carbon sink program as part of a national or international greenhouse gas policy, there are likely to be substantial savings for a net emissions approach relative to a program that is limited to reducing energy-related emissions (Richards et al., 1993; Stavins, 1997). The IPCC indicates that carbon sequestration could cost-effectively contribute 15 to 30 percent of the reductions of a net emissions stabilization program (IPCC, Working Group III, 1996). Stavins (1997) argues that carbon sequestration is best seen as a short-term strategy for reducing net GHGs because the strategy will eventually have diminishing returns.

Recent work suggests that some of the relative advantages of the carbon sequestration option will be lost if issues related to leakage, measurement, and credible commitment cannot be fully addressed. For example, monitoring the net level of emissions resulting from both sources and sinks will be more difficult and costly. Even when these additional costs are taken into account, the costs savings of including sinks, relative to strategies limited to energy emissions, are likely to be substantial (Richards, 1997).⁴ [p.8]

Hahn, Robert. (1998) *Climate Change: Economics, Politics, and Policy*.

Difficulties of Including Sinks: “Policies to control stocks could be expensive to monitor. Complete accounting of the carbon cycle is expensive requiring extensive knowledge of land use and carbon consequences. More limited programs focused on official carbon projects is more feasible. However, this project focus has its own problems of bias and incentives. Although countries may well want to pursue carbon stock management as part of an overall strategy to control greenhouse gases, they should be aware of how difficult this will prove to be in the long run.”

Mendelsohn, Robert. (1998) *Carbon Sinks: Management Tool or Bottomless Pit?*

Two Options

Stewart, Wiener, and Sands. (1996) *A Pilot Greenhouse Gas Trading System: The Legal Issues*.

10 Two options to deal with sinks -- one is to issue additional allowances to each member for sinks or to

4. The estimates of the marginal costs of carbon removal in the U.S. range from approximately 10 to 15 dollars per metric ton for relatively small amounts of carbon removal (25 to 75 million tons per year) up to 60 dollars per ton for a program that averages 440 million tons per year (Richards, Moulton, and Birdsey, 1993; Moulton and Richards, 1990).

recognize savings for sequestration projects (credits?) Based on co2 equivalent amount sequestered. Second option is to measure emissions as net emissions, and allow parties to figure out how to deal with projects, etc.

2.2.2. Discounting sinks and some gases?

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

- 13. 'Assigned amounts' can be traded, whether they derive from, for example, Articles 3(7), 3(3), 6 and/or
- 12. there would be no differentiation of AAUs on the basis of data certainty for gases or sources.

2.2.4 Permit Length

How long should a permit be for (perpetuity, time-limited)? Concern about market decisions, market power, and flexibility of the system.

BH - since emissions today do not cause the same damage as emissions in 20 years (emissions decay in the atmosphere), we would want to award early reductions. [dealt with in Intertemporal Trading Section] The point is that we are not indifferent between 1 unit today and one unit 100 years from now.

Proposals:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

- 11. All PAA units shall have a unique serial number that reflects the country of origin and the commitment period for which the assigned amount was first established. PAA units would be valid until used to offset emissions for the purposes of contributing to compliance (i.e. once used to offset emissions, PAA units would be retired from the trading system).

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

- Par. 15 All AAUs would be valid for the commitment period in which they are issued and indefinitely thereafter until used. An AAU could only be used once to offset emissions equal to the CO₂ equivalent value (i.e. AAUs are a consumable commodity).

Issues:

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

- 307 Limiting the temporal duration of permits could help lend credibility to the system by rendering less likely situations where governments sell permits (part of a nation's wealth) to a degree that would not be honored by future governments in those same countries. Time-limited permits could also reduce the risk of large countries gaining market power on the permit market.

* Time-limited permits are more attractive than perpetuities because: 1) if permits are grandfathered, then time-limited permits reduce the anti-competitive effects of entry barriers. 2) facilitate the adjustment of targets in the future. (p. 308) 3) can also help lend credibility to system - decreasing possibility that governments will sell permits that won't be honored by future

governments. 4) reduce risk of market power on permit market.

2.3 Early Action Credits

Not recognized by KP, except for CDM credits:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.
art 3.2 Parties shall have made "demonstrable progress" towards their commitments by 2005

2.3.1. How would domestic early action systems interact?

HS - there should be no interaction, but realistically, we see there would be two options for the domestic scenario - 1) it is an allocation mechanism to disperse permits to early actors, or 2) allocation of additional permits before the cap is binding against an unobserved baseline (most likely, the country would end up breaking the cap, but could do better).

2.3.2. What international early action systems should be developed?

HS: Neither of the two options above are available internationally. The international allocation has already been determined politically at Kyoto, and it is not realistic that additional permits will be created for early action. Therefore, the best thing to do is to define the property rights as soon as possible.

* See Schmalensee et al. on SO₂ opt-in).

Conditions for an Early Action Program: "Early action has not been an option under the Kyoto provisions but warrants special attention. We propose that potential use of the option is contingent on the following two conditions. The first is conditional on ratification of the Kyoto Protocol (Kopp et al., 1998). The option might only be authorized from the year in which the Protocol is ratified onwards. The second is conditioned on the stringency of overall assigned amounts of emissions. The countries that are supposed to sell the "hot air" should be not allowed to use the option. Thus, it alleviates to some extent the concern about the "hot air" trading, because it provides the incentive for legal entities in the advanced OECD countries to take abatement actions at home. If authorized, the option will accelerate the process of implementing a domestic emissions trading scheme by dealing with all technical issues associated with it. However, triggering the green light for the option requires amendment to the Kyoto Protocol because the total emissions of one Annex I country during the commitment period will exceed its assigned amounts if pre-2008 emissions reductions banked are awarded to offset the post-2008 emissions targets. If such an amendment were made, the next question is that those countries that are eligible for pursuing the option have to negotiate internationally accepted national baselines for the pre-2008 period. As the negotiations leading up to the Kyoto targets have shown, this task will not be that easy."

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Early Credits from Baseline Amount: "An alternative option to allow the banking of Annex I country's own early reductions is that any credits one Annex I country awards its sub-national legal entities for pre-2008 reductions are drawn from the assigned amounts of the country in question. On the one hand, this option would give these "first-movers" a competitive advantage over those not undertaking early actions (Environmental

Defense Fund, 1998). On the other hand, since the credits awarded to early movers would be otherwise allocated to those entities not undertaking early actions, with limited supply of early credits, the option amounts to government encourage of uneconomic rent-seeking (Fischer et al., 1998).”

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

61 Apart from CDM credits, the Kyoto Protocol all but precludes the use of early reductions to meet commitments. Therefore, Parties wishing to establish early credit programs will have to deduct those credits from their assigned amounts. “In effect, early reduction credit programs are nothing more than domestic policies adopted by Annex B governments for allocating increments of their assigned amounts – in this case to those that take early action to reduce emissions.

3. Who Trades?

3.1. What Nations should trade?

HS 1) eventually, we need to include developing nations, 2) considering cost effectivenesses, and that low cost opportunities are in developing countries, they should be involved, 3) on the other hand, including the developing countries in a system, if it harms the overall credibility of the system, could drive up costs.

* Footnote on emissions leakage and coalition building.

KP & Proposals:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 17 “The Parties included in Annex B may participate in emissions trading

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

All ann. B in compliance with KP and meeting some conditions (below)

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

Par 17 * All Ann. B nations that are in compliance with KP and conditions for trading.

3.1.1 What domestic institutions required?

HS: All that is needed is a reporting/monitoring agency; later will address issues of monitoring and enforcement.

KP & Proposals:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 7 * Parties are required to install national systems for estimating emissions

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

9. Parties with commitments listed in Annex B of the Kyoto Protocol shall be eligible to transfer or acquire parts of assigned amounts if they:

- (a) are in compliance with Articles 5 and 7;
- (b) have adopted and ratified a compliance regime under Article 18;
- (c) have a national system for tracking transfers and acquisitions of parts of assigned amount by the Party itself, and by any legal entities it may choose to authorize (consistent with paragraphs 10, 15 and 16 below);
- (d) can demonstrate their compliance with the rules of the emissions trading system, as set out in the paragraphs below.

Parties implementation of the requirements of this paragraph shall be the subject of expert review under Article 8.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

18. Each Annex B Party will need to meet conditions to ensure the integrity of the systems. These conditions are:

- (a) Parties must comply with Articles 5 & 7 of the Kyoto Protocol.
- (b) Parties must establish and maintain a national system for recording their 'assigned amount' and accounting and tracking AAUs held or traded by the Party and/or its legal entities.

19. Compliance with the conditions would be assumed to continue unless a breach of the conditions was established under the Protocol. Failure to maintain compliance with the conditions could result in suspension of the right for the Party and its legal entities to transfer AAUs internationally. However, the Party or its legal entities would not be precluded from acquiring AAUs.

Require strong domestic systems:

Center for Clean Air Policy. (1997) Greenhouse Gas Emissions Trading: Improved Compliance at Reduced Cost.

- 7 * Trading could be limited to those countries that have strong domestic systems for monitoring, reporting, verification, and strict penalties for domestic violators.

Ability to trade as enforcement/credibility mechanism:

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 198 "One possible approach linking enforcement to international trading would be to restrict international trading to those nations that are deemed to be in compliance by some supra-national group.¹² For example, if the supra-national group found that Germany and the U.S. were both in compliance with their obligations, then trading would be allowed between the two nations. A problem with this approach could arise if countries change their level of effort in enforcing an agreement. If, for example, a country traded away permits while in compliance, but then subsequently went out of compliance with an international agreement, rules would need to be developed to define who would be responsible for limiting the greenhouse gases to come back into compliance. While this problem is manageable in theory, it could quickly lead to a political quagmire. For example, the supra-national authority could be asked to make difficult decisions about whether to allow developing countries, with limited resources for monitoring and enforcement, to engage in international trading.¹³"

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for

Verification, Reporting, & Accountability.

- 43 * Effective enforcement needs to balance need to respect sovereignty with need to promote compliance. Need rewards for good behaviour and sanctions for bad. "One mechanism that appears to hold promise in this regard involves using eligibility to trade as an enforcement mechanism." For example, trades could be allowed between only "eligible" parties - those with sufficient monitoring/enforcement systems. That way, parties without the sufficient monitoring/compliance systems would have to use only domestic measures until they upgrade their systems. From then on, trade could be restricted to parties that were in compliance in the period before.

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 9 "At minimum, a country must establish a fixed emissions cap and create a specific number of allowances equal to that cap." Can then decide whether to keep them or allocate them to private entities.

3.1.2 Efficiency gains from regimes

Jacoby, Eckaus, et al. CO2 Emissions Limits: Economic Adjustments and the Distribution of Burdens

When trade is restricted to just OECD, benefits from trade could be very small -- only 5% of gains from global trading, or 3.4% relative to no trade. This is because there is little heterogeneity among them. Adding FSU and Eastern Europe gets to 30-40% of global trade gains.

Yellen, Janet. (1998) The Kyoto Protocol: Problems with U.S. Sovereignty and the Lack of Developing Country Participation.

- * Ann. I Trading: Using SGM model, annex I trading can reduce costs to US by approx. 1/2 relative to no trading. (assumes ideal international trading mechanism)
- * Bubble's -- if US joins a bubble with former Warsaw pact countries, Aust. Canada, NZ, costs umbrella could reduce costs 60-75% relative to no trade.
- * CDM -- 20-25% better than Ann. I trading alone.
- * Full World Trading -- reduce costs 55% relative to Ann.I trading; depending on nations involved, effectiveness of trading regime, (and levels of their targets).

Disclaimer for Cost savings estimates:

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

- 4 * Real-world cost savings may be different from model estimates. Gains from trade depend on the stringency of the emissions target, the cost of meeting that target without flexibility, and the particular countries involved.

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO2 Allowance Trading.

- 11 * The challenge for analysts is to compare realistic versions of policies, not idealized versions. (also Hahn and Stavins, 1992)

3.1.3. What is the appropriate role of non-Annex I nations?

Theoretical arguments for their involvement (Schmalensee, Stavins), against (Hahn, Goulder)

* everyone wants them in, no one wants them to pay (not feasible or fair), so disagreement is whether getting them in now will help in the long run or not.

Critique of Broad approach: The broad and shallow approach is appealing, but it has a couple of drawbacks. First, it is unlikely to be feasible, except in a very limited sense. The developing countries are unlikely to participate unless they receive resource transfers, such as through an initial allocation of permits. It is hard to see the value of getting the developing countries to sign an agreement that simply requires resource transfers from the developed world, unless a credible promise can be extracted from them to do more later if the situation warrants. For example, in exchange for some transfers now, the developing countries might agree to enter into an agreement that requires more significant reductions as their per capita income rises beyond a certain level. While this idea sounds appealing, one must question whether future governments will feel bound by such promises. Second, as I will argue below, there may be reasons to prefer an agreement that is narrow for the purpose of learning how to design institutions. In short, a broad and shallow approach has the advantage of bringing many parties on board (by definition), but I am not sure this is such a great advantage, since there is little assurance that many of these parties will participate in the future if they are asked to bear significant costs.

Hahn, Robert. (1998) *Climate Change: Economics, Politics, and Policy*.

Hahn, Robert and Robert Stavins. (1995) *Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues*.

P. 193 "Some have questioned whether developing countries should be permitted to participate in international trading, because of fears that these countries, or individuals within these countries, might trade marketable permits to others to raise cash quickly without taking adequate stock of long-term consequences. The likely problem is not, however, due to a failure of these nations to take a long-term view. The problem arises because of the difficulty in implementing effective enforcement strategies, particularly in nations lacking stable political structures. The challenge is to develop international enforcement mechanisms that are "credible," so that it is clear to countries and individuals that not playing by the rules will entail real costs."

3.1.4 Leakage

Mechanisms for Leakage:

Jacoby, Eckaus, et al. *CO2 Emissions Limits: Economic Adjustments and the Distribution of Burdens*

32 Spillover effects will occur because reductions in one country lead to reductions in demand for exports of others, relative prices of energy will shift as will prices of non-energy goods. These changes will occur both within countries (causing in-country substitution) and between countries (trade adjustments), with welfare effects extending to all countries. Some non participants will gain, others will lose.

There are two main channels through which emissions leakage may be transmitted. First, a carbon abatement policy by cooperating countries may shift comparative advantage in carbon-intensive goods toward non-cooperating countries, and so production of such goods, and emissions, may rise outside the coalition. Second, a unilateral policy may lower world demand for carbon-intensive fuels, and thereby reduce the world price for such fuels traded in international markets. As a result, demands for such fuels (and emissions) can rise outside of the

coalition.⁵

What can be done to reduce emissions leakage? If the coalition is a net importer (exporter) of carbon-intensive products in the absence of a carbon tax, then a tariff (subsidy) imposed on these net imports (exports) can reduce emissions leakage through the terms of trade. But the tariff (subsidy) would have to be set proportionately to the carbon-intensity of *every* product, a clearly impractical approach. Further, whether the welfare losses (distortions) caused by the tariffs would be greater or less than the welfare losses reduced by cutting emissions leakage remains an open, empirical question. Finally, such border tax adjustments pose a number of other problems, not the least of which is possible conflict with existing multilateral trading rules.⁶

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Estimates: MIT Joint Program for Science and Policy of Global Change. (1998) Preliminary Runs for EMF Estimates of leakage (increase in emissions in non Ann. B nations as percentage of the reduction of emissions in Annex B.)

Kyoto Protocol, No trading – 6.4% (64 mmtc) leakage to FSU and non annex B.

KP, Ann. B trading – 4%; (37 mmtc) leakage to non annex b.

TABLE 4: Estimates of Leakage

3.2 How are nations added to system?

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 3 * The way article 17 of KP is written (including all annex B nations instead of Annex I nations in the trading regime), potentially allows developing countries to engage in trade if they adopt an emissions target and are added to Ann. B.

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change. Any nation adopting a legally binding emissions limit can fully participate in trade.

⁵There is a third possible channel for leakage transmission. Under certain conditions, non-cooperating countries will abate their emissions up to the point where their own marginal benefit of abatement equals their own marginal cost of abatement (Barrett 1994b). Non-cooperating countries will abate their emissions by less than they would if they cooperated. Where non-cooperating countries undertake positive unilateral abatement, and where the marginal benefit of abatement to non-cooperating countries decreases with the level of global abatement, an increase in abatement by cooperating countries will create an incentive for non-cooperating countries to reduce their abatement. Hence, leakage may occur even in the absence of trade.

⁶World Trade Organization (WTO) rules allow for border tax adjustments where the taxed or controlled inputs are physically-incorporated in the final product, but in the case of greenhouse gases, the concern is with the carbon emitted in the process of manufacturing. The Uruguay Round allows energy taxes to be remitted on exports of manufactured goods, although there is some question about the generality of this provision and whether it could be extended to include imports.

3.2.2.1. Reasons non-annex I are not eager to join

Environment ministers vs. those in power; equity B annex I shouldn't be able to buy its way out (emissions vs. stock); would be picking the low hanging fruit. Dutch disease (McKibbin, '98, McKibbin and Wilcoxon, 1997)

- * RS They will be monitored if they join, and they would look worse in so doing.
- * HS They don't believe that they will ever see the money, so why should they agree to anything? Also, we may not be giving the money to the ones who would need to be convinced.
- * Gov gov. Trading can certainly provide incentives for government to join.,
- * Distrust of the system in general – developing countries don't believe that they will be able to really gain from a system being promoted by the same countries who have exploited them in the past; we have not shown that they will get preferential treatment for getting in on round one of this.

Pahauri, R.K.. (1998) The Clean Development Mechanism: Some Developing Country Perspectives.

- 17
- * Developing nations are concerned that trading/JI/CDM will give developed nations the opportunity to not reduce their own emissions.
 - * JI might also remove attractive low cost options in developing countries for their future use. Pachauri believes this is unfounded for two reasons: 1) developing countries would not have to accept payment only for actual costs incurred, but could drive costs up; 2) technology development will bring along a whole new set of even lower hanging fruit for the future.
 - * Mistrust of JI (through the pilot phase) came out of an "overkill" of interest from a few developed countries and suspicion that these countries were not interested in doing anything domestically.

3.2.2 Incentives for Joining

They could get \$:

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

- 4
- * Trading could mobilize substantial resource flows to developing countries assuming that abatement costs are lower there and that the treaty allocates obligations to contain industrialized country emissions while giving developing countries "headroom" to grow.

Easier to trade:

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

- 26
- The advantage of developing nations participating in full trading is that, by taking on an assigned amount, the nation can avoid the large transaction costs of proving real and additional emissions reductions for each project under the CDM, and can open their markets to broader based investments.

Evolution scheme & Voting:

Nordhaus, William D.. (1997) Climate Allowances Protocol (CAP): Comparison of Alternative Global Tradable Emissions Regimes.

CAP proposal allocates allowances based on an evaluation of a nation's ability to pay and their business as usual emissions. There is also an "evolution" scheme where nations begin making reductions or containing emissions when they reach an "entry-level income". Global abatement level is based on an global vote for emissions reduction. These characteristics provide incentives for countries to participate.

Difficulty in Getting Participation:

Cooper, Richard N.. (1998) Toward a Real Global Warming Treaty.

68 * "While the same requirements need not be imposed on all countries from the beginning, the agreement must be structured from the beginning so that all significant countries will eventually participate." (68)

* There is unlikely to be a principle acceptable to all for allocating valuable emissions rights between rich and poor countries, making Kyoto's approach almost impossible. Reason: 1) the problem is global, 2) benefits of abatement will only accrue to future generations and are highly uncertain, 3) restraining emissions will involve significant changes in lifestyles that will be politically difficult.

* **Targets allocated on the basis of past emissions will be unacceptable** to developing/industrializing countries. The other option, allocating them on a per capita basis to developing countries will not work either as it would involve major resource transfers to developing countries which would be politically unacceptable [also McKibben & Wilcoxen]

* **Some combination of historic and per-capita allocation will not solve the problem.** Another approach would be to allocate according to a fixed reduction from "business as usual". Proposes calculating a BAU trajectory for each country on the basis of recent history, development prospects, and past experience with the relationship between economic development and GHG emissions. Each country could be charged with reducing GHG's by a uniform percentage from that BAU. But this will just transfer the debate to the choice of trajectories, and there is no clear way to decide growth scenarios. [Keller PAE for options in determining growth baselines]

Growth Baselines:

Keller, Samuel. (1998) The Design of Feasible Growth Baselines.

* Baselines could be defined as emissions per GDP, requiring that emissions not grow any faster than the GDP (or in fact requiring some improvement in E/GDP)

* The problem is that there is no clear way how to set the growth baseline as we have not observed the future. Options include a "Decision Rule Approach" requiring all nations in similar circumstances to proceed according to one path, a Political Approach, leaving the baseline e/gdp up to international negotiations, or a national study approach in which analysts would evaluate the "no-regrets" options in a nation and that would become the baseline.

* This would give developing countries room to grow as their limits would be expressed in terms of their GDP, but they would be able to trade if they improve their carbon intensity.

[This is essentially similar to Lashof, Keller, and Hargrave (1997) "Output Based Allocations..." which was a proposal for a domestic allocation scheme based on energy efficiency where Fischer (1998), shows that this can act as a subsidy on output for efficient firms/nations and therefore increase compliance costs; also see Center for Clean Air Policy, 1997 "Growth Baselines"]

[also relevant for 4.2]

Cooper, Richard N.. (1998) Toward a Real Global Warming Treaty.

78 * **Graduation schemes are problematic** - graduation can cost a country its eligibility for preferential treatment under the protocol (CDM financing, assistance for national

communications, etc.), and by shifting comparative advantage in energy intensive industries to developing countries, making it harder to reduce later.

[* Add shelling to the attack on growth baselines]

Providing large initial permits to poor countries (for reasons of distributional equity) implies that they would be selling permits primarily to rich countries. Since permit prices represent an implicit or explicit tax on all participating countries, the terms of trade within the coalition for countries with the same carbon intensities in production would remain unaffected. From a distributional point of view, poor countries would receive compensation, whereas rich countries would have to pay, first, for their own emission reductions as called for by the permit price and, second, for permit purchases from abroad.

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Punishment for Free riders

Barrett, Scott. (1998) "Montreal v. Kyoto: International Cooperation and the Global Environment."

27 Important difference between Montreal and Kyoto is that Montreal deters non participants by threatening trade restrictions between participants and non-participants, Kyoto doesn't. Trade restrictions cover all controlled substances and products containing those substances. Treaty also includes provisions to restrict goods made with controlled substances, but this has never been used.

3.3 What entities would trade?

HS: Nations are responsible within their own borders for this question. Compliance with the international regime is the government's responsibility, and so it is up to the gov to decide how they achieve their targets, including by delegating trading.

Proposals:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

14. The Protocol is silent on the subject of whether legal entities can participate in the international trading system under Article 17. However, the participation of legal entities has several economic advantages. If authorized legal entities are permitted to participate in international emissions trading, the Party, and not its authorized legal entities, will remain responsible for compliance with its commitments under the Protocol.

15. If legal entities were permitted to trade internationally, it would be essential to govern the monitoring, verification, accountability and compliance of sub-national legal entities.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

10. Parties could trade directly and/or choose to devolve trading responsibility to legal entities. Devolving the ability to trade would be likely to increase the number of trades, thus enhancing competition in the market. Private sector legal entities would have direct knowledge of their abatement opportunities and costs and would likely be better placed to make decisions based on this information than would governments.

16. The participants in the international trading regime could be Parties (i.e. governments) and/or legal entities authorised by that Party to trade. Legal entities could include private individuals, companies, societies (which could include environmental and other non-governmental organisations), industry groups and brokers.

17. Devolution of the right to trade to legal entities would be at the discretion of each participating Party. However, responsibility for the Kyoto Protocol commitments would always remain with the Government as Party to the Protocol

Competitiveness Concerns with Domestic Allocation to firms: With the great concern that a government that grandfather permits to a domestic firm could give it a competitive advantage over similar firm in another country where permits are not awarded gratis, some thought that there is the need for the harmonisation of allocation of permits. However, we think that individual governments should be left free to devise their own ways of allocating permits on the following grounds. First, we think this is not necessarily the case, because even if a firm obtains emissions permits by auction, if necessary, its government still can protect its international competitiveness by means of recycling the revenues raised through auctioned permits to lower other pre-existing distortionary taxes, such as taxes on labour and capital. Second, although auctioning at least part of the assigned amounts to sub-national legal entities alleviates to some extent the concern about international competitiveness, any attempts to produce an agreement on a common rate are likely to run into concerns about national sovereignty and thus would encounter significant political difficulties

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading,

Reasons to include firms;

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 193 "Negotiators will have to decide who should participate in trading... The problem of international trading is more subtle.¹⁴ If international trading takes place among nations, there would be advantages of allowing firms and individuals within those nations to trade internationally. But depending upon the nature of domestic greenhouse regulations, this can raise serious problems of departures from cost-minimizing allocations of the control burden. In any event, limitations on trading may be necessary because of potentially high administrative costs. On the other hand, it can be argued that national governments ought not be the primary agents for trading because they may not have the appropriate incentives or information needed to minimize costs. A large part of the decision to allow various kinds of international trading will hinge on the differential ability and willingness of nations to enforce this kind of an agreement, a point that is addressed below."

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

Allowing private entities to trade is important to realizing efficiency gains because: 1) they are the ones who control abatement decisions, 2) can increase total number of transactions which will increase market liquidity and reduce potential of market power, 3) individual companies have more information on their technical options and costs for reducing emissions than the government, which can make errors in deciding how much to trade.

Modeling shows entity trading is important:

Burtraw, Dallas, Kenneth Harrison, Paul Turner. (1998) Improving Efficiency in Bilateral Emission Trading Using a simulation of trading of SO₂ permits in Europe, trading between economic agents rather than national governments achieves a larger portion of potential cost savings from trade. Under most assumptions, the more decentralized the trading entities, the greater the expected savings.

Who can actually buy?

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

20 * Need to resolve who will be eligible to buy permits -- everyone? "eligible buyers", Annex B?, All signatories? Etc.

4. Initial Permit Allocation

HS: established in KP; not really an issue for ITP program.

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

p. 15 The manner in which Parties allocate PAA units to their legal entities should not contravene Article 3.5 of the Convention and, therefore, should avoid arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

4.1. For how many periods (as defined in 2.1.1) should permits be allocated?

HS: Need to provide predictability to private sector for purposes of investments; major criterion for number of permits allocated at one point in time.

- Fundamentally not an itp issue, but an issue of long-term vs. Short term targets.

Reason to define and allocate early:

Barrett, Scott. (1998) "Montreal v. Kyoto: International Cooperation and the Global Environment."

27 Having a provision in the KP for banking credits reduces the problem of creating an incentive not to abate more than the target. However, unless countries know what the subsequent period allocation will be, they have no way of knowing the value of making abatement investments.

* Not having permanent caps can invite strategic behaviour. Suppose a country makes an abatement investment for the long term. The cost of the investment, is sunk, so the cost of meeting a more stringent target in the future is reduced, and the country's bargaining position may be weakened; leading to underinvestment in abatement in the near term.

4.2 What is the baseline?

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 3 * 1990 is baseline for most gases and countries

* Nations in transition can choose base year if established in national communications.

* Can choose 1995 for base year for HFC's, PFC's, and sulfur hexafluoride

4.3 How allocations determined?

It will be hard and need to consider a lot of factors

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Negotiations on initial permit allocations are likely to involve criteria such as gross national product (GNP), real GNP, population, land area, and dependence on fossil fuel production.⁷ All criteria will have adherents, essentially those with larger allocations under those criteria,⁸ and several criteria may therefore need to be blended to create international consensus on emission allocations.⁹ ...

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 196 "The most difficult problem associated with any international greenhouse-gas control program will be achieving agreement on both the global emissions cap and initial, individual national control obligations. The trading program highlights this problem because it makes it explicit. Since the program would create a new environmental "currency" denominated in tons of CO₂ (or other gases), every nation will know immediately its reduction responsibilities.

A variety of alternative allocation mechanisms have been suggested, including allocations based upon GNP, real GNP, total population, adult population, land area, and emissions.¹⁵ There are numerous other possibilities. Each of these criteria will have adherents, largely those with larger allocations under that criterion.¹⁶ Several criteria may need to be blended to create international consensus on emission allocations.¹⁷ For example, it is clear that the developing countries have relatively little incentive to participate unless they see clear economic benefits from an agreement. At the same time, the wealthy countries will want to make sure their burdens are divided in ways that are perceived as equitable. Whatever the initial allocation, subsequent trading can lead to a cost-effective outcome.¹⁸ This potential for pursuing distributional objectives while assuring cost-effectiveness is an important attribute of the tradeable permit approach."¹⁹

4.3.1 Theoretical - doesn't matter; except for Transaction costs, market power,...

But it does in the real world: Another normative lesson is linked with positive issues. Above we emphasized the political advantages of *freely allocated* permit systems, as employed with SO₂. But the same characteristic that makes such allocation attractive in positive political economy terms — the conveyance of scarcity rents to the private sector — also makes free allocation problematic in normative, efficiency terms (Fullerton and Metcalf 1997). Goulder, Parry, and Burtraw (1997) estimate that the costs of SO₂ allowance trading would be 25 percent less if permits were auctioned rather than freely allocated, because auctioning yields revenues that can be used to finance reductions in pre-existing distortionary taxes. Furthermore, in the presence of some forms of transaction costs, the post-trading equilibrium — and hence aggregate abatement costs — are

⁷For an overview, see: UNCTAD 1992; Grubb and Sebenius 1991; Bertram 1992; and Bohm and Larsen 1994.

⁸For example, under an allocation system related to population levels, the big players in the market would likely be India and China, as permit sellers, and the United States and perhaps the former Soviet Union, as buyers. See: Epstein and Gupta (1990).

⁹For example, the Canadians proposed using population and GNP combined as allocation criteria when chloroflourocarbon (CFC) reduction obligations were being considered in the development of the Montreal Protocol.

sensitive to the initial permit allocation (Stavins 1995). For both reasons, a successful attempt to establish a politically viable program through a specific initial permit allocation can result in a program that is significantly more costly than anticipated.

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO2 Allowance Trading.

But for : Transaction Costs

Stavins, Richard N. (1995) Transaction Costs and Tradeable Permits.

- * In the presence of some transaction costs, post trading equilibrium and total compliance costs are dependent on initial allocation.

& Market Power:

Hahn, Robert. (1984) Market Power and Transferable Property Rights.

- * Where there is market power, allocating permits can be important

4.3.2 FCCC process determination

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

- * Overall emissions to be reduced 5.2 per cent compared to 1990 baseline levels.
- * Differentiated reductions (Annex B) to reflect differing national circumstances.

4.3.3 New entrant procedure important

HS: The challenge for the ITP program, is how to provide incentives for LDC's to join and what kind of baseline should be used for new entrants.

[see 3.2.2]

4.3.4 How much of allocation can be traded?

HS: All of it; subject to adequate safeguards on enforcement.

KP & Proposals:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 17 "Any such trading shall be supplemental to domestic actions for the purpose of meeting commitments."

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

7. The above Parties believe that international emissions trading should ensure that real emissions reductions are delivered at lower cost, and that the trading of 'hot air' should not lead to overall reductions being lower than would otherwise be the case. 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.* A Party's

compliance with this rule shall be the subject of expert review under Article 8.

3. Recalling the principles and objectives of the United Nations Framework Convention on Climate Change, and the Kyoto Protocol, the international emissions trading system shall be designed to contribute to the achievement of real, cost-effective and verifiable environmental benefits whilst ensuring that:

- (i) trading of "hot air" should not lead to overall reductions being lower than would otherwise be the case;
- (ii) trading is supplemental to domestic action for the purposes of meeting commitments under Article 3* (in accordance with Article 17); and ...

5. We believe that domestic actions should provide the main means of meeting commitments under Article 3. This is consistent with the ultimate objective of the Convention. In this context a "concrete ceiling" on the use of all the flexible mechanisms has to be defined. In addition, Article 17 states that international emissions trading "... shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments....". The rules governing the international emissions trading system should reflect this principle.

6. We have not yet come to a firm view on as to how the ceiling should be defined and welcomes discussion with other delegations. The ceiling could be defined in relation to a number of variables, including: the assigned amount, 1990 emission levels, or required efforts by a Party.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

20. Article 17 provides that trading is to be supplemental to domestic actions but does not quantify that term or authorise the Conference of the Parties to quantify it.

21. International emissions trading will be more effective in achieving emissions reduction at lowest cost if there are no restrictions on the quantity of AAUs able to be transferred or acquired to contribute to compliance with a Party's assigned amount'. The ability to trade without quantitative restriction would encourage ratification of the Protocol; encourage earlier emission reductions and minimise the overall cost of achieving the collective Annex B environmental objective.

22. Internationally mandated limits on the quantity available to be traded, by substantially reducing the benefits available from trading, would increase the cost of emission reductions; discourage ratification of the Protocol; and ultimately, in the long term, reduce the quantity of reductions that can be achieved, thus delivering less environmental benefit.

Reasons against a Rigid Cap:

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 48 * It is possible to set a limit on emissions traded -- for example a % of the assigned amount - but this "does not seem desirable. Defining supplementarity in terms of a constraint on emissions trading seems to be the wrong approach. It proposes a permanent solution for a transition problem [this should be handled] by requiring Parties to demonstrate adequate domestic efforts to control emissions."

* Other options include imposing a transaction fee on all trades that could be used to retire allowances or invest in the CDM, etc..

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

63 A cap on trading would be arbitrary. It could increase compliance and transaction costs without bringing additional environmental benefit. If a party delegated trade to legal entities, these restrictions could impose burdens on domestic regulators and increase transactions costs as regulators and companies would have to devise ways to ensure that trade fell within the quota.

66 "It would be anomalous for COP-4 or subsequent COPs to attempt to regulate trading on the basis of projections of a Party's expected emissions. Such rules would introduce considerations in no way connected with a parties actual emissions..." Another way to get at the issue of "hot air" is for parties seeking to acquire parts of assigned amounts to use their transfer agreements to ensure that their revenue and resources are going to investments in GHG emissions control projects or building domestic regulatory infrastructure.

"Restricting trades interferes with the operation of an inter-source trading market. If Annex B governments elect to allocate the assigned amounts to individual sub-national legal entities and authorize them to trade on the international emissions permits market, no country would know up-front what a percentage of its obligations would have been fulfilled via emissions trading unless all transactions require to be pre-approved by the government or the endorsed agency... Clearly, this rule would raise transaction costs and inhibit trades, which would limit the effectiveness of emissions trading.

Imposing a general restriction to solve a limited concern runs the risk of throwing out the baby with the bath water. A ceiling on trading on the fixed, arbitrary and once-for-all basis proposes a permanent solution to a transition problem. Moreover, setting a ceiling makes it even more difficult to set stringent emissions targets for the subsequent commitment periods beyond 2012. It is the lack of the post-2012 targets that restricts the choice of the compliance mechanisms and tools and that creates some divergence of views in assigning liability.[?]

Zhang, ZhongXiang. (1998) Towards a Successful International Greenhouse Gas Emissions Trading.

Alternatives:

Demonstrate Steps: Instead of imposing a percentage limitation on the use of emissions trading, one possible resolution to the "hot air" concern would be to require the Parties to demonstrate adequate domestic actions according to a set of criteria against which such actions can be measured. Such criteria should be defined by the Conference of the Parties. Unlike a ceiling on trading, this option refers to process rather than to outcomes.

Zhang, ZhongXiang. (1998) Towards a Successful International Greenhouse Gas Emissions Trading.

A Transaction Tax: Another option involves imposing a transaction tax on trades involving "taxable" allowances, with the tax rate to be set by the Conference of the Parties (Zhang, 1998). Such a tax could be imposed only on the buyer side and could differ to reflect the direction of emissions trading flows, with zero or low rate for transactions within the advanced OECD countries themselves but high rate for transactions between them and countries with economies in transition. In order to prevent countries from attracting more trades by setting even lower transaction tax rate, the low rate should be uniformly imposed on trading within the OECD countries, and the high rate on those transactions with non-OECD countries. Buyer countries could use the proceeds from such a tax to strengthen their research, development and diffusion of low-cost climate friendly technologies, to subsidize transfer of such technologies to non-Annex I countries, or to buy and retire a portion of their allowed emissions permits from the market. They could also be used to retire the "hot air". Although imposing a transaction tax raises the cost of meeting their allowed emissions limits, it is much less trade-restrictive than imposing a percentage limitation on the use of emissions trading, because legal entities avoid the risk of being bumped over the national threshold. It

alleviates to some extent the concern about the "hot air" trading, because legal entities in the advanced OECD countries face higher transaction tax rate when engaging in trading with their counterparts in other Annex I countries. It also provides the incentive to search for cleaner technologies, particularly when the proceeds from such tax are used as buyer countries' R&D investments in climate friendly technologies and as their payments for buying and retiring a portion of their allowed emissions permits from the market.

Zhang, ZhongXiang. (1998) Towards a Successful International Greenhouse Gas Emissions Trading.

5. Market Design

5.1. Stylized criteria for efficient functioning of the market

HS: We are talking about trade at multiple levels (gov. to gov, firm to gov, firm to firm). This is a completely new area. In traditional TP systems, criteria is (See Hahn & Noell, 1996) agreement on property right, no prior approval by government, etc. ... but they may not be important in a context where we've got 35 not necessarily cost minimizing agents, and we don't know what they'll do

BH: to what extent can the design of the system get nations to act as cost minimizers? (Public choice problem, lack of information and ability to figure it out?)

RS: Evidence from Bohm experiment that they may in fact act as cost minimizers - to the extent that they are concerned about the future stream of abatement costs, they SHOULD.

BH: Then why don't they do so domestically?

Criteria:

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

190 "The full measure of potential cost savings offered by tradeable permits in greenhouse gases can be realized only if efficient markets develop. Four conditions are necessary for this to occur: (1) a sufficient degree of compliance must be achieved, (2) transaction costs must be low enough not to prevent efficient permit exchanges from taking place, (3) the market for permits must be competitive, and (4) the policy must be seen as one that will remain in place of a significant period of time.

5.2 What is the interaction between the system and various subsystems?

5.2.1. Can domestic policy instruments (taxes, etc.) be compatible with the ITP system?

HS Answer is yes. Give example of domestic carbon tax with tax credits and example of domestic CAC.

- If there is an ultimate control, perfect coverage international system (ultimate downstream of carbon equivalent emissions), then international trading will take place freely - trading at one to one levels.

- there will be many different forms of domestic tradable permit programs (upstream system vs. Downstream system) these programs will not be perfect (i.e. they will not cover all emissions in the country) and they will be

different. Trading between these may not be straight forward and will require an intermediary exchange.

BH - how can we get an equilibrium with different permit schemes operating in each country? ANSWER: Everything hinges on country enforcement.

5.2.2 Multiple Markets (EU bubble)

HS: Its ok for conduct of ITP, but may not be cost effective.

QF: Bubbles can be seen in two ways – like a formal version of emissions trading where all transactions are carried out by governments before the commitment period and where no subsequent trading is allowed; or a very loose way to enable trading within the bubble if formal emissions trading does not emerge - so long as the group meets its emissions target, individual emissions levels do not matter. Also, members of a bubble can engage in trade with those outside the bubble to meet commitments.

Gains from Bubbles:

Yellen, Janet. (1998) The Kyoto Protocol: Problems with U.S. Sovereignty and the Lack of Developing Country Participation.

- *Ann. I Trading: Using SGM, annex I trading can reduce costs to US by approx. 1/2 relative to no trading. (assumes ideal international trading mechanism)
- * Bubble's -- if US joins a bubble with former Warsaw pact countries, Aust. Canada, NZ, umbrella could reduce costs 60-75% relative to no trade.

KP Language:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

- Art. 4 * "Any Parties included in Annex I that have reached an agreement to fulfill their commitments under Art 3 jointly, shall be deemed to have met those commitments provided that their total combined aggregate anthropogenic CO2 equivalent emissions of these greenhouse gases Y do not exceed their assigned amounts" The respective emission level allocated to each of the Parties to the agreement shall be set out in that agreement"
- * If the group fails to meet its target, each party is responsible for its commitment under the agreement.

5.2.3 CDM Exchanges

HS: Baseline problem again, here spatially rather than intertemporally.

KP & Proposals:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

- Art. 12 * Developing countries can transfer "certified" reductions from projects to Ann I parties.
- * Reductions from 2000 on can be transferred and used to meet first budget period commitments.
 - * Private sector is allowed to participate
 - * Determining additional reductions and specifics still to be determined.

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

- 6 * CDM credits may involve "leakage" in uncapped countries, but this needs to be weighed with the amount of leakage from capped and uncapped countries if the same amount of abatement were undertaken only within the capped nations.

The Baseline Problem: Considerations of simplicity and the experience of the SO₂ allowance system also argue for using absolute baselines, not relative ones, as the point of departure for tradeable permit programs. The difference is that with an absolute baseline (so-called "cap-and-trade"), sources are each allocated some number of permits (the total of which is the "cap"); with a relative baseline, reductions are credited from an unspecified baseline. The problem is that without a specified baseline, reductions must be credited relative to an unobservable hypothetical — what the source would have emitted in the absence of the regulation. A hybrid system — where a cap-and-trade program is combined with voluntary "opt-in provisions" — creates the possibility for "paper trades," where a regulated source is credited for an emissions reduction (by an unregulated source) that would have taken place in any event (Montero 1997). The result is a decrease in aggregate costs among regulated sources, but this is partly due to an unintentional increase in the total emissions cap (Atkeson 1997). As was experienced with EPA's Emissions Trading Program, relative baselines create significant transaction costs by essentially requiring prior approval of trades as the authority investigates the claimed counterfactual from which reductions are calculated and credits generated (Nichols, Farr, and Hester 1996).

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

Description of CDM(JI): Joint implementation (JI), provided for in the Framework Convention on Climate Change, involves cooperation between two countries, with one funding emission reduction in the other to help the first meet its reduction commitments.¹⁰ Joint implementation projects are already being undertaken by a number of countries.¹¹ While many of these involve intergovernmental agreements, the private sector can be involved directly. The U.S. Initiative on Joint Implementation provides for private-sector proposals, to be approved by a government panel.¹²

Reasons for CDM: The potential economic merits and demerits of joint implementation have been widely discussed.¹³ Joint implementation has been promoted as potentially serving three related purposes: (a) a first step toward establishing an international tradeable permit system; (b) a cost-effective option for industrialized countries to finance emission reductions in developing countries; and (c) an activity to identify when it is cost effective to bring new emissions sources or sinks into an existing international greenhouse management scheme.

Joint implementation also raises many concerns. When applications are between developed and developing countries, where only the former commit to binding targets and the latter do not, it will be difficult to determine the emission-reduction effects of a specific joint implementation project (Tietenberg and Victor 1994). The effects of low-cost abatement projects are particularly difficult to estimate, because such projects may be nearly profitable

¹⁰For a comprehensive review of the legal and practical aspects of joint implementation see: Kuik, Peters and Schrijver (1994).

¹¹JI has taken on a significant "life of its own," including the creation of a number of institutions that have been developed purely for the purpose of furthering JI projects. See various issues of the periodical, *Joint Implementation Quarterly*, now in its second year of publication (in the Netherlands).

¹²For a recent summary of joint implementation projects, see: Zollinger and Dower 1996.

¹³See, for example: Barrett 1994b; Bohm 1994a; Loske and Oberthür 1994; Jepma 1995.

in the absence of the JI arrangement, and hence may be carried out without any policy intervention. In general, bilateral JI efforts are hampered by significant transaction costs and poorly defined property rights (Richards 1996).¹⁴ Further, there are significant incentives for parties to a joint implementation project to exaggerate a project's net emission reduction effects. Lastly, a system of JI agreements — on its own — would inevitably be inefficient, since countries would ignore benefits to third-party nations. In other words, the free-rider problem could not be overcome.

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

5.2.4 JI credits (betw. Ann I)

HS: This is the same issue as early credits; if it is about granting credit for action before 2008. If after, it is the same as inter-firm trading discussed elsewhere.

QF: JI between Annex I nations is only valid during the commitment period. Credits granted under JI must be subtracted from the host nation's cap, so this is same as inter-firm trading with added conditions that the projects must be "additional", approved by both countries, etc.. Why should credits be granted for CDM exchanges prior to commitment period but not JI credits?

KP:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 3:

10. Any emission reduction units, or any part of an assigned amount, which a Party acquires from another Party in accordance with the provisions of Article 6 or of Article 17 shall be added to the assigned amount for the acquiring party.

11. Any emission reduction units, or any part of an assigned amount, which a Party transfers to another Party in accordance with the provisions of Article 6 or of Article 17 shall be subtracted from the assigned amount for the transferring party.

Art. 6:

1. For the purpose of meeting its commitments under Article 3, any party included in Annex I may transfer to, or acquire from, and other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy provided that:

(a) Any such project has the approval of the Parties involved; (b) Any such project provides a reduction in emissions by sources, or an enhancement of removals by sinks that is additional to any that would otherwise occur; (c) It does not acquire any emission reduction units if it is not in compliance with its obligations under Articles 5 and 7; and (d) The acquisition of emission reduction units shall be supplemental to domestic actions for the purposes of meeting commitments under Article 3.

2. The COP, serving as the meeting of the Parties to this Protocol may, at its first session or as soon as practicable thereafter, further elaborate guidelines for the implementation of this Article, including for verification and reporting.

3. A Party included in Annex I may authorize legal entities to participate, under its responsibility, in actions leading to the generation, transfer or acquisition under this article of emission reduction units.

¹⁴This also suggests that current efforts to better define property rights and reduce transaction costs in joint implementation programs are well placed (Schmalensee 1996).

4. If a question of implementation by a Party included in Annex I of the requirements referred to in this Article is identified in accordance with the relevant provisions of Article 8, transfers and acquisitions of emission reduction units may continue to be made after the question has been identified, provided that any such units may not be used by a Party to meet its commitments under Article 3 until any issue of compliance is resolved.

Since parties have caps, as long as enforcement and monitoring are solid, not a problem, treat the same:

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

- 8 Article 3.10-11 requires each party trading JI credits to subtract those credits from their assigned amounts. Therefore, the responsibility is on the individual parties to ensure credits are real, certified, and quantified.

Diff. Between JI & Trading: It should be pointed out that inter-governmental emissions trading differs from joint implementation (JI) as specified in Article 6 of the Kyoto Protocol, at least for two reasons. First, inter-governmental emissions trading separates the issue of the financing from the source of generating allowances, whereas ERUs to be transferred and acquired are always tied with specific JI projects. Second, under normal conditions, no specific approval is needed to take the transactions in inter-governmental emissions trading, whereas any JI projects need the approval of both the host and investor Annex I countries.

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading.

5.3 Intertemporal Trading

HS: Yes, banking should be allowed. KP allows it, but only has one period. So need to begin defining subsequent periods.

* Borrowing will be harder. Modeling of the time path of emissions profiles shows that KP is not the efficient path, so would want to allow borrowing. But we don't want to put all of this onto the permit program. The better way to deal with it is by defining the ultimate goal of the convention and defining caps for all nations.

BH - a ton emitted today is not equivalent to a ton emitted tomorrow.

* (for language and citations, see RS Sequestration paper) - For purposes of efficiency (not cost-effectiveness) if marginal benefits are constant/linear and benefits and costs should be discounted at same rate, then it will be best to discount emissions permits in quantity terms (e.g. 1 ton abated today = 1.04 t abated tomorrow).

* Maybe get CO2 equivalent credits at time of banking and devise exchange rates for when actually used.

KP & Proposals:

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

* Commitments are defined over a five year period (cumulative emissions over the period 2008-2012), and parties reducing beyond their commitment can bank emissions to future periods. [article 3.13]

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

- 11 PAA units would be valid until used to offset emissions for the purposes of contributing to compliance (i.e. once used to offset emissions, PAA units would be retired from the trading system).
[NOTE – Same language for US et al proposal, par. 15]

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper

on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

At a Party's request, any AAUs not used to offset emissions or the remaining portion of its 'assigned amount' would be banked forward into the next commitment period pursuant to Article 3(13).

Nature of Problem:

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 198 "The temporal component of any pollution problem can be important, but this is particularly so in the case of "stock pollutants" which tend to accumulate in the environment at a rate which significantly exceeds their natural rate of decay. Accumulations of greenhouse gases are of this nature and thus raise a set of time-related issues. If the overall goal of some public policy were to limit the rate or degree of climate change, significant tradeoffs would exist with regard to the timing of any proposed reductions in greenhouse gas emissions. Earlier reductions would have the effect of slowing the potential onset of climate change.

Within the context of a tradeable permit system, these temporal considerations can be addressed, to some degree, through provisions for (or restrictions on) "banking," a mechanism that enables firms or nations to make early emission reductions in exchange for the right to emit a comparable amount at some later date. This notion could be extended to sinks as well as sources. It could be advantageous to allow nations to engage in banking of greenhouse gas allowances, since this would allow for intertemporally efficient market exchanges and would tend to delay the onset of global climate change.

On the other hand, the ability to hold permits over time raises concerns about possible strategic behavior, in the form of nations or sources that might receive large initial allocations and then chose to "hoard" their permits to exercise "market power." Regulated leasing of permits could be employed to address these concerns, at least in principle.²⁰

Experience with Banking; Banking offers a greater degree of intertemporal flexibility, thus lowering the cost of abating GHG emissions. There has been heavy use of banking in the US Acid Rain Program (cf. Ellerman et al., 1997), which has led to early reductions and substantially lower overall costs of compliance. In an international GHG emissions trading scheme, three types of banking can be distinguished. The first type of banking has built into Article 12.10 of the Kyoto Protocol. It specifies that CERs obtained under the CDM during the period 2000-2008 can be banked for later use in meeting Annex I country's commitments during the first commitment period 2008-2012. This banking clause provides the incentive for private firms in Annex I countries to invest in emissions reductions in developing countries prior to the beginning of the first commitment period. The second type is similar to the banking element built in the US Acid Rain Program. Once an emissions trading scheme, either domestic or international, is established among Annex B countries, permit holders are allowed to bank their unused permits to offset future emissions or to sell them to others. If property rights to permits during the commitment period are well defined, banking would encourage permit holders to go further with reducing emissions than their required emission limits in early years if it were more cost-effective for them to do so. The third type is early credits [discussed earlier in this outline]

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Discounting/Crediting temporaly:

Peck, Stephen C. and Thomas Tiesberg. (1997) A Property Rights Approach to Climate Change

If nations agreed on a concentration target of 550 ppm in 2070, approximately 425 billion tons can be emitted. Because of the natural decay, however, actual emissions could be much more and still meet the 550 target. One way to take this into account would be to issue permits for 425 billion ton, to emit GHGs would require a certain number of permits depending on when the emissions occur. Emissions in 2070

would require one permit, emissions in 2069 only (1-decay rate), etc. This would provide a credit for emissions that occur earlier in time.

Experience with banking/borrowing

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 7 * NZ Fisheries License Trading - Fishers can borrow up to 10% of following year's allowance by must then meet that limit in the next year. 10% can also be banked
- * Banking can allow significant savings especially for industries with large long-term capital expenditures, there has been heavy use of banking in US So2 program and in lead phasedown. This has led to early reductions and lower costs.
- * Banking/savings may be more important for domestic programs because KP only has one commitment period (although saving emissions reductions into the future is allowed).
- * 2 levels - "internal" banking and borrowing within the commitment period, and "external" banking between commitment periods. Unrestricted internal banking is already provided for.

5.3.2 Borrowing

The case against: "Although banking is relatively uncontroversial, borrowing is much more controversial (cf. Matsuo, 1997; Mullins and Baron, 1997; Zhang and Nentjes, 1998). Opponents fear that borrowing would make it more difficult to check whether emission sources are in compliance with their emission limits. If borrowing is allowed, firms facing bankruptcy have an incentive to borrow without being able to meet their future commitments. Borrowing could conceivably even discourage trading among individual emission sources, thus reducing market liquidity. Borrowing could also undermine the incentive to search for cleaner technologies. To some extent, the delayed response will mean additional committed warming."

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Safeguards for ensuring Borrowing meets env. Goals:

- limiting the contribution of borrowing to meeting an emission target;
- restricting borrowed permits to own use, rather than sale to others;
- restricting borrowing to special circumstances, such as insufficient availability of allowances on the international market;
- making borrowing of the allowance contingent on the stringency of overall emission limits (perhaps postponing its adoption until more stringent limits for the subsequent commitment periods are agreed). In any case, borrowing should not be allowed for the countries that are supposed to sell the "hot air"; and
- restricting how far into the future permits can be borrowed. For example, borrowing in the current period should not go beyond the subsequent commitment period.

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- * Some safeguards for allowing borrowing could include: + limiting borrowing to nations with caps in the following period + restrict borrowed allowances to own use + restrict borrowing to special circumstances (insufficient availability on international markets) + limit borrowing to one commitment period

5.4 Rules for Trade between Annex I

HS: Trade on the international system can be firm - country; country-country; or firm- firm, rules must support all three; but between firm trading in different countries is not defined by the “center”

5.4.1 How is a trade executed?

HS: During the true up period, would reconcile books.

Proposal:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

Par. 20: There are a number of ways in which the emissions trading market could be organized.

The following sets out the main options (these provisions could also apply to legal entities):

(a) Auction. Any transfer or acquisitions by a Party shall be carried out through open, competitive bidding accessible to all Parties.

(b) Prior notification. Parties shall notify the UNFCCC of their intention to transfer or acquire PAA units prior to any transfer/acquisition, and the UNFCCC Secretariat shall make such information available to all other eligible Parties. This could be limited to transfers/acquisitions above a specified amount.

(c) Use of available market mechanisms. Transfers and acquisitions by Parties may be carried out directly or through any mechanisms to facilitate transfers such as brokers, exchanges, or auctions.

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

30. All trades of AAUs would result in a debit and credit to the relevant accounts (i.e. a simple double-entry accounting system). For international trades, the 'seller' would request that its national recording system remove the AAUs in question from its account and authorise the national recording system of the 'buyer' to credit the buyer's account with those AAUs. For domestic trades (i.e. those that did not cross national borders) only the national recording system in that country would need to be involved.

Tradeoffs:

Russell, Douglas. (1998) The Kyoto Protocol: implications for emissions markets.

2 "Some parties would prefer.. Simple international structures, Other parties are concerned about the credibility of emissions trading should the international rules not also ensure equal access on the part of all parties to emission reduction credit opportunities."

Requirements for a trade:

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

55 Nations should be required to report all transactions, including those of their private entities. Private transactions will need to be effected through a deduction from the sellers national account, and an addition to the buyer's national account. Parties should agree not to recognize or accept permits for compliance in the absence of a demonstration from the exporting nation that they had subtracted those amounts. This effectively means that all trades are really nation-nation.

5.4.2 How, when, who certifies trades?

HS: This doesn't matter in an international tradable cap and trade system, leave it up to the parties.

BH: Depends on which trades - it matters for quotas [gov-gov].

Proposals:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

- 3 PAA units acquired (sold) are added (subtracted) to party's assigned amount.
 - * Parties annually report to secretariat the amount and serial numbers of units traded (by party and its entities). Parties verify to secretariat that legal entities transferring permits are registered owners of those units.
 - * UNFCCC secretariate (or other authority) will annually report on adjustments of assigned amounts through trading

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

24. The national recording system of a Party would record AAUs issued by the Party and transfers and acquisitions of AAUs by the Party, including those AAUs devolved to legal entities, and subsequent transactions by those entities. The national recording system would also be required to provide verification of ownership of AAUs. A Party could choose to maintain a list of all legal entities it authorises to trade.
25. By recording every change of legal ownership, the national recording system would protect against the possibility of counterfeit AAUs being generated and questions regarding legal ownership of legitimate AAUs.
29. One way to track AAU trades by the Party and its legal entities would be for the national recording system to operate an account for the Party and accounts for all legal entities authorised to trade.
30. All trades of AAUs would result in a debit and credit to the relevant accounts (i.e. a simple double-entry accounting system). For international trades, the 'seller' would request that its national recording system remove the AAUs in question from its account and authorise the national recording system of the 'buyer' to credit the buyer's account with those AAUs. For domestic trades (i.e. those that did not cross national borders) only the national recording system in that country would need to be involved.
31. National recording systems would only be required to track the account from which AAUs are to be transferred from (or to) and the quantity of AAUs to be transferred (including the serial numbers for the purpose of verifying ownership). Contractual information beyond the number of AAUs transferred between participants would not have to be divulged. Participant could choose not to divulge price details of individual trades to protect commercially sensitive information.

Create Int. Authority:

Center for Clean Air Policy. (1997) Greenhouse Gas Emissions Trading: Improved Compliance at Reduced Cost.

- 7 * An international trading authority should be created to "issue allowances, record trades, track all trading activity, and maintain accounts for all countries."

Don't need to worry in cap and trade system:

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua.

(1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

14 * Certifying trades is the biggest difference between allowance trading and credit trading systems. "Allowance trading does not require the certification of trades, as the authenticity of each allowance is built into the structure of the program."

8 * Lead Phasedown - Trading did not require prior gov. approval, trading reported to EPA at end of quarter as part of other reports

10 ...there should be no requirements for prior government approval of individual trades. Such requirements hampered EPA's Emissions Trading Program in the 1970s, while the lack of such requirements was an important factor in the success of lead trading (Hahn and Hester 1989). In the case of SO₂ trading, the absence of requirements for prior approval has reduced uncertainty for utilities and administrative costs for government, and contributed to low transactions costs (Rico 1995).

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

5.4.3 Limits to trade

[Also See 4.3.4]

HS: Our stance is that there should be no limits to trade unless it affects the integrity of the system.

Costs of restrictions:

Montgomery, W. David. Preliminary Modeling Results, CRA Model.

Annex B trading with "restrictions" (undefined) generate only half of the cost savings of free Annex B trading (14% versus 29% relative to no trading).

Bernstein, Paul M. and W. David Montgomery. (1998) How Much Could Kyoto Really Cost? A Reconstruction and Reconciliation of Administration Estimates.

16 GDP loss (%) to us(1990@2010)

notrade -1.27

annl (no hot air) -1.09%

AnnI (no rest) -0.91

5.5 Information Provision

HS: all trades (prices?) should be posted, let all else develop naturally.

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

4 Secretariat & parties make public list of all entities authorized to participate in trade.

5.5.1 What price information needed?

BH: ISSUE - do we want an auction for price signal?

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

National recording systems would only be required to track the account from which AAUs are to be transferred from (or to) and the quantity of AAUs to be transferred (including the serial numbers for the purpose of verifying ownership). Contractual information beyond the number of AAUs transferred between participants would not have to be divulged. Participant could choose not to divulge price details of individual trades to protect commercially sensitive information

Auction:

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 5 * US Acid Rain Program has annual public auction of 3% of allowances conducted by EPA. "does not raise revenue for government, but serves a useful purpose in providing a highly visible price signal and addressing potential concerns about market power."
* Can argue that price information should be included in emissions trades and that the public benefits of revealing prices outweigh the private interest of parties involved. Price information could be required in reporting requirements or through regular public auctions.

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

- 11 * Annual EPA auctions may have helped reveal market valuations, but bilateral trading has also informed auctions (Joskow, Schmalensee, and Bailey)

5.5.2 Role of int. organizations, national gov

Proposals:

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

23. Markets play a central role in the efficient exchange of "goods" such as commodities, shares, bonds and financial instruments. Existing international markets have a number of well-established practices for contracting, delivery and settlement. An issue for international emissions trading is whether it is necessary to establish a new official institution to facilitate trades. Given the large number of existing commercial market institutions that handle international transactions (both financial and commodity), there seems no benefit in establishing a new international forum/institution to cater for trades of AAUs. The only additional function, over and above those required in the absence of trading, is a system to record ownership and transfers of AAUs at the national level.

Tradeoffs with central purchasing agent:

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

- 8 * Central purchasing agents are advocated to reduce search and approval costs, but could also invite market power. A better way to reduce transaction costs would be through organized exchanges and fungible allowances.

Role in past programs;

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 6 * RECLAIM: gov. entity maintains public record of all transactions, availability and prices in official registry and maintains bulletin board to help facilities identify availability.
 * Existing programs do not require that prices in private trades be revealed, though SO₂ has an auction. This is usually left to private sector.

Private sector brokerage role in SO₂ & Auctions Finally, the SO₂ program's performance demonstrates that the private sector can fulfill brokerage needs, providing price information and matching trading partners, despite claims to the contrary when the program was enacted. Entrepreneurs have stepped in to make available a variety of services, including private brokerage, electronic bid/ask bulletin boards, and allowance price forecasts. The annual EPA auctions may have served the purpose of helping to reveal market valuations of allowances, but bilateral trading has also informed the auctions (Joskow, Schmalensee, and Bailey 1996).

Stavins, Robert N.. (1998) What Can We Learn From the Grand Policy Experiment? Lessons from SO₂ Allowance Trading.

[BH experience with lead and ET confirm this]

5.6. Monitoring

HS: wide agreement on reporting and monitoring (self and annually, reports); this works also for the ITP system.

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P.190 "For a tradeable permit (or any other) policy to be truly effective and operate at least cost, firms or nations must comply with the policy's requirements. In the international trading context, this means that nations must accurately report changes in greenhouse gas sources and sinks and must purchase the appropriate number of permits if their net emissions exceed their permitted level. Monitoring and enforcement costs for an international body would be significant, but it is essential to keep in mind that such compliance problems arise with a number of alternative approaches as well."

P. 197 "Clearly, there are significant tradeoffs between monitoring ease and accuracy. For example, it would be theoretically desirable to allow full flexibility for nations to achieve their emissions targets (permit levels) through any means they might choose, including reduced fossil-fuel combustion, on the one hand, and reforestation, on the other. But this would also necessitate an extremely expensive monitoring system *or* the adoption of some simplifying assumptions (regarding the impact of given fuel uses on emissions and the relative impacts of various reforestation programs)."

5.6.1 How, when, who monitors for compliance?

Decomposition of Monitoring & Enforcement: Inevitably, the institutional question of who would monitor and enforce such an international program seems paramount. Here it is useful to decompose the "monitoring and enforcement problem" among coalition countries into three separate issues: monitoring; enforcing violations at

the margin; and maintaining an enforcing coalition.¹⁵

Mechanisms for Monitoring First, the monitoring problem is really quite similar for different policy instruments, and, it may not even be necessary to monitor. This is because an international tradeable permit system — and some other instruments — could be based on *ex ante* demonstration of likely compliance, rather than *ex post* validation (Victor and Salt 1995; Schmalensee 1996), an approach that has been used successfully in the past in international economic agreements, if not environmental ones. This is not to suggest that compliance problems are trivial; only that they are not necessarily insoluble. Thus, monitoring, *per se*, need not be a great obstacle...

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

Self reporting; external verification

Cooper, Richard. (1996) A Treaty on Global Climate Change: Problems and Prospects.

In looking at tax instruments: (from Hahn '97)

Regular reporting and external monitoring of actions relevant to the treaty is required.

Stewart, Richard, Jonathan Wiener, Philippe Sands. (1996) Legal Issues Presented by a Pilot International Greenhouse Gas Trading System.

Members make standardized annual reports of emissions and permit trades to a monitor. The monitor checks self-reporting systems, checks annual reports, and certifies members.

Tietenberg, Tom, and David Victor. (1994) Possible Administrative Structures and Procedures.

- * Self-reporting of emissions and permit trades, layered with veracity checks will produce transparent information. Public opinion and normative pressure will deter violations.

- * There is a norm of following international treaties. Rely heavily on domestic enforcement of international standards. Develop mechanisms for dispute resolution through negotiations.

International review:

Center for Clean Air Policy. (1997) Greenhouse Gas Emissions Trading: Improved Compliance at Reduced Cost.

7 * International teams under FCCC secretariat could conduct reviews of domestic emissions calculations and compliance systems; reviewing country records and performing detailed reviews every few years.

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

5 * US Acid Rain program is "gold standard" for monitoring. High quality continuous monitoring of all emissions sent into central EPA tracking system. Monitors cost between \$100,000 - 150,000 each.

- * For CO₂ emissions from energy, could examine fuel transactions relatively easily. For other gases & sources, this would be difficult. [seems mostly an issue for the parties, not for the ITP system]
- * International institution would only have to approve and verify that the domestic monitoring system is functioning properly. Veracity checks should range from the local to national level. All

¹⁵I am grateful to Bob Keohane for having pointed out the importance of this decomposition.

reporting should be standardized.

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.
Art. 7, * Each party must submit inventories annually after 2008 through national communications,
8 these are reviewed by expert teams

Tietenberg, Tom, and David G. Victor. (1994) "Implementation Issues for a Tradable Permit Approach to Controlling Global Warming"

166. Design principles for monitoring system: 1) rely heavily on self reporting – polluters have most information about their activities, other modes are not economical or politically viable. 2) Create layers of veracity checks – self reporting has risks of deception, veracity checks should be carried out domestically by parties, and those checks should themselves be reviewed. 3) Promote transparency of behavior through wide availability of collected data, 4) begin monitoring processes promptly, 5) design monitoring procedures and institutions with future expansion in mind.

5.6.2 Reporting Requirements

Proposals:

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

26. Each Party would be required to report annually on trading activity to a designated authority approved by the FCCC COP. This report would identify the aggregate quantity of international trades and any changes to the Party's 'assigned amount' pursuant to Articles 3(3), 3(1), 3(11) and 3(12). This would enable the designated authority to produce a syntheses report of each Party's 'assigned amount', including AAU holdings by each Party and transfers to, and acquisitions from, other Parties.

27. The synthesis report would confirm, at an aggregate level, that correct double-entry book keeping between Parties had occurred. In the event of discrepancies in the reports submitted by Parties, the designated authority would request that those Parties investigate and correct such discrepancies.

28. Two or more Parties could voluntarily consolidate their national recording systems into one system, provided that each individual Party's account was reflected. This might simplify tracking of AAU transfers and preparation of synthesis reports as well as reduce the possibility of discrepancies between Parties' reports on trading activity.

35. At the end of the commitment period and following finalisation of emission inventories, each Party would be required to submit a report to the designated authority 11. This report would include emissions for the commitment period and aggregate information on the number of acquisitions and transfers of AAUs and any changes to a Party's 'assigned amount' pursuant to Articles 3(3), 3(10), 3(11) and 3(12) (i.e. a compilation of annual emission inventories and information on trading activity). Based on this information, the Party could ascertain whether it had exceeded its 'assigned amount'.

36. The report would also indicate the serial numbers of AAUs used by the Party for the purposes of contributing to compliance. AAUs used by the Party to contribute to compliance would no longer be valid and would be required to be removed from the Party's national recording system (i.e. AAUs are a consumable commodity).

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

16. The UNFCCC Secretariat shall make information on the Parties that are eligible to participate in international trade publicly available. Each Party shall maintain a record of names and contact details of authorized legal entities within its jurisdiction that it authorizes to trade, and such information shall be made available both to the UNFCCC Secretariat and to the public.

17. Parties shall track and record information on all transfers of PAA units by authorized legal entities within their jurisdiction. This information should include the amount and serial numbers of the PAA units transferred, and identify the entities and their authorizing Parties between which the transaction has taken place.

18. Parties shall report, at least annually, to the UNFCCC secretariat (or an authority designated by the COP) the amount and serial numbers of the PAA units and the counterparts of all transfers and acquisitions that result in changes to their assigned amounts, including those involving legal entities. Parties shall verify to the UNFCCC Secretariat (or an authority designated by the COP) that a legal entity transferring PAA units was the registered owner of the PAA units in question.

19. The UNFCCC secretariat (or an authority designated by the COP) shall produce, on an annual basis, a tabulation of the adjustments to assigned amounts required under Articles 3.10 and 3.11 for each Party that has carried out transfers or acquisitions of PAA units.

Self Reporting and its problems

Kerr, Suzi. (1998) *Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits*. p. 11 "Information comes primarily from self-reporting as required under the Convention or from direct observation and measurement. The quality of data passed to the international agency is often suspect. In developed countries the level of compliance could be partly observed by considering the adequacy of domestic laws and regulations because the existence of a law or regulation implies a certain level of enforcement. Increasing the amount of information and its quality can be costly because of sovereignty issues that inhibit direct enforcement and because the international agency is usually not involved in projects."

Need Proxies:

Tietenberg, Tom, and David G. Victor. (1994) "Implementation Issues for a Tradable Permit Approach to Controlling Global Warming"

165. For the most part, direct emissions are rarely measured, so proxies are used and then emissions are computed on the bases of the proxy using an emissions factor. There are two key issues of reporting – what is the monitorability of the proxy and how well do emission factors estimate actual emissions?

Dudek, Daniel, and Joseph Goffman. (1997) *Emissions Budgets: Building an Effective International Greenhouse Gas Control System*.

From Hahn (1997):

members should submit annual report detailing their emissions budget, actual domestic emissions, domestic offsets, exported reductions, imported reductions, emissions savings, and end of period net.

Elements of a Reporting Structure:

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) *Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability*.

13 * Two kinds of reporting - reporting of emissions and reporting of emissions trading activity to

some international authority.

- * Emissions reporting is already part of a nation's compliance trading and is described in Art. 3

- * Reporting of emissions trading activity would be required for quality assurance and enforcement. All US trading programs require immediate reporting to a gov. controlled, public registry. This could take the form of a report stating total original allowance level, actual emissions, and any trading activity. [discussed at a source level in the paper]

- * all of this should be open to public. This helps create a transparent and self-enforcing compliance system.

- * Reporting can be based on self-reporting (reports), direct or indirect inspections (direct inspections are like the inspections in disarmament agreements, indirect inspections would be inspection of related data - energy consumption), or some combination.

- * Recommends that all international trades be registered with an international body.

Victor, David G. and Salt, Julian E.. (1995) Keeping the Climate Treaty Relevant.

280 * Three elements are key - accurate, comparable and disaggregated emissions data; planned policies and measures and their potential effects; and standards against which to judge action.

5.6.3 Reporting in Other Int. Agreements

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua.

(1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

28 * There are basically two tools in monitoring and reporting -- self reporting accompanied with veracity checks, and sometimes intrusive monitoring.

- * "Although self-reporting systems are regularly established under int. environmental agreements, the extent to which the parties take them seriously is mixed and generally negative" (from GAO, 1992).

- * Intrusive monitoring has only been used in a few (usually defense related) agreements -- Intermediate-range Nuclear Forces and Conventional Forces in Europe, Nuclear non-Proliferation Treaty, etc.

- * Self reporting is also the norm for international economic agreements

Victor, David G. and Salt, Julian E.. (1995) Keeping the Climate Treaty Relevant.

281 * With some exceptions (Mitchell, "Intentional Oil Pollution at Sea: Env. Treaty Compliance and Treaty Compliance" MIT 1994), most international agreements have failed to gather enough information on what parties are doing (and planning to do) to achieve their objectives. (USGAO International Environment: International Agreements are not well monitored" 1992)

- * Other international experience (OECD, IMF, Int Labor Organization, GATT) shows that

reporting,

review and assessment can lead to effective agreements. (Sand, 1990, Chayes & Chayes, 1993; Lykke 1993; Hudec, 1993; Victor, Chayes, & Skolnikoff, 1993; Lee, 1993)

- * "visits" to assess monitoring and compliance has led to more effective reviews and has created pressure on states to stay in compliance (Sand, 1990; Chayes & Chayes, 1993; Victor, Chayes & Skolnikoff, 1993)

5.7 Enforcement

Hahn, Robert and Robert Stavins. (1995) Trading in Greenhouse Permits: A Critical Examination of Design and Implementation Issues.

P. 197 "There are likely to be two critical problems in dealing with enforcement in the international emissions-trading context. The first is that enforcement will differ significantly across countries that sign an agreement. The second is that countries that do not sign an agreement to reduce greenhouse gases will be able to "free ride" on those that do. Neither of these problems has simple solutions that are politically feasible in the near term."

P. 198 One option is to restrict trading to those nations that are deemed to be in compliance (see who trades section)

"A somewhat more ambitious alternative would allow international trading based on allowances that do not trade on a one-for-one basis, but reflect their actual value, rather than the face value of the allowance. Thus, if Denmark were in compliance, but Brazil had greenhouse gas emissions that were 100 percent above its allowable levels, then Brazilian permits would be traded at a 2:1 ratio with Danish permits. Again, the supra-national group would need to define the trading ratios between nations. This latter approach adds a level of complexity that may make the system very difficult to administer. Moreover, countries would probably be reluctant to cede this kind of authority, with its potentially large implicit wealth transfers, to an international body."

5.7.1 Liability

BH: Problem is is this country-country trades? If the US trades with Russia, is it now responsible for Russia's meeting its limits? What prevents a country from reneging on its commitment after selling all its permits?

Proposal:

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

22. Party which is found to be in non-compliance with its obligations under Article 3 will face compliance procedures under Article 18. If such a Party has transferred PAA units to any other Party, the units transferred should be invalidated in part, or in full, for the purposes of meeting the commitments of the acquiring Parties under the Protocol. Otherwise, Parties could have no incentive not to buy PAA units from Parties they expected to be in eventual non-compliance. Modalities for invalidation of PAA units transferred under these circumstances will need to be further explored. However, if a Party finds itself in non-compliance due to the full or partial invalidation of acquired PAA units, it may be appropriate for that Party to face less stringent penalties than the seller Party.

Description of Issue: Annex I trading involves either international trade in domestic emission permits or bilateral contracts for the creation and exchange of emission reduction credits. In either case, the fact that the actors trading all are in Annex I means that their respective governments are ultimately responsible for their actions and all trading entities should be governed by their domestic compliance mechanisms. The Kyoto Protocol requires each Annex I country to develop an operational capacity to keep track of their aggregate net emissions, and a capacity to develop and implement policies and measures to ensure that those emissions remain within the negotiated

targets. In practice, things could go wrong. Buyers and sellers could misrepresent their emissions to their national regulators. The national regulators could strategically misrepresent their total emissions and permit/credit balances to the international bodies charged with overseeing compliance under the Framework Convention and Kyoto Protocol. They also could simply not achieve their target net of trading and claim that conditions, possibly including the behavior of sub-national actors, were beyond their control. In response to concerns about this potential threat to the credibility of Annex I trading, a number of proposals have been offered for assigning liability for "bad" permits or credits, those coming from a non-compliant seller country. Within Annex I, seller countries are always liable for net emissions minus permit sales. The question is whether the buying side should also be liable. [p.9]

Fischer, Carolyn, Suzi Kerr, and Michael Toman. (1998) Climate Policy Instruments Under Uncertainty.

Hinchey, Mike, Kevin Hanslow, Brian Fisher, and Brett Graham. (1998) International Trading in Greenhouse Gas Emissions: Some Fundamental Principles.

45 *basic property in a market is that a given good should exchange at same price at a given time. In ITP system, the problem is that emissions credits which may be "nominally identical" will involve different probabilities that the actual emissions reductions to back the permit has been (or will be) undertaken -- effectiveness of monitoring and enforcement may differ between countries.

Case for Maintaining Seller Liability:

Wiener, Jonathan B. (1997) Designing Markets for International Greenhouse Gas Control.

3 * Allowances should be fungible, representing one unit of GHG emissions w/out reference to the country from which they originated so that buyers can rely on the value of the allowance without needing to investigate seller's behaviour.

Limitations of Seller Liability: "Seller beware" works well in domestic emissions trading scheme, such as the US Acid Rain Program whose built-in effective enforcement mechanisms make non-compliance very expensive and unattractive. However, an international "seller beware" trading scheme will be problematic, given the fact that enforcement at the international level often proves to be more difficult and less likely to be effective than at the national level because of the absence of an institution with the international jurisdiction to enforce policy. As such, the "seller beware" liability could lead to a regime of weak compliance because the lack of strong enforcement at the international level would provide few disincentive for buyers to acquire from sellers who take a lax attitude to compliance.

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Buyer Liability: "Under this approach, if a government found that some of its regulated entities met their obligations with purchased permits or credits from a country determined to be non-compliant, that government would be responsible for covering their ex post "carbon deficits". It could purchase additional "secured" permits or credits from other sources, as well as possibly being sanctioned in some fashion. The government would probably make their domestic entities liable under domestic law, but it cannot delegate aggregate national compliance responsibility... Buyer liability could put all transactions with that country at risk. Alternatively, only project-based credits, or those permit or credit sales beyond some target level of seller country emissions might be subjected to this caveat emptor test. If buyer countries were liable for seller non-compliance, buyer countries and their sub-national actors, to whom they pass the liability, would undertake a variety of risk management measures. Expert assessments of noncompliance risk would be developed to help buyers gauge the probabilities of having their permits or credits devalued ex post, and these probabilities would be used by buyers to discount the price of purchased credits from less secure sources accordingly. To the extent that noncompliance was based on the

nonperformance of a specific seller, rather than aggregate national emissions by the selling country, buyers would use the discounting mechanism as leverage to shift some of the burden of compliance back to sellers by offering higher prices for more secure emission reductions. Buyers would refuse to trade with especially risky sellers. These actions impose monitoring and risk-assessment costs on the buyer, encourage sellers to provide transparent information on their compliance, and punish unreliable sellers by limiting their gains from trading. [p10]

Fischer, Carolyn, Suzi Kerr, and Michael Toman. (1998) *Climate Policy Instruments Under Uncertainty*.

Kerr, Suzi. (1998) *Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits*.

Costs of Buyer Liability: p.8 “Buyer liability is not costless – raises transaction costs of trades and increases the risk borne by buyers. Buyers may need to be certified by their national government because they are imposing risks on the country. Buyers bear more risk, so they will search for safer credits, monitor the credits they do purchase, and look for insurance. This is costly. They will also trade less, giving up some gains from trade. In addition, buyer liability may be achieved at the cost of lessened seller liability. Buyer and seller liability are not strictly additive.

Kerr, Suzi. (1998) *Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits*.

Gains from Buyer Liability: p. 8: “For it to be valuable to hold the buyer liable, it is necessary for the buyer to have information about the seller’s actual credit creation, and/or effort. If, in addition to observing credit creation, the buyer is more vulnerable to punishment, and/or more risk averse, the international agency can create stronger incentives to correctly report credits, and hence can improve compliance. If the buyer is less risk averse but punishment can be based on less certain evidence of non-compliance, the international agency can also increase the strength of compliance incentives. If, in addition to being able to observe effort, the buyer can enforce contracts with the seller better than vice versa, and buyer effort is important for efficient credit creation, buyer liability will improve the capacity of the project as a whole to produce the promised credits.” [borrowing from Holmström and Milgrom (1990)]

Conditions for Joint Liability to be better: Introducing buyer liability, in addition to seller liability, will increase compliance, but may do so at high cost relative to the gains and relative to the costs of increasing compliance pressure on sellers. Buyers can affect seller behavior by observing seller conduct and then responding to it either by changing their trading behavior, offering less for risky credits, or by sanctioning non-complying sellers directly. For buyer liability to be beneficial, buyers must have a comparative advantage relative to the international community either in monitoring or responding to seller non-compliance, and they must not be so risk averse that bearing the risk of penalties for noncompliance would drive them from the market. Both buyer and seller must be able to be fully sanctioned. If these conditions hold it could be efficient for the international community to “sub-contract” with the buyer, with the threat of sanctions as the incentive, rather than increasing (or as a replacement for) their own effort.

Fischer, Carolyn, Suzi Kerr, and Michael Toman. (1998) *Climate Policy Instruments Under Uncertainty*.

Analysis of Joint Liability: Neither buyers nor intermediaries are likely to have a strong comparative advantage in assessing the prospective conduct of sellers, at least early on in the advent of international GHG trading. Any individual buyer country is in a very similar situation to the international agency when trying to monitor another country's GHG production. If they subcontract monitoring to specialists, the international agency could do likewise. Buyers may duplicate each other's efforts. Market reputations about seller conduct will take some time to develop. Buyers' options for policing seller behavior are inherently limited if defectiveness of credits is based solely on national aggregate emissions of the seller country versus transaction-specific findings. In particular, buyer liability is a form of joint and several liability that imposes the burden of non-compliant conduct by some

buyers on all buyers. No buyer, and no sub-national seller, can control the risk of national non-compliance. It follows that under buyer liability, buyers will face potentially high transaction costs in assessing the reliability of permits or credits offered on the international market. This will reduce trading and raise global abatement costs. Despite careful choice of sellers, buyers will still face uncontrollable risk that they will attempt to insure against by holding additional credits as a reserve margin or buying insurance from a broker. They will face high costs from of the uncontrollable risk they are required to bear. Buyers are unlikely to satisfy the conditions for being a good monitoring and enforcement agent on the international community's behalf.

Fischer, Carolyn, Suzi Kerr, and Michael Toman. (1998) *Climate Policy Instruments Under Uncertainty*.

Kerr, Suzi. (1998) *Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits*.

Joint Liability: p.9 “One advantage of holding both buyer and seller liable arises where punishments are limited and both can be punished to the greatest extent possible simultaneously. This is often impossible in practice because of social norms. If both can be punished, the enforcement possibilities are expanded.”

Recommendations : We believe that on balance an appropriately defined seller liability program is the best way to allocate liability for performance failures in Annex I trades. To implement this program we would couple ex post sanctions on non-compliant Annex I countries with qualifying requirements for Annex I countries to participate in this trading market. The sanctions would have to be serious enough to motivate seller country governments to deter cheating by their private actors (e.g., forfeiture of future quota, limits on future access to the market), given that these countries are prepared to meet their international obligations. The national qualification process would look at countries' domestic monitoring and enforcement capabilities (including the general strengths of the legal systems for regulatory and contract enforcement), and perhaps at other factors that bear on their commitment and capacity to meet their obligations. Countries that fail to meet the qualifications would still be able to participate in trading, but only through the project-level CDM mechanism described below, with buyer liability. Determining a more fully articulated set of qualification criteria and applying them in practice would be inherently subjective, but no more so than determining countries' eligibility to participate in the IMF or WTO.

Fischer, Carolyn, Suzi Kerr, and Michael Toman. (1998) *Climate Policy Instruments Under Uncertainty*.

Kerr, Suzi. (1998) *Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits*.

p. 15 “Within Annex 1, with the possible exception of Russia, the parties are relatively symmetric in their in their vulnerability to punishment, risk aversion and capability to carry out projects. If punishments within Annex 1 are considered inadequate, gains could arise from holding both liable. The punishments available in trading, however, are more serious than those for the agreement as a whole because of the threat of disallowing future trading. If individual punishments were not strong enough, this would suggest that the abatement commitments are more than the institutions can support. The seller country has an information advantage in monitoring the progress of the project, and a contractual advantage in enforcing contracts under its domestic law. Holding a buyer responsible for a homogeneous permit makes them indirectly responsible for the marginal unit of abatement wherever it occurs in the seller country. An individual buyer has no advantage in monitoring and controlling compliance in another country. The risk imposed on them will lead them to invest in monitoring and exert effort when choosing trading partners but they have no advantage in doing this. The transaction costs could have significant effects on market efficiency. The compliance gains from holding the buyer liable as well as the seller must be weighed against its cost.

Diff. Joint Liability Proposals: “It is desirable to assign the buyer-seller hybrid responsibility by introducing a process of evaluating Parties' efforts towards implementation during the commitment period. This includes annual reporting of the progress of each Party in meeting its assigned amounts. If in a given year a Party's

actual emissions did not exceed by a certain margin its annualized assigned amounts, the seller's tons acquired by the buyers would be valid. After the year when the seller is found to go beyond that tolerance margin, however, the buyers become liable for potential non-compliance by the seller. As such, the allowances acquired prior to that year would not be discounted, thus avoiding the imposition of retroactive liability for the buyer."

Zhang, ZhongXiang. (1998) Towards a Successful International GHG Trading

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

EDF proposal includes primarily seller liability (penalties for non-compliance at end of true up period), but with one aspect of buyer-awareness (permits from interim non-complying nations would be discounted to the extent of non-compliance) This would create additional market pressure on the seller (inability to sell full value of permits) [Q: while also keeping transaction costs low to the buyer (discount would be specified upfront and so buyers wouldn't have to research the sellers specific situation.)

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

16 * "Liability is straightforward for allowance trading because all covered sources need simply show they have sufficient allowances to cover their emissions at end of compliance period. Sources are liable if they do not have enough allowances. A GHG international trading system could adopt this system if the integrity of the underlying monitoring and compliance systems of allowance trading countries are high, and a compliance system at least ensures that any country or source emitting an excess ton makes the environment whole by replacing that ton with emissino reductions purchased or achieved elsewhere."

* "buyer beware" systems create uncertainty and risk because buyers are not guaranteed that they will benefit from their purchase until the seller has been certified. Seller liability is constrained because of the high transaction costs for pre-certification, and random audits have lower credibility.

* Seller beware makes sense in a strong enforcement regime because it creates incentives on selling nations to ensure domestic reductions. This might not work for the KP because 1) commitment periods are very long, and 2) there are no subsequent commitment periods. In this case, a "vintage" model (where the permits needed to cover the amount over are voided starting with the last units traded) would work better than a "proportionate reduction" model (?)

* "One problem with a buyer beware system is that it uses a fairly blunt instrument to solve a fairly specific problemY A better solution would be to target the instrument only on those Parties that are causing the problem.. Implementing a buyer beware requirement only for allowances purchased from a party found in noncompliance in the previous period."

5.7.2 Appropriate Enforcement Mechansim

* BH - need to have a continuous schedule of mechanisms/fines. Can't have just one severe mechanism past a threshold.

Proposals:

Australia, Canada, Iceland, Japan, New Zealand, Norway, Russian Federation, US. (1998) US Non-Paper on Principles, Modalities, Rules, and Guidelines for an International Emissions Trading Regime.

32. The trading rules should provide appropriate compliance and enforcement mechanisms relevant to the trading system. Other compliance issues could be addressed under Article 18.

33. One enforcement mechanism under the trading rules could be to deny (or restrict) the right of a Party (and its legal entities) to transfer AAUs if they are found to be in breach of the trading rules and/or are no longer in compliance with the conditions for issuing AAUs (e.g. in breach of conditions to trade AAUs internationally).

37. A Party that had exceeded its 'assigned amount' would be able to come into compliance during a short grace period (e.g. three months). To meet the short fall. After the completion of the grace period, Parties would re-submit a (modified) report. Parties who were non-complying could face non-compliance consequences developed under Article 18

United Kingdom of Great Britain and Northern Ireland. (1998) Non-Paper on Principles, Modalities, Rules and Guidelines for an International Emissions Trading Regime.

21. Rules about risk-sharing and legal liability will need to be elaborated, in order, inter alia, to provide compliance incentives and to improve the quality of Parties' monitoring systems. This section sets out the main parameters.

23. If a question of compliance by a Party included in Annex B of the rules of the trading system as set out in the paragraphs above is identified, transfers and acquisitions of assigned emission units may continue to be made after the question has been identified, provided that any such units may not be used by a Party to meet its commitments under Article 3 until any issue of compliance is resolved.

Continuous Schedule of Fines -- For countries that sign an agreement, the sanctions for not complying should increase gradually (Stewart, Wiener, and Sands, 1996). Such sanctions would make it easier to bring a country back into compliance. [p.19]

Summary of Different Approaches to Enforcement: Cooper effectively assumes enforcement will not be an issue for a tax if there is support for the treaty and actions are transparent so they can be easily monitored. Dudek and Goffman (1997) and Stewart, Wiener, and Sands (1996) suggest specific penalties in the case of a tradeable permits. Tietenberg and Victor (1994) suggest negotiating a mechanism for dispute resolution. Victor (1997) argues that the threat or use of trade sanctions can alter countries' behavior in order to gain compliance. Based on the implementation of the Montreal Protocol to reduce stratospheric ozone, he contends that linking international aid from other sources to compliance also can be an effective enforcement mechanism.

Hahn, Robert. (1998) Climate Change: Economics, Politics, and Policy.

Experience:

Kerr, Suzi. (1998) Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits.

11 International punishments for non-compliance are relatively weak because of the uncertain status of international law. However the international community can punish the countries to a certain extent. The first punishment is that the invalid credits would be disallowed. If the buyer has already paid for these permits, and is unable to recoup the cost, they would bear the full cost; otherwise the cost would be shared between buyer and seller. In addition, the country could be restricted in its future trading activity.[Milgrom, North and Weingast (1990) show how the privilege of trading can be used to encourage monitoring efforts by traders.] If, for example, the country is not allowed to trade in the following year

they lose all the gains from trading, which could be considerable.

Proposal with Schedule of mechanisms:

Environmental Defense Fund. (1998) Cooperative Mechanisms Under the Kyoto Protocol: The Path Forward.

42 There should be several stages of enforcement:

a) True-Up Period – at the end of the period, there should be a 6 month period where all parties could purchase credits from Ann.B or CDM to get into compliance.

B) Automatic Deduction – after the true up period, if a party is still not in compliance, its assigned amount for the following commitment period will be reduced by the amount of its excess emissions.

c) Incremental Deduction – The deduction from the following commitment period should be reduced by more than the amount in excess. “The atmosphere is affected not only by the excess emissions during that compliance period, but also by the amount of warming those excess emissions cause over their lifetime.” The rules should specify that the quantity by which a Party’s assigned amount is reduced must be greater than the exceeded amount. Recommends 20%, called the “atmospheric penalty.” This procedure would also prevent nations from using the mechanism to “borrow” from future commitments.

d) Track compliance within the commitment Period – Each party should report annually on their trading activity and on how they are progressing to meeting their commitments. Once the party’s emissions exceed a certain amount of its assigned amount, (110%) there should be a mandatory discount on all future exports of credits from that country for that compliance period. The discount would be the proportion of the exporting country’s excess emissions. This would encourage countries to stay on track. Also important, it would force the market to value each country’s exported credits differently based on their compliance, creating a premium for quality.

e) Prohibit sales and transfers – Once parties have exceeded some upper threshold, they should be prohibited from trading.

Tietenberg, Tom, and David G. Victor. (1994) “Implementation Issues for a Tradable Permit Approach to Controlling Global Warming”

168 Stages of enforcement – 1) suspicion and flag raising, 2) investigation, 3) clarification and judgement, 4) penalty.

169 Design Principles: 1) rely heavily on domestic enforcement, especially by existing institutions, 2) set international standards for domestic enforcement, 3) perform veracity checks and international adjustments through agreed procedures – enforcement will be judged on self reporting, which should be subject to verification. 4) ensure proper operation of dispute resolution procedure, 5) push early adoption of procedures, 6) transparency.

Stewart, Richard, Jonathan Wiener, Philippe Sands. (1996) Legal Issues Presented by a Pilot International Greenhouse Gas Trading System.

A small level of excess GHGs will trigger a reduction in the next period's budget. Larger violations result in larger than 1 to 1 reductions. Repeated noncompliance draws fines and finally offenders will forfeit financial securities held by the organizing body. Domestic environmental groups and holders of GHG permits will also apply political pressure.

Deduct from next year’s allocation

Dudek, Daniel, and Joseph Goffman. (1997) Emissions Budgets: Building an Effective International Greenhouse Gas Control System.

From Hahn (1997):

Any country with excess GHGs will have the same number deducted from their next budget and any permits a violator has exported will be discounted in the current budget. Shifting risk to buyers will effectively exclude noncomplying members from GHG trading. Rules out general trade sanctions.

Cooper, Richard. (1996) A Treaty on Global Climate Change: Problems and Prospects.

Most treaty violations are due to misunderstandings, so a commitment to treaty objectives and transparent actions are the key to compliance.

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- * Acid Rain Program includes high fines and forfeiture of allowances if in violation. (5)
- * RECLAIM - facilities that fail to meet their reductions are required to achieve the reduction by the following year and may be subject to \$ penalties.
- * RECONCILIATION PERIOD - in both US SO₂ program and RECLAIM, there is a two month period where sources in non-compliance are allowed to purchase allowances needed to meet their emissions. "Promotes compliance and reduces risk in the market."
- * Proposes a financial penalty and requiring a ton for ton reduction in the following commitment period
- * Effective enforcement needs to balance need to respect sovereignty with need to promote compliance. Need rewards for good behavior and sanctions for bad. "One mechanism that appears to hold promise in this regard involves using eligibility to trade as an enforcement mechanism." For example, trades could be allowed between only "eligible" parties - those with sufficient monitoring/enforcement systems. That way, parties without the sufficient monitoring/compliance systems would have to use only domestic measures until they upgrade their systems. From then on, trade could be restricted to parties that were in compliance in the period before. (see 3.1.1)
- * (EDF 1998) - subtract an amount from the next commitment period allocation which is some multiple of the amount in non-compliance. This would not only be a penalty, but would be a source of additional emissions reductions as the amount subtracted would be unavailable.

UNFCCC. (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Art. 18 * Enforcement in KP has no real teeth, relying on "moral suasion" (Baron, 1998)

Using Allocation to enhance Enforcement: ...the tradeable permit mechanism itself can help address the challenge, since permits can initially be allocated to favor low-cost abaters, i.e. permit sellers. Such an allocation can reduce the probability of marginal violations, because it makes sellers vulnerable to enforcement actions by the (enforcing) coalition of countries (Keohane and Nye 1977). On the other hand, under such an initial allocation (of permits to low-cost controllers, which may largely be developing countries), the incentives for the high-cost controllers (the buyers, most likely the industrialized countries) to maintain the enforcing coalition (the original agreement) are reduced. In the past, this factor has contributed to the collapse of international agreements (Lien and Bates 1987).

Ban on Trade on Carbon Fuels and products (Barrett '94). But this introduces distortions on the global economy, the cost of which would have to be weighed against distortions of free-riding/non-compliance.

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

5.7.2.1 Levels of fines/sanctions

* RS - a) enforcement must be high enough to encourage compliance, [BH - not quite, unless its variable] and b) low enough to be credible (US Clean Air Act). C) upper bound in theory should be the marginal abatement costs. [? marginal damages?]

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 15 * US SO₂ program has high fines \$2000 per ton and offset the excess emissions with equivalent allowances. (current prices around \$100) High compliance
- * NZ fishing - high fines and possible forfeiture of vessels, also high compliance.

5.7.2.2 Experience in other int. agreements

Summary of Participation/Sanctions Debate: The sanctions need to have teeth to be effective. Chayes and Chayes (1995) have suggested that countries rarely violate international treaties on purpose. Moreover, they argue that strong sanctions can discourage participation in an agreement. Both observations may be true for the agreements they examine; however, for treaties with high costs, such as a greenhouse gas agreement with a stringent target, one cannot assume compliance will occur without sanctions. The argument about the nature of sanctions affecting participation rates is also valid, and points to a limitation of agreements. Indeed, one can imagine a voluntary action-based treaty achieving more initially (in terms of GHG reductions) than a treaty with enforceable limits because countries may do more under an action-based treaty if the costs turn out to be lower than expected. This finding is consistent with Victor (1997) and Victor, Raustiala, and Skolnikoff (1997).

Hahn, Robert. (1998) Climate Change: Economics, Politics, and Policy.

Kerr, Suzi. (1998) Buyer v Seller Liability: Improving the Credibility of Clean Development Mechanism Credits. p. 11. Formal dispute settlement procedures and non-compliance procedures have been created in recent international agreements, such as the Montreal Protocol on Substances which deplete the Ozone Layer, but the formal sanctions which are available within them have never been invoked so their credibility is uncertain. [Werksman (1996) p. 118]

Barrett Scott. (1998) "Montreal v. Kyoto: International Cooperation and the Global Environment."

29 In first take of Montreal protocol, there were no compliance mechanisms either. It did have incentives for participation and these were used later for enforcement.

* Countries almost always comply with international agreements and most of these agreements do not have mechanisms for punishing non-compliance. Some (Chayes and Chayes, 1995) take this to mean that enforcement mechanisms are not needed. Others, (Dwons, Rocke, and Barsoon, 1996) say countries just sign onto agreements that they would want to comply with anyway.

* Montreal Protocol – in 1992, parties drew up a list of measures that could be used if parties do not comply: 1) assistance (technology transfer and financial assistance), 2) issuing cautions, and 3) suspension of rights and privileges including financial assistance, trade, etc.

Tietenberg, Tom, Michael Grubb, Byron Swift, Alex Michaelowa, Zhong Xiang Zhang, Frank T. Joshua. (1998) Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting, & Accountability.

- 41 * Best developed system is dispute resolution under GATT. Disputants form expert panels who investigate claims and make judgements.
 * Economic sanctions can be used (Hudec, 1993), but their effectiveness disputed (Hufbauer, et al, 1990). When sanctions are unilateral, there would be a danger that enforcement would single out mostly weak states and not the strong.

6. Conclusions/Synthesis

Challenge - building credible monitoring & enforcement w/out central authority: There is little doubt, as I emphasize below, that in the international domain satisfactory solutions to these monitoring and enforcement problems will be preconditions for the successful implementation of any policy instrument, be it market-based or otherwise. Looked at this way, the central challenge is to understand how a credible and effective system of monitoring and enforcement can be established (at reasonable cost) in the absence of a centralized authority (Keohane 1996).

Stavins, Robert N.. (1997) Policy Instruments for Climate Change: How can National Governments Address a Global Problem?.

6.1. Future Research

[See Hahn, “GreenBook” 1998 for list of issues]

6.1.1. What should the rules (similar to Nordhaus' voting mechanism) be for changing the system?

6.2. Credibility

6.3. Dealing with JI/CDM

6.4. Time-path of Emissions

6.5 Lessons Learned:

1) We prefer an ITP system that may sacrifice emissions reductions (would be less stringent), but that would be credible and well constructed over a system that is full of holes [CDM/JI].

7. Appendix -- Relevant Sections of Kyoto Protocol Text

Articles 3,4,6,17, 12

ENDNOTES:

1. For practical policy purposes, acid rain precursors may be thought of as "uniformly mixed" within relevant regions (airsheds).
2. A comparison of an international system of greenhouse tradeable permits with alternative policy mechanisms is provided by: Epstein, Joshua M. and Raj Gupta. *Controlling the Greenhouse Effect: Five Global Regimes Compared*. Washington, D.C.: Brookings Institution, 1990.
3. See: Manne, Alan S. and Richard G. Richels. "International Trade in Carbon Emission Rights: A Decomposition Procedure." *American Economic Review Papers and Proceedings* 81(1991):135-139.
4. See: Bohm, Peter and Clifford S. Russell. "Comparative Analysis of Alternative Policy Instruments." *Handbook of Natural Resource and Energy Economics, Volume I*, eds. Allen V. Kneese and James L. Sweeney, pp. 395-460. Amsterdam: North-Holland, 1985.
5. See: Victor, David, *op. cit.*, 1991. The problem of defining which gases are appropriate for economic incentives is by no means straightforward. Consider the case of CFCs as they relate to climate change. CFCs were thought to have the greatest influence on climate change on a mass basis; recently, however, the impact of CFCs on climate has come to be considered to be much less, and may even be negligible. Of course, CFCs may need to be limited because of their effect on stratospheric ozone, but this example illustrates the potential difficulties of defining control strategies when the science is uncertain.
6. Arguments against the multi-gas approach are found in: Victor, David G. "Limits of Market-Based Strategies for Slowing Global Warming: The Case of Tradeable Permits." *Policy Sciences* 24(1991):199-222.
7. See: Cristofaro, Alexander and Joel D. Scheraga. "Policy Implications of a Comprehensive Greenhouse Gas Budget." Working paper, Office of Policy Analysis, Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency, Washington, D.C., September 1990.
8. This may be easier said than done, particularly if trading is allowed across pollutants. For example, if methane is introduced after a decade of CO₂ trading, this could have major effects on participants in the CO₂ market, giving rise to political resistance if it resulted in an effective devaluation of CO₂ permits.
9. A recent example of such cooperation is the toxicological testing of alternatives to CFCs funded by several major chemical firms.
10. See: Dudek, Daniel J. and Alice LeBlanc. "Preserving Tropical Forests and Climate: The Role of Trees in Greenhouse Gas Emissions Trading." New York: Environmental Defense Fund, February 1992.
11. See: Houghton, R. A. "A Blueprint for Monitoring the Emissions of Carbon Dioxide and Other Greenhouse Gases from Tropical Deforestation." Woods Hole, Massachusetts: The Woods Hole Research

Center, January 20, 1992.

12. This group is likely to have limited authority, given the interest of countries in maintaining their sovereignty. It could be patterned after the Montreal Protocol, which has designated an implementation committee, consisting of six parties. This committee assesses the extent of compliance and works with countries to help bring them into compliance.

13. A variant on the preceding proposal would be to allow selected countries to trade internationally, and allow the supra-national authority to review special requests from other countries on a case-by-case basis. This would be administratively cumbersome.

14. See, for example: Green, Jonathan and Philippe Sands. "Establishing an International System for Trading Pollution Rights." *International Environmental Reporter*, February 12, 1992, pp. 80-85.

15. See: Grubb, Michael and James K. Sebenius. "Participation, Allocation and Adaptability in International Tradeable Emission Permit Systems for Greenhouse Gas Control." *Proceedings of OECD Workshop on Tradeable Emission Permits to Reduce Greenhouse Gases*. Paris: Organization for Economic Cooperation and Development, June 1991; and Bertram, Geoffrey. "Tradeable Emission Permits and the Control of Greenhouse Gases." *The Journal of Development Studies* 28(1992):423-446.

16. For example, under an allocation system related to population levels, the big players in the market would likely be India and China, as permit sellers, and the United States and perhaps the former Soviet Union, as buyers. See: Epstein and Gupta, *op. cit.*, 1990.

17. For example, the Canadians proposed using population and GNP combined as allocation criteria when CFC reduction obligations were being considered in the development of the Montreal Protocol.

18. This is abstracting from the potential consequences of significant transactions costs. See discussion of this above.

19. Most proposals for allocating control obligations among nations call for proportionately higher rates of reduction in emissions by the industrialized countries (and, among the industrialized countries, by the United States) and substantial reductions in the predicted rates of increase in CO₂ emissions by most developing countries. See, for example: Krause, Florentin. *Energy Policy in the Greenhouse: From Warming Fate to Warming Limit -- Benchmarks for a Global Climate Convention*. The Hague: Dutch Ministry of Housing, Physical Planning and Environment and the European Environmental Bureau, 1989; Flavin, Christopher. "Slowing Global Warming: A Worldwide Strategy." *Worldwatch* Paper 91. Washington, D.C.: Worldwatch Institute, October 1989; and Wirth, David and Daniel Lashof. "Beyond Vienna and Montreal -- Multilateral Agreements on Greenhouse Gases." *Ambio* 19(1990):305-310.

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