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Improving on Kyoto: Greenhouse Gas Control as the Purchase of a Global Public Good

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Abstract

One way to obtain a global public good is to set up an institution to buy it, with the nations of the world contributing to the cost according to whatever sharing arrangements make political sense. An example would be the purchase of the services of national armed forces to carry out peacekeeping, with the cost separately apportioned. In these notes I suggest a way to exploit this approach to limiting accumulations of greenhouse gases in the atmosphere. The "service" that produces the control is the reduction, by nations, in the levels of emissions over time from what they would otherwise choose, also known as the "business as usual" emissions path. In the scheme as envisioned, which could be used in a successor agreement to the Kyoto Protocol, the fact that all nations are sellers of reductions ameliorates the enforcement problems typical of commitments to particular emission paths. Another difference from the Kyoto-style system: In the scheme sketched here, the distributive of burdens is explicit, rather than implicit in the allowable emission amounts. The conflation of distributive and allocational issues is, arguably, an unnecessary source of contention in the design of institutions to control anthropogenic effects on the climate system.

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Outline

Improving on Kyoto:
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David F. Bradford

1. INTRODUCTION

The purpose of this paper is to sketch out an alternative approach to controlling greenhouse gas emissions. To give the thing a name, I call it the "purchase of a global public good " (PG^2) approach. The proposed system has two main advantages, relative to the straight cap and trade approach that is (more or less) embodied in the Kyoto plan and relative to other approaches that involve countries making commitments to policies and measures to control greenhouse gas emissions. First, the enforcement is greatly simplified. As will be seen, countries can freely choose the extent of their emission reductions in pursuit of the global emission objectives, just as suppliers of ordinary goods and services choose the extent of their "contribution" to, for example, national defense. Second, the sharing of the burden of financing the global public good of greenhouse gas control is transparent, rather than buried implicitly in, for example, country-specific emission limits or commitments to policies and measures. Among other things, this property might ease the critically important incorporation of developing countries to a global control regime. A third difference is that the plan spreads the risk associated with coping with climate change in a way that may be attractive.

The issues addressed here concern institutional design. The paper is silent on the policies that would be implemented using the new institution, involving both the allocational questions of the total emissions of greenhouse gases and the assignment of emissions to countries and enterprises, and the matter of the sharing of burdens and benefits from alternative arrangements. The proposed system is conceived of as an alternative to the particular cap and trade plan put

forth in the 1997 Kyoto Protocol of the 1992 Framework Convention on Climate Control. If that protocol takes effect, the system described here might be used as the basis for a worldwide system embodied in a successor agreement. The system is also described as a global one. Although I do not develop the point, I think it could be deployed by any set of countries wishing to coordinate their climate control efforts.

I think of the PG^2 system as part serious proposal and part thought experiment. To become a serious proposal it would need a great deal more work, including work on issues identified here. Certainly, there are many issues not yet identified. Since, however, any system must solve the same essential problem as is articulated in the PG^2 approach, it may at a minimum assist in understanding the properties, especially the international distributional properties, of alternative arrangements.

In setting down these notes I have taken for granted that readers are broadly familiar with the climate control problem and the development of the international negotiations addressed to it. Most of those readers will also be familiar with the analytical tools of environmental economics on which I depend. I have observed, however, that sometimes fairly basic economic analytical ideas get lost in the policy debates. So I hope readers will not be offended by my recitation of such ideas below. The next section, in particular, is a reminder of the potential power of well-designed property rights to solve problems of coordination, while recognizing the collective nature of the objective to be served. The third section contains the description of the purchase of a global public good system. A fourth section discusses some details of the system, such as the problem of "leakage" of fossil energy-intensive production to nonparticipating countries. Section five reviews the similarities and contrasts between the existing Kyoto and the proposed

PG^2 systems. Following a brief concluding section, in an appendix I use some simple economic analytical tools to sketch some of the allocational and distributional properties of the system.

2. REMINDER OF SOME LESSONS OF BASIC ECONOMICS

PUBLIC GOODS

I would stress two basic economic ideas here. The first is the idea of a public good. "Public" is in contrast to "private." A private good is a commodity like steel, with the properties that if one person uses a unit it is not available to anybody else and, furthermore, it is possible for an "owner" of a unit of such a good to exclude others from using it. The distinction using these terms is relatively modern, but economists at least since Adam Smith have understood that, whereas decentralized production and exchange of private goods, motivated by self-interest of the participants, can be presumed to determine an allocation of resources and activity that is efficient, meaning it cannot be improved upon for everybody, to achieve efficiency in the same sense, services like national defense must be provided for collectively. (For a history of doctrine, see Musgrave, 1959; Bradford, 1970, points out the ubiquity of public goods.)

Control of the climate system is a global public good *par excellence*: For better or for worse (some projected impacts of climate change are positive for some people), a change in the climate affects everyone in the world. What seems to have been less often considered is the usual method by which a public good is acquired. For a classic public good, such as national defense, a national government typically purchases the needed resources, such as weapons systems. The burden of financing the collective purchase is normally determined separately, using a tax system. (Defense is actually a mixed example because, quite often, even in modern economies, the important resource of military manpower is not obtained through the market only; rather a significant part is conscripted.)

An example of an international public good would be peacekeeping operations of the United Nations. In that case national entities do the work of producing the public good, while the financing is shared according to United Nations rules.

The approach to climate control investigated here builds on the analogy of mustering the defense of the world against an approaching asteroid by deflecting it from a collision path. I would think we might cope with this global public good problem by organizing to purchase the needed resources and, at the same time, figuring out how to spread the cost of paying for them among the countries of the world. The idea is to identify the "needed resources" and work out a method to buy and pay for them.

PROPERTY RIGHTS

The second basic idea is that of property rights. The negotiation of the Kyoto Protocol, including, importantly the COP3bis round in Bonn in 2001, reflects the gradual acceptance of one of the most important but poorly understood ideas in economics: the economizing incentives that derive from private property. It is perhaps not surprising that this idea is unfamiliar to many environmental scientists. But economic theory teaches the power of property rights to serve environmental objectives and the emerging details of the Kyoto Protocol can be understood as exploiting the idea of property rights to certain levels of emissions of greenhouse gases. Some involved in the negotiating process were and are uncomfortable with this idea; some readers will view the concept as raising an ideological red flag. I would urge the economists to stick more firmly to their analytical guns and the others to consider objectively the possibility of exploiting the extraordinary power of private property in the service of global climate policy.

Owners of private property (who might be governments) have strong incentives (economists would say the "right" incentives) to put that property to productive use. Where relevant, owners and potential owners also have appropriate incentives to invest in the creation

of substitutes for property through invention. A corollary, one of the important insights of environmental economics, is that environmental problems can be understood as due to the absence of appropriate property rights. Policies to define and enforce new property rights can be one of the most effective lines of attack on environmental problems.

Take as an example the textbook case of companies that purchase inputs of labor, ore, etc., and use them to produce steel. In the process, the companies' factories emit smoke with detrimental impact on the health of the surrounding population. In the resulting equilibrium, there is a pollution problem: "too much" smoke is used. One way of describing the problem is that the companies are not obliged to pay for the services provided by the surrounding population in contending with the smoke (by accepting the health risk or by incurring expenses to adjust for the presence of smoke in the air). This is in contrast to the companies' use of labor, which also comes at a cost to the population that provides the service. This cost is recognized in the calculations of the companies because they are obliged to pay their workers.

A possible approach to correcting the situation is to define a new property right, for example, the right to emit smoke. Suppose the community decided that a certain amount of smoke emitted was acceptable, say measured in tons per year. Rights to emit would be defined, implemented as allowances; an emitter would be obliged to own an allowance for each unit of smoke emitted. These allowances could be bought and sold, just like units of steel or ore or labor. Companies would then have an incentive to curb the emissions of smoke by a variety of methods, including innovation, just as they have an incentive to control the quantities of other inputs used in production. In the resulting economic equilibrium, the cost, measured in goods like steel, of achieving the target level of emissions would be minimized. A large literature

attests to the promise of methods like this to improve on "command and control" approaches to controlling pollution of this type.

Some lessons to take away from this homely example:

Fixing the problem requires collective action. This is actually pretty general. Private property itself is a social artifact. Even what we think of as ordinary private property rights (for example, to real estate) are defined collectively. Often the definitions are complex. For example, the rights of an owner of a piece of real estate property incorporate restrictions due to land use zoning rules. In the jargon of economics, the basic policy problem, which has been pretty well settled in the case of real estate, is to design the property rights in such a way that, in practice, the social payoff is maximized. (A classic exposition of this perspective on property rights is that by Coase, 1960.)

The economizing power of the newly defined property rights is not dependent on who gets them to start with. If the newly defined property is assigned to the (owners of the) companies that were doing the excessive emitting in the first place, those companies will have the same incentives (because the emissions are priced) as they would have if the newly defined property were handed out to some other group in the population or sold by the government. This may seem paradoxical; the key thing to keep in mind is that an entity that uses the rights must pay for them, either by buying them from another owner or by forgoing selling them on the market. Who gets the rights initially is significant mainly as a matter of what we rather sloppily call “income” distribution. Such distributional issues are important, to be sure, but separable from the allocative function of the rights.

The example does not include a "supply curve" of allowances. It simply incorporates a fixed limit on emissions. One could imagine, however, that the community would have a supply

curve of allowances. If the price of allowances is very low, the community will not want to supply many, but rather enjoy very clean air. If the price is high, they will sell more, enduring dirtier air in return for the other desirable goods and services that can be bought, as indicated by the price. A limiting case of a supply curve for allowances would be an infinitely elastic one at some price. This would duplicate the economic effect of a tax on emissions, although the institutional form, involving priced allowances or permits, might have a different look and feel.

One could, alternatively, imagine a world in which a baseline quantity of emission allowances is set at whatever would have been emitted in the absence of any control regime, with those allowances put in the hands of the companies that, in effect, had the preexisting "right" to emit. The collective decision would then be how many of the allowances to buy and retire. This decision would be made in the light of some system for financing the purchase of allowances. Such an approach might be attractive as a way of getting started and as a way of separating the question of who should pay from the method of implementation. It is the approach I suggest here for controlling the greenhouse gas emissions.

As I have noted, Kyoto can be understood as making a start on defining new property rights: to emission of greenhouse gases. In the spirit of the preceding remark, note one could have adopted other property right concepts, such as the right to add an increment to radiative forcing (at a specified point in time). Focussing on emissions has some problems, importantly the problem of aggregation of greenhouse gases, but has the advantage of being close to what everyone sees as the essential control problem.

Two things are notable about the property right regime incipient in the Kyoto Protocol. First, there remains considerable controversy about, for example, how much of an Annex B country's emission reductions may be purchased from other countries. The idea of property

rights is not fully accepted. Second, the distribution of burdens associated with achieving the reductions in emissions called for in the Kyoto Protocol is mostly implicit in the distribution of implicit property rights, rather than explicit, as I have suggested is more typically the case when public goods are collectively provided. This conflating of the allocational and distributional tasks of the system may have made reaching agreement more difficult that would use of an approach that more clearly distinguished the two. (I should concede that "may" is the right word; it may also be that making the distributional aspects of the system harder to observe contributes to reaching agreement.)

3. THE PURCHASE OF A GLOBAL PUBLIC GOOD (PG^2) APPROACH

For purposes of discussion, I have focussed on the control of the burning of fossil fuel – in fact, I suggest implementing controls on the "import" of fossil fuels to countries, whether out of the ground or across the border. (Hereafter I keep the quotation marks on "import" when used in this sense.) In this I am influenced by the discussions and proposals of Ferguson (2001), Hargrave (1998), Lackner et al (undated) and McKibben and Wilcoxen (1999). Treatment of managed carbon sinks is straightforward conceptually, if not necessarily as a monitoring problem. Inclusion of other greenhouse gases is a little less straightforward, both as a matter of aggregation and from the point of view of monitoring. Instead of a conceptually correct approach to aggregation the Kyoto Protocol has settled for a rough approximation (using global warming potentials), which could also be applied to the PG^2 approach. The basic system sketched here could be applied to an aggregation of gases.

The PG^2 approach identifies as the "needed resources" that have to be diverted from other uses in order to produce climate control the use of fossil fuel that countries would otherwise choose. The analogy is to, say the services of scientists that would have to be diverted from

alternative employment to assist in the defense against the extraterrestrial object. In other words, to produce climate control we need to acquire the services of countries' deviations from their BAU emissions trajectories. The PG^2 approach is to use the market to acquire those services. It has three elements:

ELEMENT 1. BASELINE ALLOWANCE TRAJECTORIES ASSIGNED

The system incorporates a requirement that a participating country submit an allowance for each unit of carbon in CO_2 contained in fossil fuel added to the surface stock ("imported"), either through extraction from below the surface or through importing across the border of fuel extracted in other places. A unit carbon in fossil fuel exported to another participating country or isolated from the atmosphere by appropriately monitored storage would earn an allowance.

Each participating country, including each LDC, is assigned a baseline allowance trajectory of fossil fuel "imports" allowances. The baseline allowance amount is the sum of two quantities, varying through time and with changing contingencies: the BAU (business-as-usual) amount and headroom.

The BAU amount is the treaty-specified expression of the estimated number of allowances that would be demanded at a price of zero if such allowances were required of private agents within a country under conditions of no special regulation of the system to limit emissions. Headroom is some specified fraction of the BAU amount, for example, twenty percent of BAU. So the baseline allowance trajectory is constructed from the BAU trajectory.

Conceptually, the determination of the BAU trajectory is a purely technical matter, not an ideological or value-dependent step. (In a negotiating context, this technical matter, like many similar ones, would presumably be contentious. The separation of the financing step, discussed below, could, however, take some of the pressure off.)

It is important to understand that the BAU trajectory would not be a simple fixed path, related, for example, to a country's fossil fuel "imports" in some base year. Instead, it would be explicitly contingent on the country's economic performance, as well as on technological developments generally.

ELEMENT 2. THE INTERNATIONAL BANK FOR EMISSIONS ALLOWANCE ACQUISITION

An agency would be created with the sole function of buying *and retiring* allowances. This retirement would constitute the acquisition of resources needed to produce the global public good of climate control. To be concrete, I denote this agency the International Bank for Emissions Allowance Acquisition (IBEAA). Periodically the COP to the FCCC (or some other entity designated for the purpose) would meet and determine the quantity of (dated) allowances to be purchased and retired. These purchases might be implemented in an active international market with lots of private traders (arguably the setting best situated to "search" for economical emission reductions) or maybe just by putting out tenders to the countries of the world. In the long run, in order to control the concentration of CO_2 in the atmosphere, a very substantial retirement of allowances in the more distant future is going to be required – at some point, to the extent of zero net carbon emissions.

IBEAA would have only one central function: to purchase and retire emission allowances. This would imply ancillary functions, such as monitoring compliance with the allowance regime. Another important function would be to issue debt to finance its purchases, the rationale for referring to it as a bank. Apart from monitoring the allowance system, the IBEAA would have no role in checking on the activities of countries or businesses. The key operating rule: No verified reduction of "imports" from the baseline level, no payment from the IBEAA.

All countries are sellers of allowances in this story.

ELEMENT 3. COST SHARING

The third element of the system is a procedure for sharing the cost of the allowances purchased by the IBEAA. All participating countries would share in the financing. A country's obligation would be to pay into the system each year the sum of the value of its headroom allowances and a fractional share of the remaining expenses of the IBEAA under a formula to be determined in the negotiations that set up the PG^2 system. The approach, *per se*, is silent on the latter sharing arrangements. The analogy is the sharing of costs of international peacekeeping. Cost shares, beyond paying for headroom, might, for example, depend on per capita income or consumption levels and perhaps be responsive to the benefits countries get from protection against climate change. One would expect rich countries would pay most of the bills but "rich" might change over time.

4. ISSUES RAISED BY AND PROPERTIES OF THE PG^2 SYSTEM

ALL PARTICIPATING COUNTRIES ARE SELLERS OF ALLOWANCES

Unlike the Kyoto-style cap and trade system, under the PG^2 system all participating countries are sellers of allowances; none are buyers except in the sense that all participate in the collective purchase and retirement of allowances. (I note below a qualification to this assertion.) This is the basis for the compliance advantage of the system: If a participating country chooses not to sell, it is shooting itself in the foot (since, by construction, small reductions of emissions from the BAU levels, and *a fortiori* from the baseline sum of BAU plus headroom, are at zero cost) but it does not directly harm the overall emission control effort. I use the modifier "directly" here to recognize that a country's choice of the number of allowances to sell may affect the price obtained by other sellers and paid by the collectivity.

WHO PARTICIPATES?

The PG^2 system is predicated on a set of participating countries. Since we know that it is possible to improve upon the BAU world from the perspective of all countries (in the jargon of economics, a Pareto improvement is available), we know that, in principle, there are arrangements whereby all countries could participate and still be better off than if no controls were put in place. I do not, however, claim to have solved the free-rider problem. Arranging for the provision of this public good requires that countries want to cooperate to do it, just as they do, for example, in military alliances. In the latter case, however, one can see "private" advantages that could be important elements of the story of collaboration. What one can say is that countries should, in principle, be willing to pay *something* to participate, since only participants are eligible to sell emission allowances to the IBEAA. Beyond that point, getting countries to pitch in poses the same problem in this framework as in any other case of organizing for a collective benefit.

HOW DOES ONE DETERMINE THE BAU QUANTITIES?

There are many conceptual as well as practical problems associated with the idea of BAU quantities of "imports." To suggest the issues involved, we can think of each country as having a demand for net "imports" as a function of various determinants, important among them.

- the level of its own economic activity as measured by per capita income,
- its population,
- the world prices of the different fossil fuels,
- the country's capital stock, or stocks of different kind of capital,
- the state of technology/knowledge.

For purposes of making distinctions in this subsection, let me introduce the term "treaty" BAU, denoted BAUtr to stand for the level of allowances specified in an agreement. (I skip the distinction in the subsequent discussion.) Thus a country's BAUtr would be determined as a function of a number of elements, each of which would need to be expressed in observable terms and each of which would vary through time and depend on contingencies such as technological developments.

The nature of the problem is illustrated by the challenges that have faced efforts to project carbon emissions, as laid out in the SRES report (citation needed). The contingencies that will influence the path of emissions lead to the almost notoriously splayed picture of the range of alternative futures. The very possibility of generating those paths by specifying contingencies indicates the general direction that one would take for formulating BAUtr allowances in the purchase of a global public good system.

From the point of view of the enforcement advantages of the system, it is not necessary that the BAUtr allowances precisely match "true" BAU quantities. Allowing for inaccuracy is the function of headroom. If headroom is sufficiently capacious, a country would never have any reason to "import" more than its baseline amount.

The cost of the slack incorporated in headroom element of the baseline is the need to finance their purchase by the IBEAA before any progress is made on the climate problem. The financing arrangements, however, eliminate this cost, at least conceptually. Under the system, a country obtains headroom allowances as a grant but the financing rules require it to pay for those allowances, regardless of its choice of "import" level. If the BAUtr level exactly equaled the true BAU level, the headroom device would imply a financial wash. A country would receive in

payment for the sale of its headroom allowances exactly the amount that it is obliged to contribute to the system for those allowances.

Because headroom is relative to BAUtr, naturally, in the context of the PG^2 system, a country will want the highest possible level of BAUtr. But since a country's contribution to the cost of the program is negotiated simultaneously with the setting of BAUtr levels, there is an opportunity to design into the system very "generous" BAUtr levels, compensated for by high levels of contributions to the resultantly apparently high cost the financing the allowance purchases. The efficiency and administrative tradeoffs involved in this design feature are among the questions meriting closer analysis.

This paper has been silent on the method that a country might use to meet its desired level of "imports," given the price on sales to the IBEAA. A natural complement to the international allowance system would be a system of tradable domestic allowances. Allocating such domestic allowances presents a host of issues and opportunities, including revenue-raising opportunities, of the sort that have become familiar in the analysis of existing tradable-allowance systems, such as the one covering SO_2 emissions in the United States (Ellerman et al, 2000).

An important issue that calls for further investigation is how one would update the BAU amounts over a longer time period. It is arguably reasonable to contemplate estimating BAU levels at times close to the present, but a system designed to operate for centuries would need the capacity for updating.

The long run poses other challenges that merit further thought. As Jae Edmonds has emphasized to me, to stabilize concentrations of CO_2 in the atmosphere requires, ultimately, zero net emissions. In other words, in the long run, one would be looking for the retirement of 100 percent of baseline allowances. The technical problems to one side, the financial magnitudes are

daunting and Edmonds has raised the issue whether the baseline levels themselves could be systematically reduced over time (thereby changing their relationship to the conceptual BAU levels, that indicate what countries would want to do in the absence of climate considerations). Questions would be whether these levels could be cut without losing the enforcement advantage of the system and, alternatively, whether having very high baseline levels, relative to targeted emissions, would actually be very costly, in view of the possible methods of financing a country's required cost share.

What if a Country Exceeds Its Baseline Allowance Level?

Conceptually, since the BAU allowance is supposed to indicate what a country would "import" were it not for climate considerations, in theory, there would be no reason to exceed its BAU allowance level. The headroom element in the baseline is a protection against getting the BAU level used in the agreement wrong. If, nevertheless, a country wanted to exceed its baseline allowance, then the logic of the system would call for its buying allowances from the IBEAA. To obtain the enforcement advantages of the system would imply designing it to reduce this possibility to a minimum.

Leakage

The issue of "leakage" arises if the coverage of the PG^2 system is less than global. In a Kyoto-style system, for example, controls on carbon emissions will raise the price of fossil fuel and fossil-fuel intensive goods within participating (Annex B) countries. At the same time, because of lowered demand from the participating countries the price of fuel to nonparticipating countries will be reduced. The predicted result is a shift in the location of production of fuel-intensive goods to nonparticipating countries. Among other things, such a shift will tend to defeat the purpose of the participating country limits.

A quick sketch of the determination of fossil fuel price differentials between participating and nonparticipating countries in the PG^2 system suggests, however, that there will be some that there would be a tendency for the system to *raise* the price in the nonparticipating countries. A sufficiently strong effect would remove the problem of leakage.

If all countries are participants in the PG^2 system, the effective price of fossil fuel "at the border" will be the world price plus a going price for allowances. In that situation, variation in the price of fuel inside countries would reflect policy differences, as at present, and hence introduce no new problem.

A country that is not participating in the system would not be eligible to sell allowances to the IBEAA. Furthermore, exports of fossil fuel from a participating country to a nonparticipating country would not qualify for an addition to the exporting country's baseline. (A natural way to implement the controls would be to set up a transfer of an allowance from the importer to the exporter for each ton of carbon involved; a nonparticipating importer could not offer any allowances.) A participating country would, however, be charged with a unit of "imports" for fossil fuel brought in across its borders, whether from a participating or a nonparticipating country. The predicted effect would be to segregate exchange of fossil fuel into two markets, one among participating countries, and one among non-participating countries. Exchange across this segmentation would occur only if the price in the nonparticipating-country market were higher than in the participating-country market by the going price of an allowance.

In that situation, we would expect the price of a ton of carbon in fossil fuel ruling among nonparticipating countries would be the same as the price of the "package" of the ton of fuel plus an allowance ruling among participating countries. (Imagine a world in which fossil fuel trades for $150 per ton between non participating countries and allowances sell for $50 per ton. A

participating country would be indifferent between selling to a participating country for $100 per ton and to a nonparticipating country for $150 per ton. So the price ruling in both kinds of countries should be the same.)

In the more likely situation of no fossil fuel trade between participating and nonparticipating countries, we would expect the fossil fuel price facing the nonparticipating countries to be lower than the gross-of allowance price but higher than the net-of allowance price cost of fuel ruling among participating countries. This effect would tend to mitigate but not eliminate the issue of leakage.

BANKING

In describing the purchase and retirement of allowances, I was silent on the details as to timing. It is likely to make sense to date allowances. But, if a country contemplates neither using nor selling all of the excess of its baseline allowances over its "imports" in a year (as might be the case for a country that has not yet joined the group of participating countries), there should still be an incentive for it to economize on them. That would suggest that the IBEAA might be provided with a set of equivalences among dated allowances, for example, one 2012 allowance equals 1.05 2011 allowances. It would even be conceptually possible for such a set of equivalences to be set in advance with regard to future "imports," so the IBEAA could engage in futures trading. Enforcement considerations – no monitored excess of baseline allowances over "imports" in a year, no payment from the IBEAA – would suggest confining IBEAA transactions to allowances for the current or earlier dates.

5. COMPARISON WITH KYOTO STYLE SYSTEM

I note without commentary differences between the PG^2 system and the Kyoto Protocol regime in its current state of evolution:

WORLDWIDE EMISSIONS

In a Kyoto-style system, participating countries are assigned allowable amounts of emissions (specified by required reduction in emissions below a baseline). The total of these allowable amounts, as modulated by the compliance of participants and the behavior of nonparticipants, influenced in some degree by voluntary control efforts, by the Clean Development Mechanism and by leakage, determines the total of emissions. Putting aside questions of compliance and the behavior of nonparticipating countries, the Kyoto Protocol rigidly specifies worldwide emissions. Note that it would be conceptually possible to use a more flexible mechanism to assign allowable emissions – a "safety valve" ceiling on the price of allowances has been suggested, for example (Kopp et al, 1999). Furthermore, the banking provisions of the Kyoto Protocol provide for a degree of smoothing of emissions over the five-year period over which the limits apply.

Flexibility of this sort would be a natural aspect of the PG^2 system, since the global total of emissions from participating countries would depend jointly on the evolving baselines and the collective decision as to how much reduction to purchase from that level. These amounts could be specified in various ways.

For example, the buying agency (labeled in this paper the IBEAA) could agree to buy all amounts submitted at a specific price. Or it could specify an amount of money it was prepared to spend. It could even, in effect, announce a demand schedule for allowances. These approaches would reduce the uncertainty about compliance cost, at the price of less certainty about the climate control in any given year or budget period. The agency could, however, be instructed to purchase allowances to meet a fixed total emission target, thus duplicating the Kyoto regime.

BURDEN DISTRIBUTION

Arguably, most participants in the policy process think about the allowable emission amounts negotiated in a Kyoto-style system as indicating the emissions that will actually occur within a country that lives up to its obligations under the treaty. If, however, unlimited allowance trading is allowed – as the private property paradigm would imply – and countries take advantage of the opportunity to minimize their costs of compliance, actual emissions from a country will be determined by the market equilibrium. Indeed, this is the source of the efficiency advantage that economists see in the allowance-trading regime. The division of allowed amounts within a fixed total thus serves, not an allocational function but, instead, the function of determining implicitly the distribution of the cost of meeting the climate objective.

The PG^2 system does not commit any country to any reductions in emissions, whether directly at home or by purchase from other countries. Instead, every participating country has the opportunity to enter the market to sell emission allowances. *It does commit participating countries to share in the cost of the program*; a key feature of the PG^2 approach is to make the cost-sharing arrangements explicit. The differentiation in financial burdens among countries would be determined according to whatever determines such things in international negotiation. Again, I would invoke international peacekeeping as an analogue. Cost shares could be based on a standard such as equal per capita use of the atmospheric carbon reservoir, an approach often advocated for the long run. I, personally, doubt that this would be the outcome of conventional international politics, but nothing rules it out, either. It is not necessary to posit a particular resolution of the world's income distribution problem to deal with climate change.

ENFORCEMENT

Apart from monitoring the fossil fuel flows, the system does not involve scrutiny of individual policies of or actions by countries, or of individual of project details. This

characteristic may be contrasted with the CDM, for example. Conceptually, however, the same property holds for the Kyoto-style cap and trade regime. A participating country is free to meet its reduction target by whatever method it chooses. If it chooses to subsidize its steel industry, that is its affair.

The PG^2 system differs significantly, however, in the need for enforcement of a country's overall emission level. The default for each country in the PG^2 system is its baseline trajectory. If the BAU levels are appropriately chosen, there is no need to enforce compliance with limits. (To be sure, it would be as critical under the PG^2 system as under Kyoto that the system of monitoring be reliable.) Enforcement comes into question in collecting committed contributions. Experience with, for example, the United Nations, suggests that this collection function is not trivial. But it is a different sort of problem. One can imagine the IBEAA succeeding in the climate objectives set for it at the same time that the system contends with collecting from participants in arrears. Presumably, the IBEAA could set off payments to a country for allowances to be retired against that country's contributions. (One would need to think carefully about the incentives for "dropping out" of such a system.)

6. CONCLUDING THOUGHTS

It is banal to observe that, not least because of the international collaboration required to cope with it, the climate problem presents extraordinary challenges. In one respect, however, it is rather surprisingly simple: at any given time, control of the emission of a greenhouse gas that is well mixed in the atmosphere, of which CO_2 is of particular policy concern, is in the nature of a single-dimensional global public good. In this paper, I have tried to think through how this characteristic of the economic problem posed by control of the anthropogenic influence on the climate might be harnessed to institutional design. The particular way I have chosen to specify

property rights (in an economic, not legal sense) to address the control of emissions of carbon is certainly not the only way one might have gone about converting the problem to that of purchasing a global public good. I am not confident that the system sketched here could be implemented in practice, given the way political forces work. But since any approach to the problem that satisfies the requirements of economic efficiency can be translated into the terms of the PG^2 system, I think it offers at a minimum useful insights, in particular into the international distributional stakes involved. The appendix to follow offers the interested reader slightly more analytical depth on this use of the approach.

APPENDIX: INCIDENCE

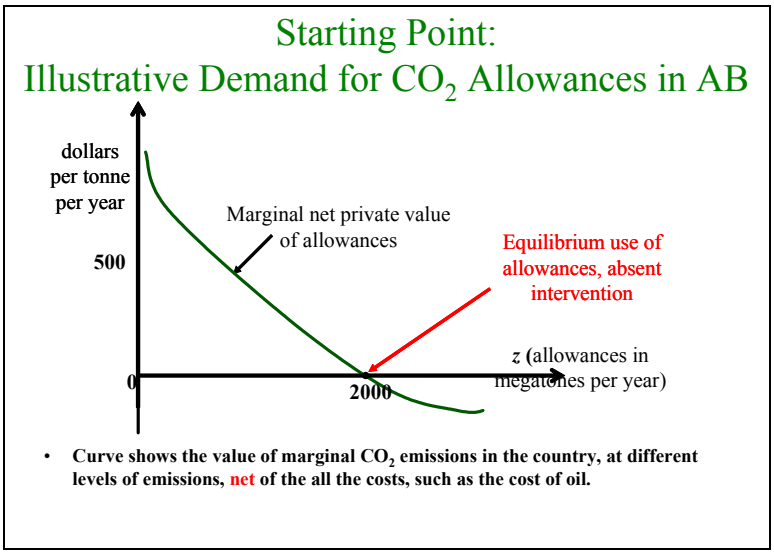
In this appendix I present some highly stylized analysis of the distributional characteristics of alternative climate regimes. Most economists will be very familiar with this material but perhaps it may serve to clarify some of the issues.

DISTRIBUTIONAL EFFECTS WITHIN COUNTRIES

The choice of aggregate GHG levels over time by the COP will have distributive effects via the impact of the price of allowances throughout economies – much like variations in the price of fossil fuel. But the way the national obligations to share in the cost of the global program are spread across taxpayers within countries can be explicitly determined as a matter of domestic policy. For example, one could imagine a tax imposed on emission allowances as one source of revenue. Or some of the allowances could be auctioned by the government.

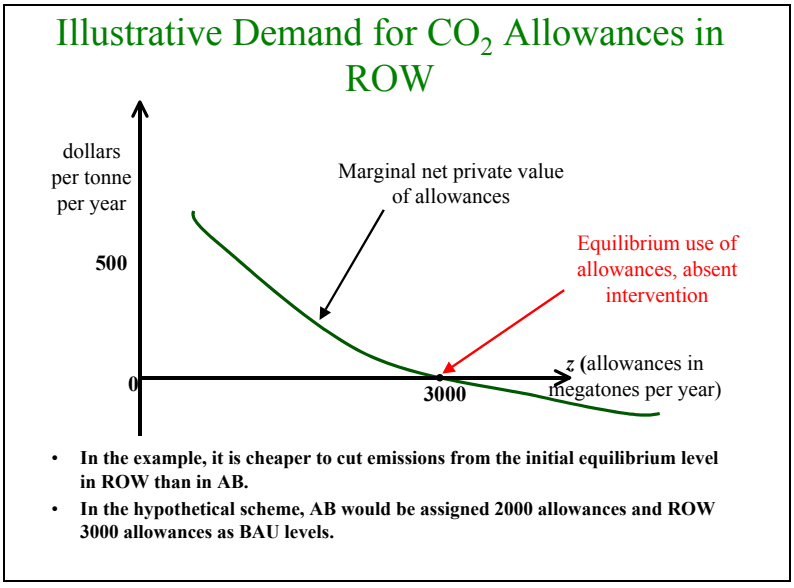
DISTRIBUTIONAL EFFECTS INTERNATIONALLY

To illustrate the possibilities, consider a homely example of a two-country world, AB (a stylized aggregate of the Annex B countries under the Kyoto Protocol) and ROW (rest of the world). Throughout this appendix I treat headroom as zero, so that the baseline allowances and BAU levels are the same. The figure below sketches a hypothetical demand curve for allowances by AB if they were priced.



I take for granted that my readers have an idea how one derives such a thing. The numbers are made up (although one could make a reasonable stab at realistic relationships) and I have completely neglected the time dimension.

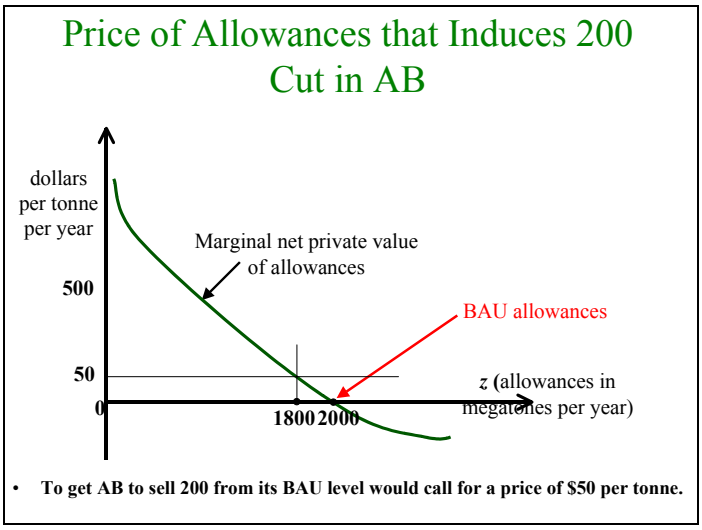
The next figure shows the same thing for ROW.

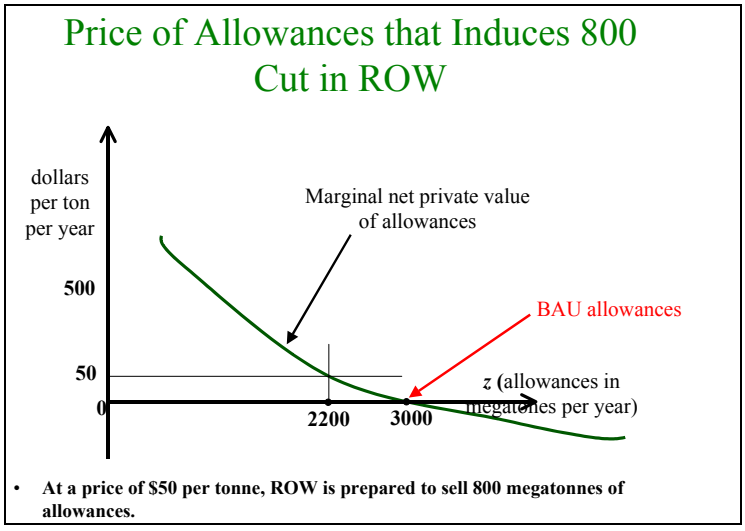


Under the suggested scheme, ROW would be assigned 3000 million allowances, reflecting its BAU demand. AB would be assigned 2000 million allowances. In the illustrative BAU scenario, worldwide emissions would be 5000 megatonnes of carbon. (In equating allowances

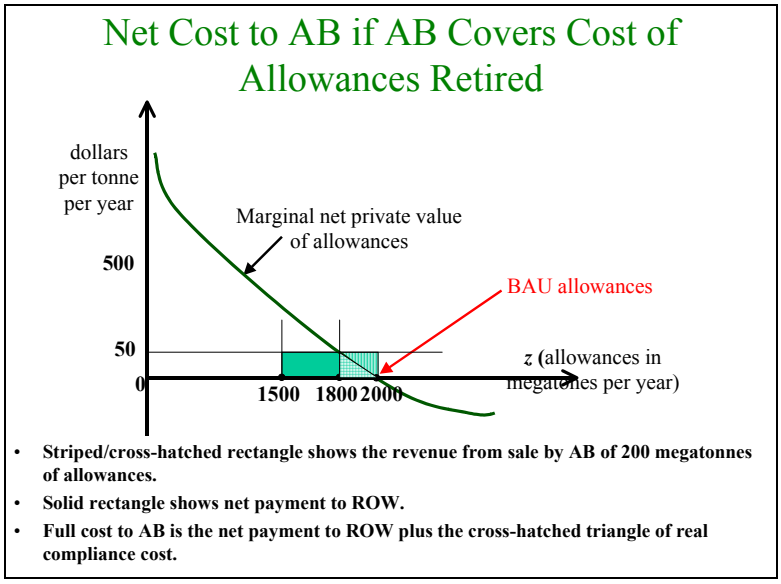
with emissions I neglect the refinement that an allowance might not be used to burn fuel in a particular year.)

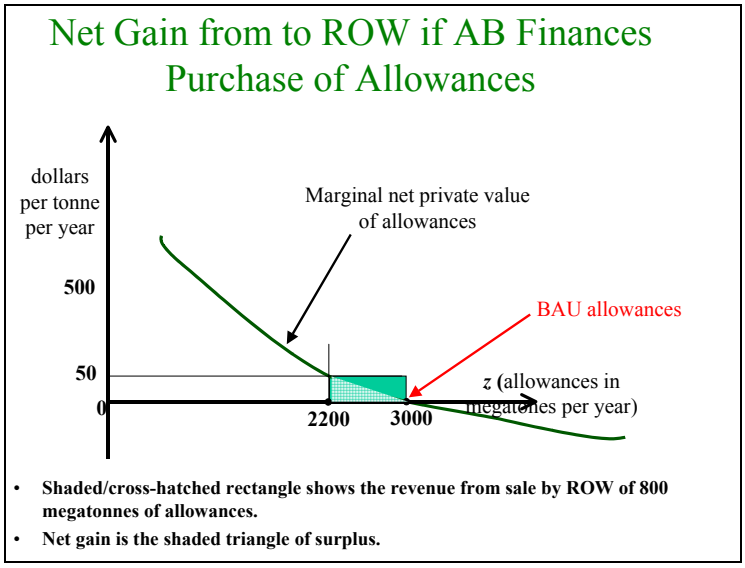
Suppose the international community decides to cut emissions by 20 percent from BAU. (Kyoto is thought to imply about a 30 percent cut for the U.S. during the first budget period.) Then one looks for the price that will call for that much reduction from BAU from the two countries. For illustrative purposes, suppose $50 per tonne of carbon does the job. (This is probably very high if the cut is not done in a rush.) The following pair of figures indicates the story for the two countries.





The sale of allowances to the IBEAA will earn the countries the amounts in the shaded rectangles in the next pair of pictures:





The total revenue from the sale of allowances in this illustrative case would be $50 billion (if I got my units right). This total outlay by the IBEAA would be financed by payments to the IBEAA by the two illustrative governments. Just viewed as a matter of national flows, the net result would be a wash for each country in the illustrative case if the financing happened to be divided 20% from AB and 80% from ROW. More plausible, interpreting ROW as developing

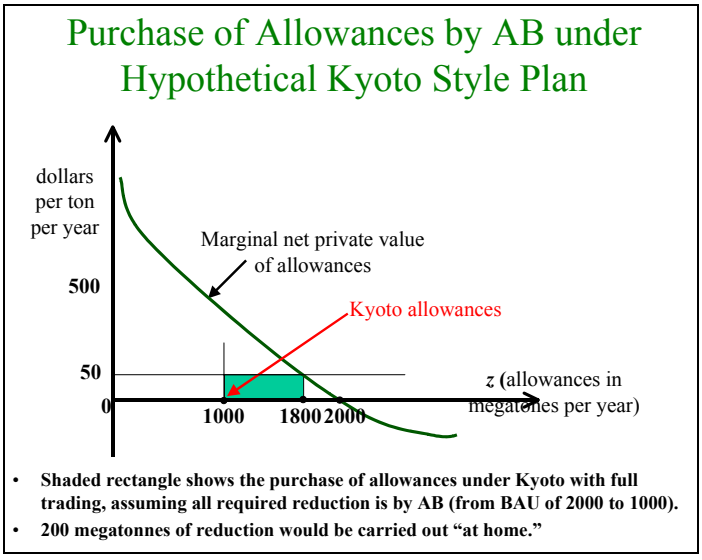
countries, would be a much larger share of financing from AB. In the extreme case, if AB paid for all of the allowances, the result would be a net transfer of $40 billion from AB to ROW (AB is paid $10 billion for allowances sold; ROW is paid $40 billion for allowances sold; AB contributes $50 billion to IBEAA to finance the purchases).

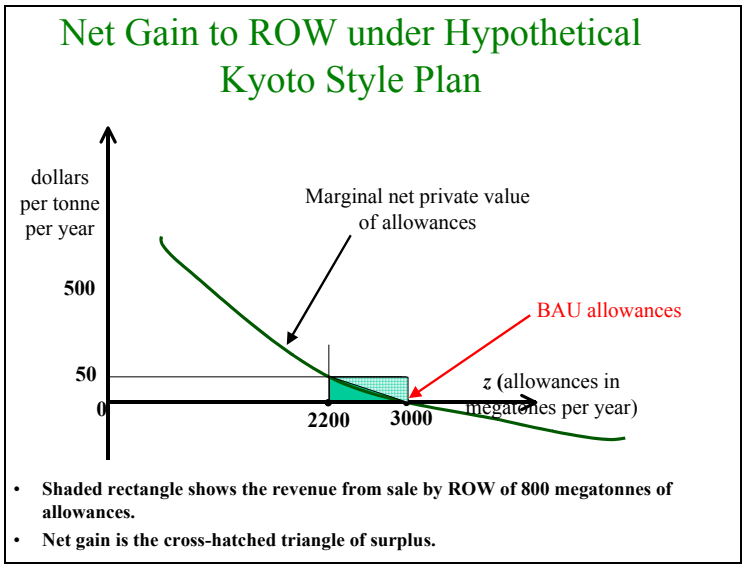
The pictures give a bit of an idea of the complexity of the incidence issues that this scheme would raise. (But similar incidence effects are buried in the command and control regimes as well.) For example, who, hypothetically, owns the BAU allowances, which increase in value from $0 to a large positive value as a result of the illustrative 20% retirement and would increase more with a more ambitious intervention? Of course, as the price of allowances rises, so does the payment required from those who would need them in their operations. If all of the BAU allowances were allocated to pre-existing users (a version of grandfathered allocation), and they, in turn, were the ones who needed to buy allowances to operate, then, in this very simple story, they would, on balance, gain from the policy (as measured by the triangles of surplus above the curves in the rectangles in the graphs above). In this little example, it appears that one could finance about half the purchase amount through a tax on allowances and still leave the grandfathered holders in the aggregate a little better off than they were in the pre-regulation situation.

- This neglects entirely the benefits from climate control. I would furthermore emphasize again that this is an extremely simple model, just to stimulate thinking. Importantly, it also neglects entirely other price effects of the program – for example, effects on the price of oil. The usual assumption underlying the sorts of demand curves for allowances that I have drawn is that all prices other than allowance prices are fixed. This would clearly be wrong. One can deal with it, but it takes more than our pictures.

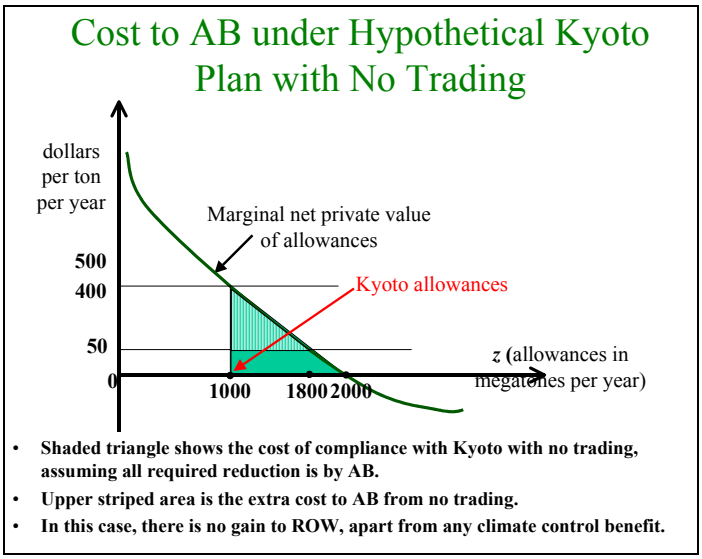
MIMICKING KYOTO

One can use the simple example to show how an abstract version of the Kyoto regime, one that aimed for the same reduction in worldwide emissions, would implement a particular pattern of financing and implicit purchase by an IBEAA. (For an analysis of the burdens on different countries implicit in the Kyoto Protocol and of the implications of alternative sharing principles for the assignment of Kyoto-style emission limits, see Babiker and Eckaus, 2000.) In our stylized world, under the Kyoto arrangements ROW is not obliged to make any reductions but is subject to a cap at its BAU quantity. AB is assigned the full reduction of 1000 megatonnes. This is equivalent to being given an allowance to emit 2000-1000=1000 megatonnes. With full trading, AB will choose to buy 800 megatonnes from ROW, at a cost of $40 billion. Note that, giving the usual interpretation to the curves and continuing to ignore climate benefits, AB loses more than $40 billion (by the little triangle under the curve between 2000 and 1800 megatonnes, or about $5 billion) and ROW gains from the program (the little triangle above the curve between 3000 and 2200, or about $20 billion). These figures characterize the "financing arrangements that are implicit in Kyoto's distributions of obligations to make reductions from business as usual" that I mentioned above.



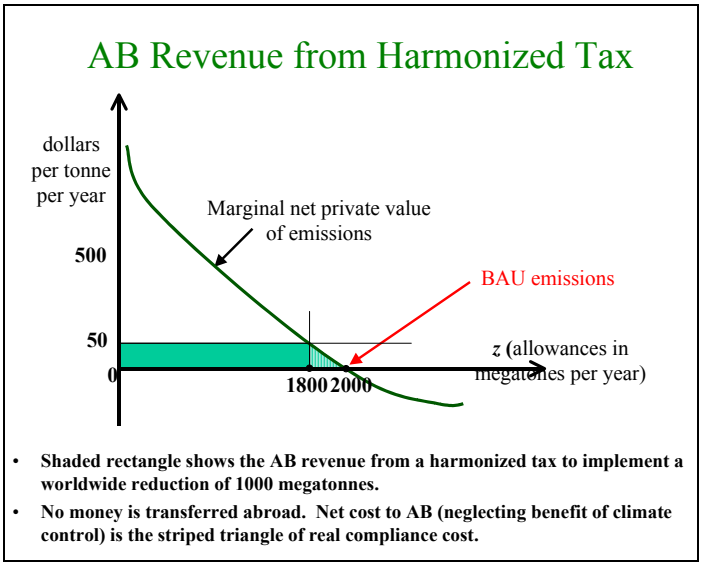


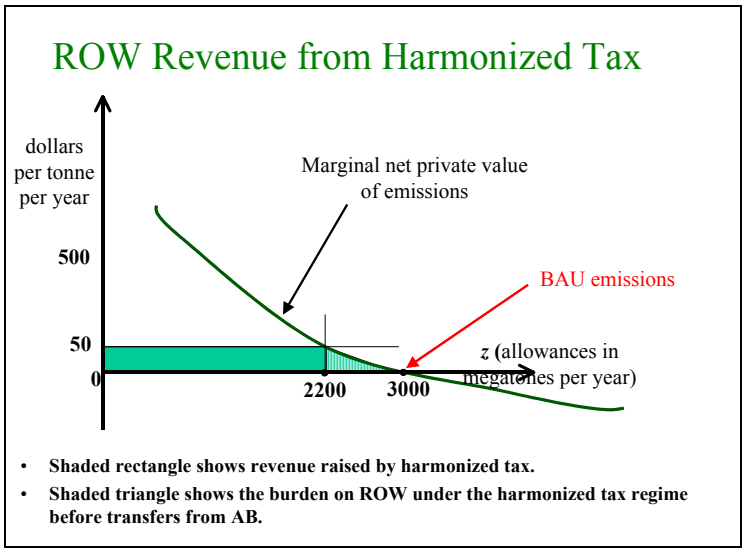
Per the figure below, if there were no international trading at all of allowances, the cost of the Kyoto program to AB would be about $200 billion and the cost to ROW would be $0 (compared to a gain of about $20 billion under the illustrative plan). The sum of the costs would be $200 billion, instead of $25 billion, a dramatic instance of sort of gain one can get by relying on a trading regime. This extra cost (the concept, not the amount) is what the Europeans have been advocating be borne, mainly by the United States.



MIMICKING A HARMONIZED TAX

We can use the same graphical tools to illustrate the use of harmonized national tax policies to implement the climate objective, as suggested, for example, by Nordhaus (2001). In this case, the required tax would be $50 per tonne. The revenues raised would be as indicated in the diagrams below.





Economists understand that the revenue from the taxes tells us nothing about the effective burdens borne by the two countries. Basically, they constitute redistributions among taxpayers within the countries – the revenues would permit reductions in other taxes, if they were not used

to compensate the groups on whom the carbon taxes are imposed (as might occur in the political process). Under the simplifying assumptions made in constructing the diagrams, the burdens on the two countries are represented by the little triangles under the curves of marginal values of emissions, as shown below. Absent transfers from AB to ROW, and neglecting the benefit of controlling the climate, ROW bears a net burden under the illustrative harmonized tax that roughly equals its net gain under the illustrative Kyoto plan with full trading.

REFERENCES

Babiker, Mustafa K., and Richard S. Eckaus, "Rethinking the Kyoto Emissions Targets," Report No. 65, Cambridge, MA: MIT Joint Program on the Science and Policy of Global Change, August 2000.

Bradford, David F., "Benefit-Cost Analysis and Demand Curves for Public Goods," Kyklos, XXIII-3, September 1970, pp. 775-791.

Coase, Ronald H., "The Problem of Social Cost," The Journal of Law and Economics, (III) October 1960, pp. 1-44.

Ellerman, A. Denny, Paul L. Joskow, Richard Schmalensee, Juan-Pablo Montero, Elizabeth M. Bailey, Markets for Clean Air : The U.S. Acid Rain Program, New York, NY: Cambridge University Press, 2000.

Ferguson, Eric. T., "Tradable Carbon Extraction Permits: An Attractive World Regime for CO_2 Abatement," paper presented at the 51st Pugwash Conference on Science and World Affairs: Challenges for Peace in the New Millennium, Agra, India, November 11-16, 2001.

Hargrave, Tim, "US Carbon Emissions Trading: Description of an Upstream Approach," Washington, DC: Center for Clean Air Policy, March 1998.

Kopp, Raymond, Richard Morgenstern, William Pizer, and Michael Toman, "A Proposal for Credible Early Action in U.S. Climate Policy," Weathervane/Resources for the Future, 1999. http://www.weathervane.rff.org/features/feature060.html.

Lackner, Klaus S., Richard Wilson and Hans-Joachim Ziock, "Free Market Approaches to Controlling Carbon Dioxide Emissions to the Atmosphere: A Discussion of the Scientific Basis," undated MS.

McKibben, Warwick J., and Peter J. Wilcoxen, "Permit Trading Under Kyoto and Beyond," Brookings Discussion Papers in International Economics, Washington, DC: The Brookings Institution, September 1999.

Musgrave, Richard A., The Theory of Public Finance: A Study in Public Economy, New York, NY: McGraw-Hill Book Company, Inc., 1959.

Nordhaus, William D., "Alternative Mechanisms to Control Global Warming," paper for presentation at the 20th Anniversary Meeting of the International Energy Workshop, Laxemburg, Austria, June 21, 2000.

Rosen, Harvey S., Public Finance, 4th Ed., New York: Irwin, 1995.

Victor, David G., The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming, Princeton, NJ: Princeton University Press, 2001.