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**Obstacles to global CO₂
trading: A familiar problem***

A.D. Ellerman

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This report is one of a series intended to communicate research results and improve public understanding of climate issues, thereby contributing to informed debate about the climate issue, the uncertainties, and the economic and social implications of policy alternatives.

Henry D. Jacoby and Ronald G. Prinn,
Program Co-Directors

For more information, contact the Program office:

MIT Joint Program on the Science and Policy of Global Change

Postal Address:

77 Massachusetts Avenue

MIT E40-271

Cambridge, MA 02139-4307 (USA)

Location:

One Amherst Street, Cambridge

Building E40, Room 271

Massachusetts Institute of Technology

Access:

Tel: (617) 253-7492

Fax: (617) 253-9845

E-mail: globalchange@mit.edu

Web site: <http://web.mit.edu/globalchange/www/>

Obstacles to Global CO₂ Trading: A Familiar Problem

A. Denny Ellerman¹

INTRODUCTION

Global trading in CO₂ emissions is appealing for two reasons. Experience with the U.S. acid rain program, established by Title IV of the 1990 Clean Air Act Amendments, has demonstrated that tradable permits are an efficient means of meeting both environmental and economic goals.² The global qualifier could be dropped, and tradable permits would still be a desirable means to meet any given carbon dioxide (CO₂) emissions target. But the global dimension makes the use of tradable permits doubly appealing. Cheaper emission reductions lie abroad so that the cost of meeting any domestic target would be much less if these cheaper reductions could be substituted for what would otherwise be required domestically.³ Global emissions trading provides the mechanism to effect that substitution.

Given the apparently large savings from global trading, it is appropriate to examine the obstacles that stand in the way of establishing such a system. The temptation is to set to work on the details of an international regime for greenhouse gas (GHG) emissions trading. These details are daunting, to use the words of Dr. David Harrison, Jr., of National Economic Research Associates. They are addressed very well in an earlier paper of his, as well as by an excellent United Nations Conference on Trade and Development (UNCTAD) draft that is now circulating (Harrison 1997; UNCTAD 1998). I am not going to take issue with anything in these studies, because I agree largely with the analysis presented therein.

Still, it is easy to overlook an important but unspoken assumption in these studies focused on the international details: an emissions trading system at the

national level. As important as it is to get the details of an international regime right, the chief obstacle to the creation of a global system of tradable CO₂ permits is the nonexistence of at least one functioning national system. To put the argument pithily, the greatest challenge lies at home; and, assuming that we decide to implement such a system, the biggest obstacle is a crassly familiar one: deciding who gets the rent generated by limiting the right to emit CO₂ (i.e., making this commodity a scarcity).

In fact, the problems of creating a national system may be even more daunting than the details of an international trading system. For what has been heretofore free will be made scarce; and scarcity presents any society with a problem of how to allocate the use of the scarce thing and the associated rent. Solving this problem of domestic allocation is difficult, but not impossible. Addressing this issue openly, such as in the recent Heinz Center study, is one of the signs that determine whether proponents are serious (Heinz Center 1998).

A corollary proposition is that, once a national system is in place, an international trading regime will develop more or less naturally, not so much as the result of global agreement, but as a matter of self-interested trade. Still, to realize the full potential of global trading, the same problem of determining who has a right to the rents created by this global scarcity will have to be confronted, but on a grander scale.⁴

In order to move the argument along, I make two assumptions that I will not seek to justify, but which are necessary to focus on the central argument. The first is that effective monitoring and enforcement will be put in place. The targets agreed to at climate change negotiations in Kyoto, Japan, in December, 1997, will be more than aspirational goals toward which all parties will endeavor. A showing of sufficient good works or other manifestations of earnest and well-intentioned effort will not be enough to constitute compliance. Achieving the target will be the only thing that counts. The second assumption is that a domestic cap-and-trade system will be put in place. Given the uncertainty of economic growth rates, fuel use trends, and technological change, it hard to see how the quantitative goal established in Kyoto would be achieved otherwise, and how other Annex I parties could expect to meet their goals efficiently without such a system.

THE PROBLEM OF ALLOCATION

A national cap, as suggested by the Kyoto Protocol's targets for Annex I parties, is most usefully seen as each party's initial allocation of the capacity of the Earth's atmosphere to act as a repository for GHG emissions. There may be debate whether a limit on that capacity exists, and if so, what it is; but it should be recognized that the ostensible, underlying premise of proposals to take action is that there is such

a limit. This capacity has become a concern, not because we have been heretofore morally obtuse, but because the scope of human activity has expanded so much.

Defining the problem as one of emerging scarcity implicitly asserts that the problem is not one of limiting a socially undesirable activity, as is the case with tobacco, for example. This distinction is a subtle one, since both motivations seek to limit use, but it is fundamental. One needs only to ask whether the objective is to eliminate the use of what is being limited. The impositions placed upon smokers do not reflect any underlying scarcity, and most people would not care if the strictures against tobacco were to lead to no smoking at all. On the whole, it would be hard to argue that society would be much changed. The argument is quite different with respect to energy. Aside from a few romantics, very few find the notion of a world without the forms of energy associated with the industrial age to be appealing. Society would be very different without such energy, whereas the same cannot be said for tobacco.

Allocation of the rights to a scarce resource involves two aspects: the use of the resource and the receipt of the rent attached to that use. The two are often combined, but they need not be. One of the advantages of permit trading systems is that the two can be separated practically as well as analytically. In principle, all would agree that the newly limited sink should be reserved for the most highly valued uses, but there will be disagreement about what those uses are. At an earlier time, there existed sufficient faith in government that some form of administrative or regulatory rationing was acceptable. Now, more faith is placed in markets so that the preferred mechanism, particularly by economists, would be that the requisite number of rights to the use of the sink should be auctioned off as tradable permits. In this manner, those valuing continued use most highly, and only those, would have access.

Alternatives for Distributing Use and the Associated Rent

An auction of these rights raises an issue that ought not to be a problem but is: what to do with the revenue. There is a rich literature on this subject, and some very appealing arguments on how the revenue might be recycled optimally. But there are two problems with any auction that involves large amounts of revenue. First, belief in the government's ability to distribute the rents optimally is no greater than belief in the government's ability to allocate use, which is the reason for the auction in the first place. As such, auctioning the permits takes on the appearance of a disguised tax. The second and more fundamental problem is the assumption that the government owns the rights that are to be auctioned. The inconvenient fact is that these incipient rights are possessed *de facto* by existing emitters and actively exercised by them. From their point of view, the auction is not just a tax in disguise, but anticipatory confiscation of rights established by time-hallowed use.

If government were little more than an invading horde that took what it wanted by force and defined the terms by which nearly everything of value was used, none of this would be a problem. But that is not the case. Those who possess the incipient rights, the squatters, if you will, are part of society and have voice. They know that their circumstances will not be improved by the actions being proposed, and they can be expected to assert their interests. At the very least, in a society that seeks to be just and equitable in dealing with its citizens, CO₂ emitters have an arguable claim to compensation.

With respect to the use of the now-scarce resource, those who will use the sink after limits are imposed are largely those who were using it before, albeit in less quantity. Conventional command-and-control regulation allocates such use explicitly to existing users; and typically a more stringent standard on new entrants is imposed. With grandfathered permits, the right to use is explicitly allocated to existing users, but the recipients are not required to use all or only the permits distributed to them. With taxes and auctioned permits, the right to use is gained only by payment, but those who make the payment and gain the corresponding right will be mostly existing users.

If there is strong sentiment to restrict access to the scarce resource, and even if existing users are opposed to the limit, a deal can and will be struck. The deal that can be struck is one in which the rights are limited, but given to the existing users, either through conventional command-and-control regulation or through grandfathered permits. As a matter of political economy, taxes and auctioned permits lose out, unless there is overwhelming consensus to take action and the adversely affected existing users are poorly organized. When the right is allocated by grandfathered permits, the grant of the rent is very explicit, and for this reason there is often objection to the arrangement. In contrast, there appears to be no grant of the rent in the regulatory form, but that is not quite the case. It is not as explicit and it may not be as secure, but it is still there, just well hidden. It shows up in the value of the asset that has been granted the right to use the now-limited resource.

Despite the political appeal of command-and-control regulation in hiding the rent, this form of regulation is increasingly seen as too inefficient to be considered seriously. It is inefficient precisely because the inseparability of use and rent impedes the mobility of resources. Thus, grandfathered permits alone seem to combine efficient allocation of use to the highest value with the politically expedient granting of the rents to existing sources. Unfortunately, the rent is transparent and will be charged to consumers. And, it is not clear that consumers are any more willing to pay equivalent charges to the local utilities or multinational oil companies than they are to pay taxes to the government.

Grandfathered Permits: What Are the Issues?

One problem with grandfathered permits is that payment of rent to existing users lends itself easily to the demagoguery that already-rich corporations will be further enriched, even though corporate profits may not be higher since charging for the use of the emissions' permit will reduce demand for that company's products or services. From this perspective, rents can be seen as compensation. Nevertheless, when compared to the effect of an equivalent tax, the rent from the permit will improve corporate profits. From a societal standpoint, the increase in profit is not the end of the story, any more than it is for taxes paid to the government. Since the corporation is a legal entity only, the revenue will be recycled in some combination of taxes, investment, and dividends. A third goes to the government in any case, hopefully to be optimally recycled. The new set of prices will create an incentive to retool the capital stock to use less carbon, and the increment of earnings will make the financing of such investment easier, perhaps reducing what would otherwise be a demand for tax credits. Dividends and appreciated stock values will benefit stockholders; however, given the role of mutual funds, private retirement accounts, and pension funds in modern American society, such a distribution may not be as inequitable as it might first sound. In fact, an interesting test suggests itself: would the government recycle its third as efficiently and equitably as the two-thirds that would remain with corporations?

Another concern that must be dealt with when allocating grandfathered permits is that a barrier to entry is created. Potential new entrants are understandably upset that the existing parties with whom they want to compete would enjoy this extra advantage, but the important issue is whether the grant affects decisions at the margin. Typically, it does not; it is a lump sum transfer that will be welcomed by any party and that will have little if any influence on the marginal decisions of existing users or new entrants. Nevertheless, potential new entrants are one of the political complications in the development of a domestic emissions trading system, even if their charges of barriers to entry are nothing more than disguised entreaties for an equitable share of the rent being created.

The seriousness with which the claims of new entrants are taken does indicate acceptance of the principle that private parties should receive the rent. It is, however, only an introduction to an even more difficult problem: who along the vertical chain of existing use has the superior claim to the right? In the case of the automobile, do the rights to the use of carbon reside in the fuel, or in the car? Or for that matter, with the driver? The same could be said of power plants. Do coal producers have the right to produce carbon, or do electric utilities have the right to emit CO₂?

Where the carbon will be monitored along that vertical chain will have a strong influence on who gets the permits, but it need not be so. In the U.S. acid rain

program, the monitoring and the distribution of permits occur at the same point in the vertical chain, the power plant. If transactions cost are negligible, then the permits could be distributed elsewhere and the power plant operator would manage to acquire the requisite number of permits. The charge to the consumer would be the same, but the payments would be different. The owner of the power plant whose value has been diminished by the limit has not been compensated, but the power plant is not the only asset along the vertical chain of existing use that may have a claim. The assets of coal producers will be affected by the new set of prices; and the same claim could be made for downstream assets, even for any consumer assets that were premised on the former set of prices.

Precedents for Allocating Permits

Although the problem of allocation is difficult, it is not insoluble. It has been done before; however, the conditions were easier. In the case of the U.S. acid rain program, the recipients of the rents, electric utilities, were presumed to be subject to cost-based regulation. Thus, the rent associated with the grandfathered permits would be passed on to ratepayers. Since nearly everyone uses electricity, this was a pretty broadly defined group. There were many rent-seeking deviations from the principles guiding the program's allowance allocations, but cost-based regulation permitted the utilities to argue that they were acting as the agents of ratepayers.⁵ It will not be possible to make similar arguments for CO₂ allowances. The generation of electricity is being effectively deregulated, and the other likely recipients—oil companies, natural gas pipelines, and large industrial users—are not regulated either. As a result, the rents will be as transparent as taxes are, but not necessarily any more politically acceptable.

Another important precedent for allocation of the atmospheric sink is land. Land is a God-given resource made more scarce by increasing human and economic activity, not unlike the Earth's atmosphere. It just became scarce a lot sooner. The history of establishing and perfecting the title to land is long and convoluted, but not an inappropriate one. Notably, in our society and most industrialized societies, no one today questions private ownership of this limited resource, even though all of us need a patch of land to call home; and any entitlement we may receive comes through private inheritance, not from the state. There surely was an original recipient of the right to this land, now lost in the shrouds of history, but no one seems to care.

Some controversy did attend the initial assignment of title in land, but it was greatly damped by the gradual emergence of the scarcity. One might marvel (or recoil in horror) at the terms by which titles to midtown Manhattan were distributed to seventeenth-century Dutchmen, but the sentiment arises from the value today, not then. It would be absolutely impossible to attempt to distribute

such title now, but at the time, the value was such that there was little or no controversy, and probably active encouragement of assuming such title.

In contrast, the scarcity that is implied by the Kyoto Protocol targets is significant, a reduction on the order of 30 percent below of 2010 baseline emissions. Such bold action is appealing politically, but it gets in the way of practical solutions by creating sizeable rents that are worth fighting over. The allocation would be much less contentious if scarcity were to be created only gradually, so that discounting of future costs would dampen the present value of the rent.

My point in making these distinctions is not to argue for any particular way of allocating the rents, but to emphasize the complexity of the problem that will be faced in setting up one functioning national system of tradable permits. Creating a scarcity, such as is implied by the Kyoto targets, raises fundamental issues of equity and the definition of rights, which are preeminently political questions. Analytically, creation of the scarcity and allocation of the rights and rents can be separated, but practically, the two are fused and there will likely be agreement on the creation of the scarcity only as there is agreement on the allocation of the rents thereby created.

EVOLVING INTO AN INTERNATIONAL SYSTEM

The evolution of a national system into a global system is most easily described as a matter of trade. When the thing being traded can be produced abroad cheaper than it can at home, we can anticipate that trade will develop across national boundaries for the same reasons that we expect emissions trading to operate within the country, or that international trade in goods and services has arisen. Parties at home will seek cheaper supplies abroad, and parties abroad will seek to tap into this new market opportunity. Two types of international emissions trading can be anticipated: with other Annex I countries and with non-Annex I sources of emission reduction.

Annex I Trading

Trade among Annex I parties is not expected to bring the large benefits associated with global trading, but it is a useful point of departure. To take the simplest case, suppose that two Annex I countries, say, the United States and Norway, have solved the domestic allocation problem and adopted commensurate domestic emissions trading systems.⁶ Each would have its own autarkic market price for the right to emit CO₂, and it is likely that the price would be higher in Norway than in the United States. This difference in price indicates an opportunity to gain from trade, and an incentive for persons in Norway to import permits from the United States. Similarly, there is an incentive for persons in the United States to abate more in order to free

up permits for sale to Norway at a higher price. Full trading between these two parties would lead to some equilibrium price, which would be higher than otherwise in the United States and lower than otherwise in Norway to the mutual gain of both. As with any traded good, there will be groups in both countries who will object, alternatively, to the competition from cheap imports, or to the higher prices created by the exports. Nevertheless, we can assume that these problems will be resolved, as they are with other goods, and that trade will occur.

Emissions trading could be easily extended to other Annex I countries. All that would be required is faith in the validity of the permit, which would be provided by accurate monitoring of emissions and effective enforcement of the domestic permit system by each trading party. Such faith in the value of the permit is identical to what applies for any good or service that is exchanged in international trade: the good must be real. Moreover, the monitoring of emissions to ensure the value of the permits is no different from what would be required to determine compliance with the Kyoto targets, even if there were no trading.

Annex I trading would be desirable, but it does not lead to large reductions in the cost of meeting the Kyoto targets. Less-expensive abatement opportunities can be found in Eastern Europe and the former Soviet Union, both Annex I parties, but not enough to bring about the much lower price that is typically predicted by global emissions models. For instance, the model we use at the Massachusetts Institute of Technology predicts a market price of about \$125 for Annex I trading but one of \$25 with full global trading (Ellerman and Decaux 1998).⁷

Figure 1, which illustrates the demand and supply for emission permits, shows just how much difference the non-Annex I countries make in these models. The demand curve is the same for both the Annex I and the global markets, but the supply curves are very different. In the Annex I market, a significant amount of permits would be supplied by the former Soviet Union to the OECD countries, on the order of 350 million tons, or approximately 25 percent of the total reduction predicted to be required of these parties. But in this model, as in others, when the market is expanded to include non-Annex I countries, much greater supply at lower costs becomes available. In this global market, Annex I countries would import about 70 percent of the total reduction requirement; and at such prices, the cost of meeting the Kyoto target for the United States is less than one-third of what it would be in the Annex I market alone.

Additionality and Non-Annex I Trading

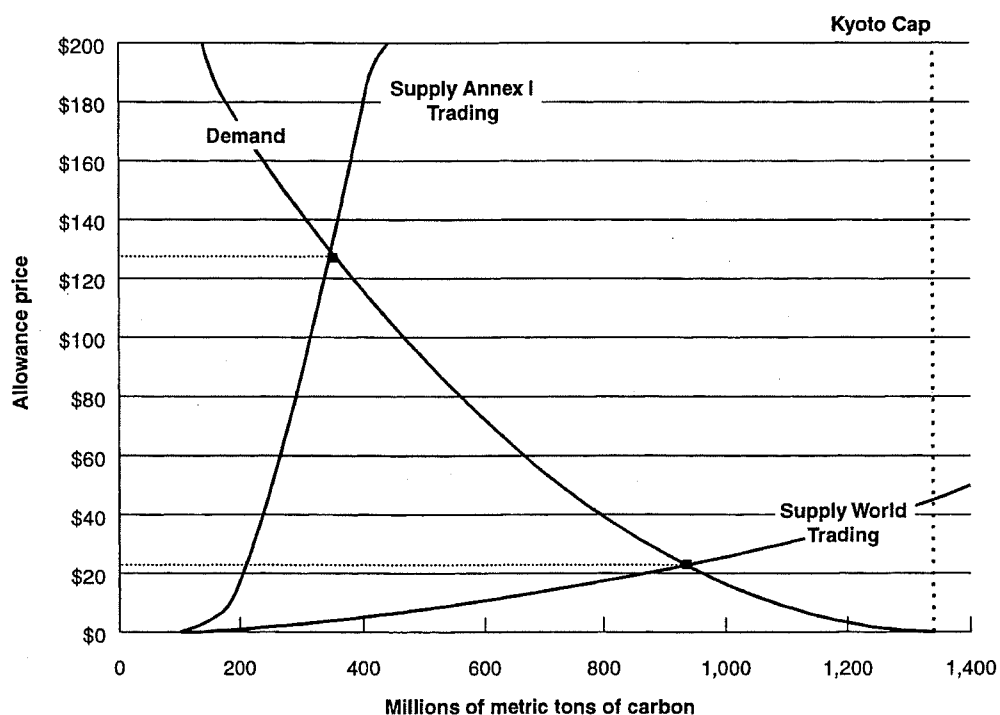
The logic of non-Annex I involvement in emissions trading is fundamentally no different than that of Annex I trading. Trade is a response to opportunity, and emissions trading is the mechanism by which emission reductions outside Annex

I can be made available. However, the thing traded must be genuine, and this requirement introduces a critical difference from Annex I trading. When there is no cap, it is much harder to establish that the permit represents a real reduction of emissions, or to use the jargon of the Kyoto Protocol, that it is “additional.”

Establishing that an emission reduction is additional involves measuring a difference between observed emissions and what emissions would have been if the emission reduction activity had not taken place. What would have been cannot be measured by its very nature; it can only be estimated. Consequently, the permit, and the reduction underlying it, is only as good as the estimate of this counterfactual, assuming of course that observable emissions are accurately measured. Good estimates can be made, but the effort to make sure they are good will be costly, and always subject to question and to challenge by anyone opposed to the proposed trade.

Making these estimates, dealing with challenges to them, and getting them approved will limit the potential for this form of trading, as they have for all forms of credit-based emissions trading. As a result, these transaction costs will limit Annex I access to low-cost substitute emissions reductions, and they will frustrate would-be non-Annex I exporters; but the underlying requirement cannot be avoided. No Annex I party with a tight cap-and-trade system can tolerate counterfeited goods. It can be hoped that standard operating procedures and institutions will

Figure 1 Aggregated Supply and Demand Curves in 2010 Under the Kyoto Protocol: Annex I Trading/World Trading



be established to reduce these costs, but the experience so far with Activities Implemented Jointly (AIJ) has not been particularly encouraging.⁸

Non-Annex I parties who wish to exploit these export opportunities will quickly realize that these costs can be avoided, and that they are avoided in trading among Annex I countries, because an Annex I cap directly creates the rights that are traded. Parties without a cap have to engage in an additional step, demonstrating the *bona fides* of the emission reduction, in order to obtain an equivalent, tradable "right to emit." If the non-Annex I country were to accept a limit and implement the necessary monitoring and enforcement to ensure the integrity of its permits, this transactions cost would be avoided and export quantities and earnings would be increased. The necessary monitoring and enforcement would already be in place at the project level, and the apparatus would need only to be extended to the national level. There would also be a certain economy of scope in negotiating the baseline in one fell swoop, instead of in detail on a project-by-project basis. Raising the negotiation from the project to the national level involves more than an all-encompassing, multi-project baseline for the first commitment period. These other considerations provide more flexibility, but they also raise issues of allocation on the international scale.

Evolving to an Annex I Cap

The critical question is, can an acceptable cap be negotiated? Within the framework of the Berlin Mandate as embodied in the Kyoto Protocol, the principle for determining the cap on a non-Annex I country in the first commitment period is clear: what emissions would be without the trading activity. The ideal would be an exact-fitting but nonbinding cap. In such an ideal, there would be no constraint on the non-Annex I country's growth and there would be no "hot air." All exported permits would reflect real emission reductions.

The reality is not so neat. No one will know what emissions would have been without emissions trading, and given the possibility that economic growth, and therefore counterfactual emissions, might be greater than expected, the prospective Annex I country is likely to want to assure itself of some "headroom" (Wiener 1997). Unfortunately, granting headroom increases the probability of hot air. On a practical level, both sides will have to compromise. The non-Annex I applicant must be prepared to accept a little upside constraint if it wishes to retain the permits created by any downside variation. Correspondingly, those on the other side of the table must recognize that a little hot air is the downside counterpart to the upside constraint on emissions. In the end, some element of enabling myth will be required, as it is in any project baseline.

Taking a longer view, if atmospheric concentrations are to be stabilized, then limits on developing country emissions are necessary at some future time. The partial

allocation of the use of the global sink adopted at Kyoto will have to be extended eventually to encompass all countries, or at least all major emitters (Yang and Jacoby 1997; Jacoby et al. 1998). Accordingly, there is some advantage in having non-Annex I countries accept limits earlier, even if some headroom were involved.

For instance, if the ultimate allocative principle for global access to the atmospheric sink had been agreed to and were enforceable, and that principle allowed headroom now for some countries, then there should be no objection. The country would be free to bank or to sell currently according to its judgment of its interests, and cumulative emissions would be no greater. Even without such an ultimate principle, there would be a strategic interest in establishing the precedent and the procedures of monitoring and enforcement, even if at the price of some hot air, as has been the case with Russia and the Ukraine in the Kyoto Protocol.

Moreover, if the concern about hot air is strong enough, nothing prevents any or several of the Annex I countries from transferring some of their limit to the non-Annex I applicant. There are even conditions under which Annex I countries might be better off by doing so, quite aside from the strategic interest. For instance, a very small part of the U.S. limit of 1.27 billion metric tons would provide comfortable headroom for Mexico. Under certain conditions—if the reduction of transactions costs associated with accepting an Annex I limit were to increase supply sufficiently—it would be possible for the United States to gain by opening up these new supplies. Otherwise, the equilibrium price would be no different; and the United States would simply have transferred some of the rent from domestic recipients to Mexico in order to serve the longer-term strategic interest in expanding the scope of Annex I limitations.

The ability of Annex I parties to use Article 4 of the Kyoto Protocol to transfer a portion of their limit to others raises new possibilities of getting non-Annex I countries to accept limits. But it also raises the very issue that will have to be solved at the national level first: how is the new scarcity to be allocated. As is the case at the national level, tradable permits allow the assignment and the actual use of the right to be separated; and the rents associated with the assignment of the right can serve a multiplicity of interests. Nevertheless, there is no more agreement on the allocation at the international level than at the national level, and perhaps less. The development of the full potential of global trading will depend upon how quickly such agreement develops, but the discussion cannot be expected to become serious among non-Annex I parties until there is some advantage in accepting an Annex I limit.

The Clean Development Mechanism

In the discussing the evolution of a global emissions market, little has been said about the Clean Development Mechanism (CDM). The reason is that, from the

perspective presented here, it is a transitional institution for which there will be little place in a global emissions trading market. The CDM's role may be transitional, but it is important: it provides the means of prospecting for cheap abatement possibilities and demonstrating the advantages of trade to both exporter and importer. Its activities will also provide experience in measurement and enforcement that will make host countries feel more comfortable in making the transition to a cap, and that will assure Annex I countries of the host country's capability to enforce an Annex I limit.

The creation of the CDM as the sole intermediary between Annex I parties and non-Annex I emission reductions does raise some troubling questions. It could become very bureaucratic and costly to non-Annex I countries that wish to exploit fully the export opportunities presented by Annex I compliance. At times, the CDM appears as a means for effecting a North-South resource transfer. At other times, an incipient cartel is suggested by the expression of concerns about avoiding price-reducing competition among host countries for projects. And at still other times, the CDM is presented as a mechanism to facilitate trade by providing valuable recording, certification, and verification services (Aslam 1998). To the extent that the CDM becomes more than a facilitator to trade, it will only raise the incentive for those most interested in trade to bypass it by becoming Annex I signatories.⁹

CONCLUSION

As with so many things, the creation of an international system of global trading will start at home. There may be very large reserves of cheap carbon abatement lying abroad that could be developed into a flourishing international trade in emission permits to everyone's advantage; however, those reserves will remain untapped until demand is created somewhere and value thereby imparted to them. Thus, the prerequisite for global trading is one functioning national system.

Once a functioning national system of emissions trading is in place, there is every reason to believe that trading would extend beyond national borders, particularly with other Annex I parties. Trade outside of Annex I will face unique problems that raise costs and diminish prospects of abundant supply, but these problems also create the incentive for non-Annex I parties to accept Annex I limits and thus to participate more fully in the benefits of this trade. Expansion of the system will come neither quickly nor easily; but there should be little doubt that an international emissions trading system will develop in this manner, by accretion and as a matter of self-interested trade.

Recognizing that the main obstacle to global emissions trading lies at home does not make the creation of a domestic system any easier. The problem is not in

the monitoring or the enforcement, which must occur in any case; but in the distribution of the rents, which is fundamentally a political and even a philosophical problem. And the issue is not just one of public vs. private good, but also of deciding among a number of private claimants with equally plausible claims. Unfortunately, the type of system that lends itself most easily to expansion abroad is also that which makes the rents most transparent; and transparency may not make agreement any easier.

Currently, disagreement extends beyond the issue of allocation and reveals a fundamental lack of consensus on the nature of the problem. Those who view the problem as one of allocating a scarce resource are typically not much concerned about the allocation of the rents, for it is really a matter of adapting to new circumstances and assignment of the rents to existing users is a convenient way of compensation. For others, the issue is not allocating a scarcity, but limiting a socially undesirable activity, and for these, there can be no issue of preexisting rights or of compensation, and no other place for the revenue generated than the government.

Quite evidently, there is not a sufficient consensus to impose any single view, nor is there sufficient accommodation in the positions of parties to permit the sort of political solutions that will permit legislation to pass. In the meantime, it is worth working on the many details of an international system, because those details will facilitate the development of a market once national action has been taken. But nothing will happen until there is agreement on some distribution of the rents that will be created by this new scarcity.

NOTES

1. Senior Lecturer, Sloan School of Management, and Executive Director, Joint Program on the Science and Policy of Global Change and the Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology. This paper has benefited greatly from a thorough critique of an earlier version by David Reiner of MIT and from editorial suggestions by David Reiner and by Angela Wilkes of the American Council for Capital Formation.

2. Schmalensee et al. (1998) provides a quick summary of the essential features of the initial experience with emissions trading under the U.S. Acid Rain Program.

3. This point was emphasized in recent testimony by Janet Yellen, chairman of the Council of Economic Advisors, and illustrated in the recently released supporting analysis (Council of Economic Advisers, *The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis*, July 1998). Other models of global emissions and economic cost arrive at similar conclusions, when comparable assumptions are made.

4. Heather Ross has recently published a feature on the RFF Weathervane emphasizing the centrality of this issue (Ross 1998).

5. Joskow and Schmalensee (1998) provides a good discussion of the allocation of SO₂ permits.

6. Norway has in fact decided to implement a system using grandfathered permits to meet its Kyoto Protocol commitment (GECR 1998).

7. Permit prices in 1985 dollars. It must be noted that these models, and the costs they generate, assume the equivalent of efficient trading within each region.
8. UNCTAD (1998) is unequivocal on this point. For instance, "Under the pilot program for AIJ, [the] verification process has led to the rejection of many proposed trades, and can take one to two years, creating high transactions costs and uncertainty" (p. 6). Or, "In general, past programs that impose emission caps coupled with allowance trading have performed well, whereas credit trading systems have generally not performed to expectations" (p. 1).
9. See Ellerman, Jacoby, and Decaux (1998) for a more complete development of this argument.

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Massachusetts Institute of Technology
Joint Program on the Science and Policy of Global Change
One Amherst Street (E40-271)
Cambridge, Massachusetts 02139-4307