General Distribution **OCDE/GD(96)173**

JOINT IMPLEMENTATION, TRANSACTION COSTS, AND CLIMATE CHANGE

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Paris

45093

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This document is also available in French under the title “Application Conjointe, coûts de transaction et changement climatique.

FOREWORD BY THE OECD SECRETARIAT

The concept of Joint Implementation (JI), and how it might be applied to the problem of abating global greenhouse gas emissions, is under active debate by the Conference of the Parties, the body charged with implementing the United Nations Framework Convention on Climate Change. Within this forum, several OECD countries have promoted the rapid implementation of JI, while others have recommended that a more cautious approach be taken, pending formal international agreement on the modalities of JI. Against this background**,** the first Conference of the Parties, which took place in 1995, decided that JI should be established only in a "pilot phase" up to the year 2000.

This paper does *not* address the question of whether or not JI *should* eventually be implemented, or in what particular *form*. It merely reflects on the premise that, *if* a JI system *were* eventually to be agreed at the international level, governments might wish to reduce the transaction costs associated with operating that system. Obviously, such reflections will depend to some extent on the original design of the JI system, so some of these design questions have had to be raised in the attached paper. However, they are discussed here *for expositional purposes only*, and should specifically *not* be interpreted as an endorsement of any particular implementation option by OECD Member countries.

More generally, the paper is published as a working paper under the responsibility of the Secretary-General, and does not necessarily reflect the views of any individual Member country.

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EXECUTIVE SUMMARY

Flexible tools to promote cost-effectiveness in environmental protection, such as tradeable permits, environment fees, and Joint Implementation (JI), are increasingly finding their way onto OECD environmental policy agendas, notwithstanding occasional reservations about both their political and technical merits. While the theoretical efficiency of market-based tools is well-documented, transaction costs can seriously erode their cost savings potential in actual practice. As a result, regulators wishing to reduce compliance costs using these tools need to design them (and their supporting institutional infrastructure) with a view to managing transaction costs, or risk not achieving the primary benefits that they offer in the first place.

This paper briefly reviews the concepts and theory of transaction costs and how they affect market operations and outcomes, with special reference to the problem of abating emissions of the "greenhouse gases" that lead to climate change. Next, the relationship between transaction costs and policy design is explored, largely in the context of program evolution and outcomes over time. The specific examples reviewed here include efforts to establish markets for water in the arid western United States, as well as efforts to create environmental commodity markets.

The lessons learned from these on-going market-based policy experiments may also be valuable for Joint Implementation, as it may eventually be applied to the climate change problem. A key conclusion is that differences among criteria applied by states in the evaluation of water transfers have a significant impact both on transaction costs and on the level of transactions. More extensive criteria provided more opportunity for disagreement, and this disagreement significantly increased transaction costs. The new opportunities created by market-based policy innovations pose a threat to the existing distribution of rents from resource use. In effect, the new rents created new transaction costs, as the consensus over distribution was renegotiated. Often, the single most important factor in reducing transaction costs was the acceptance of the policy innovation by the regulators themselves.

The transaction costs of flexible policy tools like Joint Implementation can be significantly reduced through conscious attention to critical design elements. In this regard, the elements to be considered are the same attributes of property that are of interest to any potential investor. Is there security in tenure? Is this a durable asset or does it have a fixed life? Does it appreciate or depreciate over time? Who can own these assets? How is their transfer executed? Policy-makers can help by adopting a responsive and supportive transactional infrastructure, as is the case in the US sulphur dioxide allowance trading system. Computerised tracking, public access to information, organised auctions, and limited trading oversight all add to the potential for market formation -- the most critical hurdle for any environmental commodity. With the international debate over Joint Implementation intensifying, uncertainty over its fate, particularly as to whether investors would ever realise any benefit from their actions, is critical. Without some indemnifying institution, it is unlikely that any private actor could surmount the transaction costs for all but exploratory efforts.

I. INTRODUCTION: JOINT IMPLEMENTATION TRANSACTIONS

Under the United Nations Framework Convention on Climate Change (FCCC), signed by over 150 countries in 1992, the industrialised country parties (listed in Annex I to the FCCC[1]) are obliged to "adopt national policies and take corresponding measures" to limit greenhouse gas emissions and to protect and enhance greenhouse gas sinks and reservoirs.[2] The FCCC further provides that "[t]hese parties may implement such policies and measures jointly with other Parties."[3] The COP, which had its first meeting in Berlin in April 1995, was to take decisions on "criteria for joint implementation."[4] While the primary focus of the meeting was set on the development of a protocol, joint implementation was placed into a pilot phase.

This provision for joint implementation (JI) in the FCCC opens a world of opportunities for investments in abating net greenhouse gas (GHG) emissions. It allows any party operating under FCCC Article 4(2)(a) to undertake its GHG abatement activities[5] wherever conditions and partners are most welcoming. Because GHG emissions mix globally in the atmosphere, abatement undertaken anywhere generates equal global benefits. But, as with the production of other goods and services, different locations may have comparative advantages in providing GHG abatement services. JI therefore creates a new world market in GHG abatement activities: it confers economic value on GHG abatement services and stimulates investment in, and exchanges of, that service in the world economy.

JI can be seen as another example of the "greening of world markets". Environmental values are being incorporated into standard transactions and into measures of national economic activity, and market-based approaches are increasingly being used by governments to achieve environmental protection. As examples of the latter trend, governments are increasingly employing tradeable permits systems to address problems such as air pollution, water pollution, and fisheries management.[6] These market-based approaches seem to be attractive because they can achieve environmental goals in a more cost-effective manner.[7] Based on this experience, some analysts have advocated that efforts to regulate GHG emissions should employ a formal system of tradeable permits[8], or at least an "informal" system allowing international "co-operative arrangements" or "joint implementation" of GHG abatement activities.[9] The provision for JI in the FCCC could lead to such an "informal" market system, based on project investments in return for GHG abatement credits.

As with any market (or market-based regulatory) system, a critical issue for the development of JI will be the functioning of the market. The market will function best (maximise net benefits) when transactions are costless and participants are competitive. If trades are prohibitively difficult to arrange, or if some players in the market exercise market power (*e.g.* an oligopoly), the market will not operate optimally. Thus, the "macro" global gains expected from JI depend critically on the "micro" aspects of transactions and transaction costs.

Despite the *theoretical* attractiveness of JI, however, there are several *practical* hurdles that will have to be overcome before it will be able to contribute very much to the achievement of the FCCC's goals on an on-going basis. These hurdles involve both political and technical issues, a few of which are reviewed later in the paper. During the current "pilot phase" of JI, the Conference of the Parties (COP) of the FCCC is examining these problems at closer hand. It remains to be seen how they are eventually resolved, and this paper does not presume any one possible outcome of this process over any other. Instead, it is primarily concerned with the "narrower" issue of how transaction costs might be minimised in any JI scheme that might eventually be adopted.

Elements of JI transactions

A JI transaction can be described as an agreement between an "investor" and a "host"; in which the host provides GHG abatement services in return for valuable consideration from the investor. The host provides these GHG abatement services by conducting GHG abatement activities and then transferring to the investor (by sale or lease) a quantity of GHG abatement services which are termed "credits"[10]. The investor earns the right to report these credits to those who are interested, who might include the FCCC bodies, a national government, and the public. The investor in return provides something of value to the host, which can be in any form that the JI partners agree on, such as cash, low-emitting energy technologies, water treatment systems, telecommunications services, and so on.

The precise terms of the exchange -- such as the amount or fraction of GHG abatement credits to be assigned to each party, the price paid by the investor, the obligations of each party -- would be determined by the parties to the transaction as part of their agreement. In general, *hosts* are likely to benefit by increases in local economic development, and by reductions in local pollution or other environmental problems associated with GHG emissions. Hosts will also be able to use the creation of GHG abatement credits as a new source of wealth and bargaining power: a new item of value to exchange for whatever the host finds desirable. Hosts with attractive JI projects will audition potential investors to invite competition toward the best deal for the host. Meanwhile, the *investor* receives GHG abatement credits at lower cost than the investor would have to pay at home (or in an alternative JI project) for the same abatement. Thus, the investor will secure the same GHG abatement at lower cost, or more GHG abatement at the same cost, than in the absence of the opportunity for JI.[11]

The JI transaction is entirely voluntary on both sides. It will occur only if it is mutually advantageous -- if both parties would be better off with the joint project than without it. Thus, if the host perceives that giving up the GHG abatement credits would be a greater loss than the value of the goods and services provided in return, the host will not make the deal. The minimum the host would be willing to accept to undertake the GHG abatement activity is limited by the amount of value it would receive for the next best use of these resources, which may be an alternative JI offer, or some other domestic activity. Similarly, if the investor could find alternative GHG abatement credits at less cost, it would not make the deal. The maximum the investor would be willing to pay for the GHG abatement credit is the cost of the next most costly source of GHG abatement, such as a domestic activity or an alternative JI deal. There will thus be competition among both hosts and investors to offer the most attractive terms and to find the most attractive projects.

In principle, any country might serve as either investor or host, or both.[12] A country (or its private enterprises) might invest in some JI projects overseas, and, simultaneously or at other times, be the host for JI projects invested in by other countries. The identity of the parties to each JI transaction will depend on the relative costs and benefits to each. In general, however, investors are likely to be from countries with *high* marginal costs of abatement, while hosts are likely to be in countries with *low* marginal costs of abatement.[13]

JI transactions are also likely to involve the private sector. For example, private companies subject to national emission abatement requirements could be allowed under their national regime to satisfy those requirements through JI activities.[14] Indeed, the role of private enterprises in JI is really no different from the role of private enterprises in all GHG abatement, domestic or otherwise. That is because, as a form of international law, the FCCC governs *parties* (nation-states), but GHG emissions arise largely from *private enterprises* (though also from state-owned enterprises and activities). Hence each nation-state party to the FCCC implementing abatement policies and measures (domestic as well as JI) will have to induce abatement action by private enterprises, through such mechanisms as government financing, taxation, regulation, or cajoling. Moreover, one cannot easily assume the national identity of the GHG abatement services generated (or arranged for) by any particular private enterprise, because many private enterprises are multinational or mobile. Instead, nation-state parties to the FCCC will have to demand, in effect, the assignment of GHG abatement credits from the particular private enterprises which actually undertake abatement. Such assignment will occur via compliance with government regulation or taxation, or by contract. That is, the private enterprise will offer its GHG abatement services to the nation-state in return for avoidance of taxes or regulatory penalties, or in return for contractual benefits, such as government funds. In turn, national governments will report such abatement to the FCCC.[15] Under JI, the only difference is that the private enterprise will have obtained this GHG abatement credit *outside* the country, before assigning it to the nation-state. Private enterprises are likely to play a major role in JI because they have the financial resources and the incentives to make such investments.[16]

Similarly, non-governmental organisations (NGOs) could participate in JI as well. They could use their funds (or foundation grants or corporate backing) to purchase GHG abatement credits, and then resell or retire them.[17] This is an opportunity for NGOs, not only to advocate prevention of global warming, but to be directly involved in achieving it.[18] And NGOs could also play a valuable role in monitoring and certifying GHG abatement achievements at JI projects.

The JI approach envisaged here would conceptually lie somewhere between the inflexible *regulation* of emissions on the one hand, and a *tradeable permit* system on the other. Many of the same principles underlying a trading system would also apply to JI (especially the flexibility for investments to flow from high- to low-cost abaters; the need for some type of crediting for abatement action undertaken, etc.). The major difference would be that JI represents only *bilateral* trading opportunities, whereas trading systems offer *multilateral* opportunities for realising cost savings. Under JI, participants would invest in specific emission abatement projects, whereas under a trading system, participants could purchase fungible disaggregated permits, each of which represents “shares” in the market’s abatement activity “portfolio”. Trading systems are also usually characterised by a *single* international environmental target, translated into specific permit allocations for each country Party; whereas the JI system outlined here would operate under *varying* national targets. Differences such as these will probably mean that the total cost-effectiveness achieved by a JI system would lie somewhere between the cost savings offered by inflexible regulations and those offered by trading arrangements.

Table 1 describes a set of purely hypothetical JI arrangements to illustrate the variety and flexibility of JI. In each case, the investor would assign the GHG abatement credits earned to a nation-state party reporting to the FCCC, as described above. In addition, private companies, NGOs and IGOs (intergovernmental organisations) could act as intermediaries or secondary investors, arranging projects and funding them on behalf of a group of primary investors, or as a speculative enterprise with the expectation of reselling GHG abatement credits later. One might expect primary investors (nation-state parties obliged to abate GHG emissions by the FCCC, or private enterprises obliged to abate GHG emissions by nation-state governments) to lend funds to NGOs performing GHG abatement services, and to deposit funds in JI mutual funds or venture capital funds, in return for shares of the GHG abatement credit from those intermediaries' abatement activities. Thus, JI offers both NGOs (such as environmental groups) and entrepreneurs an opportunity to earn income by arranging and managing climate protection activities. Environmentally, this would help keep more emissions out of the atmosphere sooner.

Table 1. Hypothetical examples of JI partnerships

Type of investor	Type of host		
	Nation-state	Private enterprise	NGO
Nation-state	US AID funds boiler conversion at Russian state energy company.	German GTZ funds efficient lightbulb installation in private apartment buildings in Argentina.	Swedish government provides forest conservation assistance in Namibian biological reserve.
Private enterprise	Dutch electric utility transfers carbon scrubber to Thailand state steel manufacturer.	Japanese agricultural company provides nutritional supplement for Indian livestock.	US electric utility funds erosion control by Brazilian conservation group.
NGO	WWF provides technical assistance to Zairian forestry agency.	NRDC trains Polish managers in energy efficiency methods.	EDF funds carbon storage accounting at Egyptian NGO afforestation project.
IGO	GEF funds turbine upgrade at Peruvian state power company.	Asian Development Bank funds new motor development by Korean automobile company.	UNEP provides assistance to conservation group in Kazakhstan.

Global gains from JI

Taken together, multiple individual JI transactions, each with important mutual benefits for the participants involved, could have substantial global benefits:

Cost-effectiveness

A key principle of the FCCC is that "policies and measures to deal with climate change should be cost-effective."[19] Because GHG emissions mix globally in the atmosphere and have global effects on climate, emission abatement is equally valuable for preventing global climate change, no matter where it is obtained. And because the costs of GHG reductions vary across countries, the locational flexibility enabled by JI will facilitate the achievement of any aggregate amount of GHG abatement at lower cost than would be generated using an inflexible regulatory approach (although, as noted above, not necessarily at lower cost than a tradeable permit approach might produce).

For example, Barrett has estimated that the cost of capping GHG emissions by the European Union (EU) would be 50 times higher if each EU member state had to cap its own emissions than if there were flexibility to locate emissions reductions wherever in the EU they could be obtained at least cost.[20] Cost variations across industrialised and developing country regions can be expected to be even larger, suggesting substantial global cost savings for almost any given level of reduction desired in global net emissions. Estimates made using OECD's GREEN model[21] indicate that the costs of abatement of energy sector carbon dioxide vary across world regions by a factor of about 20, and that a Toronto-type target[22] could be achieved at roughly half the global cost if locational flexibility were allowed via tradeable credits. And this estimate assumes full cost-effectiveness *within each region* of the globe, which Barrett had shown to be decidedly non-trivial even within the EU; thus, the OECD estimate significantly understates the true global cost savings.

Increased cost-effectiveness through JI thus means that protecting the global climate could be accomplished while conserving scarce social resources for other urgent priorities such as combating poverty, providing health care and education, and protecting the environment (for example, by purchasing additional climate protection).

Resource flows

By allowing countries to invest in GHG abatement projects wherever they are less costly, JI would stimulate a flow of financial and technological resources from countries where the cost of abatement is high, to countries where it is low. In general, that would mean a flow of financing and technology from wealthy industrialised countries to developing countries and to countries with economies in transition. The OECD GREEN model estimates that under a Toronto-type target, allowing trade in GHG emissions abatement credits would generate financial transfers from the OECD (and OPEC) member countries to developing countries of some $3.6 billion in 1995, rising to $118 billion by 2020.[23] While these estimates assume relatively frictionless transactions and thus represent the potential of JI to induce investment in GHG reductions, even significantly smaller flows would nonetheless contribute to solving the problem. In fact, for some developing nations, a marginal increase in investment flows, although small in global terms, could have a very large impact for that nation.

In the aggregate, these potential investment flows would vastly exceed the financial assistance expected under the financial mechanism of the FCCC (Article 12), and even the total outlays of the World Bank's Global Environment Facility (GEF) on all environmental issues (funded at $1.5 billion over three years). Such a flow of resources would make available to developing countries the means and technologies to invest in their economic and human development, and to do so without high emissions of GHGs (this is especially important since developing countries are projected to be the major emitters of GHGs in the coming decades[24]), and while reducing local environmental problems, such as air pollution and forest loss. JI is thus a key avenue for the transition to global prosperity without a global environmental crisis.

The success of JI would depend critically, however, on the ease with which JI activities could be arranged among interested participants. If joint activities are difficult or costly to arrange, few will be undertaken, and the potential benefits of JI will be lost. If there are limited resources available for emission reductions, transaction costs reduce the effectiveness of those resources by diminishing the amount actually devoted to reducing emissions. The degree of such “transaction costs” will partly depend on the criteria for JI established by the Conference of the Parties, and partly on the institutions created or adapted to facilitate JI arrangements.

Reservations about JI

Although there may eventually be a role for JI in helping to reduce the costs of GHG emission abatement, several questions are being raised during the process of negotiating the actual implementation phase of the FCCC. These questions range from concerns that JI would transfer too many abatement obligations from developed to developing nations, to the charge that JI would deplete the stock of low-cost reductions available to developing nations in the future.[25] While it is not the objective of this paper to address all of these issues in detail, many of them have important implications for the future of JI, for the cost-effectiveness of GHG reductions, and ultimately, for the effectiveness of the FCCC itself. Our view is that much of this debate is more a reflection of *political* uncertainty about the future allocation of GHG reduction responsibilities (emission entitlements), and about the costs of moving away from the status quo[26], than it is about the *technical* merits of new policy tools, such as JI. Nevertheless, to the degree that these issues persist, JI is likely to continue to remain in an uncertain status, and may be burdened with unnecessary transaction costs as a result. For these reasons, a few of the most important reservations that have been expressed to date about JI are reviewed below.

Some observers oppose JI between developed and developing countries, on the grounds that JI may violate the Polluter Pays Principle (PPP). In general, the PPP requires polluters to pay the full costs of measures required to bring the environment into conformity with government-imposed regulations (e.g. abatement targets). If a country has adopted a particular abatement target itself (as many industrialised countries have done), it could be argued that the achievement of that target at lower cost through JI represents as "subsidy" to those countries, and therefore violates the PPP.

However, a closer look at the both the PPP and JI reveal that this is *not* the case. The argument here hinges mainly on the observation that the PPP only requires polluters to pay the *full cost* of pollution prevention and control measures -- not *more than the full cost*. Since JI projects achieve the instalment of "adequate measures", and are paid for by the countries which impose these restriction, the fact that they do so at lower costs cannot represent a violation of the PPP.

Another question often raised about JI is whether its incentive and enforcement structures are so incompatible that they will lead to strategic behaviour by participants.[27] For example, what would prevent investing or receiving nations from overstating the carbon value of "transferred" credits? This problem derives from the lack of specific "baselines", against which JI activities can be judged. In theory, the appropriate "baseline" is that level of emissions which would occur *in the absence of any abatement effort*. This will inevitably be a difficult level to estimate, because it is so hypothetical. One option might be to assume that the "baseline emission level" and the "abatement target" are equivalent, and to judge JI activities against stated targets. Although this has some appeal, it would only be possible where specific targets exist. In the case of greenhouse gas emissions, it is noted that only the developed countries have adopted such targets; none yet exist for the developing countries.

Of course, any abatement effort (whether or not this is a JI initiative or entirely a domestic activity), will inevitably raise questions about the credibility of that effort, relative to the "baseline." Nevertheless, credibility problems of this type do have a variety of solutions.[28] For example, the validity of any transaction presented by any nation to its international peers would depend to a significant extent upon the credibility of the proposing nation itself. If country A has an aggressive GHG reduction program, backed by tough domestic regulations, the credibility of its program is likely to be transferred to any JI investments it may undertake. JI-derived credits could also be viewed as a type of "currency", albeit in environmental terms. These credits created by the actions of sovereign states could be valued not only by the technical aspects of the underlying investment projects, but also on the basis of the reliability of the parties to the transactions. In this sense, reliance on markets to properly value assets would be a primary source of accountability for inflated carbon abatement claims. In addition, transparent monitoring systems (perhaps monitored by accredited NGOs) could be designed to verify country abatement claims, regardless of whether these claims are JI-based or entirely domestic.

Another concern is that JI might encourage the transfer of "older" abatement technologies from the developed to the developing countries, thereby slowing down the rate of adjustment from existing (energy inefficient) production and consumption patterns in the industrialised countries, to "state of the art" modern ones in the developing countries. Proponents of JI respond that: (i) transferring old technology is better than transferring none at all; (ii) unless the cost-savings associated with JI can be realised, not much abatement may actually occur in the industrialised countries anyway; and (iii) JI can help promote the transfer of more environmentally-friendly technologies than would otherwise have been the case.

The allocation of credits among nations, especially in cases where multi-national corporations make JI investments in several countries at the same time, is another issue that would have to be resolved in any JI system. Presumably, this allocation problem could be handled on the same "negotiating" basis that would ensue at the country level, but the complexities associated with these negotiations should not be underestimated.

Finally, opponents also sometimes argue that JI will erode the national sovereignty of developing nations, since they will be in a poor negotiating position vis-à-vis the industrialised countries in the establishment of JI projects. Proponents would respond that "national sovereignty" means, among other things, the ability to negotiate bilateral contracts freely with other states. If properly designed, JI would encourage industrialised countries to compete with each other to attract developing country partners; it would also confer a new "bargaining chip" on developing countries, who would now be in possession of an economically-valuable asset (i.e. low-cost GHG abatement potential).

The resolution of all these issues remains the responsibility of the international negotiating process, and it is not the purpose of this paper to presume the outcome of those negotiations. As the *Ad Hoc* Group on the Berlin Mandate (AGBM) moves forward to develop JI proposals for consideration by the COP, the international framework for addressing climate change will eventually acquire more concrete form for all participants. In this evolutionary setting, however, it is appropriate to consider the possible place of JI in the international policy structure that ultimately emerges. Is JI a transition tool to facilitate the development of experience in international co-operation, before a truly global regime of tradeable permits is set into force? Or is JI completely compatible with (and integral to) the potential for a tradeable GHG permit to emerge? The answer depends completely upon the actions taken by the parties themselves.

For example, JI could develop as a multilateral policy tool as an adjunct to existing regional economic agreements, such as the North American Free Trade Agreement (NAFTA) or the European Union (EU). Alternatively, JI could eventually be subsumed into a process of routine international transactions in tradeable GHG reduction permits. If this latter view were to prevail, one concern sometimes raised is that JI might impede the development of a global GHG trading regime, or least reduce its overall efficiency. Given the incremental pace of the international negotiating process, it is unlikely that JI would engulf the entire process (except, perhaps, as a surrogate for other issues), or that there will be a "big bang" GHG market. Rather, JI seems more likely destined to play a "bridging" role, both between parties with different emission abatement responsibilities, as well as between different policy regimes. The challenge will be to design this "bridge" so that it contributes as much as possible to the goal of economic efficiency, while still meeting other policy objectives. Keeping the transaction costs of JI to a minimum will be an essential part of that strategy.

Structure of the paper

This paper examines the role of transaction costs in joint implementation under the FCCC. The central questions it attempts to address are how transaction costs may affect the development of JI under the FCCC, and how rules and institutions for JI could reduce or magnify these transaction costs. Section II provides a description of transaction costs and a discussion of their influence on markets and environmental problems in general. Section III surveys empirical examples of institutions created to help reduce transaction costs in markets. Section IV explores the importance of transaction costs to market-based environmental regulatory tools, such as tradeable credit systems. Section V assesses current experience with international GHG abatement projects of the type that might become JI projects, focusing on the transaction costs faced in these projects, as well as on the resulting pace and extent of abatement projects. Based on these generic assessments of transaction costs in markets, Section VI then examines the kinds of criteria and institutions that have been proposed for JI in terms of their impacts on transaction costs. Finally, Section VII offers our recommendations for managing transaction costs in JI.

II. GENERAL THEORY OF TRANSACTION COSTS

Transaction costs are the costs incurred by participants in an exchange, in order to initiate and complete the transaction. Such costs occur to some degree in all real-world transactions, and thus affect all real markets. All participants may incur transaction costs, including both buyers (investors) and sellers (hosts). Transaction costs are not only the out-of-pocket expenditures necessitated, but the opportunity costs -- the lost time (delay) and resources (*e.g.* money, managerial attention) -- that could have been devoted to the next best opportunity for that participant.

Types of transaction costs

Transaction costs take many forms, but some of the main types are search costs, negotiation costs, approval costs, monitoring costs, enforcement costs, and insurance costs.[29] ***Search costs*** are the costs of finding interested partners to the transaction. A merchant hoping to sell a product may need to expend time and money to find potential buyers, such as by paying to advertise the product. A prospective buyer or investor may need to hire a broker to search for good opportunities. Once the participants have identified each other, ***negotiation costs*** involve the costs of coming to agreement. Negotiating terms may take time, visits to the site of a project, and hiring lawyers to draft contractual language. ***Negotiation costs*** may also occur within each participant to the exchange, as boards of directors, union members, or other internal constituencies must agree to the terms of the transaction. ***Approval costs*** arise when the negotiated exchange must be approved by a government agency. The regulatory approval process can delay the completion of the transaction, and can impose modifications on the deal the participants have otherwise found desirable.[30] ***Monitoring costs*** are the efforts participants must make to observe the transaction as it occurs, and to verify adherence to the terms of the transaction. Thus, a purchaser of industrial goods might expend time and money (*e.g.* by hiring a company which provides this verification service) to inspect the goods received and compare them to the contract terms, as to quantity and quality. An investor in a project might conduct periodic site visits and demand audit reports on the progress of the project. Closely related are ***enforcement costs***, the expenses to insist on compliance once divergences are detected. Thus, a purchaser discovering that goods received are defective may decide to expend further efforts to redress the problem, such as by suing the seller in court or by exercising enforcement options within the contract such as cancellation. Finally, the risk of failure of the transaction (for various reasons, from engineering failures of equipment to government disapproval) may lead the participants to incur ***insurance costs***. Insurance may take the form of purchasing an insurance policy promising money compensation in the event of a loss, or it may be obtained in-kind, such as by purchasing additional commodities on a spot market to supplement a long-term contract that may turn out to be insufficient. ***Insurance costs*** may likewise be reflected in a risk premium paid in the transaction itself (*e.g.* a depressed purchase price as a compensating differential for accepting project risk). ***Insurance costs*** may also involve the costs of diversifying against the risk of failure in any one enterprise by purchasing a portfolio of enterprises with uncorrelated risks.

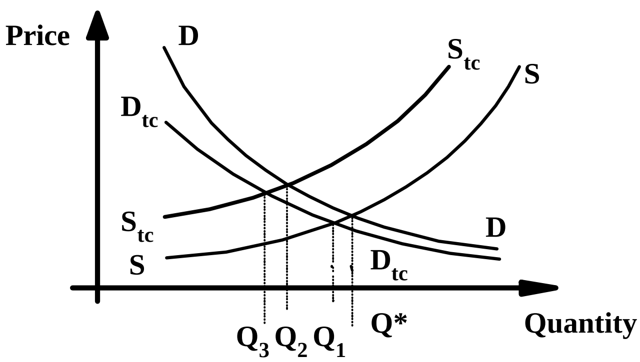
Role of transaction costs in markets

Role in markets generally

Transaction costs play a pivotal role in markets. The most obvious impact of transaction costs is that they raise the costs (and hence, lower the net benefit) to each participant of the prospective exchange. They thereby discourage some transactions from occurring. Where the transaction costs exceed the benefits to a participant of engaging in the transaction, that person (if economically rational) will not participate.[31]

Put another way, transaction costs can be considered as a "margin" or "wedge" between the buying and selling price of a good or service in a market.[32] By raising the buyer's cost and/or lowering the supplier's (net) price, transaction costs shift the real demand and supply curves and result in an equilibrium volume of exchanges that is lower than that volume would be in the absence of these transaction costs. This proposition holds true whether the transaction costs are fixed, or vary with the volume or value of trades.[33] It is illustrated for a simple market in Figure 1. In the absence of transaction costs, the equilibrium of supply (S) and demand (D) occurs at Q* purchases. In the presence of transaction costs borne only by purchasers (shown by the adjusted demand curve D_{tc} the market clears at Q_1; borne by sellers (shown by the adjusted supply curve S_{tc} the market clears at Q_2; and borne by both, at Q_3. The particular relationship among Q_1, Q_2, and Q_3 will depend on the shapes on the supply and demand curves (*i.e.* in part, on how transaction costs vary with the quantity of transactions), but clearly all will be less than Q*. As transaction costs rise, the wedge between purchasers' cost and seller's gain widens, and the equilibrium quantity of market activity declines.

Figure 1. Supply and demand in the presence of transaction costs



Thus, whatever the good or service at issue, rules or institutions that *lower* transaction costs will tend to expand trade toward the full social value that participants would gain from trade (*i.e.* to increase efficiency), while rules or institutions that *raise* transaction costs will tend to inhibit trade and reduce the social gains from trade (*i.e.* to reduce efficiency).

Empirical evidence of this proposition is easy to find; consider the transaction costs of buying a house (broker's fee, government taxes on the transaction, etc.). The impact of transaction costs on environmental commodity markets -- such as tradeable permits for pollution -- has long been recognised, but has received only occasional treatment as a quantified or empirically analysed factor in the operation of such markets.[34]

Role in environmental externalities

A second application of transaction costs, specific to environmental and related problems, presses this analysis further. Consider the well-known argument[35] that environmental harms occur because they are "external" to market transactions. Such "externalities" arise when the participants to a transaction (supplier and consumer) do not take into account the harm that their activity causes to third parties -- when the private costs of the participants to the exchange diverge from the full social impact of that activity. In a situation of externality, private markets will overproduce the activity that gives rise to external damages. For example, a purchaser of cement and the cement plant which makes the cement may not incorporate into their transaction the damage done by dust emitted from the cement plant to neighbours of the cement plant. If so, the price of the cement will not reflect the damage caused to the neighbours, and as compared to other cement plants not causing such harm (or as compared to substitute building materials not causing such harm), this cement will be under-priced in terms of its full social costs. It will therefore be over-purchased by the market. If such external damages were "internalised" into the transaction between the cement purchaser and the cement plant, those participants would recognise (in the higher price for cement from this plant) the social costs of their activity, and the market would shift away from this "dirty" cement maker to purchase more from "clean" materials makers. By making the "polluter pay" and reflecting that social cost in the price paid by private purchasers for the polluter's cement, internalisation of externalities would reduce the pollution and shift production to cleaner facilities.

One way to achieve the internalisation of environmental externalities is for the government to enforce a "polluter pays" rule; that is, to require the polluters to pay for the social costs of their pollution. For example, the government could impose a tax or fee on the cement dust emissions equal to the incremental damage caused by each ton of emissions. This would force the societal damages to be reflected in the costs and prices of cement making, and lead the market to reduce purchases from "dirty" cement makers to a lower, socially desirable level. Or, the government could restrict the quantity of such emissions to the socially desirable level (the level that would obtain if the social costs were fully internalised), and allow permits for those emissions to be traded. The market price of a permit for a ton of emissions would then be the same as the tax/fee per ton set to achieve the same level of emissions.[36]

In a (theoretical) world of zero transaction costs, however, such government action would be unnecessary because the victims of the pollution (the neighbours) could themselves force the pollution costs to be internalised. If the *neighbours* had the initial entitlement to be free of pollution, the polluter would have to pay them the value of their losses, assuming it wanted to obtain the right to continue emitting dust. If the *polluter* had the initial entitlement to pollute, the neighbours would have to pay the polluter to reduce its emissions; from the polluter's perspective, continuing to pollute would be a decision to forego such a payment. In either case, a bargain between the polluter and the neighbours would result in reduced pollution by internalising the social cost of the pollution into the polluter's calculus. In a world of costless transactions, this bargain could be reached among the polluter and the neighbours.[37]

But in the real world, there are transaction costs: the costs of identifying the victims and sources of pollution, of finding useful methods of reducing pollution, of negotiations among victims and polluters, of monitoring the subsequent pollution levels, and so on. And the ***negotiation costs*** will include not just the direct costs of time spent at the negotiating table, but also the problems of free-riders and holdouts in any proposed negotiated settlement.[38] From this perspective, it is these transaction costs that prevent markets from fully internalising the external costs of pollution, and reducing transaction costs would therefore help reduce environmental externalities.[39]

Temporal issues

Figure 1 is a *static* vision of the relationship between transaction costs and markets. It is also important to recognise that transaction costs can vary over time (*i.e. dynamically*), and that these fluctuations should be taken into account when thinking about them. For example, it is entirely possible that transaction costs may be higher in the early stages of JI development (the phase in which the COP is currently engaged) than they are in the later stages.

Transaction cost in the climate change context

Both of these perspectives on transaction costs are relevant to the problem of climate change. The second aspect of transaction costs -- their role in the perpetuation of environmental externalities -- helps explain why global climate change may occur even where there is agreement that it would have seriously adverse consequences. The first aspect of transaction costs -- their role in affecting the volume of market activity and social gains from trade -- will be important in the operation of any market-like mechanisms created to limit the pace and magnitude of climate change, such as JI.

Role in climate change as an externality

First, consider transaction costs in general as a potential cause of excessive GHG emissions. Each unit of emissions of a GHG is associated with some increase in atmospheric radiative forcing, which may enhance global warming and perhaps lead to damages.[40] But much of the value of any such damages would generally be external to the transaction that generates the GHG emissions. For example, those emitting carbon dioxide from fossil fuel facilities (or clearing forest sinks, etc.), and their consumers, will incur some (slight) damages from the global warming thereby induced, but most of the damage they cause occurs to third parties (*e.g.* to people in other countries, or in later periods of time). Thus, the full social costs of the emissions are not faced in the private emissions-generating transactions. In consequence, activities that generate GHG emissions appear more financially attractive in the private market-place than they really are to society, and they are therefore over-produced by private markets, relative to the optimum allocation of economic resources.[41]

In the absence of transaction costs, potential victims of global warming could bargain with emitters to force the internalisation of those costs. But because there are real transaction costs, such a bargain could be difficult to attain. With multiple emitters of GHGs and multiple potential agents which may be affected by climate change, the costs of identifying all the affected parties, negotiating an agreement, and monitoring it could be high. Free-riders and holdouts might be frequent. The costs of identifying methods of abatement and of promoting the diffusion of such methods in consumer markets can also be significant.[42] If the benefits of such an agreement were viewed as uncertain (say, because the scientific prediction of global warming were uncertain, or because even given a confident prediction there was still uncertainty about the regional and local impacts of such warming), and/or if the social costs of limiting GHG emissions were perceived as high, the transaction costs could be a formidable obstacle to agreement.[43] From this perspective, the FCCC itself functions as a mechanism to surmount these transaction costs by fostering a multinational bargain to bring the damages of GHG emissions into the internal calculus of each GHG emitter.

Role in Joint Implementation as a market-based mechanism

Second, consider transaction costs in the special case with which this paper is chiefly concerned: as they would influence the operation of a market-like mechanism to abate GHG emissions -- a mechanism such as JI. This aspect of transaction costs reflects the straight-forward, general-first-case described above: transaction costs will inhibit market activity, and thus limit the gains from trade. If the FCCC creates tradeable credits for GHG abatement actions (through formal or informal mechanisms), but high transaction costs inhibit trade in those credits, the advantages of such a system -- cost-effectiveness and resource flows -- will be impaired.[44] If the criteria and institutions that govern JI foster high transaction costs, there will be fewer JI transactions than are ideally desirable, frustrating the global community's ability to achieve GHG abatement cost-effectively, and to mobilise resource flows toward countries with low marginal costs of control.

Figure 2 depicts transaction costs as an increase in the cost of abatement. The costs of GHG emissions abatement in the absence of transaction costs is traced by the lower cost curve (MC). (The lower cost curve begins at negative cost to reflect the possibility of cost-saving interventions.) The actor in this case will invest in abatement until the cost exceeds the horizontal cost limit line (C). This cost limit can be interpreted as the actor's “reservation price,” that is, the maximum the actor would be willing to spend on this abatement activity because another abatement activity is available at that reservation price (say, domestic abatement in the case of a country, or its own internal abatement options in the case of a firm). Or, the horizontal cost limit can be interpreted as the actor's perceived marginal benefit of abatement, so that the actor will not invest beyond the point where marginal cost exceeds marginal benefit. In any event, in a world without transaction costs, the actor will invest up to Q* abatement. But with transaction costs, the actor's cost of abatement is the upper cost curve (MC_{tc}), the actor will invest only up to Q_1 abatement. The quantity of JI activities funded, and the flow of resources to hosts, both decrease.

Figure 2. Abatement investments with transaction costs[45]

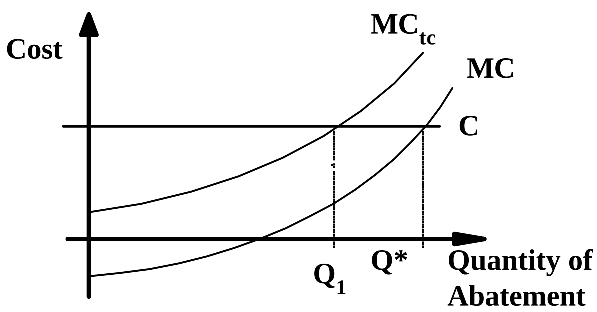


Figure 2 implies that transaction costs are borne by the investor, but recall from Figure 1 that transaction costs may be borne by either, or both, parties. Considering JI *investors* as purchasers of GHG abatement credits (demand), and JI *hosts* as sellers of GHG abatement credits (supply), one can see from Figure 1 that the equilibrium quantity of abatement credits traded -- the quantity of JI investments made -- will fall as transaction costs rise for either or both groups of participants.

The operation of several markets for environmental improvement is providing direct empirical evidence of the adverse influence of transaction costs on the volume and social benefits from trade. In Los Angeles, where regulators are attempting to reduce emissions of local air pollutants such as ozone and

NOx by using a tradeable credits scheme, high transaction costs for certain kinds of trades have inhibited those trades.[46] In Wisconsin, high transaction costs virtually scuttled a program for trading in water quality protection.[47] In Jakarta, a program to allow water rights trading meant to enable poor residents to purchase water from those who already receive piped water has been partially hindered by transaction costs.[48] Examples like these are discussed more fully in Section IV below.

All six types of transaction costs discussed above are likely to confront JI transactions.[49]

- ***Search costs*** will be incurred as investors and hosts seek out partners for mutually advantageous projects. Certain hosts and certain investors may be interested in specific types, sizes, locations, or time horizons of projects, or other characteristics. And more generally, investors and hosts may want to survey the range of alternatives before making a decision. ***Search costs*** may be seen in brokers' fees, charges for information services, or the delays incurred while trying to find a suitable partner.

- ***Negotiation costs*** will arise as interested partners work out the details of project design, obligations on each participant, assignment of benefits (such cash or technology payments and GHG abatement credits), and the schedule over which benefits will be paid for multi-year projects. Legal drafting may be needed to spell out contractual terms, and to provide for contingencies. Negotiations will also take time to conclude.

- ***Approval costs*** will be incurred at least when the GHG abatement credits are presented to national or international authorities for recordation. Advance approval of the project may also be required, most likely by the host government, but possibly also by the investor government to meet the terms of its JI program.[50] If the COP of the FCCC decided to require centralised advance approval for each JI project, this would add significantly to ***approval costs***. ***Approval costs*** are chiefly likely to be felt in terms of delay and uncertainty, but could also involve out-of-pocket costs involved in generating application information for submission to the approval authority.

- ***Monitoring costs*** will be necessary to ensure that participants are fulfilling their obligations (Is the boiler being converted? Is the forest being protected? Is the payment being made? Is the technology being received in usable form?). Monitoring will also be needed to measure the actual GHG abatement achieved by the project in real time (as opposed to forecast estimates). Thus ***monitoring costs*** will largely be in the form of technical expertise, equipment, and operating expenses.

- ***Enforcement costs*** will arise if monitoring reveals departures from the agreed transaction. ***Enforcement costs*** may be in the form of litigation or administrative proceedings.

- ***Insurance costs*** will likely be incurred to guard against project failure. If the investor is liable to its government or to the FCCC to demonstrate GHG abatement, the investor will want to safeguard its investment in the JI project. Project failure might occur if, for example, a wildfire destroyed a conserved forest, if energy technology failed to work, or if the host failed to perform its obligations. Similarly, the host might insure against the risk that it operates the project but the investor fails to pay. ***Insurance costs*** might come in many forms, including financial insurance policies, purchases on spot markets, and diversification of projects.

Some of these transaction costs might be relatively fixed costs, that is, expenses that do not vary with the size of the transaction. ***Approval costs***, for example, may be a relatively fixed cost that must be incurred whether the transaction is small or large. However, ***approval costs*** may also vary with the uniqueness of the project proposed and the experience of the regulators in reviewing such proposals. Other transaction costs may vary with the size of the transaction, such as ***monitoring and insurance costs***.

A formal tradeable credits system would also involve these kinds of transaction costs, but in general, JI is likely to involve higher transaction costs than a formal system of tradeable credits. Under the current FCCC, the target level of emissions abatement required of each party is not precisely defined; nor is it yet known what type of abatement regime might exist after the current "pilot phase for activities implemented jointly" expires in 2000. The quantity of JI credits that might ultimately be needed is therefore quite uncertain. Compounding this uncertainty is the current (interim) lack of clear criteria for approval of JI credit claims. These uncertainties in the value of JI credits would add a risk premium to the JI market which would ultimately be manifested as a cost of transactions.[51] Further, to the extent that such uncertainties persist, they would inhibit the formation of firms and institutions to reduce transactions due to uncertainty concerning the underlying demand for such services. In addition, the JI transaction contemplates a full life-cycle project finance arrangement, rather than a one-time exchange of commodity (abatement credit) for cash. The costs of finding a suitable JI partner, negotiating the project finance deal, and monitoring performance over several years would all add to the transaction costs of JI, compared to a more formal tradeable credits system. Still, project finance markets do operate today, so saying that transaction costs for JI would be comparatively *greater* does not imply that they would necessarily be *prohibitive*.

In the next three sections, we consider each of these types of transaction costs in the context of markets in general. We then return to their specific treatment under JI in the last two sections.

III. INSTITUTIONS DESIGNED TO MANAGE TRANSACTION COSTS

Several institutions have been developed by governments and private enterprise to mitigate transaction costs in markets. In fact, some theorists applying game theoretic concepts to the co-evolution of economics and law have hypothesised that institutions and property rights change over time in order to facilitate market development and reduce transaction costs.[52] Numerous examples of such incremental institutional changes exist around the world. For example, Costa Rica established a program to encourage reforestation through the creation of transferable tax credits. Initially, the program required land owners wishing to sell these credits to travel to the capital (San Jose) to effect the transfer. These transaction costs proved to be burdensome to small rural landholders and the program was under-utilised. In response, the government lifted the requirement to effect transfers in San Jose, and a robust tax credit market now thrives.[53]

Currency in markets

The usefulness of currency -- money -- is largely explained by its role in reducing the costs of transactions. In a pure barter economy, trades are hampered by the incommensurability of goods and services. It is costly for participants to estimate the exchange value of each whole item (say, a cow) and to find exact matches among other participants (*i.e.* to acquire other goods worth the full value of a cow). In addition, it is costly for each participant seeking a trade to have to search for another participant holding precisely the item desired, and interested in precisely the item being offered for trade. If the cow owner wants to trade the cow for a pig, then (assuming for the moment that the cow and the pig are of equal value), she must find a pig owner who happens to be interested in trading for a cow.

Currency helps solve these problems. It is divisible, so it can be disaggregated to match the exchange value of each item. If the cow is worth 10 units while the pig is worth 8, dual exchanges can occur in currency instead of being delayed until an exact cow-pig match is found. And currency allows the participants to buy and sell from intermediaries who hold no goods to exchange, but who do hold currency. The intermediary can purchase the cow one day and find a buyer the next, while another intermediary handles pig transactions. Each intermediary collects information on likely buyers and sellers, and earns a return on the use of that valuable information. In these ways, currency and market exchange reduce participants' ***search and negotiation costs***.

In the international context, there are several different national currencies. Participants interested in selling goods and services from one country to buyers in another might encounter transaction costs related to the difference in currencies. International currency regimes help reduce these transaction costs. Exchange rates specifying the relative purchasing power of different national currencies are widely published. Institutions like the International Monetary Fund (IMF) were originally established to help bring stability to international currency transactions, so that international trade in goods and services could expand.

In the context of the FCCC, GHG reduction credits generated by JI transactions could have currency-like attributes. To the extent that individual nations provide programs for the standardisation of JI credits, their fungibility would increase. For example, if a nation certifies the GHG reduction outcome from a JI investment as a specific number of credits and those credits are then registered as exported (host) or imported (investor), they should be fungible. Of course, the risk of inflating outcomes is present, but as with currency, market discipline exerts itself through the discounting imposed in exchange rates. However, the absence of JI credit hampers the evolution of JI from individual pilot projects to a system which produces transactable reduction outcomes. In the latter case, investors could specialise in the production and certification of GHG reduction credits which would then be transacted among individual firms.[54]

Banking

Banks offer an intermediary for investment. Depositors place funds ("savings") in banks and earn a return (interest) that is a share of the return that the bank earns for investing those deposited funds in other ventures. The bank thus serves as a visible place of exchange for investors and projects, reducing the ***search costs*** that would attend efforts by investors to find and learn about individual projects. Moreover, if the bank's portfolio of investments is diversified, it reduces the risk of project failure to each depositor, and thus reduces the ***insurance costs*** of investing.

The usefulness of banks in reducing transaction costs does not imply that establishing a single centralised bank for all investments, or all investments of a particular type, would be ideal. Although designating a single bank might reduce ***search costs*** (because every investor and project host would know immediately where to go), such centralisation would also concentrate market power. A monopoly bank would pay lower returns to investors and charge higher costs of investment capital to borrowers.

In the context of the FCCC, banking or saving is just beginning to be discussed largely in the context of the AGBM. In the consideration of the specification of QELROs, considerable attention has been focused on the cost-saving potential of cumulative reduction targets. Under this approach, a nation would commit to limiting its emissions for a specified time period -- for example, 10 years. In effect, the country would be allowed to vary emissions from year-to-year as long as total emissions remained within the budget. With this cumulative approach, unused emissions could be carried forward or “banked”. JI credits would augment a nation's ability either to meet its present budget or, if saved, to meet future reduction commitments. It has also been proposed that early banked reductions be given a premium or interest rate corresponding to the avoided damage from slower (rather than faster) rates of temperature change.[55]

Ownership registries and exchanges

A key aspect of ***search costs*** is the identification of potential partners. Imagine if every person interested in investing in corporate equity (shares of stock of a corporation) had to identify all the possible companies himself; or if every corporation trying to sell stock had to identify interested individual investors itself. The transaction costs would easily swallow most stock sales and the market for corporate equity capital would be severely curtailed. The logical solution to this problem is to establish an array of registries or listing services that would publicise stocks for sale, important information about stock values, and the daily sale price. The development of stock exchanges such as the New York, London and Tokyo exchanges, NASDAQ, and numerous smaller exchanges, is thus partly explained by the market's interest in reducing transaction costs. These pivotal institutions reduce ***search costs*** by collecting and publishing stock offering information. They also serve as a physical place for transactions to occur each day, where buyers and sellers (or their representatives) can meet to conduct business. Rules requiring standardised full disclosure of company information that might affect stock value, such as those enforced by the US Securities and Exchange Commission (SEC), help ensure that all potential buyers are roughly equally informed to acceptable minimum standards.

The market for international project finance tends to deal with larger single investments and a smaller number of daily transactions than the stock exchanges, but similarly can benefit from visible registries of interested investors and project hosts. The private arm of the World Bank, the International Finance Corporation, is one example of a collected listing service for potential private investors and project hosts. Private investment banks also serve this function by packaging large project finance deals. In addition to reducing ***search costs***, these packaged (or "syndicated") project finance offerings also reduce ***insurance costs*** by diversifying project risks for each investor and investor risks for each project host.

Increasingly, telecommunications and on-line computer services are providing the information needed by interested market participants. One can imagine stock listings posted on computer network “bulletin boards” being available world-wide. Similarly, prospectus information on international project finance could be made available through international computer network postings. In fact, at least one such service is presently being operated by the World Business Council for Sustainable Development through the International Business Action on Climate Change (IBACC) initiative. The IBACC project identifies, assesses, and lists potential JI projects. In addition, the project attempts to match project proposals with investor needs on the basis of submitted profiles. At the present time, the project has posted 36 projects on the Internet, with total greenhouse emission reduction potential of 115 million tons.[56]

Monitoring, inspection and certification services

Monitoring costs can also be significant obstacles to transactions. This may be particularly true in international transactions where physical events, such as delivery of goods, occur far from those who have a financial interest. In consequence, inspection and certification institutions have developed to facilitate these services, and thereby to foster transactions. An example of a private entity providing inspection and certification services for commercial import and export transactions is the Société Général de Surveillance (SGS), a Swiss company which, among other services, provides personnel to monitor the delivery of goods at ship docks and compare actual deliveries to invoice records.

In the context of the FCCC, public and private entities might be mobilised to provide monitoring services. One option would be for the COP to establish a central monitoring body which would inspect and certify GHG abatement levels at each project. Such monitoring would need to apply to domestic as well as to JI projects, since both must be reported to the COP, and both carry the possibility of inaccuracy or exaggeration.[57] Indeed, since domestic abatement activities are likely to be the great majority of total abatement activities, one might expect COP inspectors to concentrate on domestic activities. Sovereignty concerns would be identical in the inspection of both domestic and JI projects, since the sovereignty of the JI host is at least as valuable as the sovereignty of the domestic abater.

A central COP monitoring body would, however, be administratively costly for the COP. And if it imposed extensive information-generating requirements and delays on obtaining GHG abatement certification, such a central bureaucracy could sharply increase the ***approval costs*** of abatement, thereby reducing the total amount of abatement undertaken. An alternative institutional design would be for the COP to establish monitoring criteria as part of its guidelines for national communications to the COP under Article 12 of the FCCC, and then to offer accreditation to NGOs to provide local monitoring services under those criteria. Thus, to the extent required by the COP, individual countries undertaking GHG abatement (whether for own reporting or for sale of JI credits) could arrange with a neutrally accredited NGO to perform monitoring and measurement of actual abatement. Certification by the accredited NGO of the quantitative results would then be attached to the country's Article 12 communication.

Insurance services

The risk of failure or liability imposes ***insurance costs*** on many transactions. For the most part, this insurance is obtained through private market sources, such as by purchasing an insurance contract ("policy") from an insurance company, or by diversifying ventures across different risks, through mutual funds and other packaging or syndication services.

In some cases, governments also provide insurance. For example, governments insure small depositors against the risk of bank failure, in order to reduce the transaction costs for each depositor and facilitate a higher national savings rate. Governments often provide insurance against health risks, by offering national health care (as in the UK or Canada), or by offering compensation for certain kinds of injuries [as in New Zealand, Japan (toxic pollutant exposures)], and the USA (workplace accidental injuries, coal miners' Black Lung disease)], to pool the risk of such injuries across wide populations, thereby reducing the cost to individuals. And governments often insure citizens against the risk of floods, hurricanes and other disasters.

In the international context, governments sometimes provide insurance for private international project financing. For example, the US Overseas Private Investment Corporation (OPIC), a government agency, offers insurance to private investors against the risk of political upheaval in host countries. It can often be difficult for private investors, particularly small and medium-sized companies, to diversify their activities enough to avoid such political risks.

In the context of the FCCC, a variety of insurance alternatives are possible. For example, nations could provide insurance for JI projects through the use of sovereign guarantees. Nations with established GHG emission baselines, credible emissions monitoring, and specific GHG emission limitations could credit JI projects. By taking the additional step of deducting the credited emission reductions from its allowable emissions, the JI host would provide *de facto* insurance for the project. To the extent that JI credits are fungible, investors with a pool of credits could sell drawing rights as insurance against project failures. Individual JI projects could also “self-insure”. For example, in the case of carbon sequestration from reforestation, a larger than required area could be planted, in order to compensate for the losses to disease or fire. Diversified portfolios of JI projects would also reduce the risk and cost of any single project failure.

IV. TRANSACTION COSTS AND ENVIRONMENTAL POLICIES

The preceding section provided a very brief overview of the types of institutions and policies that have been developed over time to manage transaction costs. Inasmuch as transaction costs are frequently an afterthought to normal market transactions, they are seldom, if ever, considered in the context of environmental policies. When transaction costs *are* considered, they are most often cited in studies of market-based incentive policies. However, transaction costs are not only relevant, they can be significant, for *all* policy problems. This section reviews specific policy experiences in order to observe differences in transaction costs. Particular attention is paid to evaluating the effect of policy changes on these costs. In addition, comparative government studies are used to assess the effect of alternative policies on transaction costs.

Traditional command regulations

Transaction costs are normally associated with market activities. However, transaction costs are also present for non-market activities. For example, many environmental policies are implemented through command regulations in which the polluter is required to adopt specific control strategies. These command regulations can be established as a uniform standard (as in the United States), or they can be negotiated on a plant-by-plant basis (as is done in much of Europe). In each case, the costs, termed administrative costs, associated with establishing the command regulation are often substantial. The costs of identifying and characterising the specific control technologies for even a single class of industries can be difficult and time-consuming. In extreme cases, the regulated parties can legally challenge the classification being used and/or performance of the technology being advocated.

Voluntary reduction programs

Increasingly, environmental problems are being addressed through a variety of voluntary, co-operative agreements. For example, much of the approach to reducing greenhouse gases is being accomplished through voluntary industry initiatives. In fact, the earliest JI-like investments were undertaken voluntarily by AES Corporation, an independent power producer, seeking to sell "environmentally neutral" power by offsetting the CO_2 emissions from its plants. This strategy has proliferated in a variety of forms under a variety of names.

The general strategy in each case is to negotiate either an industry-wide standard or to pursue firm-specific contracts. A variety of industries have used industrial codes of practice or product conformity criteria to enhance customer value by insuring minimum quality levels and/or interoperability of components. Increasingly, firms are being offered the opportunity to reduce emissions under well-defined contractual commitments with regulators that are voluntarily negotiated.[58] For example, under the Climate Challenge program developed by the US Department of Energy (DOE), electric utilities are establishing voluntary greenhouse gas reduction commitments which will be formalised in memoranda of Understanding between each participating utility and the DOE. These agreements are taking a variety of forms, ranging from specific tonnage reductions by the year 2000 measured against historic 1987-90 baselines, to reduced rates of emissions growth. With over 700 entities involved in the program, the negotiations over both the standard agreement and individual program elements have taken over 18 months. While the utilities are represented by an association, the Edison Electric Institute (EEI), each company has participated in both the association deliberations, as well as in the individual negotiations with the DOE.

Natural resource commodity markets

One of the richest analogues for evaluating the effect of alternative policy designs on transaction costs and the underlying markets is provided by several water transfer markets operating in the western region of the United States. For the most part, water in this region is governed by a system known as “prior appropriation”, under which water users have specific entitlements to specific quantities of water, based upon the seniority of that entitlement. These water rights to specific natural flows are overlaid with contracts for water that are administratively allocated from public water resource supply projects. Some projects are owned and operated by the individual states, others by the federal government. In addition, the allocation of uncertain water flows in rivers which flow between several states are established by legal agreements, known as "compacts".

As water resources within this arid region have come under increasing competition among alternative uses, more effective and flexible allocation mechanisms have been sought. Each of the seventeen irrigated western states has pursued a different course in policy development concerning water transfers. This provides a rich laboratory for an empirical assessment of the importance of policy and institutional design for transaction costs and market activity.

Water rights transfers

Existing studies of water transfer programs in the western US[59] have highlighted the importance of dissent as a determinant of transaction costs and market efficiency. MacDonnell (1990) compared the transaction costs produced under two different approval regimes. In the state of Colorado, transfers proposed by private parties are evaluated in a legal proceeding in which all parties with a perceived interest may be represented. In New Mexico, proposed transfers are presented to the State Engineer's Office which evaluates third-party effects and rules on both the transfer and any needed restrictions. Disputes are frequent in the Coloradan system, and rare in the New Mexican case. As a result, transaction costs averaged $380 per acre-foot in Colorado, but only $184 per acre-foot in New Mexico for water rights which were selling from $300 to $1500 per acre-foot. Even more striking is that opposed transfers in Colorado had transaction costs ranging from 2.4 to 45 times greater when compared to unopposed transfers. In the New Mexico case, there was statistical support for economies of scale in the applicant's costs (*i.e.* transaction costs declined with the size of transfer).

In each case, there is regulatory oversight of proposed transactions in order to insure that existing rights and uses would not be impaired by the transfer. However, the two approaches differ markedly in their oversight strategies. In Colorado, the legal setting for evaluation encourages, if not requires, advocates to deploy both legal and hydrologic experts in support of their interests. In New Mexico, the system is designed to avoid these expenses by vesting the state engineer with both decision-making authority as well as the presumption of expertise. Most importantly for joint implementation, MacDonnell observed that:

"An important difference among states is found in the set of criteria used by the relevant water a authority in approving, amending, or denying a transfer. The more extensive the list of criteria, the more studies will have to be carried out, and the greater the room for disagreement."[60]

The result is that despite the substantial potential for gains from trade in water resources, high transaction costs resulting from legal challenges, environmental and hydrologic study requirements, and the uncertainties associated both with poorly-defined rights and approval processes, can offset much of this potential. Advocates of such non-structural approaches to water resource management hope that transaction costs will decline over time with experience and with the development of new institutions to streamline transactions.[61]

Water banks

Water transfers were initiated in the arid west as one policy response to help alleviate chronic supply problems associated with both the vagaries of weather, as well as to shifting public support for large-scale public works. Some states, such as California, have been slower to adopt more flexible, market-based water management strategies than others. In California, the right to allocate, use or transfer a surface water right is generally held by a government entity (*e.g.* water districts or federal and state water agencies), rather than by individual farmers or businesses, as is common in the Rocky Mountain states. These institutions commonly respond to political, rather than monetary, incentives in choosing how to manage their resources.[62] However, even California has had to face the strains posed by continued periodic droughts. In response, Emergency Drought Water Banks were developed to help reallocate water supplies during the droughts of 1991, 1992, and 1994.

The creation of the water bank transformed water management in California in two critical ways. The first was the formal signalling of diminished resistance to water transfers by the California Department of Water Resources (CDWR), at least during this crisis. Agricultural water users had also opposed water transfers out of concern that the transfer of water from one user to another could provide the precedent for the permanent reallocation of entitlements. Nonetheless, while leery of losing long-term water rights, rural communities became comfortable with the short-term drought relief provided by the water banks.[63] The second reform was the creation of a centralised market to facilitate transfers. Previously, buyers and sellers largely pursued bi-lateral negotiations arranged by brokers or entrepreneurs, which were then subject to the cost and uncertainty of extensive regulatory oversight.

Under the water bank program, the state offered fixed purchase and sale prices for water under a standard contract. In this regime, prices were not allowed to fluctuate in response to underlying supply and demand conditions. As a result, the effectiveness of the program depended upon the prices set by the state. Subsequent analysis of operations for 1991 has shown that the state set prices higher than would have been offered under normal market conditions.[64] As a result, total water transfers jumped from 302,098 acre-feet in 1990 to 775,165 acre-feet in 1991.[65]

For 1992, the state changed the rules of operation for the water bank. First, the state abandoned its "posted price" approach, in exchange for a brokered system in which potential buyers (in this case, irrigation districts) had to provide the CDWR with funds and commitments in advance. The CDWR then arranged the trades. As expected, offer prices fell from $125 to $50 per acre-foot.[66] In addition, the state modified the terms under which water could be offered for sale. Under the previous system of water bank transfers, farmers would simply idle their lands and sell the water. Concerns about impacts on the viability of rural communities led to a restriction on the sale of water from fallowed lands.[67]

Consequently, total purchased water amounted to 193,246 acre-feet, compared with 405,921 acre-feet from similar sources in 1991.

Concern over "third-party" impacts -- the economic impacts to individuals or businesses not directly party to the exchange -- have become a focal point of debate over market-based programs to reallocate water. The idea that water can (or should) be bought and sold like any other good in the economy is both alien and frightening to many. Pecuniary externalities from market transactions -- the financial gains and losses incurred by those not directly party to a transaction[68] -- while accepted as an everyday fact of life of the private sector economy, are frequently contested when they result from market-based regulatory action by governments. In part, this is the normal reaction to the redistribution of captured rents that had previously been generated by public policies. However, the issue is often cast in terms of equity -- are improvements in overall economic efficiency and environmental quality being achieved at the expense of less politically and economically powerful groups? Negatively affected groups generally perceive that this is the case. Whether this is true, however, is an empirical question that depends on the situation at hand. Recent studies measuring third-party impacts from the drought water bank, for example, found relatively small impacts in a regional economic scale. Nevertheless, the concern over "third-party" impacts has led to substantial restrictions in the operation of the water bank, and thus to substantial efficiency losses due to the reduction in available supplies for reallocation during drought events.

Joint implementation in water resources management

As the marginal costs of developing new water supplies have steadily risen in the West, water users, purveyors, and environmentalists have been forced to seek more innovative supply sources. In the early 1980s, the Environmental Defense Fund (EDF) developed a proposal for a large-scale water transaction between two California water agencies -- the Metropolitan Water District (MWD) and the Imperial Irrigation District (IID).[69] The essence of the proposal was that the urban MWD serving Los Angeles would pay for water conservation investment in the agricultural IID, largely the concrete lining of earthen distribution canals, in return for receiving the extra water that was conserved. In effect, this project represents a "joint implementation" of water supply, under which the relatively wealthy and water-hungry MWD paid for efficiency investments that the relatively poorer IID could not justify on the basis of its own economic interests.

Despite the clear beneficial outcome to both parties, this transaction took over 5 years to negotiate. Since California water users operate under the doctrine of "beneficial use", a powerful "use it or lose it" mindset pervades water resource management in that state. Wariness between the parties and uncertainty over the response of regulatory agencies to such a significant precedent accounted for the initial delays. However, the bulk of the delays resulted from internal debate among member firms of the IID. In effect, the proposed transaction would formalise the distribution of system resources and benefits that had previously been allocated informally. In particular, the holders of junior water rights within the district had been appropriating the benefits of excess water from more senior rights that were pooled by the district. The opportunity to monetize and capture these benefits created by the proposed transaction led senior water rights holders to prefer on-farm efficiency investments, as opposed to system-wide improvements (such as canal lining). The resulting tensions over the distribution of the new rents pitted senior rights holders against juniors and the district staff in a protracted internal debate within the IID. In effect, the new rents created new transaction costs as the consensus over distribution was renegotiated.

In many respects, this transaction mirrored the debate joined during the energy crises of the early 1970s over energy demand management investments as economically effective alternatives to new energy supply projects -- a debate with new meaning in the context of global climate change. In the California energy case, the Pacific Gas & Electric Company (PG&E) was petitioning the California Public Utility Commission to obtain rate increases to pay for the construction of 9 new electric generating stations. The analysis submitted by the company only considered the construction of the plants, and failed to evaluate whether non-structural measures such as energy efficiency programs or pricing changes would reduce the demand for additional energy supplies. At that time, EDF developed a financial simulation model which demonstrated the cost-effectiveness of these non-structural options to the satisfaction of the regulators who denied the rate requests. In both the water and energy cases, regulatory approval was critical to altering the investment proposal, and both expensive and time-consuming to obtain. While the water transaction was ultimately consummated, it has not led to any significant change in the underlying resource management doctrine. As a result, water transfers in California, even for water saved through conservation investments, are still difficult to transact.

Environmental commodity markets

Concerns over the cost and effectiveness of traditional environmental policies have led to increasing experimentation with market-based instruments for achieving environmental objectives. These programs have focused either on introducing an emission fee, which theoretically would induce the emitter to reduce emissions to an optimal level, or on the creation of new regulatory commodities, based on transferable permits denominated in the pollutant of concern. In the latter case, programs for ozone precursors, lead, chlorofluorocarbons, and sulphur dioxide are the most instructive for JI.[70] Each was developed in response to a specific environmental problem in a unique political environment.

The unique problems of regulatory commodities

As a response to market failure caused by an underlying environmental externality, tradeable permits seek to internalise the problem to polluters, via the creation both of discharge limits and of opportunity costs for discharging. In the most fully developed model of this type (the "cap-and-trade" strategy typified by the SO_2 allowance trading program or the NO_x trading regime established in Los Angeles), the regulator establishes a fixed physical limit on permissible discharges, allocates the available quantity among polluters, and focuses on monitoring and enforcement. These programs require a delicate balancing between ensuring environmental integrity of the policy strategy and the encouragement of market forces. Nowhere is this tension more evident than in the definition of the entitlement or "property right" implied by the transferable discharge permit. Most often, there is an explicit understanding that the permit represents a limited authorisation to discharge -- an authorisation which exists at the pleasure of the regulator. In practice, the creation of such programs typically involves complex political compromises which would be difficult, if not impossible, to undo once made. Nonetheless, this tacit understanding between actors illustrates why the environmental commodities created under marketable permit programs are not viewed as normal economic commodities. It further illustrates why the normal preconditions for market development -- well-defined property rights and widely available information -- do not always apply, and why regulators wishing to harness market incentives must aggressively create fertile conditions for their emergence.

Emissions trading -- bilateral transactions with case-by-case review

The US EPA first established the Emission Trading Program (ETP) under the 1977 Clean Air Act as part of the New Source Review (NSR) process of permitting new air pollution sources in nonattainment regions. The ETP allows new or expanding businesses to acquire emission reduction credits (ERCs) from other firms ("offsets"), from compensating alterations within their own facilities when expanding ("netting"), or from elsewhere within the facility ("bubbles"). The policy was developed as a tool to finesse the tension between regional economic growth and legally-imposed environmental obligations. These tools were developed initially through a set of *ad hoc* administrative procedures.[71]

In general, trading *within* facilities ("bubbles") has provided most of the emission reduction savings from the ETP; outside offset purchases have been the least-used.[72] The lack of trades *among* firms under the ETP has been attributed to a number of factors including: high ***search and negotiation costs*** in highly decentralised bilateral markets; perceived risks by purchasers related to both regulatory approval and to the need for continued regulatory support; unfamiliarity with NSR requirements by financiers of new projects; and legal challenges by environmental organisations.[73] In California, perhaps the state with the most ETP activity, the decentralised nature of the market has led to large differences in the price of emission reduction credits (ERCs) negotiated, even within individual air basins. For example, in the Bay Area Air Quality Management District, prices for oxides of nitrogen (NO_x) ranged from $6,500 to $20,000 per ton in 1993; for hydrocarbons, the price range was from $6,500 to $9,600 per ton.[74] In the South Coast Air Quality Management District, which regulates the worst air quality in the region, only one trade for NO_x was recorded in 1993. State-wide across air basins, prices differed by as much as a factor of six.

Transaction costs in the ETP market have been substantial, due to both their bilateral nature and to the difficulty in quantifying eligible emission reductions. However, the market developed in this fragmented fashion largely as a result of the legal and regulatory uncertainties that characterise its history. These have ranged from legal challenges to the confiscation of banked credits by regulators. The result has been a compliance "tool of last resort". As a result, brokerage fees in the ERC market have historically been near 15 per cent of the sale price.[75] Recent fees have ranged from 7.5 to 49 per cent, depending on the level of effort required by the broker. The lower rate reflects direct brokerage costs; the higher rate reflects all ***search***, ***negotiation and contracting costs***.

Banking has been demonstrated to reduce transaction costs in environmental commodity markets, as well as in standard markets. For example, in Los Angeles, trade in new source offsets for air pollution control was sluggish from 1985 through 1990, ranging from 7 to 55 transactions per year. Then, in 1991, the regulatory authority established a "community bank" to handle small-volume trades. Small-volume trades had previously been uneconomic in the face of high transaction costs. The community bank enabled those seeking small-volume trades to avoid the open-market search for potential partners, and to deposit or purchase credits directly from the bank. In its first year of operation (1991), the community bank handled 1,188 transactions.[76] In terms of Figures 1 and 2 above, this evidence suggests that for small-volume trades in Los Angeles air quality, Q^* is dramatically larger than Q_1 and that a bank can usefully facilitate the move toward lower transaction costs.

Sulphur dioxide allowance trading

The SO_2 allowance trading system established by the Clean Air Amendments of 1990 was explicitly designed to minimise transaction costs. In its summary of the proposed rules governing allowance trading, EPA stated:

> "EPA views its role as filling three critical needs of the allowance trading market: (i) Neutral, low-cost rules of exchange; (ii) basic tracking information on allowances; and (iii) certainty in the identification of a person's authority to transfer allowances. EPA therefore approached the

trading rules with the view that the system should be simple to understand and should impose minimal burdens on the participants.[77]"

Each element of the program was selected to maximise the effectiveness of the market-based compliance program. For example, early in the program's development, the decision was made to allow anyone to legally hold allowances, despite the fact that the acid rain program was targeted primarily at the reduction of SO_2 emissions from electric generating stations. This provision was key both to liquidity in the market and to the development of market intermediaries and services, such as insurance pools. This decision was reinforced by the development of a computerised allowance tracking system with provisions for public access. In addition, an annual auction of a small percentage of total allowances was required in order to insure a clearly established price signal for allowance values as an aid in planning emission reduction investments. The auction was also intended to allow new emission sources to be able to buy into the program. In addition, the Administrator of the US EPA was authorised to sell allowances at $1500/ton to sources which would otherwise be unable to obtain desired quantities.

The allowance trading program was conceived to operate in an explicitly *national* context. As such, the traditional jurisdiction and oversight of *state-based* environmental authorities was by-passed to a significant extent. States can develop their own permitting program with approval from EPA, but these permits apply to Phase II (post 2005) only, and sources are subject to review and comment only when issued. Since compliance is based upon a year-end evaluation of individual SO_2 allowance balances for each regulated plant, the oversight of individual transactions would be redundant. This approach substantially reduces regulatory uncertainty in the transaction of allowances and increases the effectiveness of the program. Nonetheless, the traditional electric utility regulatory oversight of state-based utility commissions remains, and has retarded early market development.[78]

The early scepticism of both the regulators and the industry was widespread. As a result, one of the key concerns in program design was aimed at the substantial uncertainty that was sure to impede early market development. The SO_2 investment decisions that utilities have to make frequently involve large, irreversible commitments of capital. A flue gas desulphurization device (FGD) is one obvious example. Utilities were quite certain that they would be able to comply with the new control requirements, but they were unsure about what, if any, opportunities allowance trading might provide. Could a utility rely on allowance transactions as its sole compliance option? Would a robust trading market emerge quickly enough? Would it be profitable to increase reductions beyond the government required minima for sale in the market? Given the lag times involved in both capital budgeting, design, and construction of control technologies, the industry was faced with the prospect of relatively certain near-term investment costs that could be substantially reduced if the risks and uncertainties of the allowance market could be surmounted. As in the ETP case discussed above, banking was developed as an integral element of the policy design. By insuring that allowances remain valid until used for compliance (*i.e.* to offset emissions), any over-control generated by utilities could be held either for future internal use, for sale in the market, or to self-insure against unanticipated emissions increases. At the present time, aggregate utility over-control from the critical Midwest region is estimated to be at least 2 million tons of SO_2 below the legal first-phase reduction obligation.[79]

The program was also designed to enhance the certainty of access to allowances by issuing them in a 30-year stream of annual allocations. Since emissions from affected sources are fixed at 8.9 million tons of SO_2 , there is no need for separate review of utility control strategies, such as the cessation of operations at individual facilities. EPA also reassured potential market participants that it would not freeze allowance accounts, even if a source proved to have excess emissions in a particular year, since the Agency had sufficient remedies and authorities to deal with the problem in other ways.[80]

Another critical design element in the program was the creation of public confidence in the credibility of reductions and in the overall integrity of the system. This element was critical both to satisfy critics and to elicit new investment. The requirement that affected sources had to make use of continuous emission monitoring systems (CEMS) was the key technical ingredient. While some have viewed the requirement to utilise such sophisticated monitoring systems as a loss in efficiency, this technology was critical to assuring legislators and regulators that they could know enough about emissions to allow firms complete flexibility in their choice of control strategy.

In the process of rule development as well, there are numerous examples of circumstances in which the US EPA explicitly considered transaction costs as a central element in market formation. For example, some individuals and firms wanted EPA to freeze allowance accounts in the event of disputes between partners in a multi-owner facility. The Agency rejected this request, arguing that to do so would undermine the market by introducing uncertainty in the recordation process -- a key element in allowance transfers. It also directly acted to reduce the transaction costs of the system by eliminating unnecessary duplication. An example was the case of proposed quarterly compliance certifications. Since the Agency was already receiving detailed quarterly reports from the CEMS, and since compliance could only be assessed at the end of the 30-day period following the conclusion of each calendar year, this proposed reporting requirement was dropped.

Regional Clean Air Incentives Market (RECLAIM)

The RECLAIM project started as the most ambitious and comprehensive trading program in the USA. The Los Angeles basin is the only extreme nonattainment area in the country (as of this writing).[81] As such, it is unique in its problems, which are compounded by population density and meteorological conditions. The South Coast Air Quality Management District (SCAQMD) embarked on RECLAIM as an alternative to the traditional rule-making process (otherwise known as command-and-control), with the expectation that it would be both less costly and more effective at reducing pollution. During a two year period, RECLAIM participants developed climatic, photochemical and economic models of the effects of a trading program. This effort resulted in a series of five working papers and a draft program. During 1993, the program went through a public comment period, and was changed dramatically prior to its adoption.

The basic concept embodied in RECLAIM is that the basin, and therefore each source within it, is allotted an emissions cap. Today, that cap exceeds the total emissions which will be allowable when the area must eventually be in full compliance with the NAAQS. Therefore, each source's cap will decline in future years until the total emissions cap for the area equals the amount allowed by the NAAQS. Each source is responsible for reducing a certain amount of pollution, either through outright reductions or through the acquisition of emission reduction credits from other sources.

Unlike its ambitious initial intentions, RECLAIM today only applies to stationary sources of NO_x and SO_x that emit at least four (4) tons per year. RECLAIM staff estimate that this will cover 535 sources. "Baselines will be the highest emissions during the period 1989 to 1991, reduced by an amount equal to the reductions required by the existing rules from that peak year to the start of the program. The annual emission reduction targets are based on a straight line rate of decline between the Baseline and the End-point."[82] It is hoped that a market for reactive organic gases (ROG -- or VOC) will be developed in the near future.[83] Credits, known as RTCs (RECLAIM Trading Credits) can be bought or sold on a yearly basis, and such transactions are reflected in permit modifications. The basin is divided into two sensitivity zones -- coastal and inland. Trades are allowed within the two zones and the coastal zone may trade to the inland zone, but not vice versa. Sources will have to submit monthly reports and certified quarterly reports. The program was scheduled to begin on January 1, 1994. It is estimated that RECLAIM will save Los Angeles $164.1 million, or 47 per cent of the $346.6 million price tag associated with rule-making.[84]

RECLAIM was developed under some unique constraints. First, statutory and legal authority for mobile source control is shared with the California Air Resources Board (CARB). CARB largely develops state-wide initiatives which then either have to be tailored (or factored in) to the region's air management plan. RECLAIM was also developed with a variety of special regulatory and legal design constraints. For example, the District was prohibited from using banking as an element in its program design by the California Clean Air Act. At the same time, the District was required to develop sunset provisions for the program, largely in response to constituent fears that the program would not function well. For the business community, this fear took the special form of concern over credit supplies and cost. As a result, price levels were set which would trigger the abandonment of the emissions trading market as the primary compliance strategy. The District was thus faced with the twin dilemma of being prevented from using the primary tool to assure both adequate supplies, as well as the need to insure against price-spikes during compliance periods.[85]

Recognising the need for some supporting market infrastructure, and in an attempt to build support among sceptical businessmen, the District hired a team of consultants who developed a strategy of overlapping permit issuance periods.[86] While this approach solved the problem of potential end-of-period price-spiking, it did not address the fundamental environmental protection problem of emission-spiking.[87] Because firms are allowed to use future emissions credits against present emission opportunities, there is no assurance that conditions of peak demands will not exacerbate, rather than alleviate, ozone exceedances.

In this regard, regulatory controls introduced more administrative complexity than banking, with no added performance benefit.[88] Most emissions trading paradigms are based on the premise of *ex post* crediting for reductions and no reverse banking, (*i.e. future* emission entitlements cannot be turned into *current* emission increases). In fact, it can be argued that problems of inadequate attention to the environmental implications of trading system design and practice have more often impeded, rather than aided, the development of such markets.

Furthermore, in regions without the substantial trading experience that characterises the Los Angeles area, sources are much more likely to fear the lack of emergence of an effective market. As a result, banking offers sources the encouragement to invest in over-control, by allowing them the option of preserving the financial value of that investment, while waiting for the market to emerge. In the absence of such encouragement, emissions will continue up the stack and be implicitly banked, at the expense of the environment.

Although an elaborate trading program was proposed, the SCAQMD chose only to set minimum standards to define how RTCs are traded. The market has been slow to develop, due to most firms holding excess credits for at least 1994 and 1995. Two firms, Cantor Fitzgerald and Dames & Moore have established a centralised auction system to trade RTCs, in addition to some bilateral trades that have occurred.[89] The auction is computerised with no face-to-face negotiations. The first auction was held July 29 ,1994, with 18 firms participating in NO_x trades and five firms in SO_x transactions.[90] Most sales were for near-term RTCs, but some trades had terms up to 10 years in the future.

The initial auction produced quite low prices, mostly because most firms were flush with RTCs and were trying to sell them to generate any revenues possible. In addition, RTCs used either for compliance or remaining unsold in the emitter's accounts are subject to an emission allocation fee. This fee is roughly $374 per ton while RTC prices have ranged from $2 per ton to $2,090 per ton. While the fee is intended to stimulate transactions, an exemption for RTC holders that are not "permitted facilities" is provided, which allows unused RTCs to be “dumped” to avoid the fee. About 10 million pounds of RTCs were therefore offered for sale against requests for about 2 million. Only 124,000 RTCs were actually traded, due to offers often falling well below asking prices.[91]

The auction managers charge a fixed fee to both the buyer and seller of either 3.5 per cent or $35 per ton transacted, plus a flat $150 per order placed.[92] The total fee includes a $50 fee charged by the SCAQMD to register each trade. The auction managers act as a clearinghouse, taking control of the RTCs before selling them. The SCAQMD collects the registration fee each time, so it receives at least $100 for each trade from the auction.[93] However, given that the auction generated about $10 million in trades even in its infancy, the fixed order and registration fees are relatively low. Nonetheless, despite these relatively modest costs, regulatory uncertainty remains high, and the level of market transactions relatively low. The staff overseeing transactions was given substantial discretionary authority in its review of these transactions, with the result that trade approvals can take from 2 weeks to 6 months. As a consequence, the market has been slow to develop, despite the substantial effort devoted to currency and market design issues.[94]

Nonetheless, by creating a dealer-based auction clearinghouse, the RECLAIM market has enjoyed lower transaction costs than those for the ETP in the same region previously discussed. One reason is that the RECLAIM program has clear rules about trading that limit the need for legal advice. The continuous emission monitoring (CEMs) requirements also allow for easier quantification of emissions, although the total costs spread across all RECLAIM participants for CEMs may be higher than the equivalent costs for participants in ETP trades, who are also required to certify control technologies.

Summary of policy experiences

PROGRAM	LESSONS LEARNED
Command-and-Control Environmental Regulation	Transaction costs can be high if the regulations are negotiated on a case-by-case basis, or if legally challenged. ***Enforcement*** costs may also be high under technology-based regulation.
Voluntary Programs (*e.g.* Climate Challenge)	Group negotiation reduces transaction costs.
Water Markets	***Approval costs*** are the most significant determinant of transaction costs. The more approval criteria applied to transactions, the greater the potential for conflict and increased transaction costs.
Water Banks	Attitude of legal authority -- facilitating or inhibiting -- is important in transaction costs. Rules governing transaction costs affect the level of transactions.
JI in Water Resources	Innovative transactions can have high ***negotiation and approval costs***.
Emissions Trading Program	***Search and approval costs*** have been high due to bilateral character of market.
SO_2 Allowance Trading	CEMS requirement increased ***monitoring costs***, but flexibility of the program reduces ***search***, ***negotiation***, ***approval***, ***enforcement***, ***and insurance costs***.
RECLAIM	Lower ***search costs*** than ETP due to presence of market intermediaries. ***Negotiation costs*** reduced due to clear rules, but ***approval costs*** increased due to wide discretion given to staff.

V. EXPERIENCE WITH JOINT IMPLEMENTATION-TYPE PROJECTS

As the preceding sections demonstrate, even though economists tend to neglect transaction costs, these costs have been significant in the markets for environmental commodities. In fact, transaction costs for policy innovators are frequently prohibitive, and even where they generate net benefits, there are often difficulties in actually appropriating them. JI is one such policy innovation. While JI is still under active development under the FCCC, there has nonetheless already accumulated a significant body of experience with abatement projects which have a strong JI flavour. The projects reviewed in this section were selected as a result of their strong resemblance to projects that might be expected to occur under JI. This section reviews the experience in these projects with special reference to transaction costs. Since each of these projects are JI analogues and since the actual procedures for JI (particularly crediting) have yet to be determined, the transaction costs estimated in this section can only be taken as approximations. However, the review does emphasise the relative uniqueness of each of the projects, the difficulty of estimating transaction costs, and the additional hurdles likely to be faced by policy innovators. While these reviews are largely anecdotal, it is hoped that they will add knowledge about JI transaction costs, and eventually about how to reduce them.

In each case, a set of telephone interviews was conducted with personnel either responsible for, or involved in, the implementation of the project. These interviews were designed to elicit the following information:

1. What were the ***search and information costs*** involved in choosing the project? How much did it cost to conduct the project evaluation process? Transaction costs can often be most directly assessed in terms of the time and human resources required.

2. How many person-days were lost in the bargaining and negotiation processes? Were there any legal expenses or other costs incurred in securing any regulatory approvals?

3. What are the costs of monitoring and any periodic performance appraisals for the project?

4. For all of the above, how much travel time and cost was involved?

Coal to Gas Conversion (CTG) Project, Poland[95]

The CTG project expects to demonstrate that inter-fuel substitution and technological innovation are viable means of reducing CO_2 emissions. In that regard, Global Environment Facility (GEF) funds will be used by the implementing agency (World Bank) to extend coal-to-gas conversions to medium-sized boilers whose owners could not achieve acceptable financial rates of return without concessional financing. The project is co-financed by the Kingdom of Norway ($1 million) and local sources ($22.3 million), with the GEF contributing $25 million. The duration of the project is expected to be six years.

A rough estimate of the transaction costs for the whole project is based on the allocation of funds for the initial feasibility study done by GEF. Out of the total funds of $400,000 given to the GEF, $280,000 were given to the task manager to find “fundable and feasible” greenhouse gas (GHG) abatement projects. From this amount, $50,000 was invested directly into the project, $50,000 in monitoring, $50,000 was spent on a consultant report, $10,000 was the overhead in the task managers office, and $120,000 was used to organise an international workshop on the issues of GHG abatement.[96] In addition, ten person-weeks were spent on project identification, fifteen on pre-appraisal, and twenty on the final appraisal. A total of forty-five weeks were spent by GEF staff.

High Efficiency Lighting Project, Mexico[97]

The project is designed to reduce a suite of atmospheric emissions (including greenhouse gases), through the replacement of incandescent bulbs with fluorescent light bulbs in two major markets, the cities of Guadalajara and Monterey. The project has been initiated by the GEF, with funding support from Norway, and co-operation with the Comision Federal de Electricidad, Mexico (CFE). The project will also increase the institutional capacity for technological change and energy conservation, in addition to strengthening the CFE and its capacity to implement demand side management. The project is estimated to reduce carbon emissions by 118,000 tons annually; sulphur dioxide by 3,000 tons annually; and nitrogen oxides by 208 tons annually.

All of the information needed to determine the ***search costs*** associated with the project are not available. Because the project required two years to prepare, precise breakdowns of staff time were not available. However, the costs of promoting and advertising the compact fluorescence lamps were $290,000. ***Negotiation costs*** include a banking fee for Banco National de Obras y Servicios Publicos of $23,000. Other ***negotiation and travel costs*** incurred by the GEF are not available. The management cost of the project was $1,590,000. The costs for monitoring, evaluations and final reports are also given in the report, and over the life of the project they amount to $163,000. In addition, the cost of market surveys, both for the purpose of monitoring and research, are $194,000.

The Reduced Impact Logging Project, Malaysia[98]

New England Power (NEP), a subsidiary of the New England Electric System (NEES) has entered into an agreement with Rakyat Berjaya SDN. BHD., a Malaysian forests products company (which holds a concession of 970,000 hectares) to implement improved forest management techniques on 1400 of those hectares. It is estimated that the 50-100 tons of carbon released to the atmosphere from destructive harvesting techniques can be halved by using Reduced Impact Logging (RIL) technologies. The budget for the pilot project is $450,000 in direct costs, plus up to $150,000 in monitoring and research costs. The pilot project began in August 1992, and will end in July 1995. An international Environmental Audit Committee (EAC), consisting of the Forest Research Institute of Malaysia, The Rain Forest Alliance, and the Center for International Forestry Research, is monitoring the project. Current predictions for the amount of CO_2 sequestered are between 300,000 and 600,000 tons.

The ***search and information costs*** incurred by NEP include both staff time, and consultants. Internal staff costs were between one-half and one person-year; while external costs were around $70,000. Initial project proposals involved two internal evaluations and an external evaluation by an "environmental collaborative group." In addition, time was spent briefing various regulators about carbon offset projects including the preparation of an application to the US Initiative on Joint Implementation (USIJI). NEES developed this project with the expectation of learning how to reduce the ***search and information costs*** of future projects.

The EAC monitors the harvesting guidelines developed for reduced impact logging, such as specifications for buffer zones for streams and roads and the cutting of climber vines prior to harvesting, with current funding at $80,000. In addition to this expenditure, another $90,000 is being spent on the evaluation of the carbon benefits by an expert consulting team. Travel costs are already included in these costs, except for a single trip that is made by a NEP representative to Malaysia each year. Two years have passed since the start of the project, and the total amount of money spent per trip is estimated to be $4000. Valuing staff time at $60,000 per year gives a total transactions cost estimate of approximately $309,000.

The Bynov Heating Plant Project in the City of Decin, The Czech Republic[99]

This project represents a collaboration between the Center for Clean Air Policy (CCAP), Wisconsin Electric Power Company, Commonwealth Edison, Northern Indiana Public Service Company, and the City of Decin. The project involves the switching of the heavily polluting Bynov district heating plant in the city of Decin, in the Northern Bohemia region, from brown coal to natural gas, and improving the efficiency of the distribution network. In addition to the global carbon benefits, this project will substantially improve local air quality which experiences peak SO_2 levels ten times higher than the health standards set by the World Health Organisation. The total capital investment needed is $1,500,000, out of which local officials can finance 60 per cent with the remainder to be raised from other sources. The electric utilities in the consortia are expected to be potential funding sources. The project hopes to offset 12,800 tons of CO_2 per year, 96 tons of SO_2 per year, and roughly 3 tons of particulates per year.

The project has been under development since July of 1993. Later that year, CCAP identified the utilities; this was followed up in early 1994 by an intensive effort by CCAP to negotiate with Decin officials about the “conditions of development” of the project; the legal and financial terms were then resolved. Since the general contractor for the project has now been chosen, project engineering should begin soon.

The search for the Decin project for the CCAP was relatively straightforward and illustrates the point that many JI-type activities are likely to be conducted among and between entities with pre-existing relationships. The local leaders, especially the mayor of the city of Decin had already been involved with the CCAP's Energy Efficiency Center in Prague. As the pre-feasibility study had already been prepared -- even the baseline had been calculated -- the ***search and information costs*** incurred by the CCAP in this initial phase were lower than expected.

Bargaining and negotiation was facilitated by the clear amount of funding ($600,000) that was required to enable the project to proceed. Other than program staff, the CCAP hired two lawyers to analyse and comment on the draft agreement, which was prepared by a Czech lawyer. The CCAP lawyers operated on a *pro bono* basis, but the time they spent, and the consulting fees they have foregone, are undeniably transaction costs. Roughly, the consultation would have cost CCAP about $30,000 to $50,000. CCAP staff time, including staff at the energy efficiency centre, amounted to $144,000. This type of innovative collection of project funding sources is typical of many JI-like projects.

Monitoring and evaluation of this project will be done by the World Resources Institute (WRI). In order to start the monitoring process, a full throughput analysis will be developed. After performing this analysis, WRI will try to measure the variables that affect GHG emission dynamics. The monitoring plans indicate one WRI researcher will spend a week in the Czech Republic twice a year in order to collect the necessary data. The trips would cost $2500 per person each time, and the staff-time would amount to $2500 a week. The total cost of monitoring is estimated to be between $20,000 and $25,000. Total transaction costs are therefore approximately $300,000.

The Biomass Cogeneration Project, India[100]

This project is designed to demonstrate bagasse-fired co-generation at a sugar mill in India, utilising the eight-month crushing season and another biomass fuel during the four month off-season. The project entails replacing or retrofitting existing boilers and installing co-generation equipment, including new high pressure multi-fuel boilers, high-efficiency condensing extraction turbines, and advanced pollution control equipment at the sugar mill. The highly technical nature of the project has required the assembly of a diverse coalition of expertise.[101] Total project investment costs are estimated to be $60 million. While the project is primarily commercial in nature, the JI component of the project will involve the displacement of fossil fuels by biomass fuels for the generation of both steam and electricity.

The ***search and information costs*** borne by Econergy International Corporation (EIC) in identifying the sugar mills; conducting an initial fuel assessment; and having preliminary discussions with potential customers, amounted to over 1800 hours. Another 600 hours have been allocated for the technical assessment of bagasse analysis, financial analysis, and initial environmental impact statement for each of the two chosen sites--Daurala and Simbhauli. As far as bargaining and negotiations are concerned, the preliminary discussions with the State Electricity Board's and each government are included in the ***search and information costs***. It is expected that legal and financial advisory fees for each project could be $250,000 and $100,000 respectively.

The ***monitoring and evaluation costs*** for the pilot USIJI project will be contributed by the US Department of Energy through the participation of government laboratories in Oak Ridge and Los Alamos. The total projected hours for USIJI analysis is 200 hours, but does not include the time spent by researchers in India to gather data. EIC estimates that transaction costs for the Simbhauli and Daurala projects could amount to $1.1 million.

AES Project, Guatemala[102]

This project was, in more than one way, the first JI-type project anywhere. The concept of forest-based projects to offset the GHG emissions of the power plants that AES was building and operating was suggested by WRI to AES. Initially, WRI devoted staff time to a cost-benefit analysis of various options, in order to determine if carbon sequestration was competitive among the options available for GHG reductions.

The expenses to AES for the process of ***searching and finding information*** are clear from the $14,000 grant given to WRI. However, this only accounted for about 40-45 per cent of the total costs incurred by WRI. WRI reviewed ideas and proposals from seventeen NGOs submitted in response to the opportunity for AES project funding.[103] WRI also formed an advisory panel consisting of eight people and, after about four meetings (three or four person days), the CARE proposal was chosen as the best project. All panel members served on a *pro bono* basis.

The ***negotiations*** with CARE took place in Guatemala and lasted for a period of about ten days. In addition to the staff-time spent on these negotiations, a per diem of $200 per day was paid to each negotiator. Legal costs were not incurred, since a “loosely” drafted document was accepted by both sides as being sufficient. The monitoring and evaluation of this project has, as yet, not consumed much time for AES. As the total amount of time evaluating reports and talking to CARE amounts to only one week a year, a total of five weeks have been spent on this activity between 1989 and 1994. CARE, on the other side, has not begun monitoring in earnest as yet. They are still searching for a third party evaluator to make monitoring more systematic, as well as scientific.

Total transaction costs for this project amounted to $53,500. Such low transaction costs for a pioneering project seems counter-intuitive. But, due to the involvement of a not-for-profit organisation like WRI, as well as CARE's existing project development expertise, reported transaction costs have been relatively low. Nonetheless, the ***monitoring costs*** incurred to date are a poor indication of what the actual ***monitoring costs*** may turn out to be in the future.

Mbaracayu Conservation Project, Paraguay[104]

This project was the second greenhouse gas offset project to be developed by AES. In this case, the objective was to test the feasibility of tropical forest preservation as an offset strategy. The project was designed to compensate for the emissions of the AES Barbers Point facility. Project co-operators included The Nature Conservancy (TNC) and the Moises Bertoni Foundation. In the initial process of search, negotiation and the signing of the agreement, TNC spent $10,000, in addition to four person months of staff time, for a total cost of $25,000.

Project monitoring is designed to check for any indications of deforestation by periodic aerial surveillance. However, monitoring is not a one-dimensional activity since indicators of biodiversity are also being evaluated, because the project was designed to test the hypothesis that forest preservation for GHG offset purposes could also benefit biological diversity. The total cost of monitoring for both sequestration and biodiversity is estimated at between $200,000 and $250,000. However, it has not been possible to further apportion these costs between the two objectives. This is a common problem for many of the JI-like projects, since they are frequently multi-objective in character.

VI. SCENARIOS FOR JOINT IMPLEMENTATION: CRITERIA AND INSTITUTIONS

As discussed in Section II, the choice of criteria and institutions employed to shape JI will have a significant impact on the volume of JI activities and, in consequence, on the gains in global cost-effectiveness that can be expected to flow from it. Criteria and institutions that *facilitate* JI transactions will increase the volume of such exchanges, and thus magnify the opportunities for cost-effectiveness. Conversely, criteria and institutions that *impede* transactions will diminish the volume of JI activities, and thus dampen the prospects for cost-effectiveness.

In this section, we discuss a number of the criteria and institutions that have been proposed for shaping JI. Because the Conference of Parties to the FCCC has not yet begun discussing the criteria for JI that it is directed to consider by FCCC Article 4(2)(d), our analysis here is meant to help inform the technical discussions that may provide the basis for choices eventually made by the COP.

Several kinds of criteria and institutions for JI have been discussed in the literature.[105] We analyse each in terms of the impact it would have on the different kinds of transaction costs described in Section II: ***search costs***, ***negotiation costs***, ***approval costs***, ***monitoring costs***, ***enforcement costs***, and ***insurance costs***.

Information systems

A key to reducing the ***search costs*** of JI activities will be the existence of systems to acquire and share information on prospective projects. Parties interested in engaging in JI activities may have difficulty finding interested partners. The larger the number and variety of potential partners that each party can learn about, the more likely that a mutually valuable exchange will be identified.[106]

In general, private markets will produce inadequate supplies of information because some information has a public good character: its benefits are shared and nonexcludable, and cannot be appropriated by the producer. Governments can therefore play a constructive role in collecting and disseminating information. In the JI context, information may also be lacking because of the transaction costs involved in obtaining it. As the preceding section has amply illustrated, it costs something, in search time and other expenses, to find out what players are offering what JI projects at what prices.

As described above in Section III, various institutions have developed in standard markets to facilitate information availability and reduce ***search costs***. Here, we examine several specific proposals made in the context of JI.

Clearinghouse

The idea of an information "clearinghouse" has been suggested for JI.[107] The concept varies from a "bulletin board" service, providing centralised listing of interested investors and hosts and proposed projects,[108] to a "gatekeeper", which would be the required registry through which all JI projects would have to pass. Some options could reduce transaction costs, while others might well increase them.

Central bulletin boards could be very useful in reducing the ***search costs*** for JI. Making such bulletin boards mandatory, however, would increase the transaction costs for some participants (those who would have engaged in transactions without publishing a listing), and could create a bottleneck, blocking rapid deployment of GHG abatement investments. Mandatory listing is usually required to prevent unfairness in the selection of transactions (*e.g.* the risk that an employer will give a job opening only to an inside candidate or only to candidates of a certain racial group). Unless that is a manifest problem in JI, listing should not be mandatory. It is probably better to try to have JI function with *voluntary* listing services before making listing *mandatory*.

Similarly, requiring listings to go through a single central clearinghouse would tend to stifle aggressive GHG abatement efforts. A better approach would be to foster listing services in general, but not necessarily require listing at any single site. As in the case of the California Emergency Drought Water Bank, the single most important attribute of that centralised operation was the signal from the regulator that transactions were desirable, and to be encouraged.

The World Bank's Global Environment Facility (GEF) has been suggested as a possible clearinghouse location. International banks, such as the Asian Development Bank (ADB) and the European Bank for Reconstruction and Development (EBRD) may also be good locations for this service because substantial project finance already flows through their offices; thus investor and host countries already meet through these banks to discuss mutual projects. But there may be issues of market power and domination associated with these banks, at least from the developing countries' perspectives. However, as long as these banks are not the *exclusive* listing service (by rule or *de facto* -- that is, as long as there are robust alternatives for information flow), such market power should not be a serious problem. Thus, private banks; private listing registries similar to stock exchanges like the New York Stock Exchange (NYSE), Tokyo, London, and NASDAQ exchanges; and commodities markets, should also be open to JI transactions. In the US, the Chicago Board of Trade (a commodities exchange) has already listed sulphur dioxide allowances created under the 1990 Clean Air Act among its traded commodities. In fact, it conducts the annual auction of allowances for the government.

Credit banks

A similar suggestion is the creation of "credit banks" which could accept investors' deposits and purchase credits.[109] In addition, JI hosts could deposit pre-generated credits (resulting from JI projects started by the host in the expectation of later being able to sell the credits). Such an institution could significantly facilitate transactions, as evidenced by the dramatic increase in transactions fostered by the "community bank" for air pollution control credits in Los Angeles described in Section III.[110] Such an institution would also provide the critical role of allowing investors to store reductions prior to then transfer. This function is particularly critical in the early development of a program, when uncertainty about marketability and value are likely to be the greatest.

Some have suggested that the clearinghouse or credit bank should also be the sole investment manager for JI, collecting all investor funds and selecting and managing all host projects.[111] Although a central fund would reduce ***search costs***, so would the provision of non-exclusive "bulletin boards", whereas a central JI fund would pose the serious disadvantage of centralising market power in a single institution. Such centralisation would create problems of monopoly inefficiencies and market power inequities. It would reduce market activity and depress the compensation offered to hosts for JI credits, thus reducing total GHG abatement purchased. And by removing the pressure to compete for investments, centralisation would weaken the incentive to select projects for their cost-effectiveness, thus reducing the abatement per investment expenditure. Furthermore, by preventing developing countries from soliciting competing bids from other sources, creating a single monopsony purchaser of JI credits might exacerbate the anxiety of developing countries about coercion and exploitation by industrialised countries. Thus, even if a central bank would offer advantages in reducing transaction costs, it could pose serious disadvantages of market power. Any centralised institution designated to publicise or manage JI transactions should therefore remain non-exclusive, both legally and in practice: other competitive avenues should remain available for exchanging information and selecting and managing investments.

A credit bank or clearinghouse could more usefully act as one mechanism among several (including the option of direct private bilateral transactions) created to facilitate JI transactions. It is critical to keep the option of direct private bilateral transactions open to ensure competition and non-coercive alternatives in the JI market. And it could be valuable to keep the clearinghouse (information) function separate from the bank (investment management) function, to avoid placing control over both market-making functions in one office. Thus, any information clearinghouse established should provide information services and not “double” as an investment manager.

Brokers

Private brokers or agents are likely mechanisms for reducing ***search costs*** (though the fees paid to brokers are themselves a component of ***search costs***). Already, private enterprises are setting up JI brokering services, to locate interested investors and to match them with attractive host projects. Firms like AER*X (which has brokered hundreds of pollution control credit trades in the US) and COPEC (which brokered the NEES-Malaysian JI-style pilot project to reduce collateral damage from logging and thereby to conserve forest carbon -- see Section IV above) are offering brokering as their main service. AES Corporation, which has invested its own funds in JI-style pilot projects in Guatemala and Paraguay is also developing additional projects that it may offer to other investors as a broker would. Non-governmental organisations (NGOs) may also play parts in organising JI transactions. Some NGOs have already helped arrange the JI-style pilot projects that are already underway: the World Resources Institute (WRI) assisted AES in developing its Guatemala afforestation project, the Environmental Defense Fund (EDF) is conducting project feasibility studies in Russia and Costa Rica, and the Rain Forest Alliance advised NEES and COPEC on the Malaysian reduced-impact logging project. An increasing population of brokers is likely to arise as the JI mechanism gathers momentum, with expert knowledge of both international project finance and local environmental and energy opportunities in host countries.

Identity of investor and host

Various proposals have been made to limit who may act as investors and hosts in JI projects. As noted in the Introduction (see Table 1 and accompanying discussion), a wide array of entities may eventually participate in JI, and the participation of private enterprise is both desirable and easily accommodated within the framework of the FCCC.

It is most likely that, in the near term and under the current wording of the FCCC, investors in JI will be industrialised (Annex I) countries or private enterprises from these countries, because those are the countries on whom the FCCC places an obligation to implement policies and measures to abate GHG emissions. If other countries also undertook commitments to abate GHG emissions, either under national policies or under a new version of the FCCC, they too could act as JI investors. In fact, to the extent that non-Annex I nations eventually adopted Annex I responsibilities (particularly with regard to baseline and reporting issues), transaction costs would be reduced, since many of the issues associated with the integrity of emission reduction projects would thereby vanish.

Some suggest that JI hosts should also be limited to Annex I countries. This would seem to be an unavailable constraint under the terms of FCCC Article 4(2)(a), which says JI may be conducted with "any other party." Restricting the pool of available JI hosts would reduce the opportunities to maximise cost-effectiveness of GHG abatement, which would inhibit global GHG abatement or drive up global costs or both (and would arguably violate the principle of cost-effectiveness in Article 3(3)). Segmenting the JI universe into categories of countries able to trade only with each other, or only with certain other groups,[112] would limit the potential mutual advantage (gains from trade) that both parties might obtain. On the other hand, an open regime in which parties are free to find their best opportunities with other interested parties would maximise global benefits.[113]

In addition, limiting hosts to Annex I countries would potentially increase the transaction costs of JI. Although it might reduce ***search costs*** in a superficial sense by reducing the number of possible host partners from which to select, by making the market thinner it would make it more difficult for investors to identify suitable host projects without extensive negotiation. By concentrating JI projects in a few countries with similar and interrelated economies, it would also reduce investors' ability to diversify projects across risks, and would thereby increase ***insurance costs***.

Another proposal would limit investors to routing their investments through a single entity such as the GEF. As discussed above, creating a monopoly investment manager (monopsony credit purchaser) would have serious drawbacks for both international efficiency and equity. In addition, selecting the GEF for this role poses special problems. Using the GEF to manage JI investments could add to confusion over the difference between JI under Article 4(2)(a) and financial assistance required under Article 11, for which the GEF is the interim financial mechanism. Those two financing mechanisms -- the first based on market trade; the second based on official development aid -- should be kept distinct. In addition, asking an international bureaucracy like the GEF to handle JI could increase ***negotiation and approval costs*** (chiefly arising from delays). The internal negotiations within such a bureaucracy needed to obtain project approval could be lengthy, as compared to project approval by private enterprises, or even by national governments.

Approval process

A key factor in transaction costs will be the process for approval of JI GHG abatement projects and credits. If advance approval of each JI project is required by multiple levels of government -- host government, investor government, and an international organisation -- ***approval costs*** (delays) will rise. An alternative would be to leave advance project approval to the JI partners (host and investor) as they see fit, and reserve the international role for review of the reporting of GHG emissions and abatement credits and debits. Thus, the COP would not concern itself with the broad design of the JI project or its local economic and local environmental impacts, but would concern itself with the GHG abatement credits that will actually be claimed.

In addition, case-by-case submission and approval of every claim for JI abatement credits would add significantly to ***approval costs***. A less transaction cost-intensive approach would be for the COP to establish guidelines for reporting of JI abatement results (as it will for domestic abatement), and to review national reports for compliance with those guidelines. Such guidelines could include the option of review by an accredited NGO, as described in Section II, in order to deploy monitoring capabilities widely and reduce the administrative burdens on the COP. Such guidelines ought to set out a standardised reporting format, so that all abatement credit claims come with certain common information in common quantitative terms.[114] For example, all abatement credit claims (whether domestic or JI) ought to report the actual abatement *achieved* (as opposed to *estimated* abatement) in each period for which a report is required (*e.g.* annually).

The high transaction costs inherent in a centralised, case-by-case advance approval process are well-demonstrated by the experience with the Fox River water discharge permit trading system developed in Wisconsin. There, the government allowed trades in water pollution control credits, but required submission of each proposed trade to the government for advance review. The result was almost complete discouragement of transactions.[115]

Approval criteria

The most important criteria that the COP may adopt for JI will be the substantive criteria for approving JI abatement credits claimed on national communications. Several kinds of approval criteria have been proposed.

Proof of actual abatement

A key issue is demonstrating that the GHG abatement claimed is a "real reduction"; that is, that the reduction *would not have happened otherwise*. GHG abatement policies and measures may often accelerate introduction of new technology that would have diffused into markets anyway, but more slowly; or protect a forest that would have been harvested over several years; or otherwise alter the time path of GHG emissions. The time path is crucial, because it affects the build-up of GHG concentrations in the atmosphere.

Note, however, that the same issue of “real abatement” arises for domestic actions as well as for JI actions.[116] If an abatement project is conducted wholly domestically, its results would be reported to the FCCC by the host country; the only added element in JI is that some of the financing comes from outside the host country, and some of the credits are assigned outside of the host country. The actual physical effect of the project on net (global) GHG emissions remains the same. And the problem of measuring the net change in GHG emissions remains the same: the question of whether the project reduces emissions below *what they would otherwise have been*. Even actions taken in countries with emissions targets raise this problem, because such a country's future emissions time path might have fallen anyhow (or fallen by as much), absent this project. Put another way, a national target of “returning to 1990 levels by 2000” does not indicate what the country's emissions would otherwise have been in 2000, and thus does not indicate whether specific GHG abatement projects are bending down the path of future emissions more sharply than it would otherwise have been bent.

What is theoretically needed to assess whether or not abatement is “real” is a reliable forecast of future emissions in the no-action case: a *baseline* of “what would have happened” in the absence of efforts to abate emissions. But a baseline can be constructed for a country regardless of whether it has an emissions target under the FCCC. On the other hand, note that meeting the 1990-by-2000 target implied in the FCCC does not require forecasting a baseline, unless the country wants to know how hard it must work to meet the target. Thus, Annex I countries need not necessarily forecast baseline emissions under the FCCC. If an *Annex I* country is a host for a JI project, therefore, one cannot assume automatically that it will have a baseline forecast from which to judge whether the abatement obtained is below what would otherwise have happened. Similarly, non-Annex I countries are not constrained from forecasting baselines simply because they do not have targets under the FCCC. The issue for estimating "real reductions" is baselines, not targets.

Still, the emissions abatement effect of a particular project could be measured very broadly or more narrowly. Ideally, its effects would be measured using general equilibrium analysis to reflect all the ramifications in the national and global economies. Such analysis would capture, for example, the effect of energy conservation in one country on world fuel prices, and hence, on demand for fuels in other countries; or the effect of forest conservation in one country on timber prices, and hence, on demand for timber harvesting elsewhere.

All of these kinds of "leakage" -- offsetting increases in GHG emissions elsewhere due to efforts at abatement in one locale -- would be generated by both domestic and JI projects. For example, although a JI project to conserve a forest might restrict timber supply, and thus increase the pressure on other forests, the same is true of forest conservation undertaken *within* an Annex I country. Forest conservation in the US, for example, will affect world timber prices and could increase pressure for the harvesting of forests in Asia.[117] Moreover, this problem is by no means limited to forest conservation. Extensive energy conservation in Annex I countries could drive down the world price for energy fuels and thus increase the quantity demanded elsewhere. The impact of such leakage in energy markets may be quite significant: studies have estimated that the net global reduction in energy consumption from energy savings in the USA or Europe might be between 94 per cent and close to 0 per cent of the local energy savings (depending on the country conserving, the fuel being conserved, the degree of conservation, and the economic model being used).[118] Thus, if leakage is estimated for JI projects, it ought to be estimated for *all* GHG abatement policies and measures conducted *anywhere*.

The baseline for a JI project could also be project-based rather than national or global[119]. That is, if a boiler conversion project is being undertaken, one would forecast what the emissions for that facility would have been both “with” and “without” the conversion. Such an estimate plainly omits the effect of reduced fuel demand at this facility on fuel prices and demand elsewhere (the leakage problem). But it is a viable first approximation of the change in emissions accomplished by this project. And it makes sense, given that the FCCC in Article 12 requires all parties (Annex I or otherwise) to report on their national net emissions. Thus, if a particular project (JI or domestic) causes a local decrease in emissions but, via leakage, also causes some increases in emissions elsewhere (including elsewhere in the same country), that increase should be reflected in the emissions reports to the COP required of those countries.

From a transaction costs point of view, the obvious difficulty with global general equilibrium analysis of every abatement activity is its complexity and cost. Requiring such involved calculations could discourage entrepreneurial JI projects that would offer real global benefits. Project-level baselines, within the context of the FCCC's overall reporting requirements, can be a reasonable substitute for global general equilibrium estimates. Project-level baselines still require substantial effort and technical expertise,[120] but far less cost than a global baseline and leakage estimate would require.[121] As experience with GHG abatement under the FCCC develops, more precision might eventually be required of these abatement estimates.

A related concern has been the prospect of “cream-skimming”: that JI investors might buy up the least-costly GHG abatement activities in host countries, so that when the host (a developing country) later undertakes its own target under the FCCC, its least-cost opportunities will be gone. This concern is misplaced. First, each JI transaction is entirely voluntary. If the host thinks the relinquishment of abatement credits would not be worth what the investor is offering, the host can decline the offer or demand a higher payment. This calculation will incorporate the future costs to the host of having sold the abatement credits in the first place. If the host undertakes the JI project and sells the GHG abatement credits, it will receive valuable compensation in return, in the form of cash, technology, or other items agreed between host and investor. Thus, the host will lack the GHG abatement credits, but will have new assets of greater value to the host (or else the host would not make the deal).[122] Only if developing countries are systematically lacking the capacity to make this judgement and to engage in voluntary transactions, or if they face asymmetrically inadequate information in evaluating these options,[123] would a problem arise. To the extent that such a problem in forecasting and evaluating emissions projections occurs, it is of the type meant to be addressed through the financial assistance provisions of FCCC Article 12. Second, the concern is also misplaced because the host country would have lower total emissions in the future than it would have had without the JI project. Hence, it will presumably be easier for the host to meet any emissions target agreed under a future FCCC.[124]

A key part of the process of measuring actual abatement will be the requirement for "real-time" crediting. This need not mean instantaneous monitoring, but it does mean that mere estimates of projected abatement should not suffice to establish a reportable credit. Credit should be recognised only for actually accomplished abatement, perhaps on an annual accounting basis. For a forest conservation project, this would entail some annual measurement of the actual amount of carbon added to the forest (trees, soil, etc.), or at least the *actual* or volume of trees added, rather than using a *projection* of the carbon to be stored over the 40-year life of the project. For an electric boiler conversion, it would entail some annual measurement of the actual emissions or carbon content of fuels consumed by the new facility during that year, to be compared to baseline projected emissions by the facility before the conversion. Real-time crediting would help ensure that activities do not overstate their accomplishments. And it would help the participants structure payment schedules to compensate the host properly for actual achievement.

Price floors

Some have suggested that JI investments should be subjected to a floor price of, say, $10 per ton of CO_2-equivalent abatement.[125] Such a floor price would be equivalent to a tax on JI projects having lower marginal costs of abatement, in the amount of the floor price (here, $10) minus the actual cost of the project (say, $2) per ton. It would raise the transaction costs of JI compared to equally costly domestic projects, and thus discourage JI activities. In effect, it would be a tax not only on investors, but also on JI hosts with low-cost abatement services to offer, depriving them of the opportunity to earn income from JI. It would penalise the most cost-effective GHG abatement projects, rather than encouraging them as FCCC Article 3(3) seems to prefer. Recall Figure 1, and consider the main effect of requiring every credit purchase to pay a floor price above the equilibrium price: a reduced quantity of abatement would be demanded.

Trading ratios

Some have recommended requiring JI credits to be applied at a ratio greater than one: that is, for every unit of national abatement to be claimed via JI, more than one unit of actual JI abatement would need to be obtained.[126] Thus, a JI credit for one ton of CO_2-equivalent reduction per year would be worth less than one ton of CO_2-equivalent reduction obtained domestically.

The usefulness of a trading ratio depends on its purpose. Trading ratios are sometimes used in tradeable emissions permit systems to deal with geographic variations in the damages sustained per unit of emissions. If a unit of emissions would be more injurious on one side of a lake than on the other, a trading ratio may be a good way of requiring extra credit purchases for equivalent emissions on the vulnerable side. However, because the global damages from GHGs do not vary according to the location of the emissions, this use of trading ratios is *not* especially appropriate to the GHG case.

Trading ratios might also be used to reflect the uncertainties associated with measuring the credit-generating activity, in order to ensure at least equal actual abatement. As discussed above under "Actual abatement," the certainty of abatement does not vary according to whether the project is domestic- or JI-based, but rather varies with the accuracy of the baseline forecast, the quality of the project design, etc. However, real-time accounting, discussed earlier, would address these uncertainty issues more directly and more successfully than a crude two-category trading ratio.

Trading ratios can also be used to ensure an "environmental bonus" -- an extra quantity of emission reduction to be obtained along with each trade. Such ratios would clearly be an additional cost on each transaction, similar to a transaction tax, and would discourage transactions and the cost-efficiencies and resource flows that these transactions generate.[127] Whether they would actually achieve an environmental bonus is also unclear. At one extreme, a trading ratio of 100-to-1 or 1000-to-1 would extinguish all trading, with zero environmental bonuses earned (and clearly zero cost-effectiveness gains and zero resource flows to hosts). At the other extreme, a trading ratio of 1-to-1 would facilitate trades, but also with zero "bonus" emissions retirement. The environmental bonus would be maximised somewhere in between, but the optimal trading ratio is unclear: it may be very close to 1:1. Absent modelling or empirical studies, it cannot be assumed that a trading ratio set at any particular level will, in fact, provide an environmental bonus.

If the purpose of the trading ratio is to reduce global emissions, the crux of the matter is really the overall target, not the exchange value of each credit. Whereas tightening the target would both increase protection of the environment and stimulate JI transactions, raising the trading ratio on JI would discourage transactions without necessarily protecting the environment. Moreover, if raising the trading ratio is really an argument that the target is not adequate to protect the environment, we would argue that that this important issue should be debated openly among the parties to the FCCC (as required by Article 4(2)(d)), rather than being shrouded in the relative technicality of a trading ratio.

Quantity ceilings

Some have urged placing a ceiling on the quantity of JI credits that an investor may earn, such as a limit of 15 per cent of the investor's total national reductions needed to reach its 1990 level by 2000.[128] In considering this idea, it bears noting that the FCCC places no such limit on JI transactions, and plainly authorises parties to implement some or all of their policies and measures jointly with other parties.

Even if the COP had the authority to impose such a limit, its rationale might be questioned. First, such a ceiling would increase transaction costs. Consider a country imposing emission reductions and allowing private enterprises to satisfy those reductions either at home or through JI, subject to a maximum limit on JI of 15 per cent of total national reductions. At first glance, this rule would inhibit JI activities that might have exceeded 15 per cent, and will thus keep investment resources at home instead of flowing to host countries. Moreover, higher transaction costs may keep JI well below the 15 per cent limit in any event. In advance, no private investor would know whether its project would be the one determined to fall over the quantity threshold. Thus, both ***approval costs and insurance costs*** would rise. Investors would have to research the likely magnitude of competitors' JI investments and try to predict the risk of being bumped over the 15 per cent threshold. Even if that risk seemed small, it might impose an ***insurance cost*** large enough to exceed the difference in marginal abatement costs between JI and domestic actions, and thus result in all or many private investors avoiding all (or at least large) JI investments. It might induce investors to fund only small projects with rapid results that could fit under the 15 per cent limit without worry, and thus discourage larger technology transfer or capacity-building investments.

A cap on the percentage of national abatement actions undertaken through JI in effect tells investors from wealthier countries not to spend (much of) their money in poorer countries. That message seems startlingly perverse for an international agreement meant to stimulate financial assistance and technology transfer to developing country hosts. It would be remarkable if a domestic policy exhorted rich neighbourhoods to promote sustainable development, but prohibited the rich from collaborating with poor neighbourhoods too much in that effort (the comparable rule would read "the rich may only spend 15 per cent of their money in poor neighbourhoods; 85 per cent must be spent in rich neighbourhoods"). Nonetheless, there has already been substantial political pressure on rich nations not to invest "excessively" in JI projects abroad, and it is noted that this pressure originates in both richer *and* poorer countries.

Some endorse the quantity limit idea as a way of preventing industrialised countries from "exporting sacrifice."[129] The reality is the opposite. Investments in JI do not export sacrifice, but rather offer valuable investment resource flows to host countries. Investors will pay (provide funds and technology) in return for GHG abatement services. Host countries would not suffer income losses because investors would pay the costs (otherwise, the hosts would not make the voluntary deal in the first place). Keeping GHG abatement within industrialised countries can mean income losses there, as economic activity is restricted, but that does not help developing countries. On the contrary, it probably means slower world economic growth overall, and thus, fewer goods and services being purchased from developing economies.

In any event, it is unlikely that JI activities will exceed 15 per cent of national emission reductions in most countries, because JI investments will be "naturally" constrained by the normal risks associated with overseas investments and by the fact that lower transaction costs will often prevail domestically. But for some countries -- those with only very high-cost domestic abatement options -- most likely countries with no domestic fossil fuel energy supplies, the option of using more than 15 per cent for JI will be economically important. And for a host, losing a major investment because of a 15 per cent JI limit might often be a serious blow to its own development aspirations.

Timing limits

Another proposal has been to allow JI abatement to count for credit only to meet some yet-to-be-negotiated post-2000 target.[130] In response, note that the FCCC currently imposes no such limitation, and expressly provides in Article 4(2)(a) that parties may "implement jointly" the "policies and measures" to limit emissions or protect sinks, with the aim of returning to 1990 levels by 2000. It is therefore difficult to see how the COP could impose such a limitation. In any event, even on policy grounds, such a timing limit would be problematic. First, there is as yet no international target for GHG abatement beyond 2000; thus, there will be no incentive for investors to engage in JI relative to that period, and no JI will occur. Second, segmenting credit for JI by time period would raise the ***approval and insurance costs***, as investors and governments try to anticipate and sort out which credits will apply during which time periods. Third, postponing the incentive for JI would delay efforts to assist developing countries onto a lower-emissions path. It would deprive developing countries of needed development assistance *now*,[131] and would maintain developing countries on rapid emissions-increasing growth paths, forfeiting the chance to begin bending down the curve of future global emissions at an earlier date.

GHG segmentation

Some also suggest that JI credits for abatement of one GHG, perhaps methane (CH_4), should be applicable only to domestic reductions in that gas, and not applicable to reductions in other gases, such as CO_2.[132] At first glance, this proposal is difficult to interpret because FCCC Article 4(2)(a) target does not divide itself into targets by gas. Instead; it covers “all GHGs not controlled by the Montreal Protocol”. Thus, the circumstance would not arise in which a country needed domestic reductions of any particular gas; and the COP would seem to lack the authority to create such a circumstance. Moreover, even if it did arise, it would presumably apply as much to domestic actions as it did JI actions.

Assuming that such a situation *did* arise (for example under national gas-by-gas limits), this proposal would segment the market, and would increase ***search costs***. Investors would have to search for exact gas-gas matches for their domestic needs. This would entail a move back toward a barter system, with attendant increases in transaction costs (see Section II above).

Because GHGs contribute to potential global climate change through the common effect of increased radiative forcing, their impacts can be compared and matched across gases. The IPCC is continuing to develop and improve its "Global Warming Potential" indices, which allow at least approximate cross-gas comparisons. Not employing best approximate comparison factors like the GWP does not mean avoiding comparing the gases; rather it means implicitly trading off their value at some arbitrary rate, such as the relative marginal *cost* (rather than the relative marginal *benefit*) of abatement of each gas; or implicitly setting the value of abatement of one gas, such as CH_4, to zero, which is clearly inefficient. Using approximate comparison factors for policy would be far superior to using implicit and arbitrary trade-offs.

For the purposes of JI and GHG abatement under the FCCC, allowing comprehensive cross-gas comparisons would improve cost-effectiveness (by allowing a wider range of abatement opportunities) and would improve environmental protection (by ensuring that reductions in one gas do not lead to increases in another).[133] The approximate comparison factors provided by the GWPs should be adequate to serve for near term abatement investments.[134] Moreover, encouraging multigas abatement efforts by allowing such cross-gas comparisons would stimulate research by investors into improved measurement of sources, sinks and GWPs.[135]

Liability and insurance

What happens if the JI project does not achieve its projected GHG abatement performance? The selection of a liability rule influences subsequent bargaining between transaction participants, and therefore the optimal liability rule depends in part on the transaction costs of such bargains. In other words, the choice of liability rule influences the difficulty or ease the market has in arranging risk-bearing by contract. Liability should in general be placed on the actor for whom risk avoidance is least costly; or on the actor which could bargain under least transaction costs to reassign risk-bearing by contract to the actor for whom risk avoidance is least costly.[136]

In the JI context, the implication is that liability for the risk of project failure should be placed on the participant most easily able to avoid that risk, or most easily able to bargain with others to reassign that risk to the participant who will accept it at least cost. At first glance, the host might seem to be the most easily able to avoid JI project failure, because the host is closest to the daily operations of the project. But the investor shares a role in project design and in the selection of projects around the world, and may bring technical expertise that is of value in ensuring project success.

In part, this question is already answered, for good or for ill, by the FCCC. Under the FCCC certain parties (Annex I) are required to take policies and measures to abate GHG emissions. Thus, these countries are "liable" to the COP if they fail to meet their specific commitments. In turn, these parties will presumably impose some requirement or inducement on private enterprises within their territory to abate GHG emissions. These private enterprises, and/or their national governments, are most likely to be the investors in JI transactions. Thus, the FCCC and national government policies pursuant to it, will place “liability” for achieving GHG abatement on *investors*. If a JI project (or a domestic project) fails to achieve projected GHG abatement, it is therefore the *investor* who will ultimately be called to account by its national government, or by the COP.

The investor could insure against this liability in several ways. The investor could purchase an insurance policy against whatever penalties might be imposed for failure to meet its GHG target, or for the cost of procuring alternative GHG abatement services, if the main abatement project fails. It is possible that both private insurance companies and governments might offer these kinds of insurance policies. Second, the investor could also bargain with the host, in order to require that the host to share some of this risk in the contract terms of the JI agreement, such as by reducing the contract price slightly, or by making payments over time contingent on project performance (measured via real-time accounting). Third, the investor might arrange in advance to procure *extra* GHG abatement credits, in order to cover the risk of some failing to “deliver”. Fourth, the investor might try to purchase GHG abatement credits on a “spot market”, created by short-term abatement activities offered by hosts.

Fifth, the investor could try to diversify its risk by investing in several abatement projects (or partial shares of several projects, along with funds pooled from other investors, in a kind of JI mutual fund). This portfolio of projects might be diversified by *type of project* or *technology* (*e.g.* energy, forest conservation, etc.); *time horizon* (short-term vs. longer-term GHG abatement payoff); *host country location*; *host country economic structure*; and so on. One might therefore expect privately organised mutual funds or venture capital funds to develop, offering shares in risk-diversified JI project pools.[137]

VII. SUMMARY AND RECOMMENDATIONS

Both economic theory and experience with markets indicate the importance of transaction costs, and of the institutions designed to reduce those costs. Broadly, transaction costs inhibit efficient exchange.[138] In so doing, they contribute to the sources of environmental degradation in the first place. They can also frustrate the use of market-based methods for environmental protection, such as JI. Empirical evidence for the importance of transaction costs comes from several standard markets, such as those for real estate, commodities, and financial services; as well as from environmental markets themselves, such as those involving tradeable air pollution control allowances, tradeable water pollution control credits, and transferable land development rights (Section IV). In addition, evidence from the JI-style pilot projects initiated to date (Section V) indicates the potentially decisive role that transaction costs could play in inhibiting this emerging market. In fact, transaction costs, implicitly or explicitly imposed, are probably the single most serious threat to the eventual emergence of a JI market. To reduce transaction costs in JI, we offer several recommendations:

- JI transactions will be expedited by the existence of clear property rights and obligations. This suggests that the COP should clarify, at the earliest possible date, the accepted roles and responsibilities of national governments, private businesses, NGOs, and international organisations in the JI accreditation process. The status of "credits" for JI investments should also be clarified. These steps would take some of the uncertainty out of the JI concept, thereby reducing both the ***approval and insurance costs*** associated with it. Clearer property rights would also reduce ***monitoring*** and ***enforcement costs***, by focusing these activities on the correct parties at an earlier point in time.

- The COP and national governments should also foster information exchange centres for JI. For example, they might fund public "bulletin boards" or other listing services, and they should allow the operation of private/NGO services, such as registries and stock exchanges, brokers, and mutual funds and venture capital funds which would reduce ***search costs***. The COP should also adopt clear guidelines for project prospectus information, in order to reduce both ***negotiation and approval costs***. The role of private enterprise in JI will be essential, and is already consistent with the structure of the FCCC. It should be encouraged accordingly.

- The COP, in its adoption of criteria for JI, should draft guidelines for standardised reporting of the GHG abatement performance achieved by JI (and domestic) activities. Such reporting would reduce ***monitoring costs***. We suggest that the COP require real-time (*e.g.* annual) accounting of actual GHG abatement accomplished, rather than allowing investors to claim credit based on estimated future abatement streams. This procedure would also reduce ***approval and enforcement costs***.

- The COP should carry out its role of monitoring GHG abatement claims (necessary for both domestic and JI activities) by using guidelines to review *ex post* national abatement reports, rather than by requiring advance approval of each proposed project *ex ante*; and by accrediting NGOs to act as monitoring inspection and certification services, pursuant to these guidelines. These recommendations would reduce both ***approval and monitoring costs***.

- A variety of proposals made to date for the parameters of JI would also *increase* transaction costs and discourage JI transactions. These proposals should therefore *not* be adopted, if the main policy interest is the size of these costs. These proposals include: (i) limiting the identity of investors and hosts (market segmentation *e.g.* by restricting hosts to Annex I countries); (ii) price floors (*e.g.* $10 per ton for JI credits); (iii) trading ratios (*e.g.* 1.5:1 JI credit weighting); (iv) quantity ceilings (*e.g.* JI credits limited to 15 per cent of a countries total GHG reduction to meet its 1990 level); (v) timing limits (*e.g.* no JI crediting until after 2000); and (vi) GHG segmentation (*e.g.* JI credits in methane cannot count toward domestic reductions in CO_2).

However, two important caveats should temper this last recommendation. First, it is recognised that there will typically be *other political objectives* than just the size and allocation of transaction costs at stake in COP negotiations about JI. Fulfilling these other objectives might justify the use of any (or all) of the above-noted strategies, despite their potential negative impact on transaction costs. For example, some argue that accepting the idea of "timing limits" may be necessary in order to achieve international consensus about the need for JI in the first place.

Second, even though *reducing* transaction costs will generally be good for overall economic efficiency, it is also possible that tolerating *increasing* transaction costs, in order to achieve *greater efficiencies elsewhere*, may be appropriate. On a *net* basis, therefore, increasing transaction costs may sometimes be justified.

For example, certain institutional arrangements designed to reduce transaction costs could cause other market problems, chiefly problems of *market power*.[139] Notwithstanding the reductions in ***search costs*** that might be obtained by having a central clearinghouse or investment manager, through which all JI investments must pass, we strongly recommend *against* the creation of a centralised institution with the exclusive power to make JI investments, to post JI information, or otherwise to act as the "gatekeeper" for JI activities. Such an exclusive centralised entity would probably exercise inordinate market power, distorting both the efficiency and the equity of the JI market. A monopoly investment manager (monopsony purchaser of JI credits) would offer lower prices for JI projects to hosts, and would therefore probably invest in a lower quantity of JI abatement activities. It would accordingly be less motivated by cost-effectiveness, and would thus select suboptimal GHG abatement projects. It might also be more coercive of developing country hosts. Finally, assigning such a central fund manager role to the GEF in particular would confuse the GEF's primary function of providing financial assistance under Article 11 of the FCCC with the quite different purposes and structure of JI transactions under Article 4(2)(a), in addition to adding an unnecessary layer of bureaucracy to JI transaction decisions.

- Instead, we recommend that the COP and national governments act to foster multiple, non-exclusive, visible clearinghouses for JI information, as well as multiple, non-exclusive, entrepreneurial investment management vehicles, as the basic strategy for reducing JI ***search costs***. In addition to government-created information clearinghouses, there should be wide opportunities for private information posting services (akin to stock exchanges), and private investment management services (operated by JI investors themselves, by mutual funds, by venture capital funds, by NGOs, and so on).

Allowing a wide variety of private and public institutional options for publicising and organising JI projects will be the key to making JI work successfully. Multiplicity will contribute to both cost-effectiveness and fairness, by ensuring vigorous competition among both investors and hosts, and by assuring a ready supply of alternative partners and innovative project ideas.

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NOTES

1. Annex I lists twenty-three OECD members (excluding Mexico, Turkey, Hungary and the Czech Republic) and twelve Eastern and Central European countries (including both Hungary and the Czech Republic). In essence, therefore, Annex I identifies the industrialized nations.

2. Article 4(2)(a). Greenhouse gases (GHGs) include carbon dioxide, methane, nitrous oxide, and other trace gases. Sinks and reservoirs of GHGs include forests, tundra, and other systems that remove GHGs from the atmosphere.

3. Article 4(2)(a). In Article 3, Principles, the FCCC similarly states that "[e]fforts to address climate change may be carried out cooperatively by interested Parties."

4. Article 4(2)(d). The FCCC does not strictly require the COP to adopt criteria for joint implementation at its first meeting in March 1995, only to "take decisions" regarding such criteria. Such decisions might, among other possibilities, delegate the development of draft criteria to a subsidiary body of the COP. Criteria could also be developed over time, through "learning-by-doing".

5. We use the term "abatement" here to include both limitation of source emissions and protection or enhancement of GHG sinks.

6. See OECD (1989); Hahn and Stavins (1993); Dudek, Stewart and Wiener (1992).

7. Hahn and Hester (1989).

8. *E.g.* Dudek (1987); Grubb (1990); US Dept. of Justice (1990); Stewart and Wiener (1990, 1992); Green and Sands (1992).

9. *E.g.* Stewart and Wiener (1990); US Dept. of Justice (1991); Hanisch (1991); Norway (1991); Hanisch *et al*. (1992); Wiener (1992); Stewart and Wiener (1992).

10. Environmental currencies, like the legal tender of sovereign nations, have been created under a variety of names ranging from allowances to RTUs (RECLAIM Trading Units) to ERCs (Emission Reduction Credits). The use of the term "credit" is expository. However, it does connote the important concept of "worth".

11. If the investor is simply attaining the same level of GHG abatement that it would have at home, but at lower cost, that is still an important global benefit, because it enables those saved resources to be expended on other socially important tasks; if the world community decides that

there ought to be more GHG abatement, the quarrel would then be with the targets themselves, rather than with JI. Note that with the same target but without JI, the investor would obtain the same amount of GHG abatement at home, but at higher cost, thus reducing its resource investments in other activities, such as health care and official foreign assistance, and possibly delaying GHG abatement activities.

12. Acting as both investor and host for a single project is the definition of a domestic GHG abatement project. In that sense, domestic abatement is not the norm, but is rather a special case of general global abatement.

13. In general, marginal costs of abatement are likely to be higher in industrialized countries and lower in developing countries, but this pattern need not be true for all cases. It is plausible that attractive JI projects would occur in industrialized countries (certainly in former state-run economies such as Eastern Europe and the Former Soviet Union). It is also conceivable that some developing countries could act as investors, but this is less likely, so long as developing countries face no constraints on their GHG emissions under the FCCC. If developing countries did undertake emission targets in a revised FCCC, they would more likely benefit from investing in JI themselves.

14. Torvanger *et al*. (1994), pp. 57-58.

15. The reporting provisions of the FCCC occupy a central role in the credibility of abatement activities undertaken either domestically or internationally. See Dudek and Tietenberg (1992).

16. In addition, investments by private enterprises would avoid the confusion between JI under Article 4(2)(a) and financial assistance under Article 11 that might occur if governments or the Global Environmental Facility (GEF) attempted to perform both functions. See Jones (1994*b*), p.2.

17. Under the emissions allowance trading program used by the USA to cut SO_2 emissions by 50 per cent, NGOs are purchasing SO_2 credits to retire them and thereby hasten environmental protection. See Taylor and Kansas (1993).

18. Because the FCCC Art. 4(2)(a) speaks in terms of “parties,” NGOs seeking to purchase and retire GHG abatement credits might need to act under a framework agreement established bilaterally among FCCC parties. Alternatively, parties to the FCCC could establish national registries which would allow *any* individual to record ownership of credits. This latter approach is common to most contemporary emissions trading systems.

19. Article 3(3).

20. Barrett (1992).

21. Burniaux *et al*. (1992).

22. Industrialized countries would reduce their energy-sector CO_2 emissions 20 per cent from 1990 levels by 2010 and stabilize at that level thereafter; developing countries would be limited to 50 per cent increase in emissions from 1990 level by 2010 and would stabilize at that level thereafter. See Burniaux *et al*. (1992) p.16.

23. Barrett (1992) p.121, based on Burniaux *et al*. (1992).

24. IEA (1994).

25. See Ghosh and Puri (1994) for a flavor of these issues and discussions.

26. Recent research concerning transactions costs and institutional change in resource management underscores this point. See Howitt (1995) and Colby (1995).

27. Bohm (1994).

28. Jones (1994) and Dudek and Tietenberg (1992).

29. Different authors have used different categories to describe transaction costs. Stavins (1994) groups transaction costs into three categories: search and information costs; bargaining and decision costs; and monitoring and enforcement costs. Foster and Hahn (1994) divide transaction costs into three different categories: direct financial costs of completing a trade; costs of regulatory delay; and indirect costs associated with the uncertainty of completing a trade. McCann (1994) emphasizes the difference between search and negotiation costs, on one hand, and the risk premium paid to reduce the uncertainty of value of a commodity or right, on the other. We attempt to encompass in a useful way all of these important kinds of transaction costs in our own taxonomy.

30. In general, all market transactions require legal approval or legitimacy. In routine transactions, the terms of government approval have been incorporated into the background rules defining property rights and influencing the negotiation of the exchange. For example, sales of personal property operate in the context of legal rules for title and voluntary contract, which the parties know can be enforced in court (a government entity) if there is a dispute after the exchange has been completed (*ex post*). In some transactions government approval is mediated not by courts *ex post*, but by administrative regulatory agencies *ex ante*.

31. See Coase (1960) and Dahlman (1979).

32. See Stavins (1994) for a model of transaction costs employing this approach.

33. See Stavins (1994) for a proof.

34. An early treatment was done by Downing and Watson (1974). Empirical estimation of the role of transaction costs in market-based approaches to environmental resource issues have addressed air pollution in St. Louis, [Kohn (1991)]; air pollution in Los Angeles [Foster and Hahn (1994)]; and drinking water in Jakarta [Crane (1994)].

35. At least since Pigou (1932).

36. Permit prices and fees would only be equal under stringent assumptions concerning the cost of information about polluters' cost functions, the liquidity of the permit market, the transaction costs in that market, and the ability of the fee to be dynamically adjusted.

37. Coase (1960) first made this point. It has since been elaborated by Calabresi (1968); Coase (1988); and Stigler (1966). Calabresi summarizes: "Thus if one assumes rationality, no transaction costs, and no legal impediment to bargaining, <u>all</u> misallocations of resources would be fully cured in the market by bargains. ... transactions will ex hypothesis occur to the point where bargains can no longer improve the situation [make both parties better off]; to the point, in short, of optimal resource allocation. We can, therefore, state as an axiom the proposition that all externalities can be internalized ... except to the extent that transactions cost money or the structure itself creates some impediments to bargaining." Calabresi (1968), pp. 67-68.

38. If the *neighbors* must pay the polluter to reduce pollution, each neighbor may calculate that it will do better to let the others pay for the pollution reduction, and to share in the overall benefits while paying nothing. But as each of the neighbors will face a similar incentive to “free-ride” on a shared benefit, the total offered by the neighbors will be less than the full benefit of reduced pollution, and pollution will continue to exceed the socially desirable level. Alternatively, if the *polluter* must pay the neighbors for the entitlement to emit, some neighbors might hold out for a higher payment, thus excessively restricting pollution, and again failing to maximize social well-being. Other transaction costs would similarly cause the polluter's and neighbors' costs to diverge from the true social costs.

39. See Dahlman (1979).

40. See IPCC (1990).

41. If the risk from global warming is slight, then the magnitude of the externality and the degree of overproduction are also slight, but the principle remains that the market is distorted by the divergence between social and private costs.

42. For example, the diffusion of efficient compact fluorescent lightbulbs in Mexico may have been inhibited by the transaction costs to consumers of acquiring information about these lightbulbs. See Anderson (1993), paras. 37-40.

43. See *e.g.* Barrett (1991*b*).

44. See Jones (1994*a*), p.10. One of the first to emphasize the importance of transaction costs in the context of tradable credits for GHG abatement was Barrett (1991*a*), p.87. See also Torvanger *et al*. (1994), p.13.

45. Adapted from Torvanger, *et al*. (1994), p. 42.

46. Foster and Hahn (1994), pp. 24-25.

47. Tripp and Dudek (1989), pp. 386-388.

48. Crane (1994).

49. See Barrett (1991*a*), p.87; Barrett (1993*a*), p.10; and Wexler *et al*. (1994), p.4.

50. Some nations could require technical studies to establish the effectiveness of proposed greenhouse gas reduction projects. Private investors would also wish to have technical and

economic evaluations of feasibility prior to committing funds. In each case, the need for technical documentation is likely to determined in part by individual national program designs. Under the US Initiative for Joint Implementation (USIJI), for example, an Evaluation Panel will examine proposed projects for admission into the USIJI before credits can be recorded. However, to the extent that sovereign guarantees are provided for agreed-upon GHG reduction credits, the need for technical assessments is diminished. Nonetheless, to the extent that approvals are contested by others, approval costs could be substantial.

51. See van der Burg (1994), p.117; McCann (1994), p.16.

52. For an early discussion of these interactions, see Davis and North (1971).

53. Tattenbach, Franz, Executive Director, Fundacion para el Desarrollo de la Cordillera Volcanica Central, Moravia, Costa Rica, personal communication September 8, 1994.

54. See Dudek and Tietenberg (1992) for an overview of GHG reductions as currency in the context of permit trading.

55. See Dudek (1996).

56. World Business Council for Sustainable Development (1996).

57. This issue arises largely in the context of national GHG responsibilities framed in terms of policies and measures. If national commitments are established as quantitative emission limitation and reduction objectives (QELROs), then domestic projects not involved in JI transactions would not need to be separately monitored, since monitoring would focus on national emissions. Negotiation concerning the development of a Protocol to the FCCC, framed either as policies and measures or QELROs, is presently occurring.

58. Early reduction programs for toxic air emissions were offered to industries in the USA under Title V of the Clean Air Act. The US EPA has been operating a voluntary energy efficiency program called “Green Lights”, which uses a standard contract with industry.

59. Colby, *et al.* (1989) and MacDonnell (1990).

60. MacDonnell (1990), p. 54.

61. Demonstration projects to test the flexibility of legal, regulatory and administrative procedures have characterized the pioneering efforts in states without established trading precedents.

62. McDowell and Ugone (1982); Rosen and Sexton (1993); Smith (1992); Thompson (1993).

63. Coppock and Kreith (1992).

64. The asking price by the Water Bank was $175 per acre-foot, in contrast to recent private prices ranging from $30 to $50 per acre-foot. See Lund *et al.* (1992) and McCann (1994).

65. Jones and Stokes Associates (1991); Lund *et al.* (1992).

66. Lund *et al.* (1992).

67. Dixon *et al.* (1993); Howitt (1993).

68. The loss of sales for a hardware store due to a new competitor locating around the block is an example of a pecuniary externality. Pecuniary externalities differ importantly from physical externalities, in that they are an essential by-product of a market-based economy which relies on relative prices to guide investment, production, and consumption choices.

69. See Stavins (1983) for a complete description of this project.

70. Transferable rights programs have been developed more broadly. For example, the number of taxicabs in New York City are fixed and regulated through a system of transferable medallions. Agricultural quotas, particularly those controlling production, have frequently been transferable. Tripp and Dudek (1989) provide an overview of a variety of existing transferable rights programs.

71. Dudek and Palmisano (1988).

72. Hahn and Hester (1989).

73. Hahn (1989); Dudek and Palmisano (1988).

74. California Air Resources Board (1994).

75. Margolis (1995).

76. See Foster and Hahn (1994), p. 18. The community bank provides credits based on the volume requested, rather than on a price, so part of the dramatic increase in the number of transactions may be independent of the decrease in transaction costs. However, the purchase price is likely to be a small part of the cost (compared to transaction costs) for small-volume trades, so the reduction in transaction costs is the likely predominant cause of the surge in transactions.

77. US EPA (1991), p. 63042.

78. Some 110 individual sources named in Phase I of the program are required to produce SO_2 reductions, beginning at the end of 1995. Despite the fact that compliance remains nearly a year away, significant transactions have already occurred. One broker estimates that over 2.4 million tons have been exchanged in arms-length transactions, and that over 12.5 million tons have been transferred on the allowance tracking system [(Emissions Exchange Corporation, 1994)].

79. US General Accounting Office (1994), p. 26. Cumulatively, over the first phase interval from 1995-2000, over-control is expected to approach 6 million tons.

80. US EPA (1993).

81. "Nonattainment" is a term used to describe regions, typically metropolitan areas, whose ambient air quality levels exceed those established as the legal minimum by the Clean Air Act.

Exceedances may be in one or several criteria pollutants. Typically, nonattainment refers to ozone and the precursors NOx and VOCs.

82. South Coast Air Quality Management District, Draft "RECLAIM Executive Summary", March 8, 1993, Los Angeles, California.

83. The SCAQMD has been conducting a design process for VOC trading in the basin. The district expected to have the program completed by July of 1995.

84. LaGanga, Maria (1993). "Emissions Trading Plan is Slow to Get Into the Air", *Los Angeles Times,* May 27.

85. It is not clear that price volatility in the absence of a link to sunset provisions is an *a priori* problem which markets and their intermediaries are not otherwise equipped to handle. In fact, in the absence of volatility, some market instruments or derivatives do not emerge.

86. Carlson, Dale *et al.* (1993). "An Analysis of the Information and Reporting Requirements, Market Architectures, Operational and Regulatory Issues, and Derivative Instruments for RECLAIM". Report submitted to South Coast Air Quality Management District (Contract No. R-C93074), July 6, 84 pp.

87 Price-spiking has been a concern expressed with most trading systems. There have been a variety of strategies proposed to deal with what appears to be largely an a priori theoretical concern. In the acid rain trading program, a backstop price of $1500 per ton of SO_2 was established.

88. Banking, particularly of the form contemplated in the Illinois NOx trading design, couples the environmental protections of a one year credit life with contemporaneous use or "deep discounting" on peak ozone days, with fiscally prudent management of the banked inventory to maximize the incentives for market development.

89. Margolis (1995).

90. Cantor Fitzgerald *et al*. (1994).

91. Cantor Fitzgerald *et al*. (1994).

92. Personal communication with Joshua D. Margolis, Air Trade Services, Dames & Moore, San Francisco, CA, 25 November 25 1994.

93. If an RTC is unsold, it reverts back to the seller with another $50 registration fee.

94. Carlson and Sholtz (1994).

95. The principal sources of information here were Charles Feinstein, global warming specialist, GEF and Mr. Rachid Benmessaoud, task manager for the project, World Bank.

96. The cost of sponsoring the international workshop should be spread between this and similar projects that the GEF will fund in the future, since all of these projects will benefit from the

conference. If all of the costs of the conference are *not* borne solely by the CTG project, then the associated transaction costs would decline proportionally.

97. Information about this project has been acquired through Dr. Russell Sturm (IIEC) and World Bank Report No. 12448-ME.

98. Bradley Spooner and Tom Sullivan, NEES (personal communication), November 1994.

99. The information about transaction costs presented in this section is based on a telephone conversation with Mary Bittle Koenick (CCAP) on 10 November 1994, and on the comments of Ned Helme, Executive Director (CCAP) at the Carbon Offsets Forum, Washington, D.C. on the 14th of November.

100. Information in this section is based upon interviews with Richard Adcock, Econergy on 18th November, and with Richard Renner, Econergy on 28th November 1994.

101. Project participants include Econergy International Corporation, Duke Power Engineering and Services, Lockheed Environmental Systems and Technologies Co., Niagara-Mohawk Power Corporation, Los Alamos National Laboratory, Oak Ridge National Laboratory, Environmental Defense Fund, Utility Biomass Energy Commercialization Association, Winrock International, TransAlta Utilities Corporation, and the Tata Energy Research Institute.

102. Information on this project is based on an interview with Paul Faeth (WRI) on 16th November, and conversations with Sheryl Sturges (28th November) and Kevin Peirce (8th December), both of AES.

103. It is interesting to note that all of these proposals were submitted in response to knowledge of AES's interest among the informal NGO network. No formal solicitation of projects was issued.

104. Information concerning this project was supplied by Alan Randall of The Nature Conservancy.

105. Useful surveys of potential criteria are provided by Jones (1993) and Kuik *et al*. (1994). Preliminary discussions of potential institutions to deal with transaction costs are provided by those sources and by Torvanger *et al*. (1994) and Wexler *et al*. (1994).

106. In addition to minimizing search costs, information about more potential partners will invigorate competition in JI markets, both among potential investors and potential hosts, and thereby help ensure that transactions maximize net benefits both to the parties involved and to the global community.

107. See Hanisch (1992); Hanisch (1991); van der Burg (1994) p.119; Heintz *et al*. (1994) p.173.

108. See Wexler *et al*. (1994), pp. 7-8.

109. Torvanger *et al*. (1994), p.7.

110. See Foster and Hahn (1994).

111. *E.g.* Hanisch (1991).

112. See Torvanger *et al*. (1994), pp. 7-8, for a description of such "regional regimes."

113. Torvanger *et al*. (1994), p.9, appear to agree.

114. See Torvanger *et al*. (1994), pp. 62-63.

115. See Tripp and Dudek (1989).

116. If Parties have obligations stated in terms of *policies and measures* to be undertaken to reduce greenhouse gas emissions, then there is a problem of establishing the efficacy of control investments. Furthermore, if we consider the problem faced by individual firms required to meet reduction responsibilities, the problem of establishing the actual abatement from control investments is *not* limited to JI projects.

117. Sedjo (1994).

118. See *e.g.* Bradley *et al*. (1991), pp. II-10.7-10.8; Burniaux *et al*. (1992), p.15; Reinsch and Considine (1992); Rutherford (1992).

119. See Jones (1994), p.7.

120. See Anderson (1993).

121. Similarly although less precisely, Arts *et al*. (1994) recommend giving the "benefit of the doubt" to reporting countries when evaluating estimates of JI projects.

122. Furthermore, because the provision of these valued resources to the host by the investor, in return for the GHG credits, will make the host better off (wealthier) in the future, the marginal cost of GHG abatement in terms of social resources foregone may well be lower for the host in the future.

123. See Parikh (1993), p.6.

124. This assumes that the FCCC continues to impose targets based on total national emissions ceilings (*e.g.* 1990 level by 2000). If the FCCC imposed a percentage reduction target, the cost of control might not be correlated with the magnitude of historical emissions.

125. See Metz (1993), pp. 10-11; Parikh (1993), pp. 12-13; Merkus (1992).

126. See *e.g.* Germany (1994), pp. 6-7. The idea is criticized in Jones (1993), p.9.

127. For a formal proof, see Hahn (1990).

128. See Arts *et al*. (1994), pp. 48, 67; Heintz *et al*. (1994), p.170; Metz (1993), p.10.

129. See Arts *et al*. (1994), pp. 48-49.

130. See *e.g.* Arts *et al*. (1994), p.48.

131. See Parikh (1993), p.4.

132. See *e.g.* Germany (1994), pp. 13-14.

133. Stewart and Wiener (1992); Stewart and Wiener (1990).

134. Jones (1993), p.6; Barrett (1993b), pp. 27-28.

135. Wiener (1994).

136. Calabresi and Melamed (1972).

137. On “pooled funding,” see *e.g.* Jones (1993), p.13; Barrett (1993*b*), pp.26-27; Anderson (1993), para. 59; Torvanger *et al*. (1994) p.41; Wexler *et al*. (1994) pp. 11-15. Wexler *et al*. describe "packaging" or "syndication" of JI projects by the GEF, the IFC, and private or NGO enterprises, and conclude that such a packaging function should be open to multiple types of organizing entities.

138. *E.g.* Jones (1993); Kuik, *et al*. (1994); Germany (1993).

139. Market power by international investment managers is particularly worrisome because there is no "competition policy" or antitrust law for international markets. See Scherer (1994); Economist (1994).