

**Principles for the Design of Compliance Institutions for International  
Tradeable Permit Markets:  
Joint Implementation of the  
Framework Convention on Climate Change**

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*This paper considers the design of a compliance system for a tradeable permit market as an informal mechanism design problem in an international situation with limited information, and weak enforcement. We specifically consider the embryonic tradeable permit market associated with the 1992 UN Framework Convention on Climate Change (FCCC). We outline the practical constraints on the compliance system for this market in terms of information flows, incentives and capacities. Then we use a heuristic contracting model to apply results from contract theory, and find the important elements of an effective system. We conclude that clear definition ex ante of compliance, in terms of verifiable outcomes, is critical to effective monitoring and enforcement. The best way to define compliance will depend on a tradeoff between efficiency, risk and transaction costs, and may vary among different types of project. We also conclude that the buyer country, which is a developed country, should be held solely liable for compliance ex post. This is because of its advantageous position as a monitor and enforcer for the global community in a given project.*

# 1 Introduction

This paper takes an economist's perspective on the design of effective compliance institutions for international tradeable permit markets. It builds on the insights and empirical evidence of recent political science literature<sup>1</sup>. It combines this with a more formal model of compliance drawn from economics. It develops four general principles for compliance institutions. It applies these principles to the design of Joint Implementation of the Framework Convention on Climate Change.

We have conclusions on two aspects of compliance within Joint Implementation; the specific definition of compliance for individual permit-generating projects; and which country the international community should hold responsible for achieving compliance. We propose that pre-certification, which is the process of defining compliance for a specific project, be limited to two aspects. The first is the definition of the baseline. The baseline is the level of emissions which would be obtained in the absence of the project. This is the level against which all achievements will be measured<sup>2</sup>. In a real tradeable permit market this would be the permit allocation. The second is the definition of the methodology for calculating carbon permits given ex post observable<sup>3</sup> and verifiable outcomes.

We propose that accountability (formal responsibility) for the outcomes of Joint Implementation projects be simplified and clearly defined. This would avoid over-assessment and reduce the ambiguity, and hence lack of clear incentives and enforceability, which arise from multiple lines of accountability. We propose that the "buyer" country government bear full responsibility for the actual production of permits<sup>4</sup>. The buyer country and domestic or international non-governmental organizations (NGOs) or private companies could enforce the compliance of buyer companies through domestic law. In turn the buyer company can use a

legally binding contract with the “seller” company to ensure that the permits are created<sup>5</sup>. This would not preclude indirect enforcement pressure on the seller government and company but the primary liability would lie with the buyer government and could not be avoided<sup>6</sup>. This conclusion contrasts with existing proposals for monitoring and certification where seller or joint responsibility is assumed<sup>7</sup>.

The science on Global Climate Change is becoming more certain, with the most recent Intergovernmental Panel on Climate Change (IPCC) report cautiously stating that human activities have influenced the world’s climate<sup>8</sup>. However our knowledge of how to design regulation is lagging. Although a large group of developed countries committed themselves to the goal of reducing carbon dioxide emissions to 1990 levels by the year 2000, as that year approaches, few countries appear to be likely to achieve this goal<sup>9</sup>. We have limited knowledge of, or experience with regulating environmental problems on this scale effectively and cost efficiently.

One promising area in which limited gains have been achieved is “Joint Implementation”<sup>10</sup>. Article 4.2a of the Framework Convention on Climate Change states that “These Parties [developed countries which have agreed to commitments] may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention...”. Joint Implementation involves a developed country company such as a United States Electric Utility investing in an energy efficiency project or carbon sequestration<sup>11</sup> project, which would not otherwise have occurred, in a developing country which is a party to the Convention<sup>12</sup>. After the Pilot Phase of Joint Implementation, the utility may be able to claim the “carbon permits” created by the project, to use against their domestic obligations<sup>13</sup>. The “permits” are the difference in net carbon

emissions between “baseline” emissions (i.e. what would have happened without the project), and emissions when the project is carried out<sup>14</sup>.

The advantage of Joint Implementation is that very low cost emissions reductions can be achieved<sup>15</sup>. Joint Implementation can be regarded as an embryonic tradeable permit system. In a fully defined tradeable permit system, a total level of global emissions would be set for each period<sup>16</sup>. Each country would be allocated a share of this total in the form of emission permits (carbon permits) which would sum to the total level. Carbon dioxide is what is called a “uniformly mixed” pollutant which means that the location of emissions does not matter. Countries which have low costs of reducing emissions below their allocated level could sell some of these permits. Countries which face high costs of controlling emissions to their allocated level or would like to exceed it could buy permits. Thus compliance is directly facilitated by lowering compliance costs. There is no environmental effect from trading as long as there is adequate enforcement to ensure that emissions only occur when there are permits to match.

If, as appears likely, global climate change becomes a more important issue internationally<sup>17</sup>, there could be pressure to develop a full tradeable permit system. This could arise partly because of the disjunction between those countries which can and are willing to bear the costs of abatement, and those which have low cost abatement opportunities. The countries which are most concerned, and are able to contribute resources to address the problem, are mostly developed countries. There are many abatement opportunities in developed countries. However because developing countries are rapidly creating and changing their capital stock, the marginal cost of changing it to more environmentally friendly technology is relatively low compared to the cost of making existing equipment, infrastructure and institutions prematurely

obsolete. Therefore, if resources can be effectively transferred to developing countries, low cost abatement opportunities will be realized. Developing countries are more likely to comply with an agreement if they regard it as equitable and voluntarily participate than if they are forced<sup>18</sup>. If a full tradeable permit market develops out of Joint Implementation, it is critical that we design the institutions which support it carefully.<sup>19</sup> These institutions will heavily influence the later structure of the market, and its effectiveness in controlling carbon emissions by generating real behavioral changes.

There are two possible types of mechanism for transferring resources to developing countries. Resources can be transferred directly from one country to another (tradeable permit approach), or money can be contributed by developed countries to a fund and then transferred to developing countries by the fund administrators. Tradeable permits have significant efficiency, and in the long run, robustness advantages over fund systems.<sup>20</sup> If Joint Implementation is considered to be effective, it is more likely that tradeable permits will be the instrument of choice for dealing with the need to transfer resources and technology, rather than traditional and frequently costly and ineffective “aid” channels.<sup>21</sup>

There are two fundamental institutional issues we need to deal with to make Joint Implementation or an international tradeable permit system for carbon permits work in a way which is acceptable to all parties. One issue is ensuring compliance, i.e. that the permits created and traded come from real reductions in carbon dioxide emissions or increases in sequestration<sup>22</sup>. The second is ensuring that trade is carried out fairly so that all parties benefit from the institution. Here we deal with the compliance issue. The question of compliance in international markets shares many features with domestic enforcement but has a critical difference. Because of national sovereignty it is impossible to create an acceptable international agency with

sufficient power to monitor and enforce; i.e. an agency equivalent to the US Environmental Protection Agency combined with the US legal system. Thus we need to be more creative, using such international law and treaty enforcement instruments as exist, combined with domestic information and capabilities to maximize the level of compliance.

The international community is concerned about compliance for three main reasons. The first is that we want to achieve the short term overall objectives of the Framework Convention. Second, we are concerned about fairness in the implementation of the Convention. If some countries are able to avoid their obligations this is not fair to those who comply. Third, in the medium to long term, if many people cheat or are perceived to cheat it will be harder to maintain and build cooperation<sup>23</sup>. However compliance is not the only objective of international agreements. Sometimes there will be a tradeoff with sovereignty, with costs of administration or with the risk that countries face. These can be regarded as constraints or additional goals<sup>24</sup>.

The compliance problem we are concerned with is compliance within the tradeable permit market. This problem is embedded in a wider problem of compliance with the international agreement the market is used to implement.<sup>25</sup> The tradeable permit market is simply a tool to implement the international agreement more effectively. It cannot improve the relationship between the goal chosen and the actual solution to the environmental problem.<sup>26</sup> A tradeable permit market can improve compliance or goal achievement by reducing the costs of compliance<sup>27</sup>. However it can also threaten compliance, by making behavior less transparent and hence perceived compliance more manipulable. A poorly designed market can also put the ultimate responsibility for compliance in the hands of actors with less concern and capacity. A well designed market will maximize the cost saving while ensuring that the required behavioral changes occur to achieve the goals of the agreement.

Poor compliance within the market can weaken compliance with the agreement as a whole. For example suppose a developed country colludes with a developing country and claims non-existent carbon permits. This not only lowers the value of permits, but also allows the developed country to reduce its domestic abatement effort. A high level of compliance by at least some actors in the market directly implies a certain level of compliance with the agreement. It will also lead to improved monitoring techniques, and to incentives for complying firms to ensure that Joint Implementation projects and other carbon abatement programs are valid and not used by other firms or countries to gain competitive advantage<sup>28</sup>. Thus the two compliance problems are inter-related.

This paper draws on several literatures, the economics literature on crime and enforcement and contract/mechanism design, and the political science and legal literature on compliance. In the economics literature, Becker (1968)<sup>29</sup> formalized the analysis of optimal monitoring and punishment recognizing that non-compliance is a rationally chosen action. An agent will comply if the probability of being caught times the fine is greater than the value of non-compliance. Becker's analysis is in a domestic setting where the government has centralized power to enforce. Fines and probabilities of punishment can be directly chosen relatively easily though sometimes with high cost<sup>30</sup>. His analysis is also considering individual compliance rather than country level compliance so he can ignore collective action problems.

Taking a different but complementary approach, the economic literature on contracts<sup>31</sup> starting with Coase (1937) considers how to write contracts and structure institutions when there are information problems and transaction costs. Compliance problems arise in contracts when either, actions (compliance) are not fully observable, or when they are non-verifiable, so that they cannot be used as evidence in a court of law. Thus formal law enforcement will be weak.

The inability to perfectly observe actions, or the appropriateness of actions, and/or the inability to act on the information received (e.g., due to sovereignty concerns) leads to the problem of moral hazard<sup>32</sup>. Compliance problems also arise when payments and punishments are limited. If the agreement is too ambitious it may not be possible to write a contract which will achieve its goals.

The model of compliance which comes from the contract literature has the following characteristics. Compliance effort is encouraged by making positive transfers dependent on observable outcomes which are related to compliance effort<sup>33</sup>. In contrast to Becker, the rewards are a continuous function of observed compliance which allows for the reality of partial compliance. Also, given that compliance is rewarded based on observable outcomes not effort, agents may put in optimal effort and carry out the best actions possible, but fail to produce the required outcome due to forces beyond their control. In these models the random elements of observed outcomes and hence rewards and punishments are accounted for explicitly. Participation in contracts is voluntary and this constraint is built into the model. This means that each agent must at least in expectation receive a positive benefit from being involved in the contract, whether it be the agreement as a whole or a specific joint implementation trade. These attributes of the contracting model are appropriate to modeling international compliance.

Petrakis and Xepapedeas (1996) consider the problem of compliance as a formal mechanism design problem. They look at a situation where there are transfers to less environmentally conscious countries and individual country emissions are unobservable. However they assume that total emissions are observable and base their complex mechanism on this. In problems such as climate change or ozone depletion, it is only possible to observe total emissions through the sum of individual emissions. The relationship between emissions and

ambient levels is very uncertain and involves lags of emissions and natural sources as well as anthropogenic emissions. Their model would be more appropriate to a problem such as sulfur dioxide in Europe where pollutant movements are better understood and ambient levels are more directly related to local and neighboring emissions.

The law and economics literature also deals extensively with similar problems. Calabresi (1970) develops a theory of accident law and appropriate liability structures. This was further developed by Brown(1973), Diamond(1974a, 1974b), Diamond and Mirrlees(1975) and Green(1976). This literature is dealing with a different and clearer set of institutional constraints to those in an international cooperation problem, but uses a similar microeconomic foundation to that used here.

There is a long literature in political science and international law on why countries comply with treaties.<sup>34</sup> Some of this literature is also relevant to compliance with an international tradeable permit market. The traditional “common wisdom” approach to compliance in political science comes from a theory of deterrence.<sup>35</sup> The aim of a deterrence based strategy is to raise the costs of non-compliance by creating a severe, credible threat of punishment (Schelling (1960)). This is equivalent to Becker’s approach. These models tend to assume that actors are rational utility maximizers and can effectively control their actions.<sup>36</sup>

In contrast Chayes and Chayes (1993) discuss compliance with international law and argue persuasively that compliance is achieved through positive inducements and assistance rather than deterrence and punishment. The political science literature in general stresses the capacity of agents to comply, and of governments to enforce compliance.<sup>37</sup> A lack of capacity to comply exacerbates the problem of moral hazard, because it is difficult to observe true effort in a case where the ability to control outcomes is limited. The political science emphasis on

capacity leads to similar conclusions to the contracting model where the optimal compliance system not only involves choosing appropriate rewards and punishments but altering the contract to deal with varying capabilities. One major strand of work<sup>38</sup> emphasizes three elements of success in international environmental institutions, concern, contracting and capacity. This work takes different levels of concern as institutional constraints. It looks at how tradeable permit markets can alter contracting conditions, for better and worse, and give greater flexibility in the use of existing capacity.

Recent political science literature has begun to explore the effects of institutional design on compliance. Compliance is modeled as a rational action but one which is constrained by capacity, information and incentives. For example Mitchell (1994) argues that in some cases, prevention of non-compliance is more effective than ex post monitoring and reward or punishment. He also shows that sometimes institutional change can increase the capacity of agents to legally enforce compliance of others as well as their incentives to enforce.

This paper continues this institutional approach. We attempt to synthesize these economic, legal and political science ideas and apply them to the particular agents, characteristics of projects, and institutions involved in Joint Implementation. This paper considers the compliance problem as an informal mechanism design problem<sup>39</sup>. First we outline the actors, interests, capabilities and information flows inherent in the Joint Implementation situation when trades are between developed and developing countries. These are regarded as exogenous<sup>40</sup>. Second we draw on economic theory and experience of regulation, both of the environment and in general, to provide guidelines for the design of a new institution. We conclude the paper with a proposed structure for compliance with Joint Implementation of the Framework Convention on Climate Change.<sup>41</sup>

## 2. Definition of Actors, their Interests, Information and Capabilities

### ACTORS AND INTERESTS

There are three main actors in any Joint Implementation project, the principal which is the international community as a whole, and the two agents, the buyer and seller countries<sup>42</sup>.

#### *International Community*

The international community is concerned about the output of the project directly. It creates the institutions overseeing projects. All countries are involved in this “actor”, to the extent that they are concerned about climate change. Climate stability is a public good. Countries as a group want to be able to cooperate to achieve more reductions and environmental protection. Each country is willing to take on some obligations if others do as well and the costs are fairly shared<sup>43</sup>. Legally the Subsidiary Body on Implementation and the Conference of Parties as a whole will probably represent this “actor” in the short term (INC (1994))<sup>44</sup>. Non-governmental organizations<sup>45</sup> and scientific communities<sup>46</sup> may also play the role of this actor.

Regarding the international community as a unitary actor is an unusual assumption in international politics. I do not claim that countries act in a unified way. Rather, I wish to analyze how countries would best design institutions if they were able to cooperate and maximize their joint interests. This both yields normative conclusions for design, and suggests a benchmark against which actual institutions may be compared. The comparison may give insights into the sources of failure of cooperation, and the effects of the power structure on cooperative agreements.

The international community maximizes expected global benefits from abatement of greenhouse gases, net of the costs to the community of implementing the abatement. The global benefits from additional compliance through Joint Implementation, are the marginal value of additional climate stability. Equivalently they are the reduction in marginal cost of abatement elsewhere<sup>47</sup>. Because each individual abatement project is a small contribution to the global abatement effort, the international community can be regarded as locally risk neutral.

To induce abatement the international community must provide rewards or punishments to the agents. Providing rewards and punishments is costly. They must be sufficient to induce participation in the global agreement. It must collect sufficient monitoring information to allow it to apply the rewards/punishments. The information allows the rewards to be contingent on abatement so that after the agreement is signed, agents choose to follow through on their commitments. An improved level of information allows more accurate relationships between effort and observed compliance. It reduces the conditional variance in rewards and punishments. This means there are less opportunities to cheat. There is also a lower risk of not receiving a reward when the agent has put in optimal effort (or conversely being punished when not guilty). The cost of improving information is high and convex.

The international community cannot completely control the rewards and punishments countries and companies receive. For example, the reward to a company which protects some rainforest largely comes from consumers' responses to their perception of the action. Consumers, NGOs etc. do not always respond in the ways that the international community would find most effective in encouraging compliance. For example, the Brazilian government is frequently held responsible by the public for deforestation. However, it is unclear that they are the cause of deforestation, or that they have the ability to create a solution to the problem. The

international community may be able to influence the direction of public pressure. They could more clearly identify appropriate formal responsibilities for actors, and provide evidence of deliberate non-compliance. The major question addressed in this paper is how these responsibilities should be defined and who should be held responsible.

### *Seller*

The second actor is the seller of carbon permits or the “host” country. This is a less developed country which is a party to the Convention<sup>48</sup>. The country wants to get the best possible return from the use of its resources. Carbon permits are one possible product which companies and the country as a whole can create to trade. The seller country is concerned about the alternative uses of land or capital, the effects of current behavior on future baselines for the international treaty, and their future access to the use of their own resources. They are also concerned about the external benefits from trade. These include transfer of technology and skills, and access to capital. We assume that they are a small player internationally, and have no direct concern about the global benefits created by the project. The seller receives a permit payment, and a reward from the international community. Both of these are partly contingent on their compliance effort. Because they are risk averse, they prefer that they receive rewards which are closely related to effort. The costs they bear are the actual costs of implementation, planting trees, monitoring reserves, buying land etc. In addition they pay a share of the transaction costs of creating and implementing the project. Basically they would like to create permits as cheaply (in the broadest sense of the word, i.e. including all costs and side benefits) as possible and sell them at the highest price possible. They will maximize their own benefits subject to the constraints of the compliance system.

Any NGO or company within the seller country which is able to create permits for sale is also part of the “seller”. However, companies or NGOs will frequently have different interests from the country as a whole when domestic regulation is inadequate<sup>49</sup>. For example, an electricity company may want to build a hydro-power plant which will have climate change benefits. However the dam may impose large costs on the surrounding area through flooding, and loss of eco-tourism possibilities such as white water rafting. A country with inadequate regulation of development may not be able to ensure that the company makes the appropriate decisions for the country as a whole<sup>50</sup>. Current rules for the pilot phase require national government approval for all Joint Implementation projects<sup>51</sup>.

### *Buyer*

The third actor is the buyer of the rights. This is a developed country signatory, such as the US with obligations under the treaty. The buyers want to minimize their costs of compliance with the treaty, and to broaden their opportunities for future compliance. They may also be interested in external benefits of compliance and trade. These include positive publicity which helps with marketing, and access to new markets<sup>52</sup>. Fundamentally they want to buy permits as cheaply as possible subject to the constraints of the compliance system.

The buyer country can be represented by private companies and NGOs. With appropriate domestic regulation, the companies’ interests are very closely aligned to the government’s interests<sup>53</sup>. Some buyers are motivated by environmental concern, for example the Nature Conservancy or Conservation International. These buyers are directly concerned with ensuring compliance. These actors have been major pioneers in the early part of the market but are likely to be less important as the market grows relative to their available capital.

The benefits of participation in a trade are the value of the permits and any external benefits. The costs include the payment for the permits as well as any direct costs of investment, technology transfer etc. The costs also include the costs of any permit payments or other rewards and punishments used to induce optimal effort by the seller. The reward/punishment from the international community includes the permit value, to the extent that permits are only allocated contingent on performance, as well as any other issue linkage etc. used to induce buyer behavior.

The buyer's utility function will tend to be less risk-averse than the seller's. Revealed risk aversion depends on underlying risk preferences, ability to protect against or pool risk over a number of projects, and on the other risks agents are currently bearing. Ability to protect against risk depends on access to insurance markets. These are better developed in developed countries. A buyer company may be able to pool independent country specific risk over a range of countries where a seller is not able to. Buyer companies, at least in this stage of the market, tend to be larger, frequently multinational companies with large portfolios. They are therefore closer to risk neutral.

#### *Incentives for non-compliance*

The seller and buyer are the agents in the contract. As individual countries they are not directly concerned about the small effect that one instance of non-compliance will have on the treaty, and hence global climate change, as a whole<sup>54</sup>. They will want to be free-riders. If they are not effectively monitored, and encouraged to comply through the rewards and punishments, they have incentives to collude to non-comply and not produce as many permits as they state.<sup>55</sup> This non-compliance lowers the cost of permits and creates a gain they can share.

For example, suppose that a permit market has been created. Property rights have been allocated by formalizing, the current developed country commitments, and developing country rights to continue the development path which would have happened in the absence of an international agreement. The United States has committed to these targets because it wants other countries to also commit to a global agreement. The US is concerned about climate change. However, controlling CO<sub>2</sub> is costly and for a given level of emission reductions, the US would always rather the cost was borne by other countries such as those in the European Community. Because global climate stability is a public good, the US always has some incentive to free-ride. If the US was able to avoid its responsibilities without being observed and at no cost, it would want to partially do so.

Suppose the US implements its commitment by creating a domestic tradeable permit market. A permit is required for every unit of fossil fuel at the point of first sale in the US. The total permits allocated in the US add up to the commitment  $T = 1990$  US emission levels. Suppose an oil company has  $t$  permits but wishes to produce more than  $t$  units of oil. It can gain additional permits either by purchasing them from other permit holders domestically, or by utilizing Joint Implementation and investing in a reforestation project in Costa Rica. The oil company is not directly concerned with the success of the reforestation project. The vast majority of the climate change benefits which are generated go to other citizens of the globe. They are concerned to the extent that they are held responsible for matching fossil fuel production to domestically valid permits by their own government. Similarly, the US is not directly concerned with the validity of the permits created in Costa Rica. It is only concerned because of the international pressure to conform with the agreement. If there is no enforcement

to ensure that the permits relate to real ongoing reforestation, neither the oil company, nor the US lose a great deal from a failure in the reforestation project once the permits have been obtained.

If international and hence domestic enforcement pressure is weak, the oil company may propose to a land holder in Costa Rica that the landholder pretend<sup>56</sup> to carry out a reforestation project, and provide the “permits” created to the oil company. If there is no enforcement the landholder makes a profit by selling permits which it was almost costless to create. The oil company makes a profit by getting permits more cheaply than would be possible in a real reforestation project. If US domestic enforcement is stronger than enforcement of permits from Joint Implementation, real abatement in the US will be replaced by false abatement in Costa Rica. Trading will lead to higher overall emissions.

In contrast, suppose that the overall agreement is strongly enforced. The US will feel required to comply strictly. Suppose that the US is held responsible, not only for control within the US but for permits created for sale to the US in other countries. Then they will have a strong indirect incentive to monitor and enforce projects such as the reforestation project. The company will feel strong pressure from domestic regulation to ensure the validity of the permits they are buying.

In contrast, in a conventional market if the seller (buyer) does not comply with the contract the buyer (seller) loses directly. For example, if an electric utility makes a contract with a coal supplier and the coal is not delivered, the electric utility is hurt. This gives the buyer and seller direct incentives to monitor each other and ensure compliance even in the absence of an effective legal system. They have incentives to design the contract to give them adequate access to information so they can monitor and so it is largely enforceable without recourse to the court system. The overall high level of compliance with contracts is primarily due to these informal

pressures, backed up by domestic law. Governments do not primarily enforce laws. Individuals enforce laws, with the assistance of legal structures. To improve compliance with Joint Implementation we need to bring the agents' interests in line with those of the principal by changing their incentives to mimic those in a private market<sup>57</sup>.

## **INFORMATION AND COMPLIANCE CAPABILITY**

Now that we understand the incentives and objectives of the actors we need to understand the constraints on their information and capabilities. There are two basic types of information they have access to, and two approaches to inducing compliance. Non-verifiable information can be responded to through assistance and informal pressure. Legal/official enforcement pressure can only be used in response to verifiable information.

### *Non-verifiable Information and Informal Influence*

Non-verifiable information is information which cannot be proven. Therefore it cannot be used for formal domestic or international enforcement, or strong pressure by NGOs through the media. Although international compliance disputes rarely go to a formal court, the arguments which determine how they are dealt with are most strongly supported if the information on which they are based is unambiguous and available to all parties.

Most information which is available is non-verifiable, or can only be made verifiable at high cost. The major flows of non-verifiable information are between the seller and the buyer. This is information both receive during the process of designing and implementing the projects and observing each other's actions. Thus the costs of mutual monitoring between buyer and seller are relatively low.<sup>58</sup> They are able to use this information to enforce the contract through

their close ongoing relationship, even if it cannot be used in formally enforcing the written contract through domestic law.

For example, in one Joint Implementation project, Nations Energy Corporation (NEC), a wholly owned affiliate of Tucson Electric Power Company is working with Biomasa-Generación, a Honduran Company created for the project. They aim to generate electric power from wood-waste, for sale to Empresa Nacional de Energía Eléctrica (ENEE)<sup>59</sup>. NEC may be able to observe Biomasa-Generación's level of attention to installing and maintaining the efficiency of their technology, and to making appropriate daily decisions to ensure stable fuel supplies. However if they observe subtle signals of a low level of effort, they will not be able to prove it in court. Even if they could prove it, going to court is very expensive and therefore inefficient for addressing small variations in the carrying out of a contract. However, they can respond informally to this information. If NEC observes low levels of equipment maintenance by Biomasa-Generación they may be able to use this information to tell that contract breaches have or will occur. The equipment is likely to break down. Then they will not produce as much carbon saving as anticipated. NEC can act to punish or prevent such breaches.

Buyers have the capacity to punish because they can withhold payments, or not renew contracts. In many situations the buyer has greater ability to control compliance than the seller. If the problem is due to lack of capacity in the seller, the buyer can help to solve the problem to their mutual benefit. For example they could provide technology, technical training, or additional capital. The buyer is able to choose which seller to write contracts with. They will tend to choose partners who are interested in creating or maintaining a good commercial relationship, and over whom they can exert informal influence. Similarly sellers can choose to contract with buyers whom they trust or feel able to control.

National governments also receive non-verifiable information from companies and NGOs within their country, though this will be weaker. They receive information which is not directed at JI enforcement but which may be relevant. For example, because of the economic importance of energy there are extensive tracking and reporting systems in place in most countries. Information reported for tax reasons or volunteered during negotiations with the government over regulation, may also be relevant. They cannot always respond to this information formally but have the ability to use informal pressure on their own citizens. In developed countries, companies' concern about how the government will treat them in the regulatory process, and domestic NGO pressure provide strong informal forces for high levels of compliance.

In many developing countries the government has less power over companies<sup>60</sup>. Developing country government agencies are frequently lacking some form of capacity necessary to enable and enforce compliance. In the Indian Civil Service the constraint is financing<sup>61</sup>, while in many countries the constraint is educated and trained personnel. The World Bank has found that the most common obstacles to successful implementation of projects are “managerial” or “institutional”<sup>62</sup>. NGOs tend to be less well developed because of their poorer and often smaller group of supporters. This is partly ameliorated by transfers of resources by international NGOs to support local NGO activity<sup>63</sup>.

International NGOs and private companies often receive non-verifiable information about the actions of other companies and projects. They are unable to use this information directly, but they can pass it on to the international agency or national government and suggest when it may be worth seeking verifiable information.

Non-verifiable information is extremely useful but cannot be used as the basis of formal accountability. We need to design accountability to encourage those with good non-verifiable

information to use their informal influence. In particular, buyer companies have good information and a significant amount of influence over project implementation so they should be induced to use this effectively. Buyer governments have reasonable access to information about their own companies, and can influence their behavior. Seller governments and companies may have good information. However in many cases they do not have such a strong influence on project management.

### *Verifiable Information and Legal Enforcement*

Verifiable information can be proven or authenticated. It can be used for legal enforcement of either the Convention or domestic law. Verifiable information is observable to all parties if they exert the effort to observe it<sup>64</sup>. The definition of compliance should be based on verifiable information so there is no ambiguity. However, due to the high monitoring costs the international community will not always actually observe the verifiable information. It will rely on coarser measures and on self reporting which can be manipulated. For example, this approach is currently taken in the Montreal Protocol<sup>65</sup>.

Figure 2.1 shows a stylized pattern of flows of verifiable information. These flows of information come primarily from self reporting as required under the Convention or from direct observation and measurement. Each company or NGO is required to report to their government, which in turn reports to the international community. International NGOs and other companies also receive information which they can pass on to the international community<sup>66</sup>. Increasing the amount of information provided to the international community and its quality can be costly. Sovereignty issues inhibit direct monitoring<sup>67</sup> and the international community is frequently not directly involved in the projects. Thus it is more expensive for the international community to collect information than it is for the buyer.

**Figure 2.1 Stylized Major Flows of Verifiable Information and Legal and Informal Enforcement**

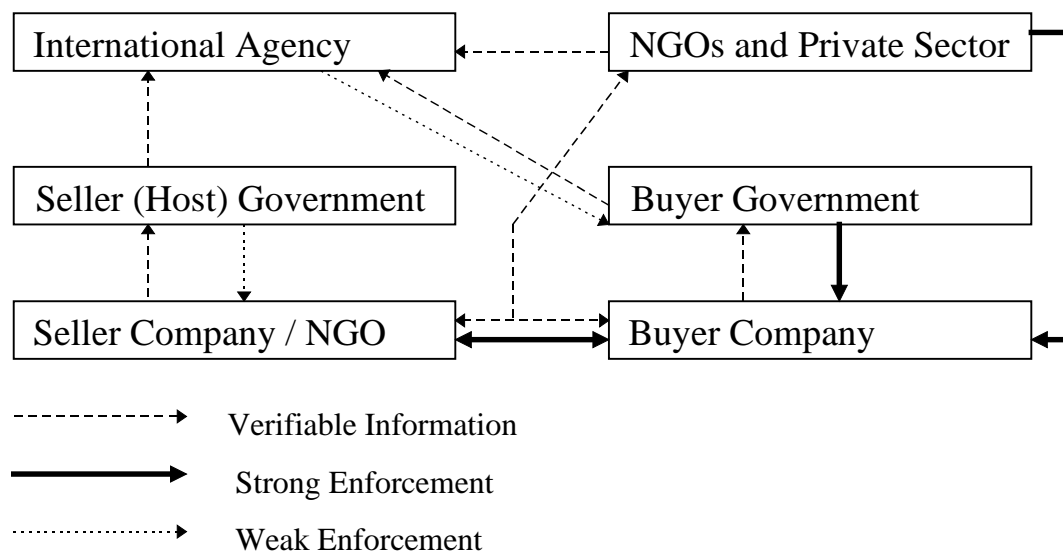


Figure 2.1 also shows the directions of strong and weak formal enforcement. International enforcement of compliance on the buyer country is weak because of the uncertain status of international law<sup>68</sup>. This means that the cost of raising rewards and punishments is high. However the buyer country can be punished to a certain extent by the international community<sup>69</sup>. They may be concerned about maintaining their international reputation. They have a lot at stake in other cooperative agreements. They may be concerned directly about climate change (and have concerned citizen watchdogs) because of their high income levels. They also tend to have strong epistemic communities<sup>70</sup> which are an effective lobby for compliance. Democracies may tend to comply more often<sup>71</sup>. In developed countries the level of compliance can be partly observed by considering the adequacy of domestic laws and regulations because the existence of a law or regulation implies a certain level of enforcement.

Ability to reward or punish the seller country is often extremely weak<sup>72</sup>. Seller countries do not have strong obligations under the Convention. They were not historically responsible for creating the climate change problem. They do not have climate change mitigation as a domestic priority and tend to have high discount rates. They frequently have unstable governments so that their international reputation is not valuable. These factors frequently mean that it is difficult to force them to accept responsibility for global environmental issues. For example, India and China only participated in the Montreal Protocol after they were assured of funding so that they would bear no real costs<sup>73</sup>.

Of course many small countries, which are very dependent on developed countries because of trade or debt, are relatively easy to pressure. For example, Mexico has followed the US lead on the Montreal Protocol and is trying to meet the developed country targets partly because of their links through NAFTA. To a certain extent, developing country compliance is rewarded by further project assistance through agencies such as the Global Environmental Facility. However because funding for projects is usually given in advance of output, it is difficult to immediately punish non-compliance. Thus the seller government cannot be effectively sanctioned. The cost of increasing the reward to the seller tends to be much higher than the cost of rewarding the buyer, although both are high.

In contrast, enforcement under domestic law in the buyer country either through government enforcement or by private agents suing the buyer company is strong. It works through the existing legal system. In addition the buyer is able to enforce its contract with the seller company relatively strongly. It can make its contract enforceable under domestic law either in the buyer or seller country<sup>74</sup>. Buyers can also protect themselves against non-compliance by several methods including requiring a performance bond which is forfeit if the

contract is breached. They can vary the contractual terms to suit the specific project and seller. They will tend to choose to deal with companies in countries with greater political stability, and stronger domestic law. They will deal with companies which are willing to sign contracts enforceable under US (or other developed country) domestic law and accept other contractual provisions which increase their incentives to comply ex post.

If the buyer feels unable to enforce the contract they can choose not to be involved in the project<sup>75</sup>. Although this reduces the number of projects it is probably optimal. If they cannot enforce it, or employ someone to enforce it on their behalf, it is unlikely to be enforced and therefore is a weak project. The combination of good non-verifiable and verifiable information, and informal and legal influence, means that the costs to the buyer of providing rewards to the seller are relatively low. The reward is based on a signal which is close to true effort.

When domestic legal systems are not strong it is difficult for governments to enforce domestic compliance with accurate reporting of carbon permits. A developing country government can have some influence over the outcome. However their capacity to enforce environmental laws tend to be low<sup>76</sup>. If the outcome is unfavorable it can always credibly claim that it was beyond its control<sup>77</sup>.

In a “market” such as Joint Implementation, the buyer of the rights has a comparative advantage over other actors in encouraging, facilitating and enforcing compliance by the seller. The joint implementation contract can be written to allow good access to information by the buyer. The contract can provide opportunities to reward the seller for good performance for example, through expansion or continuation of the project. If there are unforeseen problems with creating the carbon permits, such as shortage of finance or the need for specific technology, a developed country buyer is in a good position to provide these and hence allow compliance.

Thus the buyer has the ability to enforce the contract as well as any private contract between similar parties. What is lacking is the incentive to enforce. This incentive must be created through the institutional structures supporting Joint Implementation and the Climate Convention as a whole. Happily, the international community also has a greater ability to put pressure on the buyer rather than the seller.

### **3 Designing Optimal International Trading Rules**

We have outlined the basic constraints in the situation in which the global community is trying to achieve compliance. Now we turn to the problem of designing an optimal contract for trading. The basic structure of the problem is that the global community is the principal and there are two agents, the buyer and the seller. The principal is of course dealing with multiple potential trades. Each is independent of the others, but the contracts for each are constrained to be similar. The principal is in essence designing rules which govern all or at least most trade. In addition it is worth remembering that the trading rules are a small part of the overall agreement. At the same time, the principal has separate contracts with each agent. These deal with their domestic obligations or basic property rights under the agreement. For example the US has direct responsibilities under the FCCC. It will also be governed by the rules covering Joint Implementation or a carbon trading program. Here we deal only with the design of the trading rules.

The buyer and seller voluntarily enter the trading contract. A country will choose to trade if the expected utility of benefits and rewards minus the compliance costs and transaction costs is positive. Incentive compatibility constraints arise because buyers and sellers are able to choose

their own level of effort. They need appropriate incentives to choose the internationally optimal effort levels. The buyer (seller) will put in additional effort until the marginal expected reward from their extra effort, is equal to the marginal cost.

The global community has two instruments to influence the decisions of the agents through the choice of rewards and punishments. The first is to decide how to define compliance, and hence what actions and outcomes will lead to reward or punishment. The second is to decide on the magnitude of rewards and punishments to each agent, conditional on the actions and outcomes.

#### **COMPLIANCE DEFINITION**

Compliance as measured for determining rewards and punishments must be based on verifiable information and must be unambiguous for legal reasons. Ultimately, true compliance with Joint Implementation is that the permits which are claimed by buyer countries are for real net carbon dioxide emission reductions in the periods stated. If compliance in this sense were perfectly observed and enforceable so that countries only receive permits when they are “real”, then this is all a compliance system would normally concern itself with. However emissions are not normally directly observable. If compliance is not clearly defined as a function of verifiable information there could be some ambiguity in the definition of a permit so that after a project is implemented there could be disagreement about the permits created and thus about compliance. Ambiguity tends to lead to weaker enforcement<sup>78</sup>.

Even when there is no ambiguity based on verifiable information, there is a risk of non-compliance. Not all verifiable information is actually observed by the principal for each project

due to the costs of monitoring. Thus a simple definition of compliance which is based on readily available information can have advantages.

Two major sources of ambiguity in a carbon permit market are the definition of baselines, and the methodology for estimating the number of carbon permits created, as a function of observable outcomes and variables. The current baseline in a developing country is “what would have happened otherwise”<sup>79</sup>. Permits are emission reductions (increases in sequestration) relative to this. One part of the definition of compliance could be defining these two things clearly and having them approved by a credible certification agency before the project begins.

For example, FUNDECOR, a non-profit group in Costa Rica designed a forest protection, reforestation project in the Central Volcanic Mountain Range as part of a plan to consolidate the National Park System in Costa Rica. They named this project CARFIX<sup>80</sup>. In order to try to sell carbon credits, as part of the financing of the project, they first created models to predict what would have happened to land use in the area without the project. To do this they predicted future deforestation based on historic patterns in specific regions, land quality and proximity to roads. As a second part of the project they created a model of carbon sequestration in the region. They used this to predict carbon sequestration under their plans to reforest and protect. The combination of the deforestation estimates and the carbon model created a baseline of carbon loss. They claimed the difference between the two as the potential carbon credits. From the principal’s point of view, they would need to certify the deforestation estimates and the structure of the carbon model. The baseline carbon estimates can be certified in advance, because no new information will be obtained. The estimates of carbon sequestered during the project will depend on how much land is actually protected and reforested. Thus all that can be certified in advance is how the carbon permits will depend on these measurable outcomes of the project.

The certification process would clearly define what the agents are responsible for doing during the implementation. That is, if the project achieves  $C$  observable outcomes they receive  $Y = f(C)$  permits<sup>81</sup>. This defines compliance during the project implementation.

$C$  is the observed signal of compliance as defined. What is observed depends on true effort by the seller and buyer, through their effect on true compliance. The effort exerted by the buyer and seller affects both the mean and variance of compliance. However they cannot fully control compliance. There could also be uncontrollable shocks which affect true compliance such as diseases, droughts or civil disturbances. The measure of true compliance is based on verifiable information. However information is costly to gather so not all relevant components are actually observed for any given project. Thus there is some variance in what is observed,  $C$ , relative to true compliance. The variance depends on the information gathered.

For example, in a reforestation project compliance could be defined as a function of the land area reforested and the density of the forest. The amount of carbon sequestered depends on the agents' efforts in choosing appropriate species, planting, watering and protecting the land. There may be random shocks to the success of the project due to natural events such as droughts, or from man-made shocks which cannot be controlled by the actors, such as guerrilla warfare. In addition, even contingent on the actual level of sequestration achieved, the monitoring may be done with a degree of random error based on satellite images. The agents are rewarded based on the monitoring information.

Thus the definition of compliance determines the information needed to monitor. The definition, and how accurately that monitoring information is gathered, determines the risks the actors face and the accuracy of their rewards and punishments. The choice of compliance definition involves a tradeoff between three things; first, cost efficiency in the way that the goals

of the agreement are achieved; second, the administrative and transaction costs involved in defining project compliance and monitoring the observable outcomes; and third, the allocation of risk among the international community and the agents. The following sections discuss each of these issues in turn.

*Cost effectiveness and the relationship between emissions and the definition of compliance*

To minimize expected costs of abatement, the responsibilities of the agents during the project would ideally be defined in terms of actual emissions abated or carbon sequestered. These are what is of ultimate concern for environmental improvements. If the rewards are based on emissions, agents incentives are perfectly aligned with the principal. They will try to abate as efficiently as possible. However usually it is impossible to directly measure emissions. Therefore rewards will be based on something related to emissions. The loss of efficiency due to imperfect monitoring depends on the technology for abatement and the complementarity between controlling the proxy and controlling true emissions<sup>82</sup>.

Sometimes observing an initial investment or a simple action is sufficient to calculate the actual emissions abated without bias. For example, once a wind power plant is built, the owners have incentives to run it as efficiently as possible and therefore create the expected permits. In many cases however such good proxies are not available. More extensive ex post monitoring is needed to get an accurate compliance picture. Intermediate outputs such as the installation of technology, or the area of land reforested may be easier to monitor than emissions. However, they reduce the flexibility of the project implementers and produce inefficient distortions in their behavior<sup>83</sup>. Also they may be a poor proxy for actual emissions if the technology is not used well. This would mean that measured compliance was not closely related to the emissions which actually affect climate change. If sequestration is measured as area reforested, the true

production of carbon sequestration will be inefficient because project implementers will only be concerned with carrying out observable aspects of the contract. They will not use their experience and knowledge to ensure that the project is carried out to maximize the production of carbon. For example they may plant trees but will not choose appropriate trees, will not plant them carefully and will not protect them against human or animal invaders.

The specification of technology standards in controlling US air pollution rather than emission standards has reduced investment in research on minimizing emissions and has led to inefficient and ineffective emissions control<sup>84</sup>. The US is now moving away from this approach in many areas. For example, in the US 1990 Clean Air Act, the regulation of sulfur dioxide emissions was changed to a tradeable system of allowances for actual emissions. Some research suggests that there have been large efficiency gains from the movement to regulation of emissions rather than technology despite the fact that trading of allowances was initially limited (Burtraw(1996)). Costs of abatement have turned out to be up to an order of magnitude lower than those predicted ex ante by economists and engineers<sup>85</sup>. Innovation and diffusion of technology to reduce CO<sub>2</sub> emissions and encourage sequestration could be the most important output of Joint Implementation. We should design the process to stimulate innovation and diffusion not hinder them.

In the case of the MARPOL<sup>86</sup> convention, intentional oil pollution at sea Mitchell (1994) shows how compliance was eventually defined as having double hulled tankers because the cost of monitoring discharges was prohibitively high. This is an expensive way to control pollution from the point of view of the tanker owners. Inefficiency in production was considered to be less important than reducing enforcement costs. The enforcement of discharges was infeasible given the prohibitive costs involved.

### *Monitoring / Transaction Costs*

The disadvantage of very accurate definition and measurement of emissions is that there will be high transaction costs due to high levels of oversight. This is often a less recognized danger. If the costs of certification and monitoring are excessively high, fewer projects will be carried out. This will result in loss of potential gains to both the seller and the buyer<sup>87</sup>. Extremely high standards of oversight in some US environmental markets led to almost complete paralysis of the markets, very few trades and high overall costs of regulation (Hahn and Hester(1989)). The value of an approach such as Joint Implementation is that it lowers abatement costs. If being involved in Joint Implementation projects is made very expensive, fewer projects will be done and these gains will be lost<sup>88</sup>. Higher costs of abatement will tend to lower the gains to cooperation and hence the overall level of cooperation. Thus CO<sub>2</sub> reductions will be lower. Therefore we should make pre-certification and monitoring of compliance as simple as possible to reduce transaction costs.

In the reforestation example different types of land will yield different amounts of sequestration and the sequestration rate will vary over time. As long as these variations are not too great, it would be simpler to have a methodology, which specifies the number of permits which will be allowed, based on a few land types and a simple time structure. The danger with simplification is that people will do reforestation projects on land which does not yield very much carbon sequestration if this land is cheaper. They will receive the same number of permits<sup>89</sup>. However as the level of detail becomes finer, the danger that the costs of monitoring and modeling will outweigh the advantages of the project becomes high. For example, for the CARFIX project the project developers spent \$10 000 simply to validate their methodology for

carbon certification after it had already been developed<sup>90</sup>. To this point this cost has been a complete loss. They have not received any carbon related funding.

The costs of reporting under complex monitoring regimes, which are transaction costs of making a trade, will affect different agents differently. Large projects will be able to spread these costs over all the permits they create whereas small projects will tend to be blocked. Very sophisticated agents such as electric utilities will be able to deal better with the bureaucratic requirements. They have previous experience with similar processes and so face lower transaction costs. In contrast, local communities wishing to carry out a reforestation program will find the requirements very heavy. Previous work has shown that in a domestic market, the market for lead permits during the US lead phasedown, even small transactions costs reduced the level of participation in the market. Small companies were most affected (Kerr and Maré(1996)).

Thus the benefits of increased monitoring are improved integrity of the market and greater flexibility in compliance strategy. If the increase in monitoring does not lead to improved compliance it is an unnecessary burden. When there is a benefit, it has to be traded off against the two costs of increased monitoring. These are the loss of efficiency in the market because some otherwise advantageous trades are not carried out, and the direct monitoring and rewarding costs, which can sometimes be considerable.

### *Minimizing and Allocating Risk*

Any trans-national contract, and particularly a contract involving a developing country, faces high set-up costs and high risks. If the rules for carbon permits are transparent and can be applied before significant investment is made in developing the project, the up-front project risk

may be reduced significantly. Buyers will then be more willing to invest in further project development.

Agents are frequently more risk averse than society with respect to an individual project. If the only objective was to minimize the total risk burden, the definition of compliance would be closely related to effort to achieve society's goal (i.e. effort to reduce net emissions). This could be done by defining compliance in terms of controllable actions. This would reduce risk in the relationship between effort, compliance and ultimately rewards and punishments. If the agents are risk averse, additional risk will reduce their marginal effort for a given marginal reward when costs are certain. Thus higher marginal rewards will be needed to get the same level of effort. Increased risk will also require higher expected net benefits to make participation worthwhile. However it is difficult to separate uncontrollable from controllable risks. Not making agents responsible for risks they can at least partially control, means they will use their effort and private information less efficiently to achieve society's true goals.

In reality if the observed outcome is too extreme relative to effort, the agents will legitimately claim that it was beyond their control so that they should not be punished. For example, suppose a volcanic eruption destroys the forest after the permits have been claimed. It is unlikely that the permits would be taken away. The contract will be renegotiated and is thus non-credible and unenforceable in extreme situations.

***Principle A*** *Compliance should be clearly defined before a project begins as a function of ex post observable factors.*

***Principle B*** *The actual definition chosen should take into account the tradeoff between cost efficiency (define compliance as close to the social goal as possible), transaction costs*

*(define compliance based on easily observable factors) and risk management (define compliance as controllable outputs).*

## **ACCOUNTABILITY**

Once we have decided how compliance is defined, that is, what agents will be held accountable for, we need to decide who should be accountable. It must be clear who will be punished or rewarded, how, and in what situations. Compliance is a joint output of the buyer's and the seller's efforts. More than one signal may be received about compliance. However it is rare that the international community can observe which agent is responsible for compliance or non-compliance. The buyer and seller can however observe each other reasonably well.

We argue that, in the case of Joint Implementation, the compliance system should hold only one agent responsible for the required output. The allocation of responsibility to one agent changes the structure of our principal-agent model to one with a monitoring/enforcement agent where the principal only contracts with one agent. This is more efficient for the principal than writing separate contracts with the buyer and the seller, as long as the agent has more information and more enforcement capability<sup>91</sup> than the principal and is not too risk averse<sup>92</sup>. When one agent acts as a monitor/enforcer it faces additional costs. It must bear the costs of monitoring and enforcement and it faces more risk because it is responsible for the effects of the other agents actions which it may not be able to fully control. Thus the principal will have to pay the monitor/enforcer to induce them to accept this role. On the other hand, the principal is able to reduce its monitoring and enforcement effort. The second agent will face less risk because it is being rewarded and punished by the monitor/enforcer who has more accurate information on its true effort. The second agent will face less risk from uncontrollable events. Thus the second

agent will participate for a lower expected reward. If the appropriate agent is chosen, and the agent does have better access to information or better ability to reward/punish, on balance the principal will be better off delegating responsibility for monitoring and rewarding the second agent.

When there are several agents involved in carrying out a project, each could be held partially responsible for the outcome<sup>93</sup>. However, group responsibility is less effective because no agent takes full responsibility. It is impossible to effectively sanction when each claims that the other is responsible. Diffuse responsibility also leads to diffuse authority for the successful implementation of the project and may make it more difficult to implement<sup>94</sup>.

One situation where joint responsibility is used effectively is in peer monitoring models of permit provision in rural villages<sup>95</sup> (e.g.: The Grameen Bank in Bangladesh). In the Grameen Bank, money is lent to an individual who is part of a defined group. If the individual does not repay the loan, the entire group is punished by taking their collateral, or denying them future credit. The key difference between a group receiving credit in a rural village and the buyer and seller in Joint Implementation is that the former group is homogeneous in capacities and ability to pressure each other while the latter is not. The punishment for non-compliance in a “Grameen Bank” is loss of credit to the entire group which is credible and severe. In contrast, enforcement in an international agreement is much weaker and more uncertain.

If we are going to have sole accountability we must first consider which agent should take responsibility. Either the seller or buyer country can be responsible for ensuring that the project has its methodology pre-certified because this is transparent and the punishment is to not allow the trade to go ahead which is credible.

Within the contract, monitoring responsibility should be given to the agent which is less risk averse, has good information, has better ability to control risk and hence enforce compliance, and can be rewarded or sanctioned by the principal. As discussed above, in Joint Implementation, buyers tend to be less risk averse than sellers. Buyer and seller countries will both have relatively good information about each other's actions. It may be easier for buyers to write contracts which ensure access to information. They may have more capability to understand the technical aspects of some investments. Buyer countries are able to control buyer companies through domestic law so they have the ability to give their companies strong incentives for compliance. In turn, buyer companies tend to have the ability to control joint compliance better than seller companies, by choosing trading partners, writing incentive compatible contracts, and providing compliance capacity. Buyer countries are generally easier for the international community to sanction. Therefore we argue that buyers are the appropriate monitoring and enforcement agents for Joint Implementation.

In summary, by decentralizing monitoring and enforcement responsibility the risk the seller faces can be reduced, and the power of their incentives can be raised. The buyer's risk rises and they must be paid a higher expected amount to compensate for this. However their incentives become much stronger because they face full liability at the margin. The buyer is a more efficient monitor and enforcer than the international community. As long as they are not too risk averse, decentralization through making the buyer fully liable will be efficient.

***Principle C*** *Make accountability as simple and clear as possible. If possible hold one agent fully responsible.*

*Principle D* Assign responsibility to those who can bear risk, are best able to control compliance, and can be most effectively rewarded and punished.

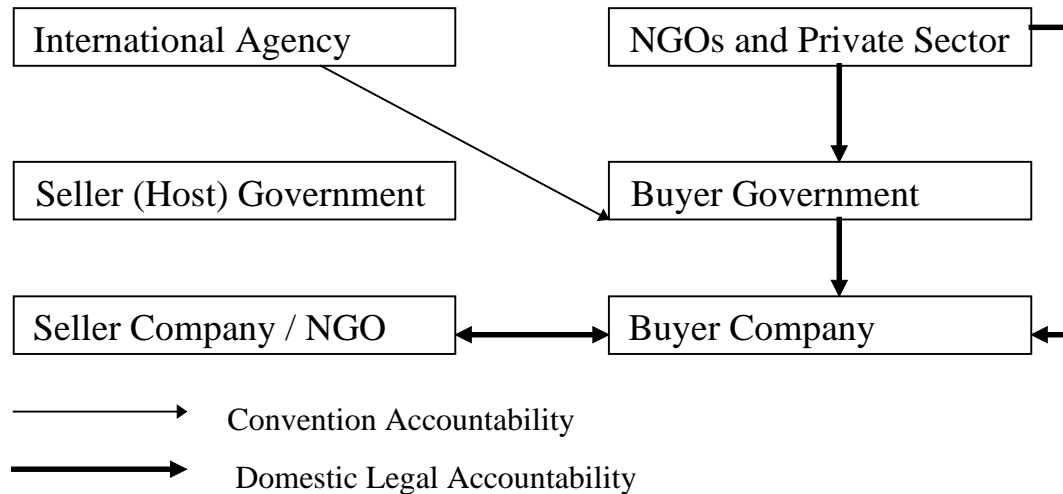
#### **4 Conclusion: Proposed Accountability Structure**

We have outlined the structure of the situation in an International Tradeable Permit Market and the Joint Implementation Market in particular. We then showed how the problem of designing a compliance system for this market can be modeled as a contract design problem and used this structure to suggest four principles for design. We have two major conclusions. The first relates to the definition of compliance and the second to the structure of legal accountability.

We conclude that compliance and its relation to verifiable outputs should be clearly defined in advance. In the case of Joint Implementation this requires defining baselines and the methodology for relating observable outputs to rewards (including permits) and punishments. The appropriate definition of compliance depends on a tradeoff among three considerations. A definition of compliance which relates closely to society's true goals will lead to cost effective effort toward those goals. The transactions costs of certifying and monitoring compliance should be reduced as far as possible without threatening the validity and cost effectiveness of the market. Wherever possible compliance should be defined in terms of controllable outputs. This avoids exposing the buyer to avoidable, uncontrollable risk, and minimizes the possibility of renegotiation and ambiguity in enforcement. Because the process of definition is reasonably transparent and controllable, it could be carried out by buyer or the seller and both can be held responsible for this step. However because the definition of compliance for an individual project

is critical to the enforcement of the overall agreement the definition must be certified by a representative of the international community.

**Figure 4.1 Proposed Primary Channels of Accountability for Implementation**



We conclude that the global community should hold the buyer country alone fully liable for compliance during implementation. There are three reasons for this. First, given the lack of information the global community has about the relative effort of the buyer and seller, and given the asymmetry in capacities between the buyer and the seller, we argue that it is preferable to hold only one agent responsible for the outcome. This increases the marginal incentives faced by the agent held responsible, reduces the ambiguity of rewards and punishments and gives the agents the freedom to carry out the project in the most effective way.

Second, the buyer of permits is a company or NGO from a developed country. The buyer company on behalf of the buyer country has the greatest ability to control the outcome of the project. They can choose a good partner and project, and provide adequate technology, expertise and capital. They can also write a reasonably enforceable contract which ensures good

information provision, and builds in rewards and punishments for the developing country based on detailed observations of effort. Buyer companies tend to have better ability to handle the risk involved in full liability. A developed country government has relatively greater ability to enforce its own companies' actions bringing their incentives into line with the country's incentives. Thus any potential punishments faced by the country will be taken into account by the company.

Third, from the global community's point of view, developed countries tend to be more susceptible to reward and punishment because of their greater concern about the issue, greater international linkages and more established and valuable reputations for cooperation. Thus the buyer country should be held solely accountable to the international community. The seller country is simply engaging in another form of trade and is accountable to the buyer under whatever terms they negotiate.

These conclusions contrast with typical prescriptions and actions. Efforts are currently made not only to certify definitions of baselines and methodologies which is admirable, but also to certify predictions of emissions<sup>96</sup>. Currently these certification processes are complex and costly. Partly this is due to the learning process but there are also concerning pressures to seek perfection. In terms of accountability, normally seller responsibility or joint responsibility are assumed. For Joint Implementation and more broadly, global climate change, we have the unusual opportunity to influence a potentially major institution at its inception. Inefficient, bureaucratic approaches which mimic domestic solutions have not been effective for other global problems. They should not be accepted without creative thought about the alternatives.

Our conclusion is specific to the constraints faced in the particular Joint Implementation market. It will not necessarily carry over to a market among developed countries<sup>97</sup> or to

domestic tradeable permit markets. For example in the SO<sub>2</sub> market in the US, buyers and sellers are symmetric and both can be credibly punished for non-compliance. However, in other situations the same approach would have worked well. In the US Lead Phasedown market the buyers were exclusively established refineries who could be made accountable<sup>98</sup>. The sellers included importers who could be transient and “blenders” who were small retail outlets. The buyers were those who were effectively punished, because they still existed when violations were discovered. They appear to have protected themselves by choosing not to trade with small sellers. This situation may have been even more efficient if this form of accountability had been explicit.

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<sup>1</sup> For key references see Haas, Keohane and Levy (1993), Chayes and Chayes( 1993), Mitchell(1994), Susskind (1994), Young (1994), and Jacobson and Weiss(1995).

<sup>2</sup> To a certain extent the need to specify “baselines” in Joint Implementation results from the problem that property rights are not defined for developing countries. Implicitly they are allowed to do what they would have done in the absence of an agreement. If their permit allocation was clearly defined the baseline would be defined at a national level and would not necessarily have to be defined for each project separately. How the country would allocate permits domestically would determine what compliance meant in a particular project.

<sup>3</sup> In the paper we make a distinction between “observable” outcomes which means that they can be verifiably observed with a high level of effort and “observed” outcomes which are those observed at the level of effort used by either the international community or the buyer. The distinction between these is the basis of the “compliance” problem.

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<sup>4</sup> This is sometimes referred to as a “buyer beware” system.

<sup>5</sup> There is some legal ambiguity on this for two reasons. First, because it is not clear whether contract should be made under municipal law in the seller country or Public International Law. Second, carbon emissions could be regarded as natural resources and thus affected by the definition of sovereignty. UNGA Resolution 3201 of 1 May 1974 on the Declaration on the Establishment of a New International Economic Order provides in relevant part that “Each State is entitled to exercise effective control over [its natural resources] and their exploitation with means suitable to its own situation, including the right to nationalization or transfer of ownership to its nationals, this right being an expression of the full permanent sovereignty of the State.” See Farhana (1996) Footnote 12.

<sup>6</sup> Some companies involved in Joint Implementation already behave as though this is true. For example a Canadian Company TransAlta Corporation which has been involved in projects states that it has “followed a “buyer-beware” approach in the creation of its joint implementation portfolio. Prior to investing in a project, TransAlta extensively researches not only the credibility of the project itself, but also the reliability of the project proponent in order to minimize risk.” Letter from Kelly L. Gunsch, Sustainable Development Business Analyst, TransAlta Corporation. April 1 1996.

<sup>7</sup> See Tietenberg and Victor (1994)

<sup>8</sup> “Based on the range of sensitivities of climate to increases in greenhouse gas concentrations reported by IPCC Working Group I and plausible ranges of emissions ... climate models,... project an increase in global mean surface temperature of about 1 - 3.5°C by 2100, and an associated increase in sea level of about 15-95cm. The reliability of regional-scale predictions is still low, and the degree to which climate variability may change is uncertain. However potentially serious changes have been identified, including an increase in some regions in the incidence of extreme high-temperature events, floods, and droughts, ...” Watson et al. (1996) p. 3 This statement of the scientific evidence is accepted by the US government despite some criticisms of the IPCC in the popular press. “We are not swayed by and strongly object to the recent allegations about the integrity of the IPCC’s conclusions.” Senator Tim Wirth speaking on behalf of the US government at COP2, Geneva, July 17, 1996.

<sup>9</sup> Germany will probably comply due to energy efficiency improvements in East Germany after Unification. The United Kingdom seems likely to comply because of a switch from coal to gas for economic efficiency reasons. (Werksman ( 1996) pp. 48-49) New Zealand appeared likely to comply in a net sense ( i.e. including sinks) due to a boom in tree planting partly in response to a tax break. All of these countries have been active in promoting more stringent targets, but are complying mostly by chance rather than through efforts directed at carbon dioxide emissions. Most other countries will be unlikely to comply.

<sup>10</sup> For a review of the legal and practical aspects of Joint Implementation see Kuik and Schrijver (1994).

<sup>11</sup> Carbon sequestration occurs when plants take up carbon dioxide from the air through photosynthesis. Planting new forests reduces atmospheric concentrations of CO<sub>2</sub> as does retarding deforestation.

<sup>12</sup> For example, in 1995 a contract was signed between the Programme for Belize (a local NGO), the Nature Conservancy, Wisconsin Electric Power Company, Detroit Edison Company, Cinergy Corporation and PacifiCorp, where 14,000 acres of virgin forest was protected creating carbon permits. In exchange Belize received \$2.6 million and conservation and management

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procedures will be established for a sustainable forestry program which will make the area economically self sustaining in 10 years. This project is known as the Rio Bravo Carbon Sequestration Pilot Project.

<sup>13</sup> "... no credits shall accrue to an Party as a results of greenhouse gas emissions reduced or sequestered during the pilot phase from activities administered jointly" COP 1 Decision 5/CP.L 7 April 1995 , COP 1 was the first meeting of the Conference of the Parties after the Convention came into force.

<sup>14</sup> "... activities implemented jointly should bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities:" COP 1 Decision 5/CP.L, 7 April 1995

<sup>15</sup> For an introductory discussion of tradeable permit markets and economic instruments see Tietenberg (1996 pp.334-338). For a proof of the theoretical efficiency of tradeable permit markets see Montgomery(1972). For a discussion of many design aspects of tradeable permits see Tietenberg (1985). Interesting discussion of the operation of real tradeable permits can be found in Hahn and Hester (1989) and Hahn and Stavins(1992). For discussion related to climate change specifically see Tietenberg and Victor (1994), Dudek and Wiener (1996), Hahn and Stavins (1994), Jackson (1995), and Kosloff and Trexler (1993).

<sup>16</sup> If not all countries were involved in the convention the limit would be on the sum of emissions in participating countries. The period of definition is usually assumed to be one year but given that carbon dioxide accumulates over time it would be scientifically and economically preferable to have a longer period within which emissions can be summed. There may however be political difficulties with this. For a discussion of optimal design of a tradeable permit market for an accumulative pollutant see Tietenberg (1985).

<sup>17</sup> Senator Tim Wirth, speaking on behalf of the US government at COP2 in Geneva (July 17 1996) stated that "the United States recommends that future negotiations focus on an agreement that sets a realistic, verifiable and binding medium-term emissions target." He also spoke strongly in favor of market based instruments "the United States will continue to seek market-based solutions that are flexible and cost-effective."

<sup>18</sup> Jacobson and Weiss p. 140 suggest that the International Tropical Timber Organization performs poorly relative to the Montreal Protocol on Protection of the Ozone Layer, because in the former the costs are mostly borne by developing countries. This is perceived as inequitable. In contrast in the latter the costs are predominantly borne by developed countries.

<sup>19</sup> There is a growing literature on the design of Joint Implementation. For some examples see Anderson (1995), Hanish et al (1993), Barrett (1993), Parikh (1994), Bohm (1994), Loske and Oberthür (1994), Jepma (1995), OECD (1992). The United Nations is currently working on the development of a pilot carbon credit market.

<sup>20</sup> For a discussion of the differences between these instruments in the context of Ozone Depletion see Kerr (1995).

<sup>21</sup> For a discussion of experiences with international environmental aid see Keohane and Levy (1995) and Connolly and Keohane (1996).

<sup>22</sup> This is of serious concern to environmental groups. For example see Sierra Club (1995).

<sup>23</sup> Ostrom (1990) pp. 94-100

<sup>24</sup> We regard sovereignty as a constraint on the power of international enforcement. It raises the cost of rewarding, punishing and monitoring by the international agency. For a full discussion of

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this topic see Susskind (1994). Risk and the costs of administration are included as part of the actors objectives.

<sup>25</sup> There is an extensive environmental economics literature examining the conditions necessary for cooperation on global commons. For a recent article which looks at the general problem of moral hazard in encouraging compliance of non-environmentally conscious countries see Petrakis and Xepapadeas (1995). Keohane (1984) gives a clear discussion of the problems with enforcing cooperation using game theory concepts. This gives the background to the problem of compliance in which Joint Implementation is embedded. The cooperation problems arise both because of incentives to not cooperate and because of free riding in enforcement. He discusses changes to the basic structure of the “game”, such as repetition and reputation effects (arising from incomplete information about “types”), which reduce these difficulties. Because of these difficulties, enforcement and monitoring by a centralized body will be limited. This makes it critical to maximize the use of those instruments which are available. See also Werksman (1996) and Mitchell and Chayes(1995).

<sup>26</sup> See Young (1994) for a discussion of alternative ways of defining the “effectiveness” of an environmental regime.

<sup>27</sup> Mitchell refers to this as reducing the “preference” for non-compliance. Chapter 2 Mitchell (1994).

<sup>28</sup> The role of DuPont in supporting the development of the Montreal Protocol to bring international regulation up to the level of existing US regulation is a classic example of this. Benedick (1991) pp. 30-31 Also in the context of ozone depletion, European chemical companies have reported infringements by other chemical companies. Parson and Greene (1995) p. 38

<sup>29</sup> For a dynamic extension of this model see Harrington (1988).

<sup>30</sup> At the international level “fines” are extremely limited due to the anarchic structure of international relations. Rewards are also limited due to the difficulties with making side-payments between countries. Thus to encourage global cooperation, we need to focus on improving our ability to make transfers. Tradeable permits are one way to do this. We can also raise the probability of punishment by having effective compliance systems. Harrington (1988) looks at the case where enforcement instruments are limited.

<sup>31</sup> For an excellent exposition see, Laffont and Tirole (1993).

<sup>32</sup> We are concerned with all forms of opportunism in Williamson’s (1985, pp. 47-49) terms, rather than moral hazard in the strict insurance sense.

<sup>33</sup> For example  $C = e + \varepsilon$ , where  $C$  is observed compliance,  $e$  is compliance effort and  $\varepsilon$  is an iid shock with mean zero.

<sup>34</sup> For a concise introduction to the literature see Mitchell (1996).

<sup>35</sup> For a recent discussion of this model see Hawkins (1984).

<sup>36</sup> See Braithwaite (1985).

<sup>37</sup> For a good discussion of these issues see Haas, Keohane and Levy (1993).

<sup>38</sup> See Haas, Keohane and Levy (1993) and Keohane and Levy (1996).

<sup>39</sup> Our approach is closer to that of transaction cost economics than formal mechanism design. We are not explicitly considering bounded rationality but we are looking for realistic guidelines which are congruent with existing law and practices. See Williamson (1985) p. 51.

<sup>40</sup> Other policies may be aimed at altering these directly. For example many aid projects are aimed at improving the capacity of developing country governments to design and monitor

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policies. Many aid projects encourage the participation of local communities and NGOs partly with the aim of increasing local concern.

<sup>41</sup> The same principles could be applied to the design of enforcement mechanisms in other tradeable permit markets but the resulting mechanism will be likely to differ because of differences in the actors, and their interests and constraints.

<sup>42</sup> The buyer and seller countries are also part of the principal because they have some concern about climate change. We model them as having two separable roles, as contributor to the principal, and as agent. The alternative would be to model the problem as a problem of production in teams where they employ a third party as a monitor. We choose the separated approach partly because there is no third party to employ. Also the principal-agent theory is better developed and understood, and thus it is easier to analyze the complex situation we are faced with. The problem with the current approach is that identified by Holmström (1982) where punishments are not credible because the group as a whole is unable to commit not to renegotiate when a violation has occurred. The institutions created to support the compliance system may be regarded as a form of commitment which reduces this problem. The problem of renegotiation, and the cost of creating credible commitments not to renegotiate, raises the cost of rewards and punishments by the principal.

<sup>43</sup> This simply means that gains from cooperation are achievable at every positive level of enforcement. The Nash Equilibrium will yield some voluntary emission reduction. Under perfect information, this level will increase, up to the first best cooperative outcome, as enforcement possibilities increase.

<sup>44</sup> Intergovernmental Negotiating Committee (INC) 26 July 1994

<sup>45</sup> For a discussion of the role of environmental non-governmental organizations in international cooperation see, Princen and Finger (1994) and Princen et al (1995)

<sup>46</sup> For a seminal work on “epistemic communities” or the role of scientific networks in environmental cooperation, see Haas (1989, 1992).

<sup>47</sup> If the global abatement target is chosen appropriately the marginal cost of abatement is equal to the marginal damages from increased climate change. The costs of abatement include all the political costs of regulatory change and cooperation.

<sup>48</sup> Here we are ignoring the possibility of trading among developed countries. In an efficient market these would not be the bulk of net flows and in any case they are easier to monitor and control.

<sup>49</sup> We do not model this additional layer of the principal agent problem explicitly either here or in the case of the buyer.

<sup>50</sup> Alternatively, a project may have significant local benefits but be against the interests of the central government. Although these may be “good” projects they may also create compliance difficulties. If the local or national government is opposed to a project, they will not assist in enforcement and may actively undermine the project. An example of this is the project by New England Electric in Sabah, Malaysia. This was one of the first carbon offset projects created but for a variety of political reasons has never been approved as a Joint Implementation Project.

<sup>51</sup> COP 1 Decision 5/CP.L 1(c). In Yamin (1996) p. 245

<sup>52</sup> See Petricone et al (1995)

<sup>53</sup> In the US, since 1992, legislation allows power companies to bank carbon offset permits. If a carbon tax is implemented in the future they may receive tax credits. US Congress (1992). All US JI projects must go through the USJI Office.

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<sup>54</sup> Of course given that a stable climate is a global public good they are directly concerned. However as the number of countries in the agreement rises they gain only a tiny fraction of the total benefits they create and we choose to ignore it to simplify the presentation. We assume that if  $R(C) = 0$  for both buyer and seller then there will be noncompliance, i.e. marginal benefits < marginal costs of compliance when effort is suboptimal. If this is not true the project is “win-win” and there is no concern with compliance.

<sup>55</sup> For an excellent survey of the literature on collusion in regulation see Tirole (1992).

<sup>56</sup> Alternatively they could attempt to claim credits from reforestation which would have happened without the agreement, i.e. for the commercial value of the wood. This is lying about the baseline.

<sup>57</sup> Jacobson and Weiss(1995) also stress the need to engage the private sector in monitoring and enforcement, particularly where there is proprietary or private information.

<sup>58</sup> The buyer is less able to judge decisions which relate to the local conditions, while the seller may be less able to judge technological decisions.

<sup>59</sup> This is a project approved by the USIJI Second Round. United States Initiative on Joint Implementation Web Site <http://www.ji.org/usiji/round2/biogen.htm>. Accessed 3 June 1996.

<sup>60</sup> Of course there are exceptions. For example the Chinese government is extremely powerful at least in the sense of being able to block compliance. It may however not be able to ensure positive compliance.

<sup>61</sup> Jacobson and Weiss (1995) p. 141

<sup>62</sup> Fairman and Ross (1996)

<sup>63</sup> Jacobson and Weiss (1995) p. 142

<sup>64</sup> For an in depth discussion of the value of verification and actual verification see Ausubel and Victor (1992).

<sup>65</sup> See Benedick (1991)

<sup>66</sup> In particular there are a variety of non-governmental certification and monitoring agencies dealing with issues such as tropical timber, and endangered species trade (TRAFFIC reports). Greenpeace has played a major role in monitoring ocean dumping.

<sup>67</sup> This problem has recently been vividly illustrated in the case of inspections of nuclear capability in North Korea.

<sup>68</sup> Formal dispute settlement procedures and non-compliance procedures have been created in recent international agreements, such as the Montreal Protocol on Substances which deplete the Ozone Layer, but the formal sanctions which are available within them have never been invoked so their credibility is uncertain. Werksman (1996) p. 118

<sup>69</sup> For example, demonstrations across the Pacific and in Germany could be argued to have influenced the French decision to stop its recent nuclear tests in Mururoa. In the Jacobson and Weiss (1995) study the developed countries, US, EU, Japan and to a lesser extent Russia complied the most. P. 138

<sup>70</sup> See Haas (1989, 1992).

<sup>71</sup> Jacobson and Weiss (1995) p. 42

<sup>72</sup> Of the countries studied by Jacobson and Weiss (1995), Cameroon was the country which complied least.

<sup>73</sup> See Benedick (1991).

<sup>74</sup> International contracts can be written under the municipal law of either country. The form of law is part of the contract negotiations. One Joint Implementation Project in the Czech Republic

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was written under Czech law but so that the English language version of the contract would prevail. Telephone conversation with Mary-Bittle Koenick, Center for Clean Air Policy, 4 June 1996

<sup>75</sup> For example, this is the policy of TransAlta which has been involved in a number of carbon offset and JI projects. *op cit.* (1996)

<sup>76</sup> Often this is due to low environmental priorities and poor institutional structures. For example air pollution emissions regulations in Santiago, Chile are “enforced” by the Ministry of Transport whose other interests are opposed to emissions controls. Inevitably the level of enforcement is low.

<sup>77</sup> For example, economic chaos in Cameroon and Russia from the mid 1980s led to a sharp decline in compliance with treaties. Jacobson and Weiss (1995).

<sup>78</sup> This has been extensively analyzed in the arms control literature. For references see Ausubel and Victor (1992).

<sup>79</sup> COP 1 Decisions 5/CP.L 1(d) . See Footnote 5. This contrasts with the approach in the Multilateral Fund of the Montreal Protocol which provided funding based on the “incremental cost criterion”. (Article 10, Annex II, London Revisions to the Montreal Protocol June 1990.) Countries were paid for costs incurred above the benefits they received from a project. Many projects in developing countries appear profitable and thus would not receive funding under the incremental cost criterion. However, without outside help they do not happen due to imperfect capital markets and so can be valid Joint Implementation projects.

<sup>80</sup> FUNDECOR: Foundation for the Development of the Central Volcanic Mountain Range, (1994) and interviews with Franz Tattenbach and Marielos Alfaro Murillo from FUNDECOR.

<sup>81</sup> This contrasts with the design of many current projects where emission permits are predicted and effectively allocated *ex ante*. For example Dona Julia Hydro Electric Project “During its first five years of operation, the hydroelectric plant is estimated to produce a net reduction of 314,283 metric tons in carbon dioxide emissions.” Bio-Gen Project “In fact, Phase 1 of the Bio-Gen project will reduce greenhouse gas emissions by a minimum of 113,500 metric tons of CO<sub>2</sub> per year of operation or 2.27 million metric tons over the 20 year expected life of the project.” <http://www.ji.org/usiji/usiji.htm#round2> 10 June 1996

<sup>82</sup> For a formal discussion of the tradeoff between lowering monitoring costs and raising the efficiency of abatement see Schmutzler and Goulder (1997).

<sup>83</sup> This is similar to the public finance result that outputs should be taxed rather than inputs. Diamond and Mirrlees (1971).

<sup>84</sup> See for example, Tietenberg (1985) pp.14-16 , and Ackerman and Stewart (1985) pp. 1333, 1337

<sup>85</sup> For discussion of this see Hahn and May (1994) and Burtraw, Carlson et al (1996).

<sup>86</sup> MARPOL is the Convention for the Prevention of Pollution from Ships.

<sup>87</sup> For a simple model with variable transaction costs see Stavins (1995).

<sup>88</sup> i.e. it will be harder to satisfy the participation constraint.

<sup>89</sup> They will under-use land which is valuable for carbon and overuse less valuable land. The size of the distortion will depend on the elasticity of land use response to changes in the relative prices of carbon permits and other products such as agricultural output.

<sup>90</sup> Interview with Marielos Alfaro Murillo, FUNDECOR, September 1996.

<sup>91</sup> For a situation where an agent has a comparative advantage in exchanging transfers see Holmström and Milgrom (1990). This is equivalent to the buyer having better information so

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transfers can be more accurate, and cheaper enforcement instruments available, for example, domestic as opposed to international law.

<sup>92</sup> This is only relevant because in our model the monitor cannot completely observe the actions of the agent. If she could the new contract would improve risk tolerance and raise social welfare regardless of risk aversion. Holmström and Milgrom (1990)

<sup>93</sup> It would be impossible to hold each agent fully accountable under international law because all punishments are potentially renegotiable and any punishment which is seen as too severe in a particular circumstance would be unlikely to be sustained.

<sup>94</sup> For a formal discussion of this “team” problem see Holmström (1982).

<sup>95</sup> For example, see Varian(1990)

<sup>96</sup> In many cases agencies certifying and approving Joint Implementation Projects for individual countries are also requiring that companies provide financial predictions. This is not an appropriate role for government particularly in developed countries.

<sup>97</sup> In a global carbon market it would be possible to have two types of permits circulating. For one generic type which originates in countries which have sufficiently high monitoring and enforcement standards to guarantee validity, the seller could be responsible. A second type would state the project and the country from which the permit originates. The permit buyer would be liable for the validity of these permits.

<sup>98</sup> For discussion of the operation of this market see Kerr and Maré(1996).