Joint Implementation: Lessons from Title IV's Voluntary Compliance Programs[1]

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Abstract

The United Nation's Framework Convention on Climate Change (FCCC), signed by more than 150 nations in June 1992, commits signatory countries to limit greenhouse gas (GHG) emissions to 1990 levels by the year 2000. Article 3.3 of the FCCC states that "efforts to address climate change may be carried out cooperatively by interested Parties" and "policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost." These statements provide the basis for the concept of Joint Implementation (JI) and the development of an international system in tradeable emissions entitlements. Joint Implementation and tradeable emissions entitlements offer an opportunity to curb GHG emissions at a low-cost through international partnerships and cooperation.

Title IV of the United States' 1990 Clean Air Act Amendments (CAAA), also known as the Acid Rain Program, is the largest public policy experiment in the use of tradeable permits. It also incorporates two voluntary compliance programs, the substitution and opt-in provisions. These programs are analogous to JI and therefore, provide instructive insight into the potential barriers to broad JI investment.

The response to the substitution and opt-in programs has been significantly different. Many more units have entered the substitution program than the opt-in program. Based on an analysis of these programs, this paper concludes that high transaction costs, particularly the monitoring costs associated with Title IV compliance, deter potential opt-in participants from entering the Acid Rain Program. The differing response to Title IV's two voluntary programs suggests that transaction costs can be a substantial barrier to JI and that minimizing this cost is necessary for encouraging greater JI participation.

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1. Introduction

The Framework Convention on Climate Change (FCCC) was signed by more than 150 countries at the United Nations Conference on Environment and Development (UNCED) in June 1992. The FCCC aims to stabilize atmospheric greenhouse gas (GHG) concentrations at a level that does not interfere with the Earth's climate system and commits signatory countries, upon ratification, to develop national plans for reducing GHG emissions. Under the FCCC, governments can utilize command-and-control or market-oriented polices to abate national anthropogenic GHG emissions. Two market-oriented policies, Joint Implementation (JI) and tradeable emissions entitlements,[2] continue to gain international support as key policy instruments for mitigating climate change. Joint Implementation and tradeable emissions entitlements offer the opportunity to curb GHG emissions at a low-cost through international partnerships and cooperation. However, the cost-effectiveness and success of these instruments in meeting the FCCC's goal will depend on the structure of the JI projects as well as the development of the tradeable emissions entitlement market.

Title IV of the United States' 1990 Clean Air Act Amendments (CAAA), also known as the Acid Rain Program, is the largest public policy experiment in the use of tradeable permits. Additionally, it is the first trading program to incorporate two voluntary programs, the substitution and opt-in programs. These programs are analogous to JI projects because they allow non-mandated units to voluntarily enter Phase I of the Acid Rain Program and participate in the Program's tradeable permit market. The substitution provision allows Phase II-affected electric utility units to enter the Acid Rain Program early while the opt-in provision applies to industrial sources that are not otherwise required to comply with Title IV. Correspondingly, JI enables countries or parties that have not ratified the FCCC or accepted a GHG emissions reduction commitment to voluntarily contribute to the FCCC's stabilization objective through international abatement actions.

The response to the substitution and opt-in programs has been markedly different. Many more units have entered the substitution program than the opt-in program. This disparity suggests that there is a cost or barrier to entering the opt-in program that does not affect participation in the substitution program. The purpose of this paper is to investigate the cause for the differing responses to the two programs and based on this analysis, to draw appropriate conclusions for the implementation of JI. The experience of the Acid Rain Program offers an instructive comparison for JI as well as the development of a tradeable emissions entitlement market.

1.1 Joint Implementation and Tradeable Emissions Entitlements

A JI transaction is an agreement between an "investor" and a "host" in which the host provides GHG abatement services in return for financial or technological investment. The host earns emissions reduction "credits" through GHG abatement activities and transfers all or some of these "credits" to the investor. In return, the investor provides financial or technological services to the host such as funding, low-emitting energy technologies, or improved information technology. The JI transaction is entirely voluntary, and any party can act as a host or investor including national governments, private enterprises, non-governmental agencies (NGOs), or intergovernmental organizations (IGOs) (U.S. Initiative on Joint Implementation, 1996). Because the cost of

[2] The words "entitlement" and "permit" are used throughout this paper to differentiate between an international trading system and the domestic Acid Rain Program, respectively. These terms can be used interchangeably and are not meant to imply any distinct property or trading rights.

reducing or sequestering GHG emissions varies among countries, JI offers the opportunity to reduce emissions at a lower global cost than would be possible if each country acted alone. Investors are likely to pursue JI projects in host countries where the marginal cost of abatement is low and will, therefore, act to minimize the global cost of mitigating climate change.

Whereas JI allows parties to invest in low-cost international projects for reducing GHG emissions, a system of tradeable permits enables individual firms to seek the least-cost method for achieving environmental compliance. Under a tradeable permit scheme, the total allowable level of emissions is set in advance, and this quantity is allotted in the form of permits among polluting firms. Affected firms that reduce their emissions below the allotted level can sell their surplus permits to other firms or bank them for future use.[3] Firms that face a high marginal cost of abatement can supplement emissions reduction activities with the purchase of additional emissions permits. Whether firms participate in the tradeable permit market or not, they have the flexibility of reducing emissions through a variety of measures including technological improvements, fuel switching, or the reassignment of production activities to cleaner plants.

1.2 Paper Outline

Chapter Two of this paper discusses the rationale for utilizing JI and tradeable entitlements as policy instruments for mitigating climate change. It summarizes current support for and investment in JI projects and outlines a three stage structure for integrating JI into a progressively more comprehensive GHG emissions trading program. Chapter Three describes the U.S. Acid Rain Program. Specifically, it highlights the differences between the substitution and opt-in programs and examines their role within the Acid Rain Program. Based on the argument that monitoring and data costs have caused a lower level of participation in the opt-in as compared to the substitution program, Chapter Four examines the potential impact of these costs on JI projects and an international tradeable emissions entitlements market. Chapter Five highlights the major points examined in this paper.

2. Joint Implementation and Tradeable Entitlements: Two Policy Instruments for Addressing Climate Change

2.1 Rationale for Joint Implementation and Tradeable Emissions Entitlements

Climate change is a global problem, and regardless of the geographical origin of emissions, emissions reduction actions impact atmospheric concentrations of GHGs equally. Therefore, to the extent that the marginal cost of abatement differs across countries and regions, there exists the opportunity to minimize the economic impact of mitigating climate change through international cooperation. The global stabilization of carbon dioxide (CO_2) emissions at 1990 levels by the year 2020 is estimated to cost 0.8 to 2.2 percent of the gross world product (IPCC, 1996). This estimate assumes that there is no trade in CO_2 emissions entitlements and varies due to differing views of the baseline emissions level and future characteristics of the international energy system. The potential efficiency gain from allowing international trade in CO_2 emissions entitlements is estimated to be 0.3 to 0.9 percent of the gross world product by the year 2020 (Table 1; IPCC, 1996). Although this estimate depends on the number of parties involved in the emissions trading market as well as the emissions reduction target, it is clear that international cooperation can substantially lower the global cost of mitigating climate change.

[3] The U.S. Acid Rain Program allows affected electric utilities to bank permits for future use, but this is not true of all tradeable permit systems.

Table 1. Cost Differences for Emissions Trading

Year		ERM Model Tax ($/ton C)	ERM Model GDP Loss (%)	GREEN Model Tax ($/ton C)	GREEN Model GDP Loss (%)
2020	No Trade	283[a]	1.9[b]	149	1.9
	Trade	238	1.6	106	1.0
2050	No Trade	680	3.7	230	2.6
	Trade	498	3.3	182	1.9

[a] Consumption losses are discounted to 1990 at 5 percent per year, in trillions of 1990 dollars.
[b] Global aggregates are based on a 2 percent reduction in emissions from the baseline.

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Table 2. Transfers and Change in Welfare given by the OECD Green Model

	United States	Other OECD	Soviet Union	China	Energy DCs[†]	India	Total
1995: *9.5% abatement*							
transfers ($1000 million)	-1.4	-1.7	1.6	1.8	-0.5	0.2	0
Household real income (% change)	0.0	0.0	1.3	1.0	-1.0	0.9	0
2000: *18% abatement*							
transfers ($1000 million)	-4.2	-8.6	6.0	7.4	-1.6	1.0	0
Household real income (% change)	-0.2	-0.2	1.9	1.8	-2.3	1.2	-0.2
2005: *25.7% abatement*							
transfers ($1000 million)	-9.8	-17.2	12.0	16.7	-4.4	2.7	0
Household real income (% change)	-0.4	-0.5	2.0	2.6	-3.6	1.4	-0.5
2010: *32.7% abatement*							
transfers ($1000 million)	-15.4	-30.6	17.8	31.2	-8.4	5.4	0
Household real income (% change)	-0.7	-0.8	2.1	3.6	-5.0	1.7	-0.8
2020: *44.8% abatement*							
transfers ($1000 million)	-31.9	-64.1	28.7	75.7	-22.6	14.2	0
Household real income (% change)	-1.3	-1.4	1.7	5.8	-7.4	2.4	-1.5

[†] Energy-rich developing countries.

Joint Implementation and tradeable entitlements not only enable parties to secure global environmental benefits at a low global cost, but they also involve the possibility of increased financial and technological transfers from developed to developing nations. The OECD Green model estimates that the financial flows could amount to as much as $75 billion by the year 2020 (Table 2; Clarke, 1995). The OECD results are based on an overall reductions in CO_2 emissions of 2 percent per year, with major emissions reductions in OECD countries and a 20 percent increase in developing countries' emissions during the period from 1990 to 2020. Due to the potential size of the financial transfers associated with as well as the investment structure of JI projects, JI offers an opportunity for industrialized countries to promote individual projects independently of the participation of global tenders such as the Global Environment Facility (GEF). Increased private investment in JI may result in international institutional structures and agreements that more efficiently allocate resources to environmental projects than do the GEF or other international aid agencies. Projects developed under JI can result in technology choices that not only meet the development objectives of host countries but also achieve the environmental objectives of the FCCC.

2.2 Criticisms of Joint Implementation

Opponents of JI argue that JI reduces the willingness of developed countries to “take the lead” in mitigating climate change, compromises the national sovereignty of host countries, and is too costly. By allowing Annex I countries to offset their commitment to reduce GHG emissions with investments in non-Annex I countries, JI decreases the imperative for developed countries to invest in GHG abatement projects within their own borders. The validity of these claims will depend on the implementation and final structure of JI agreements in addition to the future commitments of all parties under the FCCC. Any JI project involving international emissions abatement measures will require reaching an agreement between two parties. There are costs and benefits associated with negotiating agreements, and it is important to weigh both the potential costs and environmental opportunities when evaluating any JI project.

Joint Implementation has been criticized for directly undermining the objectives of the FCCC. It is feared that enabling Annex I countries to offset their emissions reduction commitments could result in uncontrolled global emissions growth (Jackson, 1995). This implies that JI projects will not be monitored to ensure that they are achieving the reductions claimed or that the emissions offsets gained through JI will not be equivalent to the Annex I countries’ reduction commitments. Initially, JI is unlikely to occur at a large enough scale for this criticism to hold, and the number of allowable JI projects available to each country can always be limited. Additionally, it is improbable that Annex I countries will invest in JI projects that cannot be monitored or that result in a greater amount of emissions due to emissions allocation or accounting differences between the two nations. As long as there are credible certification and enforcement measures, it will be difficult for parties to cheat or violate their commitment to reduce GHG emissions.

Politically, JI is criticized for threatening the national interests and sovereignty of the host country (Parikh, 1995). This argument overlooks the fact that JI projects are voluntary and that JI provides developing countries with direct access to financial and technological resources. The amount of financial and technological resources available, however, will depend on how JI investment affects and interacts with other international monetary flows. Many critics of JI fear that the level of international aid dedicated to other development issues will decline as a result of increased JI investment. Although host countries may not always be in a strong position to negotiate for JI projects that suit their development needs, JI offers an opportunity for developing countries to attract additional international assistance. By designing appropriate JI criteria and approval processes, the sovereignty of the host countries can be better protected.

The attractiveness of JI is that it achieves GHG emissions reductions at a minimum global cost. This argument assumes that the marginal cost of abating emissions in developing countries and countries with economies in transition is lower than the marginal cost in developed nations. It is unclear whether this is true or whether the transaction costs associated with implementing JI, particularly monitoring costs, cause international projects to be more costly than initially assumed. Opponents of JI argue that transaction costs reduce the number of relatively low-cost JI projects and diminish the potential contribution of JI to mitigating climate change. Allowing JI may cause parties to overlook economical energy saving projects available in developed nations (Jackson, 1995).

2.3 International Support for Joint Implementation and Tradeable Entitlements

In October 1993, President Clinton announced the *U.S. Climate Change Action Plan* for stabilizing GHG emissions at 1990 levels by the year 2000. Although the plan relied entirely on domestic actions, the Administration recognized the potential for low-cost abatement activities in other countries. In June 1994, the U.S. Government established the *U.S. Initiative on Joint Implementation* (USIJI). The USIJI aims to 1) encourage rapid development and implementation of mutually voluntary, cost-effective projects, particularly in developing countries and countries with economies in transition; 2) promote a broad range of projects to test and evaluate methodologies for measuring, tracking, and verifying JI projects; 3) establish an empirical basis for developing international criteria for JI; and 4) encourage private sector investment and innovation in technologies for reducing or sequestering GHG emissions (U.S. Initiative on Joint Implementation, 1996).

Any U.S. private sector firm, non-governmental organization (NGO), government agency, or individual is eligible for participating in the USIJI program, and as of April 1996, the USIJI had reviewed fifty-one JI proposals (U.S. Initiative on Joint Implementation, 1996). Of these, fifteen were accepted, eighteen were placed "in development," ten were rejected, and eight were withdrawn. The projects placed "in development" were not accepted because they lacked host country acceptance, raised financial and emissions additionality questions, or contained insufficient monitoring and verification information. Table 3 lists the projects accepted into the USIJI program. The USIJI is one of the first JI pilot programs worldwide and is designed to build a core of experience and knowledge for post-pilot phase JI programs.

International criteria for JI were initially discussed at the first meeting of the FCCC Conference of the Parties (COP-1) in Berlin in April of 1995. At COP-1, the Parties agreed to implement an initial pilot phase of JI referred to as "Activities Implemented Jointly" (AIJ). The initial AIJ phase will end no later than the year 2000, and during AIJ, no credits will be awarded to any party for achieving GHG emissions reductions (U.S. Initiative on Joint Implementation, 1996). In addition, the COP-1 resulted in the *Berlin Mandate*, an agreement to set quantified GHG reduction targets for specific years (such as 2005, 2010, or 2020). By initiating the discussion of JI and quantifiable emissions reduction targets, AIJ and the *Berlin Mandate* provide a basis for analyzing the feasibility of JI and likelihood that nations will accept a verifiable emissions cap. An emissions cap is necessary for establishing a tradeable emissions entitlement system and useful for crediting international JI projects.

At the second meeting of the Conference of Parties (COP-2) in July of 1996, the U.S. voiced its support of JI and the use of tradeable entitlements as a least-cost method for mitigating climate change (Affairs, 1996). Recognizing that most developed countries will not achieve the goal of reducing emissions to 1990 levels by the year 2000, the U.S. advocated the adoption of medium term reduction targets, after 2010, that are both binding and achievable. Individual nations should be allowed maximum flexibility in achieving these reduction targets and mitigation measures should be implemented through national programs. Additionally, the U.S. stressed the need for all nations, including developing nations, to take actions to limit GHGs. The COP-2 meeting provided a blueprint for action that was widely endorsed but failed to define specific provisions or requirements for JI. Instead, it instructed the Parties "to accelerate negotiations on the text of a legally binding protocol or another legal instrument to be completed in due time for adoption at the third session of the Conference of the Parties"[4] in December 1997.

[4] *Geneva Declaration*.

Table 3. USIJI Projects

Project Title	U.S. Participants	Host Country Participants	Emissions Reductions[†] (mt C)
Belize			
Rio Bravo Carbon Sequestration Pilot Project	Nature Conservancy; Pacificorp; Cinergy; Wisconsin Electric Power Co.; Detroit Edison	Programme for Belize	1,300,000
Costa Rica			
Aeroenergia S.A. Wind Facility	Power Systems, Inc.; Bluefields, International; EnergyWorks	Aeroenergia, SA	9,800
BioDiversifix: Forest Restoration	The Nature Conservancy	Guanacaste Conservation Area; National System of Conservation Areas; National Institute of Biodiversity	5,040,000
CARFIX: Sustainable Forest Management	Wachovia Timberland Investment Management	Foundation for the Development of Central Volcanic Mountain Range; MINAE	5,939,000
Dona Julia Hydroelectric Project	New World Power Corporation	MINAE; Compania Hidroelectrica Dona Julia	57,400
ECOLAND: Esquinas National Park	Tenaska, Inc.; Trexler and Associates, Inc.; National Fish and Wildlife Foundation	COMBOS Foundation; MINAE; Council of the Osa Conservation Area	345,500
Klinki Forestry Project	Reforest the Tropics, Inc.	Cantonal Agricultural Center of Turrialba	1,968,000
Plantas Eolicas Wind Facility	Merrill International, Inc.; Charter Oak Energy, Inc.; Northeast Utilities; KENETECH Windpower, Inc.	Plantas Eolicas S.A.	71,800
Tierras Morenas Windfarm	New World Power Corporation	MINAE; Energia del Nuevo Mundo S.A.; Moilnos de Viento del Arenal S.A.	51,000
The Czech Republic			
City of Decin: Fuel-Switching for District Heating	Center for Clean Air Policy; Wisconsin Electric Power Co.; Commonwealth Edison Co.; NIPSCO Development Co., Inc	City of Decin	165,600
Honduras			
Bio-Gen Biomass Power Generation Project	Nations Energy Corporation; Add-on Energy 1; International Utility Efficiency Partnership	Biomasa-Generacion	647,400
Solar-Based Rural Electrification	Enersol Associates, Inc.	COMARCA; AHDEJUMAR; AHDE	4,700
Nicaragua			
El Hoyo - Monte Galan Geothermal Project	Trans-Pacific Geothermal Corporation	C and R, Inc.	5,391,000
Russian Federation			
RUSAFOR: Saratov Afforestation Project	Oregon State University; U.S. EPA	Saratov Forest Management District, Russian Federal Forest Service; International Forestry Institute	35,000
RUSAGAS: Fugitive Gas Capture Project	Oregon State Univ.; U.S. EPA; Sealweld Corporation; Sustainable Development Technology Corpation	GAZPROM; Center for Energy Efficiency	8,182,000

† Cumulative projected project greenhouse gas emissions reductions in metric tons (mt C) of carbon equivalent. A metric ton of carbon equivalent is one metric ton of carbon or any quantity of one or more other GHGs determined as equivalent by the global warming potentials defined in the *U.S. Draft Protocol Framework*.

The *U.S. Draft Protocol Framework* is the U.S. proposal of a climate change policy architecture. The January 1997 Draft allows carbon equivalent[5] emissions trading among Parties and credits JI projects with non-participating countries.[6] Additionally, it requires the development of national measurement and reporting systems for tracking anthropogenic emissions as well as compliance and enforcement programs. The Protocol provides a flexible architecture that allows future policy changes, but it lacks a clear mechanism for moving from short-term to long-term goals. According to Schmalensee, "the Report pays insufficient attention to the long-term consequences of possible near-term choices and fails to develop analytical points of which policy-makers should be aware."[7] Despite its short-term view, the *U.S. Draft Protocol Framework* is a clear commitment in support of JI and tradeable emissions entitlements as necessary instruments in the climate change policy architecture.

2.4 A Comprehensive Process for Achieving GHG Emissions Reductions

Tom Tietenberg and David Victor have proposed a comprehensive structure for limiting GHG emissions that incorporates voluntary JI projects and culminates in an international tradeable emissions entitlement market (Tietenberg and Victor, 1994). As compared to the architecture proposed in the *U.S. Draft Protocol Framework*, Tietenberg and Victor's proposal provides a framework for developing JI and a tradeable emissions entitlement market from an initial to a final phase. The framework accounts for short and long-term economic and environmental concerns and allows flexibility in adapting to new scientific data or incorporating additional parties.

According to Tietenberg and Victor, an effective trading system relies on two types of institutions and procedures. The first involves the market institutions that specify the conditions under which entitlements can be exchanged and provide information on the entitlement trades as well as financial transfers. These market institutions must be complemented by administrative institutions. Administrative procedures ensure that the market process operates efficiently and produces the environmentally desirable outcome. Tietenberg and Victor highlight the issues associated with designing the administrative structure, including the role of certification, monitoring, and enforcement, and recommend a system that evolves through three stages.

The first stage has been established by the FCCC and involves only those countries that have accepted the goal of stabilizing GHG emissions at 1990 levels by the year 2000. The stabilization goal is not a requirement and only applies to a limited number of countries. According to Tietenberg and Victor, countries have two choices for meeting this goal. They can either seek reductions within their own borders or through international abatement projects. The transborder approach closely resembles the AIJ pilot phase. However, the AIJ phase and Tietenberg and Victor's first stage differ in that AIJ projects do not receive credit for achieving emissions reductions. Although the first stage bears little resemblance to a market in tradeable emissions entitlements, it enables participants to learn about the comparative costs of monitoring and measuring emissions as well as the costs of different types of JI projects.

In the second stage of Tietenberg and Victor's JI process, the stabilization goal is replaced by specific emissions requirements for each of the participating countries. The COP-1 and COP-2

[5] A metric ton of carbon equivalent is one metric ton of carbon or any quantity of one or more GHGs equivalent to one metric ton as determined by the global warming potentials defined in the *U.S. Draft Protocol Framework*.

[6] *U.S. Draft Protocol Framework*, Articles 6 and 7.

[7] Schmalensee, *Greenhouse Policy Architectures and Institutions*, p. 1.

meetings as well as the *U.S. Draft Protocol Framework* have begun the international discussion of emissions reduction targets, but strict requirements have not yet been set. Once reduction requirements are defined, they will provide a basis for allocating actual emissions entitlements that are freely transferable among participating countries. Although Tietenberg and Victor limit emissions entitlements to CO_2 during this stage, trades in other GHGs are possible subject to certification procedures. The informal trading system of the first stage is replaced by an organized exchange as well as a reporting network designed to minimize transaction costs and provide a public means of accountability. The second stage does not presume any particular domestic strategy for achieving emissions reductions.

During the second stage, non-participating countries can enter the trading process in two ways. First, non-participating countries can negotiate a country-specific limit on CO_2 emissions with the COP and thereby receive a certified number of national emissions entitlements. By accepting a country-specific limit, the non-participating country would become a full participant in the FCCC agreement and gain complete access to the tradeable entitlement market. This transition is comparable to an Annex B country, as defined by the *U.S. Draft Protocol Framework,* accepting an aggregate emissions cap similar to, but less constraining than, the cap for an Annex A or Annex I country. The *U.S. Draft Protocol Framework*'s differentiation between Annex A and Annex B countries corresponds to Tietenberg and Victor's distinction between participating and non-participating nations. A second means for non-participating nations to join the tradeable entitlement market is by creating and selling offset reductions through individual JI projects. The second method is much more limited than the first, but it allows increased participation by countries that are not yet prepared to fully agree to the FCCC's restrictions.

The final stage of Tietenberg and Victor's process expands entitlement trading to include more participants, a greater number of trades, and all GHGs. More governments will implement domestic markets that parallel the international trading market and a much larger number of trades conducted privately between sources will be expected. Developing the market in these dimensions will result in a denser trading market and greater potential cost savings and flexibility. Each of these developments is a matter of degree and three administrative procedures, certification, monitoring, and enforcement, are necessary for a smooth evolution from the first to final stage.

2.5 Essential Administrative Procedures

2.5.1 Certification

Two types of carbon dioxide emissions entitlements exist in Tietenberg and Victor's climate change structure: 1) allocated entitlements and 2) created entitlements. Each type of entitlement involves its own set of certification requirements. Allocated entitlements are received by countries that accept country-specific emissions reduction targets. These entitlements are used to justify emissions during a given year, traded, or banked for future use. Created entitlements arise from emissions abatement actions taken in non-participating countries and once certified, can be traded on an equivalent basis as the allocated entitlements.

The certification requirements for created entitlements differ from the requirements for allocated entitlements. Allocated entitlements are certified once a country accepts an emissions reduction target. Created entitlements are certified on a case-by-case basis. As opposed to allocated entitlements, created entitlements must satisfy the following three conditions: 1) created entitlements must demonstrate emissions reductions below an established baseline, 2) created emissions reductions must be quantifiable and feasible, and 3) created emissions reductions must be enforceable (U.S. Initiative on Joint Implementation, 1996).

2.5.2 Monitoring and Enforcement

Monitoring provides the basis for determining whether a particular country or party is complying with its emissions reduction commitments, whether GHG emissions are being reduced at a global level, and whether failures to achieve targets are due to the design of the FCCC protocol itself or its implementation. Specifically, in the case of tradeable emissions entitlements, monitoring assures that emissions levels are matched by certified entitlements and provides a base of information for determining whether enforcement actions are necessary.

Two classes of sources must be monitored in the climate change policy architecture. First, emissions sources in participating countries require monitoring to ensure that emissions levels are at or below target levels. Under the FCCC, participating countries have agreed to report national GHG emissions, and most of these nations are already technically prepared to provide accurate emissions data.[8] The second class of sources that demands monitoring are sources in non-participating countries that have earned created entitlements through JI projects. Monitoring requirements for these sources include establishing baseline data, verifying that offset reductions are achieved, and ensuring that total emissions do not exceed the target emissions level minus any traded credits.

While monitoring provides the information for judging claims of non-compliance, enforcement is the process for imposing penalties. The challenge to a tradeable entitlement system is that as the price of the entitlements rises, incentives to defect will increase and as the JI system evolves, the number of actors in the market will grow. Traditional international enforcement instruments are not suited to handle a global entitlement market that results in large financial transfers and involves many parties. Therefore, Tietenberg and Victor argue that JI and the tradeable emissions entitlement market will have to rely on domestic enforcement, international standards and accepted penalties, as well as a clear dispute resolution process.

2.5.3 Implementation Issues

The structure of the certification, monitoring, and enforcement procedures influences the evolution of Tietenberg and Victor’s proposal from its first to final stage. Through the definition of the emissions baseline level, allocation of entitlements, and treatment of created as compared to allocated entitlements, the certification requirements influence the incentives for non-participating countries to accept JI projects. The monitoring and enforcement requirements are equally important and act to verify the value of the emissions entitlements and to build confidence in the tradeable entitlement market.

The definition of the emissions baseline level and allocation of entitlements is relatively straightforward for the countries that have accepted country-specific emissions reduction targets. Once the FCCC’s stabilization goal is replaced by a specific reduction target, each country will receive entitlements based on a combination of their historical emissions levels and an allocation rule. These countries have accepted the responsibility of mitigating climate change through emissions reductions. Therefore, they are likely to agree to a mutually acceptable allocation rule through international negotiations. The difficulty in assigning entitlements arises in the case of created entitlements.

The certification of created entitlements raises the issue of “additionality.” Created entitlements are intended to reflect “additional” emissions reductions, not reductions that would have occurred regardless of whether the JI project was undertaken or not. Currently, USIJI proposals are

[8] FCCC, Articles 4.1.(a) and 4.2.(b).

required to demonstrate additionality by presenting a “reference case,” showing the emissions that would have occurred without the JI project, as well as a “project case,” demonstrating the emissions reduction projections over the life of the project (U.S. Initiative on Joint Implementation, 1996). The calculation of the reference and project cases is a technical issue and requires some form of verification if parties are to accept JI as a legitimate tool for mitigating climate change. Proving that JI emissions reductions are real and additional is necessary both for effectively crediting created entitlements and for ensuring the integrity of the international tradeable emissions entitlement market. These concerns can be partially alleviated by utilizing appropriate monitoring procedures as well as international guidance for standardizing the created entitlements certification procedures.

The relationship between the created entitlements emissions reductions and the eventual emissions cap for the host country influences the incentives for non-participating countries to accept JI projects and to limit their current emissions. An eventual emissions cap based solely on historical emissions creates an incentive to defer abatement actions and to reject JI investment now in order to elevate the future established cap. Additionally, a historical emissions rule does not account for developing countries’ desire to continue to industrialize. It is generally agreed that developing countries will be given entitlements according to an allocation rule that accounts for future development, and this rule may be calculated on a population or GDP basis (Shah, 1994). To the extent that the eventual emissions cap is determined independently of historical emissions, the incentive to pollute more now is decreased. The issue of “additionality” affects the certification of individual JI projects, while the determination of the eventual emissions cap influences the incentive for host countries to accept JI investment.

The AIJ program highlights the importance of establishing an acceptable crediting system for created entitlements whether it is based on historical emissions or allows for additional industrial growth. According to a 1995 U.S. Department of Energy (DOE) study on the benefits and obstacles of JI projects, a primary obstacle to participation in the AIJ program is the lack of GHG offsets crediting (Vetleseter, 1995). At the COP-1, the parties agreed that an investor conducting JI projects under the AIJ pilot phase would not receive credit for any GHG emissions reductions. Essentially, this decision removed a major benefit from investing in JI projects and has acted to discourage broad participation in the AIJ program.

3. The United States Acid Rain Program

The Acid Rain Program enacted in Title IV of the 1990 Clean Air Act Amendments (CAAA) is the largest public policy experiment in the use of tradeable emissions permits. The program’s primary goal is the reduction of annual sulfur dioxide (SO_2) emissions by 10 million tons or to a level 40 percent below 1980 levels. The SO_2 emissions reduction is achieved through an emissions trading system and affects only the electric utility industry which accounts for almost 70 percent of national SO_2 emissions. By establishing an emissions cap and allocating tradeable emissions permits to individual utilities, the Acid Rain Program allows utilities to seek the least-cost method for meeting the environmental restrictions. Results from 1995 show that utilities have not only over-complied with the emissions limitation by emitting 40 percent less than the program’s emissions cap (EPA, 1996) but have also achieved these reductions at about one half the cost they would have incurred under a more conventional approach (GAO, 1994).

To achieve its SO_2 emissions reduction, the Acid Rain Program requires a two-phase tightening of the emissions restrictions placed on fossil fuel-fired power plants. Phase I begins in 1995 and affects 263 units[9] at 110 mostly coal-burning electric utility plants located in the Eastern and Mid-Western States. These units must reduce emissions to a level equivalent to 2.5 pounds of SO_2 per million Btu (lbs SO_2/mmBtu) times the average of their 1985 through 1987 fuel use or "baseline." Phase II, which becomes effective in 2000, tightens the annual emissions limits placed on the Phase I units, sets restrictions on about 2000 smaller units fired by coal, oil, and gas, and imposes a permanent annual emissions cap of 8.95 million tons. All existing generation units with an output capacity greater than 25 megawatts (MW) as well as all new utility units must comply with the Title IV provisions. The two-phased approach is designed to achieve early reductions by the largest, highest polluting plants that are thought to contribute most to the acid rain problem in the Eastern half of the U.S. and Canada.

Title IV also calls for a 2 million ton reduction in nitrogen oxide (NO_x) emissions from 1980 levels. Similar to the SO_2 emissions reduction requirements, the NO_x program is implemented in two phases, in the years 1996 and 2000. However, the NO_x program does not permanently cap NO_x emissions nor does it utilize an allowance trading system. All of the NO_x emissions reductions will be achieved by coal-fired utility boilers that are required to install low NO_x burner technologies and to meet stricter emissions standards.

3.1 Key Elements of the Tradeable Permit Market

An "allowance" or trading unit entitles its holder to emit one ton of SO_2 during a certain year. Allowances can be traded with any party participating in the Acid Rain Program or banked for use in a future year, but allowances cannot be brought forward for use in an earlier year. Each regulated source in the program must hold allowances equal to their total SO_2 emissions in that year. Any source that exceeds its emissions limit must pay a penalty of $2000 per ton of excess SO_2 emitted and offset the excess emissions with an equivalent reduction in the following year. Newly constructed facilities do not receive allowances but must obtain them from existing plants.

The owner or operator of any source subject to the Acid Rain Provisions is required to install, certify, and operate a Continuous Emissions Monitoring System (CEMS) on each affected unit at the source. The CEMS tracks hourly emissions which are reported to the U.S. Environmental Protection Agency (EPA) each quarter. Accurate, complete, and consistent emissions measurement data are essential for ensuring the integrity of the market-based allowance system and the achievement of the emissions reduction goals. According to EPA's 1995 Compliance Results, 98 percent of the installed and tested monitors passed the required 10 percent relative accuracy test, and these monitors were successfully operating over 95 percent of the time.

Allowance transactions and the status of allowance accounts are tracked by EPA's Allowance Tracking System (ATS), an electronic record-keeping and notification system. The ATS provides EPA with the necessary data for determining compliance with the emissions limitations. Any party can open an ATS account, and each account contains the serial number of traded allowances, the individual unit's account balance, and the name of the account representative. The ATS is intended to expedite the flow of data between EPA and the utilities and to promote the development of an efficient permit trading system.

[9] A unit is defined as a "fossil-fuel-fired combustion device" in Section 402 of the CAAA and corresponds to a single generator and associated boiler.

In addition to the private sales and purchases of allowances that continuously occur through the tradeable permit market, EPA holds an annual auction and a direct sale. The auctions are intended to send a price signal to the allowance market as well as to provide utilities and other parties with an additional avenue for purchasing permits. The direct sale offers allowances at a fixed price of $1,500 (adjusted for inflation) and guarantees Independent Power Producers (IPPs) first priority in purchasing the allowances. This guarantee enables IPPs to access the necessary allowances for building or operating any new units.

Electric utilities can choose how to dispatch electricity, and the two-phased nature of the Acid Rain Program creates an incentive for utilities to shift generation and emissions from Phase I to Phase II units. In order to account for possible shifts in emissions through the reduced utilization of a Phase I unit,[10] Title IV requires the submission of a Reduced Utilization Plan for any Phase I unit that will be used below its baseline as a method of compliance. The plan must either 1) designate a Phase II unit (compensating unit) to which generation was shifted; 2) account for the reduced utilization through energy conservation or improved unit efficiency measures; or 3) designate sulfur-free generators (such as hydroelectric or nuclear generators). A Reduced Utilization Plan is not required if the underutilized Phase I unit surrenders allowances in proportion to the reduced utilization, if over-utilization occurs at other Phase I units in the same dispatch system, or if there is a decrease in the total dispatch system load.

The Acid Rain Program allows for a number of compliance options. Utilities can reduce emissions by burning cleaner fuel, by reassigning some of its energy production capacity to lower emitting units, or by utilizing energy conservation measures to reduce total electrical demand. Because of the wide variety of utility plant types, ages, and fuel use, there are large variations in the costs per ton of SO_2 removed. This cost differential provides utilities with a substantial opportunity to take advantage of an emissions trading scheme. Generating units with high marginal costs of abatement can achieve emissions reductions by supplementing emissions abatement actions with the purchase of emissions permits. By reducing emissions below the target level, units with lower marginal costs of control can generate additional revenue through the sale of excess permits.

3.2 Compliance Results of the Acid Rain Program

The Acid Rain Program has proven to be both an environmental and economic success. Emissions reductions achieved in 1995 were 3.4 million tons greater than the target level for the first year of the program, and these reductions have benefited the national environment (Figure 1). According to a U.S. Geological Survey, SO_2 emissions reductions have resulted in as much as a 10 to 25 percent drop in 1995 rainfall acidity in the Mid-West, Northeast, and Mid-Atlantic Regions of the U.S. (Survey, 1996) Additionally, efficiency improvements and innovation have accompanied the implementation of Title IV. Not only have scrubber costs dropped by 40 percent or more below 1989 levels, but scrubber efficiencies have also improved from 90 percent in 1988 to 95 percent or more in current retrofits (EPA, 1996). Innovative responses to Title IV include the development of sophisticated computer tools to report and track emissions and are reflected in the decreasing scrubber costs.

The allowance trading market increasingly resembles a more established commodities market. At the time Title IV was passed, the projected price for Phase I allowances was about $250 to $350

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[10] A Phase I unit is underutilized if, in any year in Phase I, the total annual utilization of fuel at the unit is less than its baseline.

per ton of SO_2 and the price for Phase II allowances was $500 to $700 per ton. Actual allowance prices have been much lower than expected, and the price of a Phase I allowance has dropped to as low as $63 per ton. In addition, the total volume of permit trading has been much larger than the minimum amount of trading required for all units to meet compliance in 1995 (Ellerman *et al.*, 1996). Table 4 shows the level of private trading as well as annual EPA auction sales and demonstrates the large increase in trading since 1994 (Bailey *et al.*, 1996). The number of allowances sold in the private market is a low estimate because it only reflects those trades that the electric utilities chose to report to the ATS. Both the evolution of the allowance price and the volume of trading reflect an allowance trading market that is increasingly becoming more efficient and highlight the fact that electric utilities are taking advantage of the tradeable permit market in order to meet the 1990 CAAA emissions limitations.

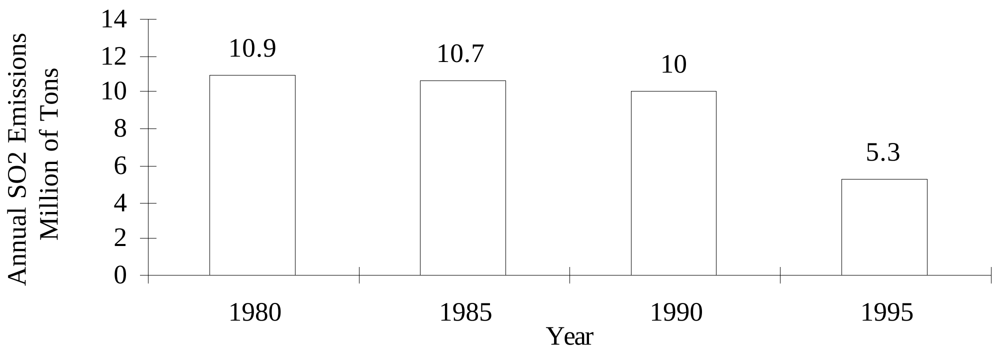

Figure 1. 1995 SO_2 Emissions Reductions by Phase I Affected Utility Units

Table 4. Allowances Sold in the EPA Auction and in the Private Market

	Number of Allowances Sold in EPA Auctions	**Number of Allowances Sold in the Private Market**	**Total Allowances Sold**
Through March 1993†	150,010	130,000	280,010
April 1993-March 1994	176,200	226,384	402,584
April 1994-March 1995	176,400	1,466,966	1,643,396
April 1995-March 1996	275,000	4,917,560	5,292,560
Total	777,610	6,740,940	7,518,550

† Allowance trading began in 1992.

The Acid Rain Program is not only the largest domestic program to incorporate tradeable permits, but it is also the first trading program to include two voluntary compliance programs, the substitution and opt-in programs. The substitution program allows Phase II affected utility units to voluntarily enter Phase I of the Acid Rain Program whereas the opt-in program allows non-utility, industrial sources to enter the program, receive tradeable allowances, and trade allowances with other utility and non-utility sources. The substitution and opt-in programs contribute to the compliance flexibility of the Acid Rain Program and have resulted in an increased level of participation in the program.

3.3 Substitution Program

An owner or operator of a Phase I unit has the option of reassigning or substituting, in whole or in part, the affected power plants' SO_2 reduction requirements to a designated Phase II unit (substitution unit). The only restriction in designating a substitution unit is that the substitution unit and Phase I affected unit must share a common owner or operator. Allowances are allocated to the substitution unit based on the least of three emissions rates for the unit in question: 1) 1985 actual SO_2 emissions rate (or 1985 allowable SO_2 emissions rate); 2) the greater of 1989 or 1990 actual SO_2 emissions rate; or 3) the most stringent Federal or State allowable SO_2 emissions rate applicable in 1995 through 1999 as of November 15, 1990. Each substitution unit's allowance allocation is calculated by multiplying the lowest of the above emissions rates by the unit's fuel use baseline. By increasing compliance flexibility, the substitution program is designed to reduce the overall costs of Phase I compliance while achieving equivalent emissions reductions.

Following approval, a substitution unit becomes subject to all Phase I requirements with regard to SO_2 and NO_x emissions. Incentives for joining the substitution program include early access to the tradeable SO_2 permit market as well as the potential benefit of avoiding the stricter Phase II NO_x emissions requirements. Electric utilities are a main contributor to national NO_x emissions and the majority of these emissions come from coal-fired power plants. The CAAA requires Phase I units with Group 1 boilers to reduce annual NO_x emissions by 400,000 tons from 1980 levels between the years 1996 and 1999. Coal-fired boilers are classified as Group 1 or 2 depending on their type of burner technology.[11] Beginning in 2000, NO_x emissions will be reduced annually by 2 million tons by 1) maintaining the same standards for Phase I, Group 1 boilers; 2) imposing stricter standards on Phase II, Group 1 boilers; and 3) establishing new standards for Group 2 boilers.

Through the substitution program, Phase II units with Group 1 boilers can comply early with the Phase I NO_x requirements and avoid the more costly standards of Phase II. These units, as long as they substituted in by January 1995, are never subject to the stricter NO_x emissions limitations but incur the extra cost associated with early compliance. This is commonly termed "NO_x grandfathering." (Montero, 1997) Units that substitute in after January 1995 are not subject to the revised NO_x limitations until 2008 and fall under the NO_x early election provision. The early election provision applies to any Phase II unit that chooses to meet the NO_x emissions reductions early whether the unit is a designated substitution unit or not. The early compliance provision is always an option, and therefore, the only NO_x benefit of the substitution program is the NO_x grandfathering.

3.3.1 Substitution Program in Practice

Due to initial rule changes and controversies, the substitution program was not expected to draw much participation. However, a total of 42 electric utilities or 182 of 629 eligible Phase II units have voluntarily entered the program (Montero, 1997). This constitutes a participation level of almost 30 percent and is a clear indication that the substitution program has created incentives for Phase II affected units to voluntarily enter the Acid Rain Program.

There are three reasons for units to enter the substitution program including a low level of unrestricted emissions, low control costs, and NO_x grandfathering. Montero has shown that while some non-affected units have joined the substitution program because their actual unrestricted

[11] Group 1 boilers include tangentially-fired boilers and dry bottom wall-fired boilers and other units applying cell burner technology. Group 2 includes wet-bottom wall-fired boilers, cyclone boilers, boilers applying cell burner technology, vertically-fired boilers, arch-fired boilers, and any other type of utility boiler that is not included in Group 1.

emissions are below their historical emissions and therefore receive excess allowances by substituting in, others have entered the program because they have low marginal control costs. Additionally, Montero demonstrates that among the 124 substitution units with Group 1 boilers, 104 are subject to NO_x grandfathering and that the incentives for substituting in increase dramatically for units with Group 1 boilers and high NO_x marginal costs. Table 5 (Montero, 1997) summarizes the participation statistics of the substitution program.

Table 5. Substitution Program Statistics

Variables	Phase I Affected Units	Substitution Units	Total Phase I Units	Other Eligible Units
Number of Units	263	182	445	447
Total Capacity (MW)	88,007	41, 643	129, 650	98,588
Coal-fired Units	257	154	411	299
Units with Scrubbers before 1990	1	25	26	31
Units with Title IV Scrubbers	27	0	27	0
Baseline Fuel Use (10^{12} Btu)	4,363	1,740	6,103	3,223
Total 1993 Fuel Use	4,395	1,718	6,113	3,890
Total 1995 Fuel Use	4,551	1,931	6,637	4,583
SO_2 emissions 1988 (mm)	8.89	1.28	10.17	2.34
SO_2 emissions 1993	7.58	0.97	8.55	2.51
SO_2 emissions 1995	4.45	0.85	5.30	2.88
Average SO_2 rate 1988 (lbs/mmBtu)	3.86	2.01	3.11	1.14
Average SO_2 rate 1993	3.30	1.67	2.63	1.08
Average SO_2 rate 1995	2.10	1.21	1.74	1.04
1995 Allowances (10^6)[†]	7.22	1.33	8.55	-

[†] This does not include auction allowances.

Although there has been significant participation in the substitution program, the substitution units have had little impact on the environmental performance of the Acid Rain Program. Approximately 96 percent of the 1993 to 1995 SO_2 emissions reduction comes from Phase I units. (Table 5) This implies that the majority of 1995 SO_2 emissions reduction is due to actions by Phase I units. Additionally, 15 percent of the 3.4 million allowances banked for future use are allowances from substitution units (Montero, 1997). The substitution program has successfully created incentives for Phase II units to enter the Acid Rain Program early, but these units have not contributed substantially to the environmental accomplishments of Title IV.

3.4 Opt-in Program

The opt-in program allows all operating stationary combustion sources that emit SO_2 but are not otherwise required to meet the mandatory SO_2 emissions limitations of Title IV to voluntarily enter the Acid Rain Program. Combustion sources are defined as fossil fuel-fired boilers, turbines, or internal combustion engines. An opt-in source must comply with the same or similar provisions as utility units and are allocated allowances upon entry into the opt-in program. Allowances are allocated based on the product of the source's average 1985 through 1987 fuel use and the least of three emissions rates: 1) the 1985 actual SO_2 emissions rate; 2) 1985 allowable SO_2 emissions rate; and 3) the allowable SO_2 emissions rate at the time the combustion source submits an opt-in permit application. If the source began operation after 1985, an “alternative baseline” is calculated based on the average heat input for all fuel consumed during the first three consecutive calendar years for which the combustion source operated after December 31, 1985 (EPA, 1995).

By reducing emissions below its allowance allocation, an opt-in source can sell unused allowances on the SO_2 permit market. Opting-in is profitable only if the revenue from selling allowances exceeds the combined costs of the emissions reduction and the costs of entering the opt-in program. Although the opt-in program results in the allocation of additional allowances above the 8.95 million ton cap set for utility units, it does not increase total SO_2 emissions. The allowances are allocated to existing sources and do not authorize new emissions. Through trading, emissions merely shift between the utility and industrial sectors, but total emissions do not increase. Additionally, opt-in regulation requires an opt-in source to return allowances when it reduces its utilization, shuts down, or withdraws from the program.

By March 1997, five companies had applied to the opt-in program. DuPont and the Aluminum Company of America (Alcoa) submitted opt-in applications that were subsequently accepted while Union Camp, the City of Dover, and the Iowa Interstate Power Company withdrew their applications citing financial and administrative issues. Union Camp submitted an application for a steam plant at its organic chemical manufacturing facility in Ohio, but its management would not approve the capital investment necessary for installing and certifying CEMS. The City of Dover, DE decided to withdraw its McKee Run application because it would have received too few allowances to offset the cost of the CEMS and of joining the opt-in program. Finally, the Iowa Interstate Power Company withdrew its application because planned modifications to its potential opt-in source will make it an affected source under 72.6 of the Acid Rain Regulations, and affected sources cannot opt-in (Miller, 1997). By November 1996, DuPont and Alcoa received admission to the opt-in program and were allocated a total of 95,882 allowances (EPA, 1996).

3.4.1 Opt-in Program in Practice

3.4.1.1 DuPont

DuPont’s New Johnsonville Plant is the world’s largest producer of titanium dioxide (TiO_2) pigment. Current production is approximately 25 percent of the total TiO_2 produced nationally and 10 percent of the world’s production. TiO_2 is a fine, white powder used by manufacturers to produce white or opaque products. About half of New Johnsonville’s production is sold for use in paints, varnishes, and lacquers. Other large consumers of TiO_2 include the paper and plastics industries.

The TiO_2 production process consumes enormous quantities of steam. Until recently, four coal-fired boilers located on the New Johnsonville site provided the plant with its necessary steam. However, located adjacent to the DuPont plant is Tennessee Valley Authority’s (TVA) Johnsonville Steam Plant, and because this plant produces electricity, it is subject to the Acid Rain Provisions. By applying as a Thermal Energy Exception within the opt-in program, DuPont was able to shut down its four boilers, obtain replacement steam from the TVA plant, and thus reduce its overall manufacturing costs.

Title IV allows an opt-in source to transfer allowances that otherwise must be deducted to account for a source’s reduced utilization or shut down to a unit that is replacing the thermal energy originally supplied by the opt-in source. A replacement unit must be affected under the Acid Rain Program and prove that it actually replaces the opt-in source’s thermal energy. Allowances are transferred from the opt-in source to the replacement unit annually and are fixed in quantity according to the Thermal Energy Plan. The calculation of transferable allowances is based on the thermal energy provided by and the allowable SO_2 emissions rate of the replacement unit. DuPont's decision to opt-in to the Acid Rain Program will provide TVA with about 7,000 annual allowances (Alexander, 1996). A Thermal Energy Plan has a fixed duration and the term of the plan extends over full calendar years. DuPont was the first industrial site to submit an opt-in permit application and it took approximately one year for DuPont to gain approval.

3.4.1.2 Alcoa

The Alcoa Generating Corporation (AGC), a wholly-owned subsidiary of Alcoa, owns four units at the Warrick Generating Station which are now participating in the Acid Rain Program. Three 144 MW units, wholly owned by AGC, are industrial boilers and are now designated opt-in units. These units are 1960-vintage coal-fired units fueled with a combination of high sulfur coal mined in southern Indiana and low sulfur Appalachian coal. All of the electricity produced by the units is used to power an Alcoa aluminum smelter located at the same site. The fourth 300 MW unit is jointly owned by AGC and Southern Indiana Gas & Electric Company (SIGECO). Because approximately half of this unit's power is used to supply the SIGECO system and grid, it is a named Phase I unit under Title IV.

The three AGC opt-in units received 30,372, 30,732, and 27,668 annual allowances, respectively, for a total allocation of 88,772 allowances. The entire opt-in process took six years from the passage of the 1990 CAAA to the issuance of AGC's permit in June 1996. The promulgation of the final opt-in regulations took about five years, and the consideration of AGC's permit required another ten months. This delay disappointed AGC and made operational planning and contracting for fuel extremely difficult. Additionally, it prevented AGC from committing to any sales of emissions permits because AGC did not know how many permits it was going to receive (Rasmussen, 1997).

According to Philip Rasmussen, the President of AGC, the opt-in process involved significant administrative and legal costs. Approximately six person-weeks were required to resubmit data previously submitted on other governmental forms, and additional legal and administrative costs were incurred while searching for desirable regulatory changes that would make the program more workable for AGC. Designating the three units as opt-in units only involved minor monitoring costs because the three industrial boilers were already equipped with CEMS. State regulations required AGC to purchase CEMS when AGC added natural gas co-fire capacity to the units. The cost of the monitors, had they been required for the opt-in program, would have been about $125,000 per unit or a total of $375,000. AGC was, however, required to make revisions to the State environmental reporting software in order to accommodate the changes required for acid rain reporting and these changes cost about $25,000 (Rasmussen, 1997).

In 1995 and 1996, AGC sold 5000 allowances each year to Ohio Edison. These allowances were created, for the most part, on the Phase I named unit because the opt-in of the other units was not accomplished until June 1996. In 1996, AGC purchased a total of 14,482 allowances from sources including AIG Trading, Arizona Public Service, Cenex, Emissions Trading, Ohio Edison, Enron, and Hunt Refining. AGC has a continued obligation to supply Ohio Edison with allowances over the next three years, and beyond that obligation, AGC will buy or sell permits depending on the current price of allowances, high sulfur coal, and low sulfur coal.

AGC's initial incentive for designating its three units as opt-in units was both economic and environmental. By opting in, AGC hoped to both reduce emissions and achieve economic gains that would help keep the cost of producing aluminum at the Warrick smelter competitive in world markets. However, the utilities' response to the Acid Rain Program was to overbuild scrubbers thereby reducing emissions to a greater extent than expected. This resulted in an excess of allowances in Phase I which in turn drove the market price of allowances downward. The availability of low-cost emissions permits prevented AGC from over-complying with its 1996 emissions requirements through the burning of additional low sulfur coal, but provided AGC with an alternative dimension to consider in its economic fuel burn models. AGC's ultimate decision was to utilize high sulfur coal and buy allowances rather than to employ the additional blending of low sulfur coal. This decision may change, however, as the price of allowances rises and the cost differential between high and low sulfur coal diminishes.

3.4.2 The Potential for Process Sources to Enter the Opt-in Program

The opt-in program was initially designed to allow both stationary combustion and process sources to voluntarily enter the Acid Rain Program. The final opt-in program rules for stationary sources were promulgated in April 1995, but the rules for process sources have yet to be finalized. Process sources are sources that emit SO_2 through a manufacturing process other than burning fossil fuels to generate steam or power and include industries such as the cement, iron and steel manufacturing, and pulp and paper industries.

In May 1995, the Cadmus Group published a draft report on the feasibility of process sources entering the opt-in program. The report analyzed eleven process industries and concluded that only three of these industries, the cement production, natural gas processing, and primary zinc smelting industries, demonstrated an ability to monitor plant-wide SO_2 emissions to a 10 percent relative accuracy. Maintaining a 10 percent relative monitoring accuracy over a compliance year is a minimum CEMS requirement for participation in the Acid Rain Program. The major cause for the sources' inability to satisfactorily monitor emissions is the fact that many process industries are characterized by multiple processes and SO_2 emissions points. In order to meet the 10 percent accuracy requirement, these plants would have to install CEMS on each stack and "the cost of applying several CEMS would be prohibitively expensive for most plants."[12]

Cement plants have substantial opt-in potential because cement kilns burn fuel and generate emissions in a manner similar to electricity units. Procedures applicable to electric utility and industrial boilers for reducing and monitoring SO_2 emissions are generally applicable to cement plants. However, the cost of applying CEMS and tracking SO_2 emissions limits opt-in feasibility for many cement plants. Cement plants are small relative to the energy consumption and SO_2 emissions of electric utility units, and few plants currently monitor their SO_2 emissions. Similar to the City of Dover, many cement plants would receive too few allowances to offset the cost of opting-in to the Acid Rain Program. In 1985, only five cement plants had emissions greater than 5,000 tons of SO_2 (The Cadmus Group, 1995).

Natural gas processing and primary zinc smelting plants are better prepared and designed to enter the opt-in program than cement plants. Natural gas processing units typically have only one emissions stack and virtually no fugitive SO_2 emissions. Therefore, the cost of installing CEMS is less prohibitive for these plants. SO_2 emissions reduction options are available for primary zinc smelting plants and most plants already have CEMS installed and operating. Of the eleven industrial process sources considered in the Cadmus Report, only the natural gas processing and primary zinc smelting industries appear capable of financing the cost of the CEMS. For the remaining nine sources, installing CEMS is too costly due to either the high number of emissions stacks that would require monitoring or the low level of SO_2 allowances that would be earned by opting-in to the Acid Rain Program.

[12] The Cadmus Group, Inc., *Process Source Opt-in Program Technical Background Document, Draft,* (Washington, DC: U.S. Environmental Protection Agency, May, 1995), p. ES-3.

3.5 A Comparison of the Substitution and Opt-in Programs

The substitution and opt-in programs offer electric utility and non-utility producers of SO_2 emissions the opportunity to voluntarily enter the Acid Rain Program. However, these programs differ in two significant ways. First, the substitution program applies to Phase II units, units that must comply with the Title IV provisions, whereas the opt-in program is open to any stationary combustion source that emits SO_2. Second, substitution units must share a common owner or operator with a Phase I affected unit. This requirement does not apply for opt-in units. Although these programmatic differences appear minor, they have significant consequences on the costs of joining the substitution and opt-in programs.

3.5.1 The "Technology of Compliance" Cost

Several costs are associated with participating in the Acid Rain Program including administrative and compliance costs as well as the costs of interacting with the tradeable permit market. The majority of these costs are commonly shared by the substitution and opt-in units as these units must comply with the same emissions regulations and interact with the same tradeable market. However, the cost of the "technology of compliance," defined as the monitoring and information technology for tracking emissions and establishing baseline data, differs for substitution and opt-in units and subsequently impacts their respective decisions to enter the Acid Rain Program.

The "technology of compliance" cost involves the cost of installing, certifying, and operating the CEMS as well as the cost of establishing emissions inventories which is required for all units participating in the Acid Rain Program. More specifically, the cost of the CEMS includes hardware and software costs as well as the cost of the necessary probes and analyzers for measuring opacity, SO_2, NO_x, CO, and CO_2 emissions.

New England Power (NEP), a subsidiary of the New England Electric System (NEES), provides an useful example for estimating the magnitude of the CEMS cost. Establishing a measure of the "technology of compliance" cost is necessary for evaluating its role in the substitution and opt-in programs. NEP owns and operates three major fossil fuel generating facilities including Brayton Point Station, Salem Harbor Station, and Manchester Street Station. The Brayton Point Station in Somerset, MA, has three coal-fired units that together provide 1,092 MW of baseload capacity and one dual fuel oil/gas fired unit that provides 441 MW of intermediate cycling capacity. The Salem Harbor Station in Salem, MA, includes three coal-fired units that together generate 310 MW of baseload capacity and one oil-fired unit that provides approximately 400 MW of intermediate cycling capacity. Finally, the Manchester Street Station in Providence, RI, consists of three natural gas fired units totaling 420 MW.

NEP designated its four Brayton Point units and three Salem Harbor units as 1995 compensating units under Phase I of the Acid Rain Program. Naming compensating units is entirely optional. Therefore, compensation units can be considered similar to substitution units because both types of units are Phase II affected units that voluntarily enter Phase I of the Acid Rain Program. By 2000, all ten of NEP's units will be subject to the Phase II requirements of the Acid Rain Program.

NEP's total capital cost of CAAA compliance has been on the order of $113 million. This includes the capital cost of the CEMS at Brayton Point and Salem Harbor which are estimated as $6.2 million and $5.8 million, respectively. The capital cost of the CEMS for the Manchester Street units was not available, but is approximately $4 million (Kenison, 1997). Based on these numbers, the total CEMS cost is about 14 percent of NEP's total capital cost of Title IV compliance (Table 6). This cost does not include the annual CEMS maintenance, calibration, and labor costs that average about $100,000 per year for each station. Although the cost of installing, certifying, and maintaining the CEMS varies from unit to unit, NEP's estimated total capital cost of CEMS as compared to its total cost of compliance serves as an approximate measure of the Title IV's monitoring and information technology costs.

Table 6. NEP's Cost of "Technology of Compliance"

	MW (total)	Total Capital Cost
Brayton Point Station	1533	$6,200,000
3 coal-fired units	1092	
1 dual fuel oil/gas-fired unit	441	
Salem Harbor Station	710	$5,800,000
3 coal-fired units	310	
1 oil-fired unit	400	
Manchester Street Station	420	$4,000,000
3 natural gas-fired units	420	
Total		$16,000,000
Percentage of NEP Total Capital Cost of Compliance ($113 M)		14%
Cost of CEMS per kilowatt (KW) of Capacity		$6/KW

Table 7. Comparison of Participation in the Substitution and Opt-in Programs

	Substitution Program	Opt-in Program
Number of Units	182	7
Total Number of Allocated Allowances	1,330,000	95,882
Number of Allowances per Unit	7308	13,697
Percentage of Total 1995 Allocated Allowances†	16%	1%

† The total number is 8,550,000 which does not account for the EPA auction allowances.

3.5.2 Role of the Monitoring and Information Technology Cost

All affected utility units, including potential substitution units, must have CEMS installed and operating by 1995. Therefore, the cost of the CEMS is not an additional cost incurred by substitution units and does not directly impact the decision to designate a unit as a substitution unit. Opt-in sources, however, are not required to install CEMS or to participate in the Acid Rain Program. In order to enter Title IV, these units must not only purchase emissions monitors but also learn how to operate and maintain the CEMS. This additional CEMS cost is a direct result of the regulatory differences between the substitution and opt-in programs.

The level of participation has been substantially higher in the substitution program than in the opt-in program. Almost 30 percent of the eligible units have entered the substitution program while only two firms have been accepted to the opt-in program. As a whole, substitution units have received about 16 percent of the total 1995 allocated allowances, and on average, each substitution unit has received about 7300 annual allowances. Together, the DuPont and AGC opt-in units received about 1 percent of the 1995 allocated allowances and an average of 13,697 annual allowances per unit (Table 7). This disparity is due to the high incurred monitoring and emissions tracking costs for opt-in units joining the Acid Rain Program as compared to the costs for substitution units. Chapter Four presents the evidence for this hypothesis and analyzes its implications for the development of JI projects and an international tradeable entitlements market.

4. The “Technology of Compliance” Cost

4.1 The Role of the “Technology of Compliance” Cost in the Substitution and Opt-in Programs

The decision to designate a Phase II unit a substitution unit is unaffected by the “technology of compliance” cost because Phase II units are required to have CEMS installed and operating by 1995. Additionally, because substitution units share a common owner or operator with a Phase I unit, the decision to voluntarily enter the substitution program is more fully understood in terms of its costs and benefits. The owners and operators of Phase I units realize the implications of the Phase I emissions requirements and are relatively experienced in dealing with the tradeable permit market. The structure of the substitution program facilitates the incorporation of substitution units into Phase I and helps minimize the cost associated with entering the substitution program.

Industrial sources of SO_2 are not required to install CEMS unless they participate in the opt-in program, and therefore, they must evaluate the potential cost of monitoring and tracking emissions when analyzing whether to join Title IV. As shown in the case of NEES, the CEMS cost is a significant portion of the total cost of compliance. This cost has discouraged broad participation in the opt-in program. DuPont, AGC, and the firms that later decided to withdraw their opt-in applications clearly demonstrate the impact of the monitoring and information technology costs on the decision to enter the Acid Rain Program.

The cost of the CEMS did not play a role in DuPont’s decision to enter the opt-in program. By opting-in its four coal-fired boilers under the program’s Thermal Energy Exception, DuPont avoided the cost of installing CEMS. Once DuPont was accepted into the opt-in program, DuPont simply shut down its four boilers and transferred its SO_2 emissions allowances to TVA in exchange for replacement steam. The number of allowances DuPont received was calculated from the thermal energy provided by and the allowable emissions rate of the TVA units. The allowances are fixed in quantity and are transferable over a specific number of years. Under the opt-in program’s Thermal Energy Exception, DuPont was never required to determine the emissions rate of its boilers or to incur an additional monitoring cost. Rather, DuPont’s only cost in joining the Acid Rain Program was the administrative and labor costs associated with filing the opt-in application and Thermal Energy Plan.

Similarly, AGC’s decision to opt-in three industrial boilers was unaffected by the cost of installing and operating emissions monitors. The industrial boilers were already equipped with CEMS due to State regulations that required AGC to purchase CEMS when it added natural gas co-fire capacity to the units. The only monitoring cost that AGC incurred in joining the Acid Rain Program was the cost of updating its CEMS software to accommodate the acid rain reporting requirements. This cost was estimated at $25,000 which is minor in comparison to the capital cost of the CEMS. Therefore, the cost of the “technology of compliance” had little impact on AGC’s decision to enter the Acid Rain Program as AGC’s units already had CEMS installed and operating.

AGC’s opt-in units are large units, and each unit received many more allowances than the average substitution unit. About 30,000 allowances were allocated to each AGC unit as compared to the average allocation of 7,000 allowances per substitution unit. Additionally, because the AGC opt-in units had CEMS installed by 1995 and share a common owner with a Phase I unit (the fourth Warrick unit operated by AGC and SIGECO), they are essentially substitution units. The AGC opt-in units’ similarity with substitution units in addition to the relative size of the units meant that AGC not only faced a low cost in entering the opt-in program, but that it could also more easily recapture the remaining fixed cost of entering Title IV through small percentage emissions reductions.

The hypothesis that the cost of the monitoring and tracking emissions is a barrier to entering the opt-in program is supported by the comparison of the DuPont and AGC cases to the experiences of Union Camp and the City of Dover. Both Union Camp and the City of Dover cited the cost of the CEMS as a major cause for withdrawing their opt-in applications. Union Camp's management could not justify the capital cost of the CEMS and applying to the opt-in program given its financial situation, and the City of Dover would have received too few allowances to offset the cost of the CEMS (Miller, 1997). The fact that these firms stated that the cost of the CEMS played a major role in their decision to withdraw their applications validates the hypothesis that the "technology of compliance" cost is a deterrent to entering the opt-in program. Additionally, the Cadmus Report, which evaluates the feasibility for process sources to opt-in, clearly echoes the experiences of DuPont, AGC, Union Camp, and the City of Dover. It highlights the impracticality and expense of monitoring sources with many stacks or a small total quantity of emissions.

4.2 Alternative Explanations for the Lack of Participation in the Opt-in Program

An alternative explanation for the low participation level in the opt-in program is the delay in the promulgation of the opt-in program's final rules. The final opt-in program procedures and requirements were published on April 4, 1995,[13] approximately five years after the passage of the 1990 CAAA. The requirements for the substitution program were finalized on January 11, 1993,[14] and the two year difference between the promulgation of these programs may explain the higher number of units in the substitution as compared to the opt-in program. There is always uncertainty surrounding any new program, and the delay may have heightened the uncertainty associated with the opt-in program. Additionally, the low number of participants in the opt-in program may simply reflect the youth of the program and increase with time.

Although the delay in the promulgation of the opt-in rules may have prevented some units from applying to the opt-in program, it does not explain the different experiences of DuPont, AGC, Union Camp, and the City of Dover. There remains a clear distinction between the units that were accepted to the opt-in program and the units that withdrew their applications. The CEMS cost is minimal or absent for the units that were accepted and high for those that withdrew their applications. Additionally, the Cadmus Group report suggests that even if final rules for process sources had been promulgated, many sources would not have participated in the opt-in program due to the cost of installing CEMS. Therefore, it is unlikely that an earlier promulgation of the opt-in rules would have encouraged significantly greater participation.

A second potential explanation for the disparity between the amount of participation in the substitution and opt-in programs is the cost of learning about and participating in the Title IV tradeable permit market. The owners of substitution units have already incurred these costs for Phase I units so there is no additional learning cost associated with the substitution units. The experience of the opt-in program to date suggests that this cost is significant. AGC faced minimal learning and participation costs due to its common ownership of the Phase I designated Warrick unit, and DuPont avoided any learning cost by selling its permits to TVA. However, two cases are too few to determine the full impact of this cost. Additionally, the statements by Union Camp and the City of Dover as well as the conclusions of the Cadmus Report point to the cost of the CEMS as the primary obstacle to joining the opt-in program.

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[13] 40 CFR Part 74, 60 FR 17100.

[14] 40 CFR Part 72, 58 FR 3590.

4.3 Title IV, Joint Implementation, and Tradeable Entitlements

Although the Acid Rain Program and a climate change policy architecture that incorporates JI and tradeable entitlements occur on the national and international scales, respectively, they share common frameworks. Both are designed to mitigate emissions, employ tradeable emissions entitlements, and incorporate voluntary agreements to increase program flexibility and participation. These similarities suggest that there are lessons from the design and implementation of Title IV that may benefit the development of JI projects and a tradeable emissions entitlement market.

The substitution and opt-in programs are analogous to JI projects. Both the substitution and opt-in programs, like JI projects, are voluntary. Additionally, these programs allow non-affected units to enter the Acid Rain Program and participate in the tradeable permit market just as JI projects allow non-participating countries to earn tradeable entitlements through emissions abatement actions. Joint Implementation projects and an international tradeable emissions entitlement market involve many more parties, industries, types of projects, and political interests and in general, are vastly more complex than Title IV. Therefore, complications within the Acid Rain Program and its voluntary programs will most likely be amplified by the JI process as well as the international trading of emissions entitlements.

The success of JI critically depends on the ease with which JI projects can be arranged between interested parties. If JI projects are too difficult or costly to arrange due to high transaction costs, few projects will be undertaken and the potential gains of JI will be lost. Additionally, there are limited resources for investing in international JI projects, and transaction costs act to reduce the effectiveness of these resources by diminishing the amount actually devoted to mitigating emissions. The type and size of the transaction costs associated with investing in JI projects will depend on the criteria for JI established by the COP as well as the institutions and procedures designed to facilitate the JI process. A recent report by the Organization for Economic Cooperation and Development (OECD) concluded that there are six types of transaction costs that are likely to impede JI transactions including search costs, negotiation costs, approval or certification costs, monitoring costs, enforcement costs, and insurance costs (OECD, 1996).

Effective certification and monitoring procedures are necessary for ensuring compliance in both the Acid Rain Program and an international emissions crediting program. The cost of monitoring and tracking emissions is unavoidable for units complying with the Title IV requirements and parties investing in JI projects. Additionally, the monitoring procedures and requirements applied to the JI process will act to build confidence in the tradeable emissions entitlement market and encourage greater international participation. Among the transaction costs listed in the OECD report, the cost of monitoring is significant because it is not only a critical component for ensuring the integrity of the JI program but also a mandatory cost regardless of the project's type or size. Based on the importance of the CEMS cost in the substitution and opt-in programs and the similarity between these programs and JI projects, it is clear that monitoring and information technology costs will influence the amount of JI investment.

The OECD Group on Economic and Environment Policy Integration conducted interviews to determine the approximate size of the transaction costs associated with JI projects. The Group selected projects resembling potential JI projects and attempted to elicit the following information: 1) the search and information costs involved in choosing the project; 2) the number of person-days lost and legal costs incurred during the bargaining and negotiation process; 3) the monitoring and project appraisal costs; and 4) the total travel time and cost (OECD, 1996). Because the criteria for JI projects have not yet been finalized, the given transaction costs are only rough approximations of the costs that will affect actual JI projects. Table 8 presents some of the results of the OECD report and highlights the fact that the monitoring cost constitutes a large portion of each project's costs. The monitoring cost includes the cost of technical expertise, monitoring equipment, and operating expenses. The search and negotiation costs are also significant largely because these JI projects are among the first JI projects attempted. Although these costs are in some cases comparable or greater than the monitoring cost, this paper focuses only on the impact of the monitoring cost.

Table 8. The Transaction Costs of JI Projects

JI Project	Total Cost	Search Cost	Negotiation Cost	Monitoring Cost
Coal to Gas Conversion (CTG) Project, *Poland*	$400,000[a]	$280,000	$50,000	$50,000 (12.5%)
High Efficiency Lighting Project, *Mexico*	$1,590,000[b]	$97,000[c]	$23,000	$260,000[d] (16%)
Reduced Impact Logging Project, *Malaysia*	$600,000	$70,000	-	$150,000 (25%)
Bynov Heating Plant Project, City of Decin, *The Czech Republic*	$1,500,000	-	$824,000	$300,000 (20%)
Mbaracayu Conservation Project, *Paraguay*	-	$10,000	$15,000	$225,000

[a] This total cost is the cost of an initial GEF project feasibility study and does not include the total project cost.
[b] Only includes the management cost of the project.
[c] Equals one half of the cost of surveys for the purpose of monitoring and research.
[d] Includes one half of the cost of surveys for the purpose of monitoring and research.

The monitoring cost of the Reduced Impact Logging (RIL) Project and NEP's total CEMS capital cost provide a useful comparison of the cost of entering the Acid Rain Program and investing in a JI project. The RIL Project is an agreement between New England Power (NEP) and Rakyat Berjaya SDN, a Malaysian forests products company, and involves the implementation of improved forest management techniques on 1,400 of the Malaysian company's 970,000 hectares (OECD, 1996). The NEP pilot project, completed in 1995, will reduce CO_2 emissions by as much as 600,000 tons over the 40 year life of the project. The UtiliTree Carbon Company is expanding the NEP pilot project to include an additional 2,500 acres that will sequester about 147,000 tons of CO_2 by the year 2000 (International Utility Efficiency Partnerships, 1997). The total budget for the NEP pilot project was $600,000, including $150,000 in monitoring and research costs.

An international Environmental Audit Committee (EAC) is responsible for monitoring the RIL project and for verifying its GHG benefits. The EAC includes the Forest Research Institute of Malaysia, the Rainforest Alliance, and the University of Florida. Research efforts to quantify and estimate CO_2 emissions reductions were led by Dr. Francis Putz of the University of Florida during the pilot phase of the project, and these efforts will continue under the expanded project. The expanded project will also incorporate research on the methane component of the RIL emissions. The EAC does not rely on a standardized method for calculating GHG emissions reductions but is in the process of developing a more reliable method for calculating the GHG benefits of carbon sequestration projects (International Utility Efficiency Partnerships, 1997).

A comparison of NEP's cost of monitoring for the RIL Project and NEP's monitoring and emissions tracking costs under Title IV supports the theory that the complexity of JI projects may amplify the comparable costs of entering the Acid Rain Program. The cost of monitoring the RIL Project is approximately 25 percent of the total project cost and is significantly higher than NEP's 14 percent cost of complying with the Acid Rain Program's CEMS requirement. This is a rough comparison because the monitoring costs described in the OECD report do not directly correspond to the cost of installing, operating, and maintaining the CEMS. Whether this amplification occurs for all JI projects or not, it illustrates that monitoring and information technology costs are substantial in the JI process.

4.4 Conclusions for Joint Implementation and a Tradeable Entitlement Market

Although the projects presented in Table 8 are only representative JI projects, they suggest a strong similarity between investing in JI projects and entering the opt-in program. First, none of the JI projects shown involves a single owner or investor as required by the substitution program. Second, there is little homogeneity between the types of JI projects. A JI project is any international project that seeks to reduce, avoid, or sequester GHG emissions and can involve a variety of abatement activities such as reforestation, conservation, or fuel-switching. The heterogeneity of the JI projects resembles the heterogeneity of the combustion and process source industries that are eligible to join the opt-in program. As shown by the Cadmus Group report and by the range of opt-in applicants, each source varies in terms of the type and quantity of emissions it produces as well as its number of emissions points. More importantly, each opt-in and JI project is unique and therefore, demands its own specific set of monitoring procedures and equipment. Finally, JI projects and opt-in units both incur a significant monitoring cost by voluntarily agreeing to reduce emissions. Joint Implementation investors, unlike substitution unit owners, cannot consider the monitoring expense independently from the cost of the JI project.

The experience of the substitution and opt-in programs as well as the similarity between these programs and JI projects suggest that Annex I multi-national companies (MNCs) are in the strongest position to invest in JI. Similar to Phase I unit owners, MNCs can take advantage of their familiarity with GHG emissions monitoring requirements and techniques to reduce the transaction costs associated with investing in JI. The Southern Company owns, wholly or partially, generating units in the U.S. and China. Similar to other MNCs, the Southern Company already understands the technicalities of reporting emissions due to its operations in an Annex I country. China Light and Power, Ltd., however, owns units in non-Annex I countries and faces a higher learning cost in investing in and monitoring JI projects. Therefore, for identical MNC and China Light and Power plants located in a JI host country, there is a greater expectation that the MNC plant will become a JI project due to the lower transaction costs associated with its emissions compliance. The MNCs' previous monitoring experience acts to internalize the "technology of compliance" cost and lower the total cost of investing in JI.

The Cadmus Report, on the feasibility of process sources entering the opt-in program, highlights the difficulty in addition to the cost of monitoring sources with many emissions points and low total emissions. Based on this analysis, successful JI projects are likely to be those projects which require minimal monitoring but involve a relatively large amount of emissions. The relative cost of tracking emissions is reduced when only a few number of emissions sources must be monitored. Additionally, more credits can be potentially gained when the initial emissions baseline is high. Larger JI projects offer the opportunity to achieve substantial GHG emissions reductions thereby furthering environmental and international support for JI as a policy instrument for mitigating climate change.

4.5 Recommendations for Minimizing the "Technology of Compliance" Cost

The OECD Group on Economic and Environment Policy Integration's report concludes that "transaction costs, implicitly or explicitly imposed, are probably the single most serious threat to the eventual emergence of a JI market."[15] The impact of the cost of the "technology of compliance" on the Acid Rain Program's voluntary programs supports this claim and suggests that any reduction in the impact of this cost can only benefit the development of JI projects and a tradeable emissions entitlement market. There are four specific recommendations for diminishing monitoring and emissions tracking costs and for encouraging broader JI investment.

First, the emissions reporting procedures and requirements for JI projects must be standardized. Standardizing these procedures will lower JI monitoring and emissions tracking costs because it will clarify the reporting needs and thereby define the technical monitoring requirements for JI projects. In considering possible alternatives, it is important that the COP evaluate the technical impact of imposing specific monitoring requirements. The monitoring requirements do not necessarily have to be technology-based but could simply account for the carbon content of fuel consumed. Once the requirements for the monitoring equipment are known, JI investors can dedicate more resources to improving the current methods rather than to searching out possible monitoring systems. Some of the current monitoring cost associated with JI projects is the cost of the technical expertise necessary for developing appropriate monitoring procedures. Implementing standard reporting procedures reduces the need to individually design monitoring specifications for each JI project and therefore, helps reduce the overall information technology cost associated with JI investment.

Second, the COP should designate an international organization as a central source for technical monitoring information. The organization will gather data on the applicable monitoring equipment and procedures for each type of JI project and assume the responsibility for maintaining and diffusing this information. This action will have a similar effect as standardizing the reporting procedures for JI in that it will lessen the technical uncertainties of investing in a JI project. Additionally, by assigning this task to an international organization, the COP will signal its support of JI to potential investors and encourage further JI investment.

Third, the COP must encourage public and private institutions to finance, publicize, and organize JI projects. Transaction costs reduce the amount of JI investment partially due to the general lack of available financing for JI projects. According to many electric utilities and IPPs interviewed by the DOE, the lack of financing is a primary obstacle to JI investment (Petricone and Vetleseter, 1995). Increasing the amount of available JI financing decreases the potential impact of high monitoring costs and facilitates investment in more JI projects. Additionally, publicizing and organizing JI projects diminishes the risk and management costs incurred by JI investors. As shown in Table 8, the search and negotiation costs are a large component of the JI project cost, and any effort to publicize available JI projects would help reduce these costs as well.

As final recommendation to diminish the impact of the monitoring and information technology costs on JI is for the COP to favor larger JI projects over smaller ones and to encourage MNCs to invest in JI. Increasing the size of the project reduces the relative size of the monitoring cost to the total project cost. Larger projects may involve higher administrative and management costs, but the monitoring cost appears to be a more dominant factor in deciding on whether to invest in JI. Additionally, as mentioned earlier, larger projects can potentially earn more emissions offsets than

[15] OECD, *Joint Implementation, Transaction Costs, and Climate Change,* Group on Economic and Environmental Policy Integration (Paris: OECD, August 1996), p. 51.

smaller projects, and MNCs are in a more advantageous position to invest in JI projects. Therefore, by encouraging MNCs and others to invest in JI, the COP will reduce the potential impact of the “technology of compliance” cost and test the limits of the environmental gains accrued through JI.

5. Conclusion

In December of 1997, the COP will meet in Kyoto to discuss the design of an international protocol to guide GHG emissions reduction efforts in the post-2000 period. Joint Implementation and a tradeable emissions entitlement market have been significant elements in the COP negotiations and have gained greater emphasis as a result of the *U.S. Draft Protocol Framework*. The Kyoto meeting provides a motivation for clarifying JI procedures and requirements, but further investment in JI does not depend on the outcome at Kyoto. Interest in JI is likely to persist, perhaps as an abatement option for Annex I countries or as part of a broader policy architecture for mitigating climate change. Given this continuing interest in JI, the Acid Rain Program provides an useful example for analyzing the requirements and potential barriers to JI.

Credible certification and monitoring procedures are essential for establishing confidence in the JI process and tradeable emissions entitlement market. Title IV’s CEMS monitoring requirement ensures compliance with the SO_2 emissions reduction requirements and maintains the integrity of the tradeable permit market. Due to the CEMS accuracy, utility units and EPA are confident that the tradeable permits reflect tangible emissions reductions. This confidence eliminates the need for EPA to approve each permit transaction, frees the tradeable permit market from unnecessary regulatory interference, and allows the permits to be properly valued by the market. The JI process will demand a similar level of monitoring as required in the Acid Rain Program. Appropriate JI monitoring procedures and requirements must be designed to hold down these costs while also maintaining the integrity of the international trading system.

The learning costs associated with interacting with the tradeable entitlement market also appear significant. The experience of Title IV’s substitution program suggests that those who are already involved in the trading program are more likely to participate. These participants have already incurred any learning costs through previous interactions with the tradeable permit market. In the context of JI, the learning cost can be minimized through the participation of MNCs or other Annex I parties. Not only do these participants bring monitoring and other technical expertise to JI projects but they also bring the motivation to achieve tangible emissions reductions.

The experience of the Acid Rain Program demonstrates that the response to voluntary programs can be large when transaction costs are low. The monitoring and learning costs associated with complying and participating in Title IV have deterred greater participation in the opt-in program but not affected participation in the substitution program. Based on this analysis, it is clear that minimizing these costs will allow interested parties to more easily arrange JI projects and will further the potential economic and environmental gains of JI.

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