

Appendix A: IDGEC Carbon Management Research Activity Scoping Report

The Carbon Management Research Activity (CMRA) will investigate the institutional issues associated with controlling greenhouse gas emissions, the cause of global climate change. This scoping report describes the two priority themes of the CMRA's research and the questions to be explored in each theme. It summarizes the analytical approaches to be used, the links to be made with other projects and programs, and the steps needed for implementation. CMRA research is a flagship activity of the International Human Dimensions Program's (IHDP) long-term project on the Institutional Dimensions of Global Environmental Change (IDGEC). The flagship activity will determine critical near- and long-term institutional issues facing the international community as it develops a global climate change regime. Additionally, the findings will prove key in designing and modifying institutional arrangements in other settings.

Introduction

A great institutional challenge facing the world is the need for a complex system of regimes to control and ultimately reduce emissions of greenhouse gases (GHGs). Since the beginning of the industrial revolution, human activities have substantially increased the concentration of greenhouse gases in the atmosphere.¹ Scientists expect that the resulting "enhanced greenhouse effect" will warm the earth's climate by as much as 5 degrees Celsius over the next century (Houghton, Filho et al. 1996). This warming could lead to numerous adverse impacts, including rising sea levels, changes in rainfall and evaporation patterns, and the increased melting of snow and glaciers in mountainous regions.

The international community has embarked on an effort to develop a global regime that will address the climate change problem.² Creating this regime, however, is extraordinarily difficult. The causes of the problem are embedded in the basic economic and social activities of both developed and developing countries. Much about climate change remains poorly understood, and its most significant impacts will not be felt for decades. Global temperatures are projected to change over the course of decades to centuries, and uncertainties remain about the timing and magnitude of this change. Finally, addressing climate change requires facing many convergent issues and interests. Each of the many countries and non-governmental organizations (NGOs) participating in the climate change treaty negotiations has different concerns about climate change. Each contributes differently to the climate change problem, each confronts unequal risks from its potential impacts, and each faces dissimilar abatement costs (Bodansky 1995). All these factors make creating effective climate change institutions a monumental challenge.³

CMRA Priorities: The Administration and Adjustment of the Climate Change Regime

Two international treaties, the Framework Convention on Climate Change (FCCC) and the Kyoto Protocol (KP), form the core of this emerging climate change regime. The FCCC establishes its overall framework. This agreement, which entered into force in 1994, sets the regime's objective as the stabilization of greenhouse gas concentrations in the atmosphere at a level that will not disrupt the Earth's climate system. It requires all countries to develop national programs addressing emissions by sources and removals by sinks of greenhouse gases. Industrialized countries and countries with economies in

transition ("Annex I" countries) must also adopt national policies and measures that will limit their emissions and enhance their GHG sinks and reservoirs. The 1997 Kyoto Protocol further requires Annex I countries to reduce by 2008-2012 their collective GHG emissions to five percent below 1990 levels.⁴

CMRA research will be directed towards two "themes" - important to policymakers and researchers - associated with this regime. Because the international community is particularly concerned with the nearer-term issues of implementing the FCCC and the Kyoto Protocol, the first CMRA theme explores those institutional issues associated with administering these existing agreements. The second theme focuses on the longer-term issues of adjusting the climate regime to changes in technology, scientific understanding, and global socioeconomic conditions. This ability to adapt to change will determine the regime's long-term effectiveness.⁵

Theme 1: Administering the Current Climate Regime

The first substantive area of CMRA analyzes the institutional issues associated with administering and operationalizing the FCCC and the Kyoto Protocol. With the FCCC in force and the Protocol in the process of ratification, both Annex I and developing countries are moving forward with the development and implementation of measures to meet their commitments. For Annex I countries, this includes not only the development of policies to reduce emissions from sources and enhance sinks and reservoirs, but also the development, transfer, and diffusion of environmentally-sound technologies, practices, and processes to developing countries.

Annex I countries can adopt a range of market-based and regulatory policy instruments to meet these commitments. Some are "market"-based in that they use economic forces to change behavior, such as: energy pricing strategies; changes in agricultural and forestry subsidies; tradable emissions permits, product labeling, and advanced technology development and demonstration programs. Others employ the more traditional regulatory approach, such as: minimum energy efficiency standards, technology standards, and fuel restrictions (Fisher, Barrett et al. 1996; Watson, Zinyowera et al. 1996). Countries will generally adopt a mix of these instruments depending on national circumstances (Lenstra and Bonney 1993; Arrow, Parikh et al. 1996; Watson, Zinyowera et al. 1996). The degree to which these instruments are effective in mitigating climate change will be a function of mix of the instruments adopted, the design and implementation of the policies themselves, and the institutional framework within which they must operate (Fisher, Barrett et al. 1996).

The Protocol's call for the development of three interlocking mechanisms complicates the administration of the climate change regime and the development of national climate change policies. The clean development mechanism (CDM), joint implementation (JI) and emissions trading (ET) will allow Annex I countries to obtain some a portion of their required reductions through collaborative efforts with other countries. Under the CDM, Annex I governments and private companies may obtain Certified Emissions Reductions (CERs) by participating in projects in developing countries that reduce GHG emissions and satisfy local development needs. These credits can be put toward the Annex I countries' Protocol obligations during the 2008-2012 compliance period.⁶ Under joint implementation, two Annex I governments or private companies can share Emission Reduction Units (ERUs) for projects undertaken jointly in that country for which emissions reduction costs are lowest. Finally, emissions trading is the purchase of

Assigned Amount Units (AAUs) by Annex I governments and companies with high marginal abatement costs from those with lower costs.

The role that the Protocol establishes for private sector in the development and operation of these mechanisms also adds complexity to the regime, as it will require the private and public sectors to interact on an unprecedented scale.⁷ Annex I governments are expected to adopt policies that will pass their emissions reductions commitments on to companies in those industrial sectors most responsible for the emissions. They are also expected to develop programs that will allow these industries to buy and sell AAUs and acquire ERUs and CERs on a global basis (Barrett 1998; Matsuo 1998; Maddison 1999).⁸ The governments remain the responsible parties in the regime, however, and the system through which this trading will occur, while market oriented, will be constrained by domestic and international institutions established by these governments. These constraints include the rules that the international community adopts governing the operation of the Kyoto mechanisms, the rules each country creates to manage the exchange of permits domestically and internationally, and the interactions among these different international and domestic institutions.

To explicate these complexities and their ramifications, the CMRA will explore two related sets of institutional issues: (1) the implications of the regime's market orientation for the operation of the Kyoto mechanisms and the nature of measures that nations adopt; and (2) the implications of these measures and mechanisms for the balance between climate protection and sustainable development. In the remainder of this section, we describe these two sets of issues and outline the important questions that arise in each.

International and National Implications of the Development of the Kyoto Mechanisms

As the CDM, JI and ET are developed, institutional questions will need to be addressed concerning both interactions among the operational international rules and between these international rules and concomitant national rules. For example, it has been proposed that an international registry be established to track and provide information on the transfers of AAUs and the acquisition of CERs and ERUs. For countries to track domestic trades, however, each transaction would have to be processed through a national registry as well, raising questions about the relationship between international and domestic trading rules.

The development of these mechanisms and the market for ERUs will also raise a number of institutional issues about the mix of policy instruments that nations adopt. Each nation's institutional structure and experience, resource endowment, and level of industrialization will determine the mix of market-based and regulatory instruments that each nation that it adopts (Fisher, Barrett et al. 1996; Barrett 1998).⁹ However, rules governing the operation of the CDM, JI and ET will also shape this mix. For example, while the Protocol specifies that AAUs acquired through Emissions Trading are to be supplemental to domestic action, the international community has not yet agreed on a definition of the term 'supplemental'. Each of the options being considered has a different affect on emissions reduction costs, however. The choice of definition, therefore, could substantially alter the nature and mix of policies instruments that different countries choose to adopt.¹⁰

Questions also exist about the applicability of the emissions trading model to the global scale needed to control GHG emissions. While considerable experience at the national level with the use of market-based approaches such as tradable permits exists (OECD 1992), international tradable permit systems have been limited (Fisher, Barrett et al. 1996). The effectiveness of tradable permits in implementing national responsibilities to alter climate

change is also not well understood.¹¹ Finally, important questions arise concerning whether or not these mechanisms are to function as the primary means for the transfer of technology to developing countries and how technologies being transferred through these mechanisms can be screened to ensure their appropriateness and long-term effectiveness.¹²

The core question with regard to this set of issues is: *from an institutional perspective, what are the implications of this market-oriented climate change regime for operation of the Kyoto mechanisms and the mix and effectiveness of policy instruments adopted by national governments?* Specific issues include:

- *How will international rules governing each of the Kyoto mechanisms affect the administration of the others?*
- *How do the rules governing this regime affect the development and implementation of policy measures in different countries?*
- *How do these rules affect the development, transfer and diffusion of environmentally sound technologies, practices and processes?*
- *What are the relative merits of market-based versus regulatory instruments in the context of the regime?*
- *What are the implications of differences among these national and international rules for the effectiveness of the climate change regime and the goal of sustainable development?*

Climate Protection and Sustainable Development

A second set of issues surrounding the FCCC and the Kyoto Protocol involves how the mix of market-based and regulatory measures adopted to implement these agreements could affect the goals of protecting the global climate and achieving sustainable development. Two aspects of these issues will be considered here. The first of these pertains to the affect that the mix of measures could have on the balance between reductions of GHG emissions from sources and the enhancement of GHG sinks and reservoirs. The second, more general issue pertains to the relationship between these measures and the larger issues of sustainable development.

As the Kyoto mechanisms become operational and the "carbon" market emerges, Annex I countries can be expected to pursue those activities that offer the greatest GHG emissions reductions at the lowest cost. Forestry measures are particularly attractive to the governments and private companies these countries, as they tend to view these measures as being relatively inexpensive, absorbing large amounts of CO₂, and having the potential to provide additional development and environmental benefits. It is therefore likely that the number of carbon sequestration activities will increase substantially as countries move forward to implement the FCCC and the Kyoto Protocol. Because tropical forests have the greatest potential for storing carbon, issues associated with this increase, as well as those associated with deforestation and land use changes, are of particular concern to developing countries. Many developing countries are concerned that removing land from productivity for periods of fifty to ninety years could cause greater harm in terms of economic losses than any benefits they might gain from the sequestration effort. They are also concerned with the implications of this increase for the balance between forest conservation and forest plantation efforts.

One aspect of the balance between emissions reductions and carbon sequestration pertains to differences among the Kyoto mechanisms. For example, the relationships among AAUs, ERUs, and CERs are not clear, and critical differences exist among the mechanisms through which they are earned. For example, most economic models that

forecast savings through emissions trading assume these potential savings will occur through CDM projects in developing countries. However, the realization of these savings could be substantially effected by the rules regarding the value of CERs relative to that of AAUs and ERUs. Should CERs be given the same value of AAUs and ERUs, the demand for CDM projects could increase. This in turn could shift the global balance between emissions reductions and sequestration (Parkinson, Begg et al. 1999).¹³ This balance could also be affected by differences in the timing of the implementation of these mechanisms, as well as differences between the CDM and the other mechanisms in market orientation.^{14, 15}

Another aspect of this balance is the impact that uncertainties associated with the future availability of GHG sinks and reservoirs. Terrestrial ecosystems and soils now absorb approximately ten percent of the annual GHG emissions from the burning of fossil fuels (Watson, Zinyowera et al. 1996). This percentage could grow in the future should sink enhancement activities increase substantially.¹⁶ While terrestrial ecosystems are expected to absorb carbon from the atmosphere for decades to come, their capacity to do so is not without limit (Cao and Woodward 1998; Walker, Steffen et al. 1999). If and when this saturation will occur is unclear, however, as it is highly dependent on a wide-range of factors that are difficult to forecast with any degree of confidence. The international community faces a considerable challenge in developing rules to regulate the use of sink enhancement measures that take into account these uncertainties.

Critical questions also exist regarding the relationship between the measures adopted under the Kyoto Protocol and the larger issues of sustainable development in both Annex I and developing countries.¹⁷ The Protocol has two objectives: to promote sustainable development and to protect the global climate in a cost-effective manner.¹⁸ While these two objectives are not necessarily incompatible (Wagner 1996; Banerjee and Taplin 1998; Barrett 1998), rules adopted to implement one objective can create conflicts with the other. For example, the choice of rules governing supplementarity could have important implications for the sustainable development path of Annex I countries. Similarly, rules restricting the use of ODA for CDM investments could force developing countries to choose between emission reduction/sequestration measures and other development objectives.

The core question for these issues is: *what are the implications of the emerging regime, and of the mix of market-based and regulatory measures adopted under it, in terms of climate protection and sustainable development?* Specific issues pertaining to this question include:

- *What are the critical factors that determine a country's ability to manage the balance between GHG emissions reduction and sequestration measures?*
- *What might be the impacts, both direct and indirect, of shifts in this balance?*
- *What are the critical issues associated with the balance between climate protection and sustainable development?*
- *What institutional structures might be adopted at both the national and international levels to better manage issues associated with this balance?*

Theme 2: The (Re)Design the Climate Regime Through 2005 and Beyond

The CMRA's second theme focuses on the longer-term on the evolution and redesign of the climate regime itself. The Kyoto Protocol sets the year 2005 as a point at which Annex I countries are to have achieved their emissions reduction targets. It is thus a useful landmark around which to build research efforts on questions about the adjustment

of the climate change regime to both national experiences and changes in technology, scientific understanding, and global socioeconomic conditions. The CMRA will explore two important sets of institutional issues in this regard: (1) those issues pertaining to the evolution of compliance mechanisms and the long-term implementation of the regime; and (2) the processes of regime adjustment and learning to account for changes in knowledge and external conditions.

Compliance and Long-Term Implementation of the Evolving Climate Regime

Changes in social and economic systems of the scale required to meet the mandates of the FCCC and the KP take time to accomplish. While the FCCC has existed for seven years and the KP for two, mechanisms for managing the implementation of and ensuring compliance with the regime remain underdeveloped and poorly understood. This set of issues focuses on the institutional challenges of treaty compliance and the means through which the climate regime can evolve to meet these challenges.

One difficulty facing the international community in crafting more effective environmental treaties is that the relationship between international agreements and domestic policy change is not well understood. A core assumption of most international relations theories is that a nation will only ratify an agreement if it is prepared to make the policy changes necessary to comply with it (Milner 1997). Treaty ratification is thus viewed as synonymous with treaty implementation. However, ratification and implementation are separate political processes, and implementation is the more difficult of the two. While no comprehensive study has been conducted, anecdotal evidence suggests that compliance with international environmental agreements is mixed at best and highly dependent on regime design (Mitchell 1994; Chayes and Chayes 1995, U.S. General Accounting Office, 1992; Victor, Raustiala et al. 1998; Weiss and Jacobson 1998).¹⁹

A better understanding of compliance and long-term implementation problems is particularly critical for an effective climate change regime (Adger 1995; Harvey 1995; Clark, Eindoven et al. 1999). In 1994 industrialized countries committed to reducing their emissions to 1990 levels; most pledged to do so by the end of the decade. However, emissions have continued to rise unabated, due in part to a failure by these countries to implement fully policies contained in their initial action plans (Climate Action Network 1995; Wolsink 1996; Climate Action Network 1997). Resource and other constraints make these implementation challenges even greater for developing countries (Gupta 1997). Because implementation is difficult, an understanding of how nations make policy changes in response to international treaties and which factors influence this process is crucial to the effective design and long-term evolution of the climate change regime.

Chayes and Chayes (1995) suggest that the problems of compliance and implementation failure are most often situations that the international community can manage through routine political processes. Improved dispute resolution procedures can address problems of ambiguity; technical and financial assistance may help resolve domestic capacity problems; and increased transparency can help mobilize domestic constituencies to bring national policies in line with international obligations. While mechanisms for managing compliance with the climate regime have yet to be developed, many issues associated with their design and implementation are appropriate for exploration under the CMRA.²⁰ Compliance issues that arise in the context of a global emissions trading regime, such as that of liability, are particularly important because of the private sector's unique role in this regime.

The core question regarding this set of issues is: *what are the essential factors shaping compliance with and long-term implementation of the evolving climate change regime?* Specific issues pertaining to this question include:

- *How have coalitions of interests at the national and international levels shaped the development and implementation of national climate change policies?*
- *What are the implications of these influences for future compliance?*
- *How does the unique role of the private sector in this regime affect compliance and implementation?*
- *How might the regime be redesigned to better promote compliance and implementation?*

Adjustment and Learning Processes in the Evolving Climate Change Regime

The second set of longer-term issues on which the CMRA will focus is the adjustment and learning processes that enable the climate change regime to adapt changing technology, scientific understanding, and global socioeconomic conditions. All regimes must adapt to changing circumstances and underlying conditions if they are to persist (Chayes and Chayes 1993). Adaptation and evolution are particularly important for regimes addressing large-scale environmental problems such as climate change, as these problems involve poorly understood complex systems that are subject to rapid, nonlinear change over short time frames (IDGEC 1999).

Because the processes through which international treaties are negotiated unfold over years to decades (Dubey 1985), opportunities exist for learning and adaptation. Negotiations on the FCCC and the Kyoto Protocol were initiated in 1988 and are expected to continue into the foreseeable future. Considerable progress has been made over this period in resolving some of the scientific and economic uncertainties, and more will be made over the next ten years (Jager and O'Riordan 1996; Shackley 1997; Agrawala 1998). The processes through which national climate change policies are developed and implemented have also been found to foster learning and adaptation (Victor and Salt 1995; Brunner and Klein 1999).

Questions remain, however, as to how regimes can adapt to changes in science and socioeconomic conditions. For example, the current process for incorporating new scientific information into the negotiating process entails the periodic assessments by the Intergovernmental Panel on Climate Change (IPCC) of the current state of knowledge. Critics of the process, however, have complained that it is slow, unresponsive to the negotiators' and national decision-makers' needs, and reflects a predominately western view of both the climate change science and associated policy issues (Leiv 1991; Boehmer-Christiansen 1994; Bate 1996; Agrawala 1998). There are also concerns about lack of attention paid to important social science issues. Finally, questions exist concerning the role of environmental and business interests, the media and the public in overall learning and adaptation process (Ungar 1992; Kempton 1993; Ungar 1995; Bord, Fisher et al. 1998; Dunlap 1998; Levy and Egan 1998; Mazur 1998; McComas and Shanahan 1999; Paterson 1999).

The core question in this set of issues is: *how can flexibility, self-correcting procedures, and social learning processes be incorporated into the evolving climate change regime?* Specific issues pertaining to this question include:

- *How effective are current processes and procedures in informing decision-makers at the national and sub-national levels about the science of climate change?*
- *What kinds of information do decision-makers, both private and public, require?*

- *What are the roles of the media, interest groups, and the public in learning and adaptation process at both the national and international levels?*
- *How might the regime be redesigned to better promote learning and adaptation?*

Analytical approaches and methodological concerns

The complexity of both the specific issues of climate change and the general problems of institutions poses challenges for researchers attempting to study them. Research efforts conducted under the CMRA will employ a range of analytical techniques, including quantitative studies, modeling, and structured case studies. To narrow the scope of the project and to maximize the potential for comparative analyses, emphasis will be placed on the Arctic and Southeast Asia, the IDGEC's two core regions, and on the international, national, and local efforts to enhance GHG reservoirs and sinks. Because of the broad scope and complexity of issues being investigated, a considerable initial effort will be devoted to elaborating the questions pursued under each theme, the nature of the independent and dependent variables for these research efforts, and the sources of data for each case study. Many of these questions are expected to be resolved during a follow-up workshop in the spring of 2000.

Organization and Linkages

CMRA research will be initiated and conducted through a network of researchers and research institutions with expertise in fields relevant to the institutional questions being examined. The CMRA Scientific Steering Committee and the IDGEC International Program Office will work together ensuring that CMRA research projects are coordinated both with each other and with other relevant research efforts through workshops, formal and informal meetings, and other means of communications. The IDGEC will elaborate on the details of this network and coordination mechanisms in a follow-up workshop in the spring of 2000.

Like other global change projects, the IDGEC will undertake the CMRA through extensive collaboration with other projects. Such partnerships can stimulate scientific progress, produce practical benefits, and increase the likelihood that research results will find their way into the policy stream. These collaborations include coordination with other IDGEC research activities and with other programs and research projects that have institutional dimensions.

The IDGEC will strive to forge strong links to other policy and natural science research efforts related to global carbon management. These include activities being undertaken by the International Geosphere-Biosphere Program (IGBP), the World Climate Research Program (WCRP), and other programs of the International Human Dimensions Program (IHDP), as well as policy research efforts being undertaken by the FCCC Secretariat, non-profit organizations, and industry groups.

Particular emphasis will be placed on building strong partnerships with natural science research activities, as understanding the institutional drivers of climate change, particularly in the context of carbon sequestration, requires a sophisticated grasp of the biogeophysical dynamics of the climate system and forest ecosystems. In this context, linkages with a number of IGBP programs, including the Global Change and Terrestrial Ecosystems (GCTE) project and the joint IGBP/IHDP Land-Use and Land-Cover Change (LUCC) project will be important. An explicit linkage will also be made to the IGBP's crosscutting activity on the carbon cycle. Other linkages will be made with the IHDP's Global Environmental Change and Human Security (GECHS) and Industrial Transformation (IT) projects. Finally, efforts will be made to coordinate activities with

research being conducted under the auspices of the World Climate Research Program (WCRP) and activities being conducted by or for the FCCC Secretariat.

The IDGEC will strive to forge associations with other relevant research efforts as well. A range of organizations is conducting research relevant to the CMRA. These organizations include UN agencies (e.g., the UN Environment Program, the UN Development Program, the World Meteorological Organization), other intergovernmental organizations (e.g., the World Bank, the Organization for Economic Cooperation and Development), national research organizations (e.g., Japan's National Institute for Environmental Studies, the U.S. National Science Foundation), environmental groups (e.g., the World Resources Institute, the Natural Resources Defense Council, the Foundation for International Law and Development, the South Centre), industry associations (e.g., the Edison Electric Institute, the International Climate Change Partnership) and research organizations (e.g., the International Institute for Applied Systems Analysis, the Royal Institute of International Affairs, the Tata Energy Research Institute). While this list is not inclusive, it is illustrative of the range of organizations with which opportunities for collaboration will be explored.

Future Steps

Comments on this draft plan will be solicited from persons involved in research and practice relating to the issues discussed here. The IDGEC CMRA Steering Committee will then revise this scoping paper based on these comments. The revised paper will serve as the basis for a follow-up workshop in the spring of 2000 involving researchers interested in conducting research under the auspices of this activity. The purpose of this workshop would be to make further refinements to this paper, to elaborate on the organizational structure of the CMRA and mechanisms for coordination, and to flesh out more specific proposals for research efforts to be conducted under the auspices of the CMRA.

Notes

¹ While there are a number of different greenhouse gases, including methane, nitrous oxides, and chlorofluorocarbons, carbon dioxide, emitted primarily by the burning of fossil fuels and the burning of forests, is the most significant.

² A regime is defined here as the "implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given area of international relations" (Krasner 1982).

³ Institutions are systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to participants in these practices, and guide interactions among the occupants of the relevant roles (IDGEC 1999).

⁴ The specific targets are as follows: 8% for the European Union, 7% for the United States, 6% for Canada, Japan, Hungary and Poland, and 5% for Croatia. Russia and Ukraine promised to stabilize at 1990 levels, while Norway, Australia and Iceland are allowed increases of 1, 8 and 10% respectively. While the Kyoto Protocol does not place additional commitments on developing countries, these countries must still take measures to reduce their GHG emissions while moving forward along a path of sustainable development.

⁵ The CMRA will also be oriented around four groups of analytical problems: "fit", "interplay", "dynamics", and "scale". These four sets of problems involve factors critical to the effective performance of institutions to address climate change, but all are poorly understood at present. The problem of fit revolves around the idea that the effectiveness of social institutions is a function of the match between the characteristics of the institutions themselves and the characteristics of the biogeophysical systems with which they interact. The better the match or fit between an institution and the relevant biophysical system(s), the more effective the institution will be. The problem of interplay concerns interactions and linkages among institutional

arrangements. These linkages may be functional or political, and may occur among different levels of social organization or among institutions operating at the same level of social organization. The problem of institutional dynamics involves the processes through which institutions change over time. Because socio-economic conditions, scientific knowledge, and other factors change over time, institutions must also be dynamic if they are to remain effective. Finally, the problem of scale refers to the need to understand better how findings pertaining to the effectiveness of institutions can be transferred across levels in the dimensions of space and time. It differs from the problems of fit, interplay and dynamics in that it deals with the generalizability of knowledge pertaining to institutions rather than with attributes of institutions themselves or features of the relationship between institutions and biogeophysical systems. See the IDGEC Science Plan (IDGEC 1999) for a more detailed description of these analytical problems.

⁶ The CDM might work as follows: a company from an industrialized country could help build a highly efficient plant in a developing country rather than a less efficient plant previously planned. This would result in emissions reductions below what would have been the case without the project investment. Those reductions would be certified as credits and the developing nation and investing company would then determine how to share the credits. The developing country could acquire technology and capital investment as well as a share of credits it could sell or bank. The company could acquire a share of credits it could use to meet its emissions reduction commitments at home.

⁷ Articles 6.3 and 12.9 of the Protocol explicitly authorize the involvement of "legal entities" in JI projects and "private entities" in CDM projects, respectively. While the involvement of private entities in the ET mechanism is not explicitly authorized, their participation is generally anticipated. As a number of observers have noted, there would only be 39 partners in the trading regime if participation were restricted to the Parties themselves.

⁸ In theory, this market would function as follows: an emitter with low control costs can reduce its emissions below the quantity allocated and sell the extra AAUs. If the market price is higher than the cost of reducing emissions, it would earn income from the extra reductions. An emitter with high control costs that needs additional allowances can buy surplus AAUs from other sources. If the market price is less than the cost of controlling emissions at its own facilities, it saves money. To work well, emissions trading requires a competitive market for the allowances, which means a large number of buyers and sellers with no single buyer accounting for a large share of total purchases. Limited GHG trading is already occurring, with companies engaged in landfill/coal mine methane capture, fuel switching, and power plant capacity and efficiency improvements selling "credit options", or the right to claim credit at some point in the future, to generators and marketers, chemical companies, and steel, metal and cement producers. Internal trading is also occurring within such companies as BP and Royal Dutch Shell.

⁹ Market-based instruments are likely to be seen as less appropriate in an economy with a high level of central planning than in one with a long history of free enterprise (Fisher, Barrett et al. 1996). In many countries, governments and industries have traditionally favored a regulatory approach because the effects of regulation are more easily measured and controlled (Hahn and Stavins 1991).

¹⁰ The international community is considering several options for such a definition, including setting a "concrete ceiling" on the percentage of a Party's assigned amount that can be imported; defining a non-binding guideline on emissions trading; making imports conditional on the adoption of specified policies and measures; and making imports dependent on an assessment of aggregate impact of domestic policies and measures. Each has different cost and policy implications. For example, a binding import ceiling could significantly increase a country's aggregate costs for emissions reductions by forcing it to adopt more restrictive and expensive standards-based policies. This shift could not only hamper the achievement of the Protocol's emissions reductions goal, but could reduce the Parties' willingness to make more stringent commitments in future periods. On the other hand, a binding emissions import ceiling could also mean higher GHG emissions prices in buyer countries, in turn stimulating the development of new and less costly abatement techniques (Fisher, Barrett et al. 1996; Barrett 1998).

¹¹ To date, the most significant use of emissions trading internationally has been for the trade of international CFC production quotas under the Montreal Protocol and for the trade of CFC consumption quotas within the European Union.

¹² The question of technology transfer also arises with regard to the Global Environment Facility, a mechanism operated jointly by the World Bank, UNEP, and UNDP to provide additional financial resources to projects implemented under the FCCC.

¹³ The Protocol does not provide for the trading of CERs earned through CDM projects, and these credits are not included in the allotment of AAUs and ERU provided by the Protocol's emissions reductions targets. Some have argued that, if these rules establish an equivalency among these different units, the banking of CERs by companies and governments that would otherwise need to purchase AAUs could lead to an increase in the global demand for CDM projects and decrease efforts elsewhere to reduce emissions (Parkinson, Begg et al. 1999). This would not only alter the balance between emissions reductions and sink enhancement measures, but the resulting reduction in the value of CERs, AAUs and ERUs alike could impede the effectiveness of the climate change regime itself.

¹⁴ Article 12.10 of the Protocol states that activities conducted under the CDM can be counted starting in the year 2000. While the Protocol does not explicitly establish a target for the implementation of the JI and ET mechanisms, Parties hope to have it operational before the year 2005, at which point Annex B Parties are to "have made demonstrable progress in achieving (their) commitments..." (KP Art. 3.2)

¹⁵ As it is currently envisioned, the CDM would be operated by a central Executive Board, which would approve, review and assess the sustainability of every CDM project. Some people are concerned that the formation of this board moves the CDM away from the concept of freely global or bilateral trading, potentially increasing the transaction costs associated with the CDM credits.

¹⁶ It should be noted here that carbon sinks can also be major sources of GHG emissions if not managed effectively. The transformation of forests and grassland into agricultural land over the course of the last century has contributed substantially to the increased concentration of CO₂ in the atmosphere, and deforestation and other land use changes remain the largest source of carbon emissions after fossil energy-related activities (Watson, Zinyowera et al. 1996).

¹⁷ A variety of definitions of sustainable development have been proposed. For example, the Brundtland Commission states "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Another definition offered by Solow (1992) is that future generations should be able to be at least as well off as current generations.

¹⁸ Article 2.1 of the Protocol states that Annex I countries should adopt policies and measures to reduce GHG emissions and enhance sinks in order to promote sustainable development, and Article 12.2 states that the purpose of the CDM is to assist developing countries achieve sustainable development and contribute to the ultimate objective of the FCCC.

¹⁹ See also Hanf and Underdal (1999)

²⁰ For example, a number of options have been suggested, including a fund for non-compliance, trade sanctions, stricter targets in future compliance periods, and others. The relative efficacy of these different options, however, is not well understood.

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