

Working Paper

A Global Climate-Change Policy Exercise: Results of a Test Run, July 27-29, 1995

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WP-96-90
August 1996



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Preface

One of the original goals of the IIASA project on Implementation and Effectiveness of International Environmental Commitments (IEC) was to explore the possibility of using simulation or gaming techniques as a way of giving policy-makers a better understanding of the problems of implementing environmental agreements. Simulation has been used successfully to understand various complex decision, policy, and negotiation processes. But, there have been no efforts of which we were aware to use simulation as a means of exploring the implementation of agreements once they have been negotiated. Prof. Edward Parson of Harvard University undertook to develop a simulation exercise concerned with implementation as part of the IEC project. This Working Paper is an account of that experience, presenting his approach to the task and the results of the experiment.

Table of Contents

1. Introduction.....	1
2. Design of the Exercise	2
2.1. Purpose and Focus	2
2.2. Participants: Their Roles and Jobs	4
2.3. Summary of Scenarios	5
Summary of Thursday Scenario: Re-vitalising the Climate Convention in 2005	5
Summary of Friday Scenario: Globalising Emission Controls in 2020	9
2.4. Models and Computer Support Tools	12
3. Results of the Test Run.....	14
4. Discussion: Ideas and Insights from the Exercise.....	18
4.1. Substantive Ideas and Insights	18
4.2. Methodological Ideas and Insights	22
5. Conclusions.....	26
References.....	27

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1. Introduction

Simulation and gaming exercises have been used to gain insight into complex multi-party decision and policy problems, in various domains. Examples have included diplomacy and negotiations, security, business strategy, emergency response, institutional reform, and the environment (Hausrath 1971; Shubik 1975; Brewer 1986). Policy exercises are a particular form of simulation in which expert participants undertake specific tasks of planning, decision-making, and negotiations in a complex hypothetical decision setting. While closely related to other simulation methods used for various analytic, heuristic, or instructional purposes, policy exercises are distinguished by four features: their focus on important, realistically specified policy problems; their open-ended character, in which few or no aspects of the simulation are prescribed by simple arbitrary rules; their use of rich scenarios to provide context for decision-making; and their use as participants of people with substantial expertise and authority in the real problem to be illuminated (Toth 1988, 1994a, 1994b).

This paper discusses the design and preliminary implementation of a Policy Exercise investigating international management of global climate change.¹ The primary focus of the exercise was on international management of emissions

¹ A companion paper discusses why one might wish to investigate hard environmental policy problems through simulations and policy exercises, and what kinds of benefits one reasonably can, and cannot, hope to attain from their use (Parson 1996).

This work benefited greatly from many colleagues' contributions, advice, and assistance. The Global Environmental Change Program of Battelle Pacific Northwest Laboratory, Washington DC (Jae Edmonds, Hugh Pitcher, Marshall Wise, and Alan Hecht) developed the MINICAM model and the graphical model interface employed in the exercise. Five participants in IIASA's Young Scientist Summer Program -- Bernd Baumgartl, Mary Glasser, Heidi Hiltunen, Marc Stern, and David Waguespack -- provided technical support to participant teams. Abram Chayes, William C. Clark, Peter de Jánosi, Jill Jaeger, Marc Levy, Howard Raiffa, Tom Schelling, Gene Skolnikoff, Ferenc Toth, and David Victor provided valuable consultation and comment on the design, execution, and proposed revisions of the Policy Exercise. Ferenc Toth facilitated the debriefing. Judit Alberti, Nina Drinkovic, and Cara Morris provided organizational and administrative support for the exercise. Finally, the twenty-five participants in the exercise provided three days of serious, engaged, challenging efforts. These contributions are gratefully acknowledged.

abatement over a time-horizon of a few decades. Domestic policy processes, and adaptation measures, were not stressed. The exercise examined questions of the definition of obligations, procedures and institutions for implementation review, and how to make commitments and procedures implementable and sustainable over time as conditions change. This exercise was developed as part of the project on International Environmental Commitments (IEC) of the International Institute for Applied Systems Analysis (IIASA). The exercise was designed in consultation with colleagues at IIASA and elsewhere between January 1994 and July 1995, and its first implementation took place at a 3-day Policy Workshop, held at IIASA from July 27 to 29, 1995.

This first implementation of the exercise was a test-run. While it was hoped that the exercise would generate substantive insights of some relevance to international management of climate change, its primary purpose was to test the applicability and limits of this design of policy exercise, and to help inform subsequent development of more narrowly focused exercises.

The plan of the paper is as follows. Section Two summarises the design of the exercise: participant teams' responsibilities, scenarios used, and computer and modelling support tools provided. Section Three provides brief narrative summaries of the test run. Section Four highlights and discusses the most significant ideas, arguments, and insights that arose during the test run. Finally Section Five assesses the success of the test run, identifies methodological lessons learned, and outlines implications for the design of subsequent exercises.

2. Design of the Exercise:

2.1. Purpose and Focus:

International agreements to manage global climate change have been in place since 1992. In that year the Framework Convention on Climate Change was signed in Rio, establishing a general framework for international management of climate change and imposing hortatory goals on the industrialised countries to limit their emissions of greenhouse gases in the year 2000 to their 1990 levels. The Convention also established a process for submission and review of "national communications", reports from each government on their current and projected greenhouse gas emissions, measures they have adopted to limit emissions, and projected effects of these measures (UN FCCC, 1992). The first Conference of the Parties, held in Berlin in March 1995, established a mandate to negotiate strengthening of emission commitments for the period after 2000, possibly including a Protocol under the Convention, intended to be ready for adoption at the third Conference of the Parties, scheduled for 1997 in Kyoto (UN FCCC, 1995).

Though active climate negotiations have been underway for five years, fundamental questions of how to define, enact, and implement measures to abate emissions remain to be resolved. Nations have not yet agreed to adopt specific, legally binding emission-limitation obligations, and there has been little progress in negotiations toward this goal; indeed, there is serious disagreement over whether the

broad approach to national commitments based on emission targets is appropriate (Victor and Salt 1995; Lashof 1995; Subak 1995). The process of submission and review of national communications, though applauded by many as a way to nudge national governments toward greater efforts than they would otherwise undertake (Chayes and Chayes 1995), remains untested. The detail, rigor, and degree of seriousness exhibited in the first round of national communications varied markedly, and both the competence and intensity of the scrutiny they will receive, and the extent of subsequent influence on national policy, remain to be determined (Climate Action Network 1995; Earth Negotiations Bulletin, 1996). Moreover, serious implementation difficulties have already arisen, as it appears that most OECD nations will fail to meet the Conventions hortatory emission targets for 2000, or the stronger national targets that some have articulated (Climate Action Network, 1995).

The Policy Exercise focused on a series of international policy questions that are not presently resolved, and that must be resolved for effective responses to anthropogenic climate change to be realised: how to define and negotiate national emission-abatement obligations; how to design international procedures and institutions to implement national commitments, including specific procedures to review national measures and their effects; and how to sustain the effectiveness of commitments and procedures over time, as national and global conditions change.

The exercise addressed these questions at the level of international agreements and their relationship to broad national policy decisions, over a time horizon of 30 to 50 years. The exercise did not consider what specific policies and measures are enacted in each nation, how these policies are implemented domestically, or how they affect national emissions. Addressing these domestic questions in an exercise of this kind would require representing specific national political, cultural, and institutional contexts at a fine scale, with many specific sub-national actor roles represented, that was deemed to be beyond the capabilities of this project, if feasible at all.²

In examining these questions, the exercise was intended to be heuristic and exploratory. It sought to help identify plausible options, consequences, and contingencies that might be overlooked in present policy debate; to promote creative thinking and new insights; to help clarify preferences and arguments about responses to, or consequences of, climate change; and to help identify priority policy-relevant knowledge needs. It was not intended that the exercise be fully realistic, and its goals explicitly excluded teaching negotiation, predicting the future, advocating a particular policy or approach, and testing hypotheses about negotiations, crisis decision-making, or climate policy (Parson, 1995 & 1996).

As the first test of this approach, the 1995 test run was also intended to provide guidance on various questions of methodology and design, concerning how simulation exercises can most usefully advance understanding of complex global environmental problems: e.g., how to balance participants' attention between planning, negotiations and technical details; how much uncertainty and complexity can be introduced; and how far in the future it is most useful to focus. It was hoped that insights from this test run would help guide development of subsequent exercises

² Ward (1985) provides a good review of the cumulative work of the Northwestern simulation project, which has sought to represent interactions between domestic politics and international relations.

that focus more sharply on specific aspects of international management of climate change.³

2.2. Participants: Their Roles and Jobs

Twenty-five people participated in the exercise, including officials of national governments, inter-governmental and non-governmental organisations, private industry and academics from 16 countries.⁴ The participants included seven researchers from IIASA. The exercise sessions lasted all day on Thursday and Friday, July 27 and 28, 1995, with a debriefing and critique on Saturday morning. A staff of eight ran the exercise -- chairing plenary discussions, recording proceedings, and handling logistics -- including four graduate-students from IIASA's Young Scientist Summer Program, each of whom provided full-time support to one participant team, as needed, with technical planning, calculations, and computer runs. Each team had a networked computer in its meeting room, providing standard capabilities such as writing, printing, calculating, and electronic mail, plus the specific climate-change assessment tools discussed below in Section 2.4.

Participants were assigned to four teams of four to six people each, representing senior policy-making authorities of the European Union, Russia, China, and the United States. Each team was instructed that they collectively held the role and responsibilities of senior decision-makers in their country or region: no one represented any individual political leader. Over the two days of the exercise teams were assigned a series of tasks and decisions. They were asked to take these as seriously as if they really held cabinet-level responsibility for the interests of their citizens, making (and articulating) whatever stipulations and assumptions they found necessary given the extreme constraints of time and information under which they were operating.

Each day was organised around a set of issues to be resolved at a major international meeting -- set in the year 2005 on Thursday and in the year 2020 on Friday. The global and national context, the issues on the agenda, and information concerning each national team's views on the issues, were all provided in the Scenarios contained in their briefing books, as summarised below in Section 2.3. Each morning, teams met separately to develop brief (1 - 2 page) proposals for the coming international conference. These were circulated over lunch, and discussed in a Plenary session immediately afterwards, where a representative of each team argued for its proposals and responded to questions and criticism. Afternoon schedules were less structured than mornings. Teams could continue to meet separately, negotiate with other teams, or establish narrowly focused working groups, as they saw fit to pursue agreement or to clarify disagreement. At the end of the day, each team was required to submit two products: a statement of what international measures, procedures, or institutions were agreed, if any; and a short "policy directive", in the form of candid instructions from national political leaders to their officials on how to treat the climate

³ Prior applications of simulations and policy exercises to international environmental problems include Jaeger et al (1991), Parson (1992), and de Vries (1995).

⁴ Participants included citizens of Austria, Bangladesh, Canada, Chile, Finland, France, Germany, Hungary, India, Italy, Japan, the Netherlands, Poland, Sweden, UK, and USA.

issue, including how to implement and respond to any measures that may have been agreed internationally.

2.3. Summary of Scenarios

The context for teams' decisions and deliberations each day was provided by a scenario, describing broad political, demographic, and economic background and trends, globally and in each of the four represented nations, as a major international conference approaches. The scenarios also summarised the major decisions on the agenda of the coming conference, and the proposals and supporting arguments that had been advanced to address them. Scenarios for both days were distributed to all participants in advance, with the proviso that the Friday scenario could be revised based on Thursday's events. No team held any confidential information.

The purposes of scenarios are to draw attention to the issues that the exercise highlights, to provide the information necessary to think specifically about policy proposals, and to provide a plausible context for participants' deliberations and decisions that lets them identify their views and preferences about matters to be decided. To accomplish this, scenarios must be rich and detailed enough to engage participants' interest and attention, free from obvious idiocies or contradictions, and plausible. In this exercise, the scenarios had to keep the climate problem a continuing international political priority -- still relevant, and still difficult. To this end, the scenarios presented a moderately benign world. On the one hand, perhaps optimistically, the international political agenda of the scenarios is not dominated by major wars, civil collapse of major countries, global depressions, or plagues. On the other hand, no fundamental technological breakthrough or global social transformation has occurred to "solve" the climate problem, and each day's scenario posits either that prior attempts at international management of climate change have failed in some important respect, or that world growth has caused new difficulties to emerge. Climate change remains unsolved, serious, and difficult.

Summary of Thursday Scenario: Re-vitalising the Climate Convention in 2005

Thursday's scenario describes a world in the year 2005, in which political attention is returning to climate change after nearly ten years in which the early promise of the climate convention has not been fulfilled. A brief summary of the scenario is provided here. The full text provided to participants is available in a technical annex.

It is March 2005, and governments are preparing their proposals for the Sixth meeting of the Conference of the Parties (COP) of the Framework Convention on Climate Change (FCCC), to be held in November in St. Petersburg. In contrast to the high aspirations of the early 1990s, little international attention has been paid to climate change since 1996. American attention to the issue dropped suddenly with the change of administration in 1997. The European Union, which led international action on climate change through the first half of the 1990s, was less effective after 1996, when its political leaders became preoccupied first with the struggle to strengthen EU institutions, and later with the absorption of the six new member states admitted in

2002. With no other OECD nations willing or able to fill the leadership void, the climate regime has made little progress since 1996.

A few OECD nations enacted strong measures to limit greenhouse emissions in the 1990s and achieved their goal under the Convention (holding emissions in 2000 to 1990 levels) apparently because of the measures; a few others, including the nations of Eastern Europe and the former Soviet Union, met this target as a consequence of recession, economic restructuring, or measures undertaken for other purposes; but most OECD nations failed to meet their targets. The Kyoto Protocol, signed in 1997, was widely denounced as a flawed treaty that imposed national emission targets for distant dates, but provided no means to implement them. After 1997, the attention and resources that most OECD governments were granting to the climate negotiations declined.

Attention began to return to the climate issue around 2002. Several record warm years diminished the remaining scientific scepticism that there was a significant long-term warming trend in the climatic record, while new measurement and modelling of the effects of sulphate aerosols provided both stronger validation for climate models, and an expectation of further warming trends as sulphur emissions continue their world-wide decline. A series of extreme regional climatic events also attracted widespread public concern, though scientific opinion was mixed on how confidently these could be attributed to the global warming trend. The record warm years of 1999 and 2001 were both accompanied by extreme summer heat waves in central North America, central Eurasia, and north-central China, while moderate to severe droughts occurred in the grain belts of North America and the Ukraine from 1999 to 2002. In 2005, public concern world-wide about climate change is higher than it has been since 1992. The most recent IPCC report, released in 2003, summarised the increasingly strong evidence that anthropogenic climate change is occurring, but was carefully non-committal on whether the global trend is the cause of recent extreme events.

The current high public concern has coincided with political changes in Europe and the United States that make the time right for renewed attention to climate change. The new American administration, in office since January 2005, made re-invigorating environmental protection a primary element of its campaign, while the EU has now emerged from its period of consolidation and assimilation of new members with stronger institutions and a new generation of political leaders eagerly seeking international opportunities to demonstrate European leadership.

Consequently, there is now (in March 2005) substantial public and political pressure to achieve more effective control of growing greenhouse gas emissions. Though emissions from the less industrialised countries have also grown substantially since the 1990s, current attention remains almost exclusively focused on the industrialised countries -- particularly in view of most OECD nations' failure to achieve their 2000 targets, and the high likelihood that those who stated targets for 2005 will also miss them. A closely related and unresolved question is how to treat the emissions of the transitional economies, which dropped sharply in the 1990s but have now returned to approximately their 1990 levels and continue to rise.

Against this backdrop, the approaching St. Petersburg meeting, the Sixth Conference of the Parties to the Framework Convention on Climate Change, will consider two agenda items: reviewing the adequacy of existing commitments for Annex 1 parties; and developing measures and procedures to improve the implementation of commitments. A variety of proposals have been advanced, ranging from minor reforms of current commitments or their implementation, to fundamental changes in how national obligations are defined.

The present commitments of Annex 1 parties, as stated in the Kyoto Protocol, are to limit national (or EU) emissions of greenhouse gases to their 1990 levels "as soon as possible but no later than 2010", and to reduce them to 90 per cent of these levels by the year 2020.⁵ On the *adequacy of commitments*, seven alternative views have been advanced in the early discussions preparing for the St. Petersburg meeting.

(On both agenda items, adequacy of commitments and implementation, the views summarised here are not intended to restrict the options that simulation participants may propose; rather, they provide strong statements of salient alternatives, to help participants focus their own views and arguments. What each of these views implies for specific decisions in St. Petersburg remains, in most cases, to be fleshed out. Some of these are mutually exclusive, while others admit possibilities of combination or compromise.)

- The present commitments are fine; what is needed are firm provisions for monitoring, verification, and sanctions against non-compliers, to ensure that these commitments are actually implemented;
- Present commitments are broadly acceptable, but are too vague and lack effective procedures to support their implementation; while intrusive monitoring and coercive sanctions are neither desirable nor feasible, present commitments should be augmented with more thorough, specific, and effective procedures for international review of implementation;
- Present commitments are not strong enough; emission limits need to be made more stringent, and brought forward in time;
- Present commitments are too restrictive and too costly, because of the lamentable decision of the Fourth conference of the Parties not to allow credit for emission reductions undertaken and financed in other countries (Joint Implementation);
- Present commitments are fundamentally misguided because they are not implementable. They purport to bind countries to a target that they can have no confidence of achieving, because national emissions will inevitably vary for reasons largely outside government control. Commitments should be redefined in terms of policies and measures to be adopted, rather than emission levels to be promised;

⁵ Annex 1 countries are the industrialised countries: the OECD (not including Mexico), plus the countries of Eastern Europe and the former Soviet states of Russia, Ukraine, Belarus, and the Baltic States.

- Present commitments are fundamentally misguided because they seek to manage emissions on a year-by-year basis, while climate change will be determined by total emissions over several decades. Substantial increases of global emissions would be acceptable in the near term if those were reliably followed by large decreases; the present commitments are hence ineffective because they do not address the basic cause of climate change; they are also likely to be excessively costly, and unfair because they do not consider the beneficial effect of large past emissions reductions, in particular by the former transitional economies;
- Commitments should be permitted to be heterogeneous. Different national governments should be permitted to commit themselves to absolute levels of emissions, to emission trends, to goals defined in terms of the underlying determinants of emissions (economic or population growth, or trends in energy intensity or carbon intensity), or to specific policies or measures to be enacted.

The present procedures for implementation are essentially those of the original Framework Convention. National parties, or the EU, submit communications every five years that report emission trends, project future emissions, describe measures being undertaken to limit emissions, and estimate the effects of those measures. The communications are compiled and reviewed by the Secretariat, and the reviews discussed by national representatives in the Subsidiary Body on Implementation (SBI). In the early preparations for St. Petersburg, six alternative views have been advanced on measures to improve implementation.

- National self-reporting of emissions, projections, and measures is unreliable; there should be developed a system of more direct, reliable, and independent monitoring of national actions and emissions;
- Governments are only likely to respond strongly to significant threats to their self-interests. The SBI should be re-cast as a smaller and stronger body, with rotating regional representation, with the authority to consider egregious cases of non-compliance (or of failure to implement), and to recommend punitive sanctions;
- The present system is broadly acceptable, and has only failed to function effectively because of insufficient resources and lack of political support by major nations. The financial and staff resources available to the system should be increased, but it should otherwise be maintained largely as is. It is naive to imagine that powerful national governments would permit any stronger or more direct intrusion into their affairs;
- The implementation process should be made less confrontational. Its basic purpose should be to learn what measures work, and to share information about how to design effective programs. This goal is corrupted by the intent to use the review process to embarrass countries whose emissions have grown faster than projected due to economic or

population growth, or whose sincerely attempted measures fail to achieve their intended results;

- An implementation review process should perform two jobs: facilitating learning about the design of effective measures; and giving governments incentives to enact serious measures. Since these two goals may conflict, they should be pursued in different bodies. There should be a quiet, relatively low-level technical body in which national officials and the Secretariat assess knowledge about emission trends, projections, and the effect of measures; and there should be a prominent, senior forum, in which the reports of nations who do not do what they promise, or do it half-heartedly, are held up for scrutiny and potential embarrassment;
- Because governments are more likely to respond to pressure from their regional peers and trading partners, review of implementation measures should be devolved to separate bodies with regional representation. These could be existing bodies, or new bodies structured along the lines of present regional economic groupings. These review bodies could include non-Annex 1 countries, even in advance of their undertaking substantive commitments to limit their emissions;
- Participation in the review process should be broadened. Substantial resources and standing within the system should be granted to independent bodies such as NGO's to do independent review of national plans and reports;

Summary of Friday Scenario: Globalising Emission Controls in 2020

Friday's scenario describes a world in the year 2020, in which concern about climate change has mounted drastically, but unequally, and the priority for emissions control has shifted decisively from the original OECD to the rapidly growing nations of the former developing world. Little progress has been made so far, though, in integrating these nations into the system of controls that has developed, and the tools for motivating serious emission controls in these countries -- particularly financial transfers, and associated institutions and implementation measures -- remain undeveloped.

In the OECD nations and the former economies in transition, attempts to limit emissions growth have been moderately successful, i.e., much more successful than during the first ten years of the climate convention. Economic growth has been moderate in North America and the Pacific, and very strong in Europe, while populations have continued to grow slowly. Technological progress has somewhat lowered the cost of abating emissions from prior estimates, but large reductions continue to appear difficult and costly. OECD emissions have not yet actually begun to decline, but have deflected sharply downward from their former growth trends.

The rest of the world, except for most of Africa and a few nations elsewhere, has now experienced three decades of sustained rapid economic growth, and continuing though declining population growth. Consequently, the non-Annex 1

nations now represent almost exactly half of world greenhouse gas emissions. The few nations that have been left behind by world-wide growth trends have become increasingly unstable, generating large flows of migrants and security worries for their neighbours. World diplomatic alignments have substantially shifted with the emergence of close co-ordination within each of three major regional blocs: Europe and Russia, the Americas, and the Asia/Pacific region. There is vigorous economic competition and diplomatic manoeuvring between these blocs, and increasing marginalisation of the poorest nations, who can no longer rely even on the blunt diplomatic tool of developing-country solidarity, as their rapidly developing former compatriots increasingly align themselves on economic, security, and environmental issues with the nations of the original OECD.

Concern about climate change has mounted throughout the world. It is now completely clear that global climate is changing, and there is wide scientific agreement both that anthropogenic greenhouse gas emissions are a primary cause of this change, and that the observed shifts in regional climates are caused by the global change.

While concern is substantial throughout the world, in Europe it is at near panic levels. The reason is a combination of three recent events: a series of extremely cold European winters; a widely publicised series of observations of highly anomalous North Atlantic ocean-circulation events; and a public statement by three eminent oceanographers that these events indicate that a major shift in ocean circulation is underway, which could over the next 10 to 20 years bring a large reduction of northern heat transport in the North Atlantic, and a long-term cooling of northern Europe by approximately 1.5 degrees C, (equivalent to the little ice age of 1500-1800 AD). The scientists made their statement to advocate much more extreme global emissions abatement, and a world-wide program of adaptive measures including increases in grain stockpiles. Their views are highly controversial, and their statements have been attacked by many of their scientific colleagues as premature and speculative, but the speculations have been taken very seriously in Europe, and there is extreme pressure for European political leaders to act.

Other theories of catastrophic and sudden climate change have caught public interest and attention in many parts of the world. In the rest of the rich nations there is substantial public support for more aggressive abatement action, though the depth of this concern has not yet been tested with costly action. Indeed, a substantial minority view, prevalent in both American and Russia, holds that climate may be changing but the change is not likely to cause much harm, and that the best response is to adapt to it.

If substantial further emission controls are to be undertaken, it is clear that highest priority target is the emissions of the rapidly growing countries of the former developing world. These countries are still far behind the original OECD in wealth and incomes, and face continuing serious economic and social problems. While their increasing wealth is changing their political character in many ways, including heightened concern for the environment, the most widespread view remains that continued economic development is the top priority, and that climate change, while potentially serious, is a secondary concern. Most non-Annex 1 governments assert that they are seriously concerned about possible vulnerability to climate change, but

that they are only willing to alter their development paths if they see serious commitment of the rich nations to sharing the burden. Most wealth and technology are still held in the “old rich” nations, and periodic diplomatic disputes still arise along former north-south lines over intellectual property, international finance, and trade.

Extending a global system of emissions management to these nations will clearly require accompanying measures to distribute the burden, and implementation processes must be developed both for managing emissions and for whatever accompanying measures are negotiated for burden-sharing, finance, and/or technology transfer.

Four factors complicate the accomplishment of these tasks. First, several decades of stagnant growth in median incomes in much of the OECD has generated a widespread sense of deprivation among their still very wealthy populations, making it politically difficult to support “foreign aid”, particularly to nations rapidly entering the middle-income bracket. Second, technological change has not reduced the estimated costs of emission abatement by as much as had been hoped. Third, the country where emissions limitation is most crucial is China, whose GDP has quadrupled since 1990, but the central Chinese government's hold on power appears very shaky. Finally, many perceive an increasingly stark moral dilemma in the division of international aid between those nations whose behaviour is most important to control if global emissions are to be moderated, and those fewer nations most desperately in need of assistance to develop and alleviate human misery.

The coming Eleventh Conference of the Parties, to be held in 2020 in Beijing, is widely regarded as the crucial opportunity to extend the measures of the climate convention to make it for the first time a truly global agreement. There are four primary agenda items:

- Establishing emissions-related commitments for non-Annex 1 parties;
- Defining the levels, terms, and procedures for financial and technological assistance that will be associated with non-Annex 1 countries taking on such commitments;
- Reviewing the adequacy of present commitments for Annex 1 parties, with particular emphasis on clarifying emissions-related commitments for the former “economies in transition”; (though many nations now argue that continuing management of OECD emission trends is a secondary priority).
- Implementation procedures and institutions for Annex 1 parties, non-Annex 1 parties, and financial and technological measures.

The agenda for the Beijing meeting does not provide specific proposed options and supporting arguments in comparable detail to those provided for 2005. The 2020 Scenario was subject to minor mid-course modification, to reflect the consequences of decisions made, issues highlighted, or insights gained from Thursday's experience. Modifications were presented to participants, along with reminders of salient aspects

of the scenario that had previously been provided, in a short briefing at the beginning of the Friday sessions.

2.4. Models and Computer Support Tools:

In addition to the scenarios and other background information, participants were supported in their deliberations and negotiations by a set of computer and modelling tools. It was planned that each team would have use of two tools to allow them to interact with formal integrated-assessment models of global climate change. These were both to be available on a fast desktop computer in the team's meeting room, for the team to use in helping to inform their planning and negotiations. Unfortunately, only one of these tools was ready to use in time for the July 1995 exercise.⁶

The tool that was completed and used was a graphical interface to the reduced-form Integrated Assessment model "Minicam", developed by Battelle Pacific Northwest Laboratory (PNL) in Washington DC. The developers of this interface made many design choices in response to requirements of the simulation exercise, and provided an early Beta-test version for use in the simulation. Their contribution to the exercise is gratefully acknowledged.⁷

The interface, implemented through a set of add-ins to Microsoft Excel, provides a simple graphical link to the Minicam model, allowing the user to specify and execute model runs in real time, and to review model run outputs in tabular or graphical formats, without requiring the technical training necessary to alter data files or Fortran code directly.

Minicam is a moderately complex integrated-assessment model of climate change, being developed at PNL in parallel with the more complex process-based model PGCAM. Minicam combines three models: a nine-region world energy-economic model that projects long-term trends in energy use and greenhouse gas emissions based on specified assumptions of population and economic growth, fossil-fuel resources, and technological change; a reduced-form atmospheric chemistry and climate model, which converts specified time-paths of emissions into projections of global-average change in temperature, radiative forcing, and sea level; and simple model that projects regional changes in temperature, precipitation, and soil moisture by scaling the results of previous General Circulation Model (GCM) runs to a

⁶ The second tool, which was operational but could not be ported to the IIASA computer environment in time for the test-run, was the Model Visualization and Analysis System (MVAS), developed by the Consortium for International Earth Science Information Networks (CIRESIN). The MVAS provides a World Wide Web-based interface for investigating integrated-assessment models. It provides remote access to view previously archived data for scenarios, inputs, and outputs, in a variety of tabular and graphical forms. The MVAS does not permit the user to design and execute model-runs in real time, but does provide a consistent interface for browsing multiple models. As with the Minicam interface, the MVAS designers allowed substantial design input based on design of this simulation and provided a beta-test version. Their willingness to contribute to the success of this exercise is gratefully acknowledged.

⁷ Minicam and its interface are documented at <http://sedac.ciesin.org/mva/minicam/MCHP.html>. Further information is available from: Global Environmental Change Program, Battelle Pacific Northwest Laboratories, 901 D Street, S.W., Suite 900, Washington, D.C. 20024, USA.

specified global-average temperature change.⁸ Finally, Minicam provides a highly simplified, illustrative calculation of regional damages from climate change, using a quadratic cost function of regional-average temperature change. By combining these component models, Minicam lets the user make estimates of population and economic growth, energy resources, technological change, energy taxes, and climate sensitivity, and from these calculates point-estimates of future regional energy supply and demand, GNP loss from energy taxes, regional climate change and illustrative regional climate-change costs.

The Minicam graphical interface is a tool to facilitate these projections. Users can select reference-case scenarios based on the IPCC's 1992 high, medium, or low emissions-growth scenarios (Alcamo et al, 1995), and within these scenarios can specify their own modifications for six input variables for each region and each time, in 15-year steps, from the present to 1995.⁹ They can then execute a model run based on their assumptions, and browse tables or graphs displaying the results of their run. Most of the approximately 25 output variables that are available to view concern regional projections of energy supply, demand, and price; but also available are projections of regional GNP, CO₂ concentration, temperature change, sea level rise, and regional climate damage. Minicam is a deterministic model, so inputs and outputs for each run are point estimates, but the interface allows the user to conduct flexible sensitivity analysis by generating, saving, and comparing multiple runs with alternative input assumptions.

The reason for providing this modelling capability to participants in the exercise was to allow projections of the consequences of specific levels of emissions control, and of specific assumptions about population and economic growth and technological change, for climate change over many decades. The only explicit policy variable represented was the carbon tax, though the three energy-technology variables under user control could be used as surrogates for other forms of policy, defined as technical goals. Participants could use model runs to explore what assumptions they considered reasonable, and what stringency of emission controls they were willing to consider; they could also use them to focus argument and negotiation over what each team was willing to do under various circumstances.

The power of Minicam, as of all formal integrated-assessment models, lies in its integration of economic, technological, and atmospheric information and assumptions, and in its ability to project long-term consequences. Still, for purposes of informing policy discussions, such models are all blunt tools. Minicam, like most integrated-assessment models, suffers from five significant limitations as a tool to inform policy choice: coarse time-resolution; regions that do not correspond to political units; limited, simplistic specification of policies; limited, simplistic specification of climate-change impacts; and no inclusion of uncertainty (though some other integrated-assessment models do include explicit representation of uncertainty).

⁸ These component models are documented in Edmonds and Reilly (1986), Wigley (1994), and Hulme, Raper, and Wigley (1994).

⁹ The six inputs that users can vary are the following: population growth rates; growth rates of labor productivity, a carbon tax (providing a surrogate for all emissions-abatement policies); annual percentage increase in end-use energy efficiency (the Autonomous Energy-efficiency increase, or AEEI); average conversion efficiency of fossil-energy into electricity; and the total cost (cents/KWH) of a non-fossil energy source.

Consequently, in an unstructured decision environment such as this exercise it is likely that participants may find either that the model cannot answer the specific questions they wish to pose, or that they do not believe its answers. Despite these risks, we provided the model and interface to participants and encouraged their use for two reasons: first, we hoped that the model would pull participants' attention toward long-term consequences of choices they might make in the years 2005 and 2020, including dynamics and cumulative effects, even if only at the level of qualitative or illustrative results; and second, we believed that the exercise would provide a demanding and realistic test of the policy-relevance of integrated-assessment models. Observing the ways the model is used, the questions posed to it, and the ways it was understood and misunderstood, could provide useful guidance to the integrated-assessment and modelling community.

3. Results of the Test Run

Following a briefing in plenary session at the start of the exercise, the four teams spent Thursday morning separately, developing their proposals for the 2005 Conference of the Parties. In their separate meetings, both the Russian and Chinese teams discussions gave highest priority to foreign investment and Joint Implementation (JI), though both teams' interest in increasing investment was mitigated by their interest in avoiding associated monitoring or controls that could infringe on their sovereignty. Russia opted for a strong support of JI, while China decided that since JI came with many strings attached and could only represent a tiny fraction of their total foreign investment, they would not pursue it aggressively. The European (EU) delegation decided quickly that the existing Kyoto targets were not strong enough, and that they had failed for lack of a sufficiently strong enforcement mechanism. Consequently, the EU developed a proposal for stronger targets (reduce greenhouse-gas emissions, gas by gas, by 10% from 1990 levels by 2010, and by 25% by 2025), and for amending the Convention to include a specific minimum set of agreed policy measures. They also proposed sanctions for non-compliance and rewards for over-compliance, to be implemented through a well-funded implementation review body, similar to the existing Subsidiary Body on Implementation (SBI) but with fewer national members and stronger opportunities for NGO participation. In contrast, the US proposed a process for the comparison and review of national policies and measures, centred on a new high-level review body. Industrialised nations would voluntarily join this body, which might resemble the NATO Council, thereby making two commitments: to bring forward policies and measures to help solve the climate-change problem (including JI projects); and to submit to a process of scrutiny and assessment.

Following teams' presentations of their proposals in Thursday's mid-day plenary session, the remainder of the plenary was devoted to exploring three sharp disagreements posed by these national positions.

The first disagreement concerned the relative effectiveness of alternative basic forms of national emission-control obligations -- targets, measures, or review processes -- or of various combinations of these forms. The EU and US positions were sharply opposed, with the EU favouring binding national emission targets, and the US

favouring commitments to bring policies and measures, and submit them to a critical process of analysis and review.

The second disagreement concerned the relationship between JI and the rich countries' emission-limitation obligations. The US and China both argued that, while the international flow of funds in support of low-cost abatement opportunities should be encouraged, granting credit for JI projects, with its associated requirements for project screening and supervision, would not serve this end. The EU and Russia both argued that emissions credit was essential to increasing the flow of investment, and that careful administrative controls were necessary to ensure the integrity of credits. Russia in particular argued that JI was inextricably linked with OECD emission targets, because a JI system with credit could provide the flexibility and limitation of risk necessary to permit cautious OECD countries to undertake binding national emissions limits.

The third disagreement concerned appropriate processes and institutions for implementation. While all teams agreed that some such processes or bodies were required, they differed on whether implementation should be managed by the existing Subsidiary Body on Implementation (SBI) of the Convention, or by a new body; whether the process should include a limited number of nations who also undertake obligations associated with their participation, or should be universal; whether the level should be Ministerial or official; and whether the process should include formal procedures for censure and sanctions, or should carry only the prospect of embarrassment through scrutiny of policies and implementation. At least as regards the implementation of OECD commitments, this discussion pitted the US against the rest of the world, with the US favouring a new, small, voluntary body, with associated obligations, and carrying only the threat of scrutiny and embarrassment, while the rest favoured a strengthened SBI wielding formal sanctions. As regards potential future obligations for non-OECD nations, the Russian and Chinese delegations did not support such stringent implementation processes.

The discussions of Thursday afternoon were dominated by attempts by the US and the European Union to find common ground, while the other two teams awaited their resolution. By the end of the day, the two OECD teams reached a partial compromise and drafted a diffuse statement, which stated that the industrialised countries should attempt more rapid, voluntary reduction of emissions; that both targets and measures were desirable in pursuing these reductions; and that implementation processes and measures should support transparency. They did not resolve the relative priority of targets, measures and processes, or the relationships among them; nor did they resolve the split between the US position that open ministerial review represented the maximum feasible pressure and the EU preference for coercive sanctions. The debate over sanctions and review processes was so delicate that in the subsequent report from their meeting, the two teams refused to allow their Rapporteur even to state that they disagreed on the desirability of sanctions.

Participants made scarcely any use of the formal integrated-assessment model provided on Thursday. The character of teams' proposals and subsequent arguments suggested that most participants were using their present (i.e., 1995) knowledge of the

climate issue in deciding how to act within the scenario, and they did not seek to use the models to look far ahead in time.

Based on the partial convergence of views achieved in Thursday's discussions, a few modifications were made to Friday's 2020 scenario. It was stipulated that a voluntary "Climate Club" of OECD nations had formed; that the Climate Club had conducted a process of review of national policies and measures largely along the lines proposed by the US; that an informal norm had emerged in this process that nations bringing forward only one piece of the solution -- i.e., either emissions targets with no specific policies or measures to pursue them, or lists of policies and measures with no declared emission goals (even though these were not legally binding) -- were not being constructive; and that, whether through this process or for other reasons, there had been substantial moderation of OECD emission growth trends. This process was acknowledged by the FCCC, but operated outside it. Meanwhile, the FCCC had largely stagnated. No further emission limits or implementation measures had been enacted within the FCCC, either for Annex 1 or non-Annex 1 nations. There were large continuing international flows of emission-related finance, which had come to be called "Co-operative Implementation" (CI). No emissions credit was granted for these flows (and hence, nearly every OECD country remained in formal violation of its obligations under the Kyoto Protocol), but the projects were routinely described and assessed under the Climate Club reviews. In another change made for Friday, teams exchanged roles: the United States traded with China, while the EU traded with Russia. Other than these changes, Friday's scenario remained as described in the original briefing material, with a large shift in global emissions and growth rates toward the non-OECD nations.

As on Thursday, each team spent Friday morning meeting separately, preparing proposals for the mid-day plenary. The EU's proposal advocated a global tradable permit system. This was forcefully rejected by the US, who argued that an expansion of CI would allow the efficiency gains of a tradable-permit system, without the invidious explicit negotiation over initial allocation of quotas that a permit system would require (In private, the US delegation also realised that, given the range of national emission targets likely to be negotiated, an expanded CI system would implicitly impose an initial allocation roughly equal to the status quo. Consequently, avoiding an explicit negotiation over allocations would strongly serve their interests.) In addition to its pursuit of CI, the US delegation proposed to establish a lump-sum \$1 billion (thousand million) "Matching Fund", provided by the US government to match emission-abating investments in developing countries by the American private sector. The EU proposal sought to expand the process initiated through the climate club, both by seeking further OECD reductions and by bringing other nations, particularly Russia, into the climate club and into the EU's bubble for the definition of FCCC obligations.

The Chinese delegation made a forceful proposal that became the centre of discussion for much of the day, and whose disparity with the US matching-fund proposal illustrated the extreme range of views of the magnitude of the climate problem. China offered a comprehensive program to sell emission-abatement opportunities to the rest of the world by allowing them to invest in modernising and expanding Chinese industry. They proposed a scale of 1 to 1.5 Trillion (million million) US dollars over 20 years, roughly 0.25% to 0.5% of OECD GDP, and

stressed that this was not foreign aid, but the purchase of cheap reductions in global greenhouse emissions. Asked whether this proposal meant that China would be willing to adopt an emissions target, they replied that they would not, but that any other nations were welcome to adopt their own targets and to implement them through emission-abating investments in China. The details would be worked out through bilateral negotiations with each major potential investor country. All teams acknowledged that this proposal, if implemented, would represent the end of the FCCC as a significant vehicle for the adoption and implementation of international climate policy.

After the plenary, teams divided into four issue-specific working groups: on OECD commitments, non-OECD commitments, implementation measures, and geoengineering (the US had proposed co-operative study of geoengineering). Two negotiations soon came to dominate the afternoon's discussions: between the US and the EU over further expansions of OECD emissions commitments; and between the two OECD teams and China over the form and magnitude of an international investment or financial transfer package, and its connection to emissions abatement measures. The Russian team participated little in these negotiations, but worked primarily with the EU, eventually agreeing that Russia would join the climate club (and the EU's bubble, for purposes of calculating emissions abatement under the FCCC) in return for aid.

In the US - EU negotiations, the Chinese team intervened to urge that these teams *not* undertake further reductions in their own emissions, since they could realize equivalent abatement so much cheaper in China. The US and EU did eventually agree on an emission obligation defined as a multiple-year average: 1 per cent per year average reduction in greenhouse gas emissions over the next 15 years. As the end of the exercise approached, the negotiations with China came down to simple bargaining over the size and terms of a fund, and a hurried agreement was reached in the final minutes that the OECD would provide a \$9 Billion (thousand million) fund matching private-sector investment in emissions abatement in China (or elsewhere in the developing world) over an initial 3-year pilot period.

In contrast to Thursday, on Friday three teams made some runs of the integrated-assessment model, but did not (or were not able to) use them to provide detailed support for their decisions. All teams made simple baseline runs to enquire about relative contributions of different nations to global emissions, in the present (2020) and future. Two teams did such runs with explicit partisan intent, seeking to illustrate how someone else was the primary source of the problem, not they. The Chinese team was the exception. They tried hard to use the model to help them decide how much they cared about global climate change, and hence how co-operative they should be in their approach to global management. To help them answer this question, they sought detailed, believable estimates of climate-change damages to China, and some way to compare their damages to those suffered by others. They found the model's presentation of damages (a single aggregate cost function for each region) too simplistic, unverifiable in its origins and assumptions, and hence unbelievable. Unable to find anything in the assessment tool to persuade them otherwise, they decided that they did not care about climate change very much, and adopted the stark position summarised above.

4. Discussion: Ideas and Insights from the Exercise

4.1. Substantive Ideas and Insights

Although one objective of the exercise was to support the generation of novel policy ideas, few of significant novelty were brought forward. As will be discussed below, a more interesting service of the exercise was to clarify and focus arguments for and against particular policy proposals. Still, of the salient proposals advanced in the exercise, three appeared to offer at least modest contributions to the present policy debate.

The first was the proposal -- advanced by the USA on Thursday, and incorporated into Friday's Scenario -- that the primary vehicle for supporting emission limitations should be a small voluntary "club", which nations would join by declaring their willingness to undertake specified obligations. These obligations would include announcing and implementing policies and measures to limit emissions, and participating actively (with Ministerial time, analytic support, and funds) in a continuing, frequent process of joint analysis, review, and evaluation of each other's measures, their implementation, and their effect. This proposal abandons the Framework Convention's universality -- both of obligations, and of standing to police them -- in favour of a voluntary system in which those who elect to take serious action police each other. This proposal attained wide support. It broke a logjam in which poor nations called for strong measures from the rich but rejected strong monitoring and implementation provisions that they foresaw would eventually bear on them too, while the rich rejected having their performance policed by governments who were not themselves under similar discipline. Though the procedural aspects of this approach eventually attained wide support, its lack of firm national emission targets remained contentious, as discussed later in this section.

The second novel idea was agreement reached by the USA and EU on Friday to accept national emission targets, defined in terms of average annual percentage emissions reduction over a specified number of years (their agreement was for 1% average annual reduction over 15 years). Though this form of commitment is, strictly speaking, equivalent to a fixed emission target in the endpoint year, participants found this form to be preferable for two reasons, both of them consequences of its highlighting interim progress. Assuming that the commitment's implementation permits the use of interim feedback, participants found this form of commitment to be less a "promise that you can't know whether or not you can keep" than a fixed-year commitment would be; and they found it to admit stronger possibilities for other nations to observe and assess each other's progress, perhaps to facilitate attainment of the goal before failure has occurred -- rather than having to wait for the goal to be missed, then arguing about a retrospective response.

The third was the proposal for a OECD government-financed "Matching Fund" adopted on Friday. This fund would provide government funds to support emission-reducing investments in developing countries, augmenting domestic and private sources of finance. It would provide capital to shift overseas investment toward more climate-beneficial forms, while avoiding the analytic or negotiation

complexities inherent in the present "incremental cost" approach being taken by the Global Environment Facility and the Montreal Protocol Multilateral Fund. The idea was not developed in detail within the Exercise: the fund's size was finally set through hurried negotiations at the very end of the exercise, while questions such as whether and how nationally provided funds would be pooled, how eligible projects and investors would be chosen and ranked, and how emissions effects would be traded off with other factors in determining matching ratios, were not addressed.

Particularly in the plenary session on Thursday and the discussion that followed through the afternoon, the exercise did provide a forum for stark presentation and clarification of basic opposing arguments on particular policy proposals. Three such arguments were prominent: the appropriate form of national emission obligations to be undertaken by the industrialised countries; the appropriateness of punitive sanctions and the search for incentives intermediate in rigor between punitive sanctions and mere transparency; and the relationship between the design of a system of Joint Implementation (or "co-operative implementation", as it came to be called in the exercise) and industrialised-country emission obligations.

On the question of industrialised-country emissions obligations, the exercise's scenario stated that the present approach, based on declaratory or binding national greenhouse-gas emission targets for specific years, was retained through 2005 and that, as appears likely from the perspective of 1996, most targets were not met. Confronted with this failure of the present approach, the US and EU teams advocated two sharply opposed responses. The EU teams on both days, with the support of the Russians on Thursday, argued that past failure to attain targets did not mean targets were an inappropriate approach; rather, they argued that stronger targets were required, plus agreement on a common minimum set of specific agreed measures, and stronger implementation measures including the possibility of coercive sanctions, to provide incentives to meet targets. The US teams argued that emission targets should not be the central element of national commitments, arguing instead for re-structuring national obligations around high-level review processes based on the self-selecting group of countries outlined above. Members of this group would not adopt binding targets or commit to *particular* policies and measures, but would commit to propose and implement policies and measures *of their choosing*, in pursuit of a shared collective emissions goal, and to submit their measures and implementation to a rigorous, high-level, open process of analysis, assessment, and review. The US argued that such a process, in which ill-conceived, inadequate, or badly implemented measures would be held up for potentially embarrassing review in a senior public forum, would put as much pressure on governments as is ever realistically attainable.

These proposals, each a descendant of a present line of argument, sparked sharp disagreement. Advocates of each approach argued that the other would elicit no significant change in national behaviour, and moreover, would be misleadingly easy to enact, because governments seeking to avoid any costly action would recognise that this approach would not constrain them to undertake it. The salient arguments advanced were as follows.

Against emission targets, the US delegations made four arguments. First, no government knows how much emission control is attainable at what cost, so targets adopted years in advance must be arbitrary, and based on guesswork. Second, future-

year targets provide no basis to evaluate national performance until the target year has passed, which is too late to influence behaviour even with punitive sanctions. Third, targets, and measurements of performance to pursue them, both embed so much complexity and uncertainty that through nuances of definition or analysis one can easily re-define measures to obscure the degree of target attainment. And fourth, any targets adopted during periods of high public concern about climate change (as in the 2005 scenario) will be unattainably stringent, because reasonable and attainable targets do not sound good enough to an aroused public. Consequently, most or all nations will miss their targets, and since reasonable governments will anticipate this massive non-attainment, such targets will lack any serious motivational force. As a model of effective international co-operation based on review of policies, the US cited the NATO Council.

Against an approach centred on review processes, the EU and others advanced three arguments. First, targets, by their greater saliency and simplicity, attract more attention than review processes, both from governments and from their many potential domestic critics. Second, without specific performance goals such as targets, any process of review of policies and measures will become diffuse and relativistic, and so lack the power to embarrass laggards. And third, in a continuing review process without specific targets, all participants will at some time wish to avoid embarrassment, so norms of tact, indirection, and mutual protection will surely develop. As an example of ineffective international co-operation based on review of policies, the EU cited the G-7 summits.

Through extended discussion, the antagonists came grudgingly to accept the merit of each others' critique of their preferred approach, and hence to agree that both specific targets or goals, and processes for review and critique, are essential. This conclusion from the exercise seems plausibly true in the real policy debate, suggesting that the present debate between advocates of targets and of implementation review processes may be more obstructive than fruitful. Participants in the exercise did not address the next level of implementation questions, though, such as how to combine the two approaches to best complement each other, or what the implications are of one approach being established first (as at present, with review processes in place but no targets). A subsequent, more narrowly focused could address these and related questions about the combination of targets and review processes.

The second major argument concerned the appropriateness and limits of sanctions. The EU teams on both days advocated punitive sanctions for non-compliance (probably in the form of trade sanctions), as part of a broader concern that enforcing compliance required strong incentives. The US teams on both days rejected sanctions, making two arguments. First, the incentives that follow merely from transparency -- from the knowledge that one's efforts and their results will be publicised, analysed, and perhaps criticised -- are all that are reasonably attainable in global environmental issues. Second, the advocacy of punitive sanctions invokes an analogy to criminal justice, which presumes that non-compliance is rare, so strong coercive punishment of non-compliance is both feasible, and legitimate. But in international environmental protection, many or most parties are likely to be out of compliance at one time or another, so the criminal-justice analogy fails and coercive sanctions are likely to be neither feasible nor legitimate (Sanctioning all non-compliers is infeasible, while sanctioning some but not all would be either arbitrary or

unfair). While all teams quickly agreed that the incentives associated with transparency alone should be actively pursued, they made no progress in resolving their differences over coercive sanctions. They also spent some time seeking to sketch out incentives or approaches to compliance that would be intermediate in stringency between mere transparency and coercive sanctions, but without success. This question could also be explored in a subsequent, more narrowly focused simulation exercise.

The third major argument concerned Co-operative Implementation (CI, or JI in conventional use outside the exercise). All participants endorsed the pursuit of low-cost emissions abatement through project investment abroad, but they differed sharply on whether such investments should carry emission credits. This argument was broader than current debates over delaying credit until experience has been gained with JI projects, or how credits and other project returns should be shared between investor and host; rather, it concerned whether such projects should ever generate credits for anyone.

The EU teams, and the Russians on Thursday, wanted credit for JI. They argued that being able to choose where to meet an emission target (at home or abroad) would reduce the risk of being unable to meet it, and that this flexibility was essential in persuading the US (or other risk-averse OECD countries) to accept targets. But if credits are important, their integrity must be defended. Consequently, these teams also advocated rigorous JI administrative procedures to screen projects, count emissions, and track project effectiveness over time, to ensure that credits granted reflect real emission reductions.

The US, which rejected national emission targets, wanted no credits for JI projects. They argued that the institutions and procedures necessary to define and secure the value of credits could only obstruct international investment flows of potential emission-reducing benefit. If large international financial flows to reduce emissions occur, they are more likely to be motivated by direct concern for climate change than by the desire to avoid specific regulatory obligations. International institutions and procedures should consequently be designed to promote and facilitate these flows, not to police and obstruct them. Crediting is incompatible with this goal.

The US opposition to credit was joined by China on both days, and by Russia on Friday, but for different reasons. These teams were concerned first with promoting investment flows, and only second with directing investments to promote global emission-reduction goals. Hence, they wanted the investment that JI represents, but also wanted to avoid onerous associated controls or procedures, which they regarded as potential infringements on sovereignty. In joining the US position against credits, they expressed the view that credit systems are more likely to deter investments through administrative delays and costs, plus the threat of disallowance, than to promote them through the prospect of obtaining a potentially valuable credit.

In addition to these proposals and arguments, two issues that did not figure in the exercise merit mention. These were ideas presented in the scenarios as plausible, and as potentially advantageous for one team. But in each case, the country that stood to gain provided only half-hearted promotion, and the proposal received no significant interest or attention. These two "non-barking dogs" were geoengineering, and cumulative-year emission obligations. The US delegation was set up to favour

geoengineering. It could have represented a low-cost way of counteracting rising world emissions, and counter risks of low-probability catastrophic climate-change scenarios; and the US would be uniquely able to undertake it, perhaps even unilaterally. But no team felt enough of a crisis to be willing to do more than set up an institution to study it. The Russian team was set up to favour cumulative-year emissions obligations. This approach is sensible, since it is in fact multiple-decade emissions totals that matter for climate change. And it would benefit Russia greatly, since they had experienced large involuntary emission reductions during their economic transition, which this approach would turn into credits for them. But on neither day did Russia advance the proposal, nor anybody else.

4.2. Methodological Ideas and Insights:

The primary purpose of this simulation, as a test run, was to generate information about how to use the policy-exercise method to study climate change and other comparably complex international environmental problems: is it suitable; what are its salient opportunities and risks; what design pitfalls are most important to avoid; and how can it be fruitfully combined with other assessment methods such as formal models. Obviously no single test could generate complete answers to these open-ended questions, but the experience of each test, combined with the insights and criticisms of participants expressed in the debriefing, can provide suggestive guidance, both hortatory and cautionary, for the design of subsequent exercises. The experience of this test run suggested several methodological lessons.

First, this test run appeared to include too broad a variety of different types of planning and decision-making tasks. The tasks included in this exercise fall broadly into three classes: Assessment, the prospective examination of the consequences of potential choices; Negotiation, the deliberations over, and joint decision-making on, the form and level of aggregate national emissions obligations; and Implementation, deliberations over and joint decision-making on procedures and institutions to support and sustain the attainment of these obligations over time, and respond to failures.

Implementation was included because it appears to be the area where current policy debate is most in need of new ideas. Negotiation was included because, in the exercise design, it was presumed that participants would not seriously engage a task implementing commitments they had not chosen themselves. Assessment was included because climate change requires a policy response over many decades, and simulation insights about either negotiation or implementation are only likely to be helpful to the real problem if they reflect participants' awareness of this long-run character.

The experience of the test run suggested two implications of this broad coverage. First, each of these tasks has a natural time-scale to which participants' attention is directed. Assessment's time-scale is long, concerned with consequences of policies sustained for several decades for long-term climate change. Negotiation's and Implementation's time-scales are ambiguous, but much shorter than that of assessment. What time-horizon participants consider when they negotiate obligations is partly of their choosing, but in this exercise, both the time gap between Thursday and Friday, and the form of emission obligation participants agreed on Friday suggest

that they were thinking of approximately a 15-year horizon. Such lead-times are fairly typical of environmental negotiations. Implementation's natural time-focus may be shorter still, concerned with identifying and responding to failures to fulfil negotiated obligations. Of course, how far ahead participants actually think in the exercise partly depends on what consequences the exercise highlights. Despite providing the model, this test run clearly failed to make long-run consequences salient enough, and so encouraged a predominance of immediate concern with striking a good deal, and associated bargaining behaviour.

The attempt to increase both long-term focus and sense of seriousness by positing a panic over a new Little Ice Age in 2020 Europe appears to have been particularly unsuccessful. In retrospect, this appears to be one aspect of the simulation design that was a clear failure. While some simulation exercises are explicitly designed to study crises, e.g., in military and diplomatic conflict, or disaster response, these exercises normally reflect the characteristics of crises in their own structure: the scenario presents serious harms, either currently occurring or imminently at risk; new information arrives at a rapid, realistic pace; and quick decisions are demanded. In this test-run, the scenarios described a crisis but the exercise reflected none of these practical consequences. The crisis was presented in order to push the European teams to ask what actions they would consider if they were suddenly compelled to grant climate highest priority. But the exercise neither gave them immediate actions to take, nor made immediate large changes in welfare depend on their decisions. Lacking either of these aspects of a crisis, the European teams rejected the premise, deciding that they were rich enough, and could adapt easily enough, that despite popular panic they did not face a real crisis. Perhaps their assessment was correct, suggesting one insight to be drawn from the exercise: while climate change may look like a grave issue for world welfare when viewed through a multi-decade telescope, it can never be a crisis. Hence, attempting to illustrate its gravity by positing a future crisis cannot be persuasive.

The three basic tasks, assessment, negotiation, and implementation, also encourage different degrees of partisan identification with particular interests. Negotiation supports the strongest identification with national interests. Assessment, through both its long view and its parallel presentation of consequences for all world regions, directs attention most strongly to global interests. Implementation is intermediate, requiring teams to think about their national interests under future contingencies in which their difficulty in meeting obligations, and hence their nation's likely role -- whether non-complier seeking flexibility and assistance, or complier concerned about responding to others' non-compliance -- are not clear.

In this test-run negotiation predominated, driving out serious detailed consideration of the other two tasks. Participants spent most of their effort negotiating emission controls and associated financial transfers, including much concern with detailed drafting of agreed text. Reflecting the complexities inherent in a four-team exercise with a broad unstructured agenda and little imposed process structure, simple mechanics of negotiations consumed much time and effort: teams deciding who they wanted to talk to in what order, shuttling between meetings, and so on. The assessment models were used infrequently, and mostly to generate support for pre-established negotiation positions. Though there were a few sharply focused and

constructive arguments about implementation, as summarised above, participants did not consider detailed implementation questions.

This experience suggests that given limited time, and the demanding and fast-paced character of a simulation exercise, it is not feasible to have participants adopt two disparate perspectives (either time-horizons, or degrees of partisan identification) at the same time, so all three of these types of tasks cannot simultaneously be engaged. Rather, an exercise must either focus on a single task type, or (given enough time), be divided into sharply separated episodes during each of which participants engage a different task.

For exercises focused on a single task type, a primary focus on either assessment or implementation could be instructive. Negotiation may have to be included, but the exercise should be carefully structured so negotiations remain subordinated to the primary focus -- and if several teams are included, negotiation process should be tightly controlled to limit wasted time. An episodic exercise could include more than one task -- e.g., negotiation and implementation -- but would have to be prepared to impose closure on previous discussions when moving between episodes and tasks,

A second serious methodological issue raised by the test-run was the importance of passing more than once through the same set of times and decisions under alternative scenarios. While early design proposals for this test run included this "twice-through" feature, this was abandoned due to limited time, a complex agenda, and the need to retain two simulated time periods. Lacking this feature, the test run could not provide internal contrast and control, to permit judging the plausibility or significance of simulation events or insights against an experienced alternative -- e.g., to compare responses under "business-as-usual" scenarios and surprising ones.

The test-run suggested several observations about the use of assessment models. A first point, obvious in retrospect, is that team members themselves should have free access to the models. In this test-run, since the staff helpers were asked to summarise teams' discussions when they were not helping with model runs, they were often occupying the only computer in the room. Consequently, team members often found they were unable to use the model themselves. A second point is to recognise the strong tendency, in an exercise structured around partisan role-play, for assessment models to be used as partisan tools. This tendency could have been turned to support the generation of useful insights, but only if participants engaged each others' partisan model runs and argued about the underlying assumptions. This test-run did not provide enough time, or enough modelling support, for such arguments to occur. The third and most serious point about model use was the critique provided by China on Friday, that for a model to be either believable or useful in such a setting, impacts must be more richly specified, multi-variate, and not aggregated to a single heuristic damage function. Moreover, if a model does provide summary evaluation, the assumptions involved in the calculation should be open to scrutiny and revision. This criticism suggests an approach to subsequent development of interface tools, in which potential user modifications are structured hierarchically. A few salient parameters would be available for immediate modification, as in the present Minicam interface; but rich documentation about other levels of model assumptions -- both parameters and functional forms -- should be easily available, and users should be

able to proceed to deeper levels of the interface that permit changing progressively more parameters, or selecting from alternative functional forms or specifications of certain key relationships (perhaps with appropriate warnings about convergence problems, etc.). Though this approach has clear attractions, there are also obviously limits to how deep the changes in model structure can be usefully pursued in a real-time simulation.

Finally, the test run clarified three methodological points that are narrower and more operational. First, this test-run provided insufficient time for participant preparation. Participants were not involved in developing scenarios, and received them only one week before the exercise. Under these conditions, it was predictable that few had worked thoroughly through scenario details (either to accept or critique them), and most appeared to be familiar only with their own team's material, though all team's details were given to all. Other similar exercises have developed scenarios in consultation with a subset of the participants, in several iterations over a period of several months (e.g., Jaeger et al 1991; Toth, 1992). Such a process would clearly have been advantageous here, and may be particularly necessary in subsequent exercises if, as discussed below, their scenarios focus more narrowly and hence more strongly constrain participants' discretion.

Second, the exercise was under-staffed. In particular, there were not enough staff able to engage the substance of proposals, negotiations, and arguments that participants generated. In some cases, more highly trained assistance to individual teams was needed. The graduate students working with each team received two days training in operating the model and interface, but very little in the broader agenda of the exercise; most were, understandably, reluctant or unable to help teams clarify confusion about their jobs, the purposes of the exercise, or the use of the scenarios, or to suggest alternative directions for teams' work when they stalled. The helpers also lacked an effective, fast vehicle for consultation, as people's absorption with other tasks and their movement among rooms prevented them from responding promptly to e-mail messages. In other cases, more effective, collective direction of the entire exercise was needed. There was no control team in this exercise, because it was hoped that the well-detailed scenarios, and the lack of need for real-time feedback on specific consequences of joint decisions, would make one unnecessary. But in at least two respects, a multi-person control team could have helped. Each afternoon, as proceedings became diffuse and the number of proposals, arguments, and parallel negotiations proliferated, more authoritative control over process could have kept the exercise on a more productive track. And on Thursday night, more detailed, forceful elaboration of Friday's scenario, that really assimilated the breadth of Thursday's discussion and pushed participants in the directions they were weakest -- with matching update of programmed model scenarios -- could have made the 2020 scenario much more focused and challenging.

Finally, this exercise probably represented the wrong set of countries. Teams were limited to four or five by logistical and financial constraints, and by the need for enough people on each team to generate disparate views. But even with so few teams, for a global climate exercise focused beyond the next 10-20 years it is much more important to include more than one large, rapidly-growing developing country than to include Russia. Russia's unique transitional situation will not persist (for good or ill) more than a few decades, and it will not likely be one of the few largest contributors

to either emissions or international financial transfers. Moreover, a single Chinese team cannot act as surrogate for the entire developing world: its situation is too unrepresentative, and moreover the important issues of negotiation and implementation cannot be captured with only one "recipient" nation. The experience of the test-run, and participants' views in the debriefing, suggest that up to six teams should be staffed (three OECD, three Developing) before adding Russia.

5. Conclusions:

The test-run was a mixed success. It generated some focused, useful discussion of central questions in the international management of climate change, which arguably emerged more sharply than in the policy debate so far; generated a few modest novelties in specific form of proposals; provided a few insights about pitfalls to avoid in simulation design; and identified promising directions to pursue.

In general, this test-run substantiated the potential contribution of such exercises to the investigation of policy and management problems concerned with global climate change. Particular weaknesses in the design of this implementation, though, limited the extent of directly useful substantive insights emerging from it. The experience of the test run and subsequent discussions suggest the major lessons and a particular promising direction for the development of subsequent exercises.

First, even with adaptation and domestic policy excluded from this exercise, the remaining substantive scope was still too broad. The agenda of subsequent exercises must be restricted.

Second, more restraint of the agenda, and less deference to participants' autonomy, is required. Even if it is deemed necessary to give participants control over certain broad negotiated or policy decisions, the exercise cannot wait for them to reach full closure on these questions before considering more fine-scale questions. Those running the exercise must be willing to extract a plausible, useful extension from participants' early deliberations, and impose it on later, finer-scale deliberations.

Third, not all of the exercise should be based on strong identification with national interests, negotiation, and tactical manoeuvring. While such a negotiation focus is vivid and engaging, and may be useful, some (perhaps most) of such exercises should structure tasks and roles differently. Even given time limits, an episodic structure, in which periods in which teams take a strategic, negotiation-oriented perspective are balanced with periods in which they act as neutral managers, mediators, or problem-solvers, would be preferable.

One particularly promising way to restrict the agenda, focusing on a problem obviously central to international management of climate-change, was proposed in the debriefing: financial transfers and their linkage to national emission-related obligations. Two exercises, each lasting two days, would examine the two canonical forms of institutional arrangements proposed -- and being tried -- to link international financial flows to implementation of environmental goals: centralised administrative systems such as the GEF and Montreal Protocol Multilateral Fund, under which centrally managed funds are disbursed on projects according to agreed environmental

criteria; and decentralised, market-like systems such as Joint Implementation or tradable-permit systems, which create transferable rights or obligations in the environmental goal being pursued.

For example, in a two-day exercise focusing on tradable permits, the first day would be spent considering large-scale design questions such as who participates, what breadth of activities or emissions is included, what entitlements are granted to whom, and how these change over time. The second day would consider finer-scale implementation questions such as the design and meaning of an emission permit; who issues them, for how long; how are they tradable; how are they transformable across time, across gases, or between sources and sinks; how are emissions verified; what options are available to those who emit without permits; and how is non-compliance detected and treated.

Each day in turn would be divided into two episodes. During the morning, participants would work in national teams developing their negotiating positions and approaches to the questions on the day's agenda. But no negotiations between the teams would actually take place. Rather, in the afternoon, participants would be re-arranged into new teams, no longer in national roles, representing international expert advisory groups assembled by the chair or secretariat. These afternoon working groups would take the morning's national positions as input, and would seek to identify plausible resolutions of agenda items that could gather support of most or all the national teams represented. The afternoon's product would be a draft single-negotiating text, to be presented to the chair, that participants believe would have a chance of both working on substantive grounds, and gathering the necessary level of support. Between the two days, a control team would take the output of the participants' work and, if necessary, impose additional specification and closure, so as to present specific bounding conditions for the smaller-scale implementation discussions of the second day.

This format would plausibly overcome the most significant weaknesses and problems manifest in this test run: too broad a focus; excessive focus on negotiation; too much time lost in simulated negotiations with associated confusion and procedural friction; and insufficient consideration of implementation details.

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